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Evaluating Renewable Energy Manufacturing Potential in the Mediterranean Partner Countries

Final report - May 2015

IRENA
International Renewable Energy Agency

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Acknowledgment

This report was commissioned and jointly financed by the European Investment Bank (EIB), under the Facility for Euro-Mediterranean Investment and Partnership (FEMIP) Trust Fund, and the International Renewable Energy Agency (IRENA). The FEMIP Trust Fund was established in 2004 and has been financed by 16 EU Member States and the European Commission. It is managed by the European Investment Bank and is intended to support the development of the private sector via the financing of studies and technical assistance measures and the provision of private equity. This report is part of the Technical Assistance Window of the FEMIP Trust Fund. IRENA is an intergovernmental organisation which promotes the widespread and increased adoption and the sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

IRENA and EIB wish to acknowledge the comments provided by the New Renewable Energy Authority (NREA) of Egypt; the Ministry of Energy, Mines, the Environment and Water of Morocco; and the National Agency for Energy Conservation Agency of Tunisia (ANME). IRENA and EIB also wish to thank the following organisations for their insights during the peer review process: the League of Arab States (LAS); the United Nations Economic and Social Development Commission in Western Asia (UN ESCWA); the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE)

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Table of contents

Table of figures

List of tables

List of abbreviations

ADEREE	National Agency for Renewable Energy and Energy Efficiency
AFD	French Development Agency
AfDB	African Development Bank
AMISOLE	Association Marocaine de l'Industrie SOLaire et Eolienne
ANME	Association Nationale pour la Maîtrise de l'Energie (Tunisia)
ATEE	Association Technique Energie Environnement
BFPME	que de financement des petites et moyennes entreprises (Tunisia)
BoP	Balance of Plant
BTK	Banque Tuniso-Koweïtienne (Tunisia)
CRTEn	Research and Technology Center of Energy
CSNER	Chambre Syndicale Nationale des Energies Renouvelables
CSP	concentrated solar power
CTF	Clean Technology Fund
DEWA	Dubaï Electricity and Water Authority
DIE	German Development Institute
DSO	Distribution system operator
ECEP	Energy Conservation and Environmental Protection (Egypt)
EE	Energy efficiency
EIB	European Investment Bank
EKF	Export Credit Agency of Denmark
EPC	Engineering, Procurement and Construction
EPGE	EP Global Energy
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EUR	Euro
EY	Ernst & Young
FEDELEC	Fédération des Electriciens et Electroniciens (Tunisia)
Fénélec	Fédération nationale de l'Electricité (Morocco)
FIMME	Fédération des industries métallurgiques, mécaniques et électromécaniques (Morocco)
FiT	Feed-in tariffs
FMO	Dutch Development Bank
FTE	Full Time Equivalent
GENI	Global Energy Network Institute
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit - German Cooperation
GW	Gigawatt
ICTSD	International Centre for Trade and Sustainable Development
IFC	International Finance Corporation
IFIs	International Financial Institutions
IPP	Independent power producer
IRENA	International Renewable Energy Agency
IRESEN	Research Institute for Solar Energy and Renewable Energies
kWh	Kilowatt hour
LCOE	Levelized Cost of Energy
LCR	Local content requirements

MASEN	Solar Moroccan Agency
MEDENER	Mediterranean Association of the National Agencies for Energy Conservation
MENA	Middle East and North Africa
MESRS	Ministry for Higher Education and Scientific Research (Tunisia)
MPCs	Mediterranean Partner Countries
MSP	Mediterranean Solar plan
MW	Megawatt
MWp	Megawatt peak
NEPCO	National Electric Power Company
NREA	New & Renewable Energy Authority (Egypt)
NREA	National Rural Education Association (Egypt)
O&M	Operation and Maintenance
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OEP	Organization for Energy Planning (Egypt)
OFID	OPEC Fund for International Development
ONEE	Office National de l'Electricité et de l'Eau potable (Morocco)
PERG	Global Rural Electrification Plan (Morocco)
PPA	Power purchase agreement
PROSOL	Tunisian Solar Programme
PV	Photovoltaic
R&D	Research and development
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RE	Renewable Energy
RECAI	Renewable Energy Country Attractiveness Index
RENAC	Renewables Academy (Germany)
ROI	Return on investment
SME	Small and Medium Enterprises
STEG	Société tunisienne de l'électricité et du gaz (Tunisia)
TSO	Transmission system operator
TSP	Tunisian Solar Plan
UK	United Kingdom
VAT	Value-added tax
WTO	World Trade Organization

Executive Summary

EIB and IRENA have mandated EY and Enolcon to carry out a study aiming at assessing the capability of a selection of Mediterranean Partners Countries (MPCs) to develop local renewable energy manufacturing industries. The objective of this assignment is three-fold:

- **Assess the competitive positioning and potential of the selected MPCs in the manufacturing of key RE components**. This assessment includes the analysis of the existing local RE supply chain and its export opportunities as well as the potential new entrants either from domestic industrial sectors, or from international players, as foreign direct investment or international technology cooperation.
- **Identify the gaps for the development of a local RE manufacturing capacity in each studied country**. This requires analyzing for each technology the barriers to developing local manufacturing capacities, in terms of skills development and training, complexity of manufacturing processes, financing for upgrades in industrial production or capacity extensions, etc.
- **Provide recommendations destined to public stakeholders and IFIs active in the Mediterranean area** to support the development of industrial capacities in the renewable energy sector**.**

This study focuses on three MPCs with relevant profiles in terms of RE development potential: **Egypt, Morocco and Tunisia**. These three countries have been selected based on three main criteria:

- The existence of ambitious national targets, support policies and achievements;
- A strong market potential and an experience in renewable energy projects;
- Local industrial assets and level of investment dedicated to renewable energy.

The study focuses on RE technologies for which the selected pilot countries have strong advantages in terms of natural resources, market size potential or track record of related industries. As a result, **solar PV, Concentrated Solar Power (CSP) and onshore wind** have been included in the scope of the study.

Analysis of the gaps for the development of a local RE manufacturing capacity in each pilot country has been carried out in regard to four key success factors, listed below:

- Substantial political support aiming at creating a long-term stable market;
- Competitive local players in the global market;
- Strong industry innovation potential and skilled workforce;
- Investment capacity and strong financing infrastructures.

All the recommendations provided in this study stem from a critical analysis conducted on the basis of the discussions held with stakeholders met in the three pilot countries. They were elaborated in response to the main difficulties and expectations expressed by these actors and with the objective to overcome the key barriers identified. They also capitalize upon the experience from other countries that have successfully developed RE manufacturing capacities.

Based on the analysis of the industrial assets for local RE manufacturing and on the review of the key success factors for local integration, our conclusions on future local manufacturing opportunities in Morocco, Egypt and Tunisia for the three selected technologies are presented hereafter:

Egypt

Solar PV: With its high solar resources and the support of the new feed-in tariff, solar PV could be a fast track technology to increase renewable energy production locally. Although the local PV-modules prices are decreasing, this technology is not yet as competitive as the incentivized fossil fuels. One major risk that may undermine the development of this sector would be that the government sets out a too ambitious threshold for requested local manufacturing share for solar PV projects.

Solar CSP: Egypt is a highly promising market for CSP-technology, offering several opportunities for local companies to manufacture components such as mirrors, steel components and power plant equipment. However, the current feed-in tariff framework is not likely to support the development of large-scale CSP-projects. Launch of new public tenders for CSP would encourage the development of the technology and the related industry.

Wind: Local companies can provide a well-established track record, especially companies producing wind towers. The construction of new wind farms in Egypt would be likely to encourage local manufacturing, in particular on high-tech components like blades. Nevertheless, the market development is limited by grid restriction in areas with a high wind potential. Generation capacity limits included in the feed-in tariff are identified as a major barrier for the development of large scale new projects. New investments either for new larger manufacturing machines or in expanding the manufacturing capacity will be necessary to set up a stable and visible upcoming market.

Morocco

Solar PV: The highest potential for local manufacturing of PV components on the medium term is seen in the BOS (Balance of System) components of solar PV plants. Morocco has also a potential in producing mounting structures and performing the electrical and construction works and installation. The manufacturing of inverters and installation of PV plants might require specific qualifications and cooperation with foreign companies with experience from other PV plants. For PV modules, Morocco does not provide the necessary infrastructure of know-how for PV cells local production. However, with large-scale investments, the module assembly using crystalline silicone cells or the module manufacturing is thought to be feasible in Morocco in the medium term.

Solar CSP: Morocco requires substantial investment and know-how for developing a local manufacturing of specific CSP components, such as mirrors, receivers, tubes or power blocks. Regarding pumps and pipes, the existing competences do not seem to meet the international requirements for CSP solar plants and production capacities are not sufficient to meet current local market demand. Regarding heat storage, local competences were identified for civil engineering work and tanks but a local supply of salt seems critical to develop a local industry.

Wind: Morocco has a strong potential for local manufacturing of wind turbine components as several companies have been involved in the last decade in wind projects and have developed know-how in this sector. Local companies would also be able to produce main electrical components, cables and parts of the generator in the short or medium-term. Transport, civil engineering work and foundations of upcoming projects could be performed by local players as well. Moroccan companies have a great capability for innovation developing partnerships and technological cooperation with international companies, which would help them to produce blades locally for upcoming projects.

Tunisia

Solar PV: With the required investments in R&D and in new production capacities, most of the required cables and transformers for large scale PV plants could be manufactured in Tunisia in the medium-term. Construction also offers significant local content potential, with leading companies having both the technical skills and critical sizes to provide civil works, mechanical and electric services for large-scale solar plants. Raw materials for the construction phase such as cement and concrete or steel could easily be provided by local companies already delivering raw materials to large infrastructure projects. Local steel companies could also deliver the necessary steel support structure for PV modules. However, the local capacity remains limited on other high value-added components such as wafers, cells, and glass or electric inverters. PV modules produced in Tunisia still need to face sharp international competition and suffer from the lack of quality control and certification.

Solar CSP: CSP technology is not considered as a promising option for the manufacturing of renewable energy equipment in the short-term perspective. Currently, most private and public stakeholders do not identify CSP as a competitive technology compared to solar PV or wind energy. The lack of a promising market forecast and an unclear regulatory framework are also seen as key barriers restraining CSP project implementation. Nevertheless, certain parts of the solar CSP technology supply chain such as cables offer promising potential if the CSP market expands. The potential for local manufacturing will be determined by the ability of the country to increase local skills, empower R&D investment and foster market dynamism. Although the leading international composite materials players are not active in Tunisia, a few locally established companies may rapidly acquire the necessary know-how to produce support structures for CSP plants.

Wind: Past projects have enabled local players to gain technical expertise and demonstrate their production capacity. Cables, electrical works, mechanical lifting as well as construction material and services can rely on solid industries, offering promising local content enhancement in the case of future wind farm development. However, no local manufacturing capacity was identified for other key electrical and mechanical components. Even though no blade manufacturing capacity was identified, a few locally established companies have or may rapidly acquire the necessary know-how to produce structures used for wind masts and blades, if foreseeable national and regional markets emerged. Capacity building, R&D support and quality assurance may be critical to enable already established industries to product gearboxes, power converters or transformers meeting high performance and reliability requirements.

Based on the findings detailed above, actions aiming at supporting the organizations which play a key role for the development of industrial capacities in the renewable energy sector in the three pilot countries, such as public authorities, business associations, and financers, have been identified.

Hereafter are presented the key actions that could rapidly be initiated or implemented at national level to promote the development of industrial capacities in the renewable energy sector.

Egypt

- Review of the existing RE regulatory framework regarding the possibility of including a supporting scheme for energy storage system (either thermal or electrical).
- Develop an overall master plan to support RE component manufacturing industry in Egypt.
- Conduct feasibility study for a selection of most relevant sites in different regions within Egypt for the implementation of CSP- and PV-plants.
- Provide awareness-raising initiatives especially focused on small and medium enterprises active in the manufacturing, installation and maintenance of electrical systems.
- Develop a national R&D-plan to support the technology development of renewable energies and the identification of niche technologies.
- Extend the soft load program for domestic and roof top application with a capacity smaller than 500 kW.

Morocco

- Amend law 13-09 to allow the opening of the low voltage market. Indeed, small-scale solar PV applications could represent viable niche markets for industrial actors, on the same level as large-scale projects, with great opportunities on the export market, including for SMEs.
- Pursue the ongoing work carried out by MASEN and the Solar Cluster to size the markets of key solar applications.
- Estimate the appetite of a limited selection of international leaders manufacturing high technology components (especially in the solar CSP value chain) for the establishment of a Joint Venture company in Morocco.
- Design dedicated education programs to support the expected development of a local industry in both solar and wind sectors.
- Propose a soft loan regime for new investments in the field of RE.
- Facilitate foreign investments through Joint Ventures by implementing specific tax and regulatory incentives, and administrative assistance.

Tunisia

- Define more specifically local content expectations taking into account the strengths identified in the solar and wind value chains.
- Increase awareness concerning RE market potential and business opportunities, especially among non-specific component manufacturers (cables and electronics, power balance, mechanical parts, etc.).
- Set up raising awareness campaigns and trainings destined to local banks to allow them to get a better knowledge of the commercial viability of RE projects and facilitate access to finance for SMEs and help them extend their production facility and meet the volume and quality standards.

Given the market dynamics observed in the RE sector in the MPCs, it remains crucial to ensure that measures and actions implemented in these countries are consistent at regional level. Indeed, cooperation and access to a larger regional renewable energy market and manufacturing capacities is key to attract investments in the entire region. To enhance the regional attractiveness, the following actions have been identified:

Coordinate national renewable energy plans and policies

Stable political environments, energy subsidy reforms, deregulating the energy sector and consistent long-term renewable energy plans should be consistent at regional level. This could be further complimented by coordinating national renewable energy plans and policies with neighbouring countries as many of the areas with greatest wind and solar potential are situated close to borders. The inclusion of RE components within the scope of bilateral and multilateral treaties and agreements in the MENA area would also contribute to better coordinating national policies at regional level and enhance the emergence of regional leaders for relevant subsectors.

Optimize development of renewable energy resources and manufacturing capacities

Instead of all MPCs attempting to develop their own resources and manufacturing capacities, a coordinated approach driven by all national governments could be more cost-efficient. The objective of such approach would be to ensure that priority subsectors are well identified by each country in the area, and that these countries agree on a common roadmap in line with their respective assets and avoiding overlaps.

Cross-border trade and R&D collaboration.

If properly managed, opening up national electricity generation sectors to neighbouring power producers would introduce stronger competition and be more effective in developing renewable energy across the region. Allowing more cross-border trade across the region would foster business linkages and encourage not just regional, but also international, technology transfer. Access to bigger markets would allow local and international companies to reach the critical production size to ensure economic viability required to develop local production assets.

Establish a regional financial framework and financing facility

A regional financial framework and financing facility could reduce the cost of capital for financing renewable power projects as well as the development of new local manufacturing assets. This should be based on an evaluation of the financial structures and credit guarantee mechanisms for renewable energy projects in MPCs to determine which are most efficient in delivering capital at reasonable cost. Again a broad regional approach would make it more attractive for cleantech investors compared to narrow investments in individual MPCs.

1. Introduction

Objectives of the study

The Mediterranean Partner Countries (MPCs) [1] face rapid demographic growth combined with relatively low incomes, rapid urbanization, and important socioeconomic development needs. They are also confronted with important energy challenges: over the period 2010-2030, energy demand in the MENA Region is expected to increase at around 3% per year and electricity demand would grow at a rate of 6% per year over the same period, according to OECD[2]. Consequently, additional power generation capacities will be necessary to satisfy this demand. Because of the region's particular energy market structures, and most importantly domestic energy prices, it is still expected that this additional capacity remains strongly hydrocarbon based[2].

However, renewable energy (RE) has become an increasingly attractive alternative to domestic oil and gas consumption, since MPCs present a strong potential for the deployment of renewable energy technologies, in particular in terms of solar and wind resources and of land availability.

Renewable energy also presents socio-economic benefits and is perceived as an opportunity for industrial diversification, new value-chain activities and technology transfer which are expected to create substantial employment opportunities for the region's growing population.

Even in a context of falling oil and gas prices, wind and solar energy will increasingly make an economic case under local conditions. It is expected that electricity production from renewable energy will become highly competitive even when compared to gas powered electricity, as illustrated recently in the 100 MW solar PV tender issued by DEWA in 2014 and awarded at $0.06/kWh.

Besides, the need for diversifying the energy mix to improve energy security for oil importing countries, and environmental issues in this region highly vulnerable to climate change make the deployment of renewable energy critical in the next decades.

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[1] Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine, Syria – currently suspended - Tunisia, and Libya in the near future.

[2] OECD, Renewable Energies in the Middle East and North Africa: Policies to Support Private Investment, 2013

At present, most MPC governments are conscious of the benefits of deploying RE technologies and several initiatives launched over the last years are expected to lead to the development of large capacities of wind and solar energy in particular:

Country	Renewable energy target	Technology-specific targets
Algeria	6%(a)	Solar - CSP: 1 500 MW Solar - PV: 831 MW Wind: 270MW
Egypt	20%(a)	Solar - CSP: 1 100 MW Solar - PV: 220 MW Wind: 7 200 MW
Israel	10%(a)	Solar - CSP: N/A Solar - PV: N/A Wind: N/A
Jordan	10%(b)	Solar - CSP: 300 MW Solar - PV: 300 MW Wind: 1 200 MW
Lebanon	12%(d) by 2030	Solar - CSP: N/A Solar - PV: N/A Wind: 400-500 MW
Morocco	42%(c)	Solar - CSP/PV: 2 000 MW Wind: 2 000 MW Hydro: 2 000 MW
Palestine	10%(a)	Solar - CSP: N/A Solar - PV: N/A Wind: N/A
Tunisia	30%(a)	Solar - CSP: 500 MW by 2030 Solar - PV: 1 500 MW by 2030 Wind: 1 700 MW by 2030

(a) of electricity generation

(b) of primary energy

(c) of installed capacity

(d) of electrical and thermal energy

Except otherwise specified, targets mentioned are by 2020

Table 1: Renewable energy targets in MENA countries[3] (EY, 2014)

In this context, EIB and IRENA have mandated EY and Enolcon to carry out this study that aims to assess the region's capability to develop local renewable energy industries in the Mediterranean region. The objectives of this study are the following:

- Assess the competitive positioning and potential of MPCs in the manufacturing of key RE components (e.g. wind masts, blades, PV modules, concentrating mirrors, tracking systems, etc). This assessment includes the analysis of the existing local RE supply chain and its export opportunities as well as the potential new entrants either from domestic industrial sectors (from the steel or glass sector for example), or from international players, as foreign direct investment or international technology cooperation.
- Analyze the gaps identified in each pilot country for the development of a local RE manufacturing capacity. This requires analyzing for each technology the barriers to developing local manufacturing capacities, in terms of skills development and training, complexity of manufacturing processes, financing for upgrades in industrial production or capacity extensions, etc.
- Propose recommendations for International Financial Institutions (IFIs) to support the increase of RE manufacturing in MPCs. Conclusions will be drawn in a business perspective to facilitate decision making by potential investors, by taking into account national specificities while ensuring regional consistency.

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[3] Pan-Arab Renewable Energy Strategy 2030, Roadmap of actions for implementation, IRENA, 2014

Scope of the study

Selection of pilot countries

Among the MPCs, this study focuses on three pilot countries with relevant profiles in terms of RE development potential: **Egypt, Morocco and Tunisia**. These three countries have been selected based on three main criteria:

- The existence of ambitious national targets, support policies and achievements;
- A strong market potential and an experience in renewable energy projects;
- Local industrial assets and level of investment dedicated to renewable energy.

Egypt, Morocco and Tunisia account for nearly 90% of the currently RE installed capacity among the MPCs. Morocco, Tunisia and Egypt are the only countries together with Jordan where national renewable plans have been adopted. The definition of RE plans is key to develop a local market, which is an absolute precondition to develop a local manufacturing industry according to both public and private actors.

The German Development Institute (DIE) emphasized the particular potential for RE local manufacturing in Egypt [4] and Morocco [5] based on their population, current and above all future domestic markets and levels of industrialization. A study conducted by the GIZ [6] also highlights the positive impact that RE development may have on GDP growth, local employment and qualification in Tunisia.

The main reasons that led to select these three countries are presented in Table 2 below:

Country	National RE plans	Market potential	Industrial assets
Egypt	Ambitious solar and wind plans with clear objectives (20 % of RE in the power generation by 2020) Feed-in tariff recently implemented solar and wind energy [7]	Feed in tariffs program recently defined Increasing electricity demand (need for additional 2GW per year to meet expected demand)	Existence of well-structured industrial base with a proven track record in large infrastructure projects
Morocco	Ambitious RE development plans (42% of power capacity covered by RE plants by 2020) Strong engagement with the Moroccan Solar Plan (MSP) targeting 2000 MW of solar energy capacity by 2020 Moroccan Integrated Wind Energy Project [8]	Significant project pipeline already planned or commissioned Increasing market size due to economic development and demographic growth Strategic location in the heart of an energy hub (connected to the Spanish electrical grid)	Proven track record of local industries involved in the development of renewable energy projects Extensive experience in other industries that managed to attract foreign investments through the development of JVs (e.g. aeronautics, automotive)
Tunisia	Ambitious RE development plans with clear objectives (additional capacity of 480 MW by 2016) New bill on electricity production from RE [9]	Rapid development of low-voltage solar PV technology Strategic location (proximity with Europe through Italy) offering promising export potential	Capacity to develop technology-intensive industries (electronics) Proven track record of local SMEs involved in the development of RE projects

Table 2: Pilot countries assets (EY, 2014)

Selection of RE technologies

The study focuses on RE technologies for which the selected pilot countries have strong advantages in terms of natural resources, market size potential or track record of related industries. As a result, **solar PV, concentrated solar power and onshore wind** have been included in the scope of the study. The study [10] led by the EIB FEMIP Trust Fund on RE investment financing confirms

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[4] GDI, Building Domestic Capabilities in RE: A case study of Egypt, 2012
[5] GDI, Achieving Inclusive Competitiveness in the Emerging Solar Energy Sector in Morocco, 2012
[6] GIZ, Renewable energy and energy efficiency in Tunisia: employment, qualification and economic effects, 2012
[7] Invest in Egypt, Renewable Energy, http://www.gafi.gov.eg
[8] Investment opportunities in Morocco, http://www.invest.gov.ma
[9] Republic of Tunisia, Ministry of Industry and Technology, The Tunisian Solar Plan, 2010
[10] EIB - FEMIP, Study on Financing of RE Investment in the Southern and Eastern Mediterranean Region, 2010

that the huge solar and wind energy potential in the MPCs could contribute to addressing key issues such as the progressive growth of energy demand or climate change mitigation. The region receives between 22% and 26% of all solar energy striking the earth. Wind speeds in Morocco, Egypt and Tunisia are among the highest within the region, with wind energy potential in Egypt estimated to exceed 100 GW (Table 3, Figure 1).

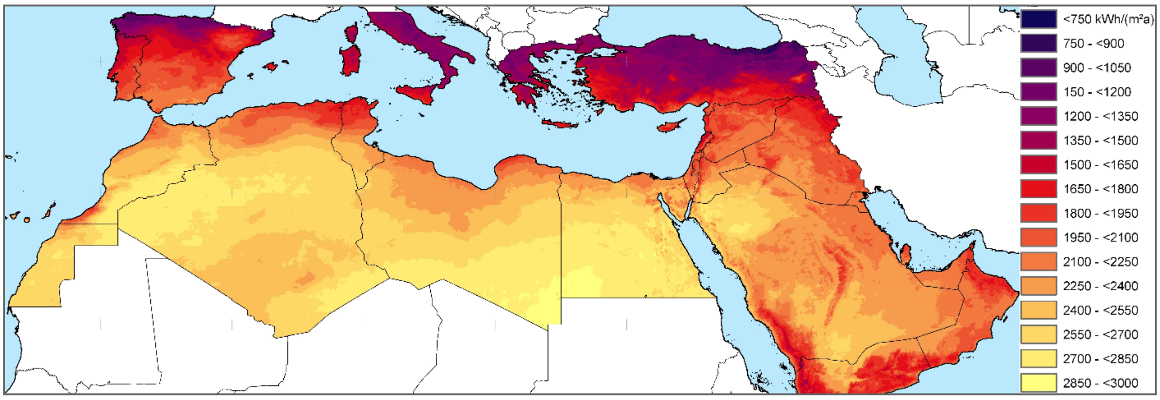

Table 3: Solar energy potential in the MPC region (GENI, 2014)

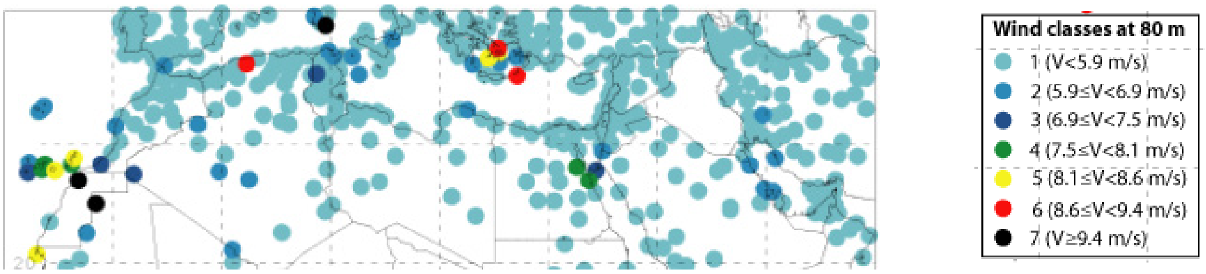

Figure 1: Wind energy potential in the MPC region (GENI, 2014)

Recent studies conducted by the GDI [11] and the GIZ [12] also support the relevance of those technologies in the selected pilot countries, outlining the potential integration of key local manufacturing industries and the positive effects of RE development on the economy, employment and qualification.

Though less mature than PV and wind technologies, a study led by the World Bank and ESMAP [13] reveals that an increasing interest in CSP has appeared in the region in the last few years with projects under implementation.

Thanks to structured tendering programs and the commissioning of one of the largest CSP plant, Morocco ranks 7th for CSP technology in the last issue of EY's RECAI [14].

A comprehensive overview of the opportunities for value creation from the deployment of large-scale solar and wind energy technologies is unveiled in a recent report by the IRENA[15]. Socio-economic effects were assessed along the different segments of the value chain, highlighting key information regarding the pilot countries: close interaction between international donors, national governments and private sector investments to support renewable energy projects in Morocco, proactive investment promotion and facilitation operated in Tunisia and Morocco or successful technology transfer in Morocco and Egypt through business partnerships in consortiums.

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[11] GDI, Building Domestic Capabilities in RE: A case study of Egypt, 2012

[12] GIZ, Renewable Energy and Energy Efficiency in Tunisia: Employment, Qualification and Economic Effects, 2012

[13] World Bank – ESMAP, Review of Manufacturing Capabilities and Potential in MENA Countries, 2011-

[14] EY, RECAI issue 42, September 2014

[15] IRENA - CEM, The Socio-economic Benefits of Solar and Wind Energy, 2014

Overview of the RE market in MPCs

The RE market in the MPC area is expanding rapidly, with a majority of countries announcing projects and setting policies to promote RE development and number of initiatives undertaken to facilitate the deployment of renewable energy[16].

According to the IFC [17], nearly $3 billion were invested in the Middle East and North Africa (MENA) region in 2012, 40 % higher than 2011 and roughly twice the amount invested in 2010. A growing recognition of these benefits is evident in the increasing amount of investment in renewable energy. It was estimated [10] that investment needs in the MPC would reach between EUR 7 and 21 billion [18] by 2020.

The total installed renewable power capacity in the MPC reached around 6.7 GW as of 2014. In terms of output, renewable energy in the region accounted in 2012 [1919] for less than 4 % of final energy consumption in 2012, a stark contrast with an average of 19 % the rest of the world[20]. Moreover, hydropower energy still accounts for an overwhelming majority of renewable capacity in the region, dominated by Egypt (2.8 GW) and Morocco (1.7 GW).

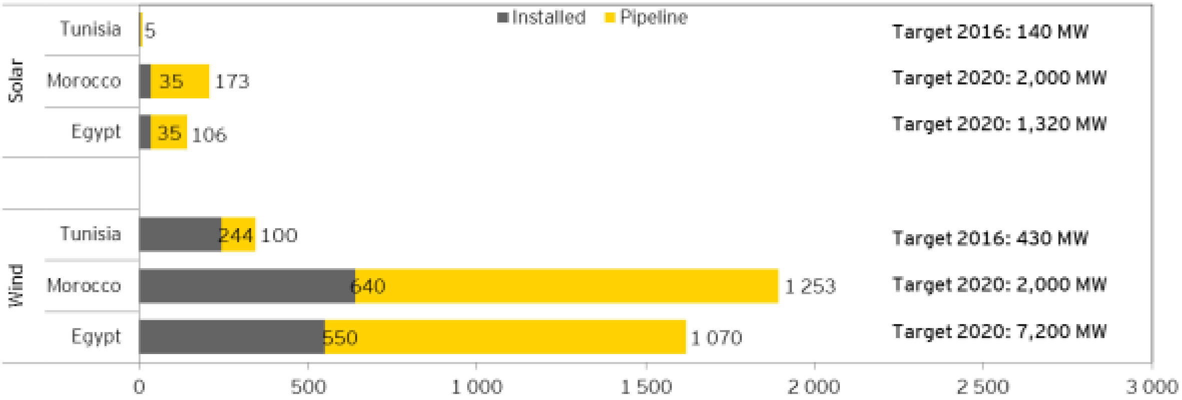

Figure 2: Solar and wind installed capacity, pipeline and target in pilot countries[21] [22]

- **Wind energy** is the most common source of electricity production besides hydropower, having expanded from 260 MW in 2006 to around 1,140 MW in 2014 installed primarily in Egypt (550 MW), Morocco (784 MW) and Tunisia (244 MW). In fact, wind development is common in the region. A good illustration of that is the 117 MW Tafila wind farm project in Jordan. This project is expected to be Jordan's first RE independent power producer (IPP) with all the output generated to be sold to National Electric Power Company (NEPCO), under a 20-year power purchase agreement (PPA). The project is sponsored by EP Global Energy (EPGE), Inframed Infrastructure, and MASDAR Power. Financing for the project is arranged by the International Finance Corporation (IFC), with participation from the European Investment Bank (EIB), the Export Credit Agency of Denmark (EKF), the OPEC Fund for International Development (OFID), the Dutch Development Bank (FMO) and Capital Bank of Jordan. Projects total costs are estimated at USD 250 million. Wind turbine prices have also been dropping and newer turbines have become more efficient especially in areas with low to medium levels of wind. The Levelized Cost of Energy (LCOE) of wind power is estimated similar to or slightly lower than the cost of the electricity produced from fossil fuels [10].
- **Solar energy** comes third in terms of installed capacity but has seen the highest average annual growth in power generation: since 2008, the average annual growth rate of solar PV production was at least 112%, as a result of the region's abundant solar radiation and continuously decreasing technology costs. CSP contributes also significantly to the growing share of solar energy in the region. As of 2014, construction is under way in Morocco (160 MW) and another 350 MW were awarded in beginning of 2015. LCOE of solar power is currently substantially higher than the one of fossil fuels (68% more for PV and 108% more for CSP), but will be more competitive in 2020 (18% lower in the case of PV and 3% higher in the case of CSP) [10].

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[16] The key initiatives are presented in Appendix D

[17] IFC, The Potential of Renewable Energy in MENA, Issue 5, 2013

[18] *Under the low scenario investments needs amount to EUR 7 billion by 2020 in 2010 prices and in the high scenario over EUR 21 billion*

[19] *2013 shares cannot be provided due to lack of data*

[20] REN21, Renewables Global Status Report, 2014

[21] REN21, MENA Renewables Status Report, 2013

[22] *Capacities are expressed in MW. Solar includes PV and CSP technologies. Others include biomass, hydroelectricity and geothermal technologies. Projects in the pipeline are those announced or for which planning have begun (some preliminary development work has been done on the project and/or it has received preliminary approval from local authorities), projects permitted, and projects which financing has been secured or is under construction.*

- **Biomass and geothermal energy** are less used in the MPC with only few operations in Israel and Jordan, totaling around 30 MW of installed capacity.
- **Hydropower** is the renewable energy source with the highest installed capacity. Indeed, Egypt has 2 800 MW of installed capacity, Morocco has 1 770 MW and Tunisia 66 MW. On the other hand, many sites eligible to hydro infrastructures are already in operation and the development potential is thus limited.

Policy deployment and target-setting are now a widespread phenomenon across the region, with all MPCs having defined renewable energy targets. By totaling the long-term plans of several governments in the region, it is estimated that these initiatives could result in 26.1 GW of additional RE capacity in the MPCs by 2020 and up to 107 GW in the MENA region by 2030. This prospect should be facilitated by the continuous declining cost of renewable energy. According to IRENA[23], solar PV module prices in 2014 were around 75% lower than their levels at the end of 2009, and installation costs for utility-scale solar PV plants have dropped by over 40 % since 2010 and are expected to fall by a further 25 % by 2020[24]. However the development of renewable energy in the region does not come without challenges.

Insufficient transmission grid capacity is often cited as a major challenge to the roll-out of renewable energy. It is estimated 17 that MENA countries would have to spend over $30 billion[17] in the next five years to ensure that sufficient grid capacity is available to provide a reliable supply of power and to integrate an increasing share of power from variable renewables. There are already number of initiatives that aim at increasing the grid capacity and improving interconnections within the region and with countries of Southern Europe such as Spain and Italy. One example is the ReGrid initiative which is a capacity building program dedicated specifically to the integration of large amount of renewable energies in MENA's electricity network. Since 2011, the ReGrid program offers different kinds of trainings, networking and exchange of experiences to energy professionals in Algeria, Egypt, Jordan, Lebanon, Morocco, Syria and Tunisia.

Energy subsidies for fossil fuels also remain a key challenge, particularly in net-oil exporting countries, as they distort the energy markets by negatively affecting the price competitiveness of renewable energy sources. As a result, government investment and finance from development banks continue to dominate in the region.

The deployment of new renewable energy capacities in the region brings major challenges in terms of local manufacturing and industrial development. Many MENA countries have been able to localize parts of the renewable energy supply chain. It is reported that 66 local companies participated in the construction of Shams 1 CSP plant in UAE, while the 160 MW CSP project in Morocco awarded last year to ACWA Power targets a local content of about 42%[25]. Similarly, about 40% of the solar field of the CSP plant Kuraymat in Egypt was generated locally. Also, the local content reaches 20-30% of the wind farms in Egypt. It is commonly known that most of the SWH systems traded in Jordan and Tunisia are locally manufactured. There is considerable interest among Arab governments to enhance local supply chains of RETs. The reason behind this interest is the belief that local manufacturing of renewable energy equipment could lead to job creation, which is one of the main political drivers for renewable energy deployment in the region.

According to the World Bank 2010 study, CSP systems offer promising local manufacturing possibilities in many Arab countries. The MENA CSP scale-up Investment Plan (MENA CSP IP), supported by the World Bank and the AfDB, is intended to strategically utilize concessional financing from the Clean Technology Fund (CTF) to accelerate CSP expansion programs in five Arab countries: Algeria, Egypt, Jordan, Morocco and Tunisia. The vision is for these countries to ultimately become major suppliers and consumers of CSP-generated electricity. The MENA CSP IP is conceived as an ambitious transformational program, leading to the installation of at least 5 GW of CSP capacity in MENA by 2020, based on the 1.2 GW triggered by the MENA CSP IP. Currently, the fierce competition with the “lower cost” PV projects seems to be slowing down realizing this ambition. However, if tangible growth in CSP is reached in the Arab region, it could become home to a new industry leading to lower costs in CSP equipment manufacturing.

Furthermore, the coordination of industrial and supply chain policies has been debated through networks and workshops. However, these efforts still need comprehensive mechanisms for follow up and channeling of recommendations to policy makers at national level, which can be achieved through regionally coordinated efforts.

The renewable energy supply chain, meanwhile, has the potential to drive economic diversification and create new jobs in local economies. However, building local research and development capacity is crucial to adapt RE technologies to local conditions.

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23 IRENA, Renewable Power Generation Costs 2014, January 2015
24 Bloomberg New Energy Finance, “PV Production 2013: An all-Asian Affair”, Solar Insight-Research Note, 2014
25 IRENA, Pan-Arab Renewable Energy Strategy 2030, 2013

Roadmap of the study

The scope of the following study covers three Mediterranean pilot countries: Egypt, Morocco and Tunisia. They have been selected as they have ambitious national targets, support policies and achievements as well as a strong market and industrial potentials and an experience in renewable energy projects. The study also focuses on three RE technologies for which the selected pilot countries have strong advantages in terms of natural resources, market size potential or track record of related industries: solar PV, concentrated solar power and onshore wind.

For each pilot country, a report based on a set of interviews with private and public stakeholders active in the renewable energy business has been elaborated. Country reports provide an assessment of the competitive positioning and potential of MPCs in the manufacturing of key RE components. This assessment has been carried out according to a set of four key success factors for the development of local RE components manufacturing:

Then, based on the conclusions of the country assessments, the study presents a detailed list of recommendations applicable at national and regional levels to enhance the development of the local manufacturing capacities. These recommendations aim at supporting the public and private organizations which play a key role for the development of industrial capacities in the renewable energy sector

2. Methodology overview

Local value chain and industrial assets

In order to allow an easier representation of each considered renewable energy technology, the component manufacturing value chain is divided into three different sub-chains: design, manufacturing of raw material, construction and manufacturing of components and the construction of the facility itself. An overall view of the complete value chain over the whole project life cycle is given below, starting with the project development phase, followed by the realization phase (covering the complete manufacturing phase) and the operation and maintenance phase until the end of facilities life time. The realization and component manufacturing stage is considered into detail for each technology.

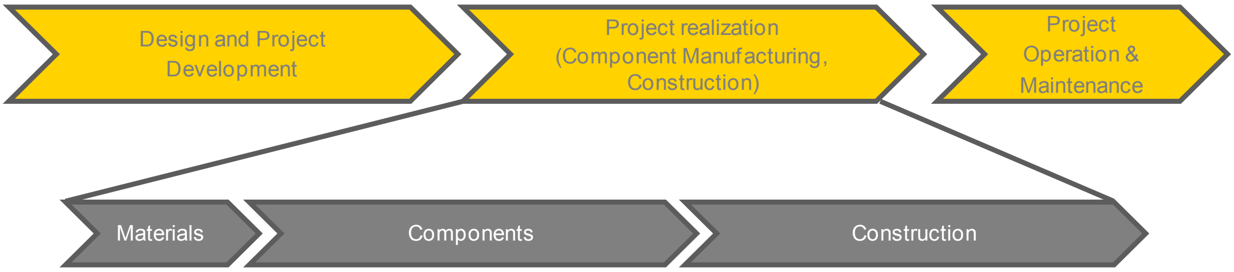

Figure 3: Overview of the general value chain for renewable energy projects (Enolcon, 2014)

The following country reports are based on a set of interviews with private and public stakeholders in Egypt, Morocco and Tunisia. During the interviews, most major players active in the renewable energy business were covered, including:

- companies able to act as leading component manufacturers active in various industrial sectors;
- Ministries and related agencies responsible for the industrial development, energy policies and promotion of renewable energies.

An overview of the interview partners is given in the section 4 of this report.

Country reports include an overview of all three regarded renewable energies (solar PV, solar CSP and wind). According to the manufacturing value chain, the different private stakeholders are mentioned based on their possible position in the value chain and their current status (already active or entrance is possible). In order to extend the overview, selected international companies already active in the region or planning to participate are also shown.

This chapter provides a general overview of the different considered RE technologies and their value chain. Although all considered technologies differ, the principle view on the value chain over the whole project lifecycle remains the same. The general value chain of a typical RE-project is divided into several phases during the development, construction and operation phase of the plant. This development is very similar to the typical development of conventional power plants or larger facilities.

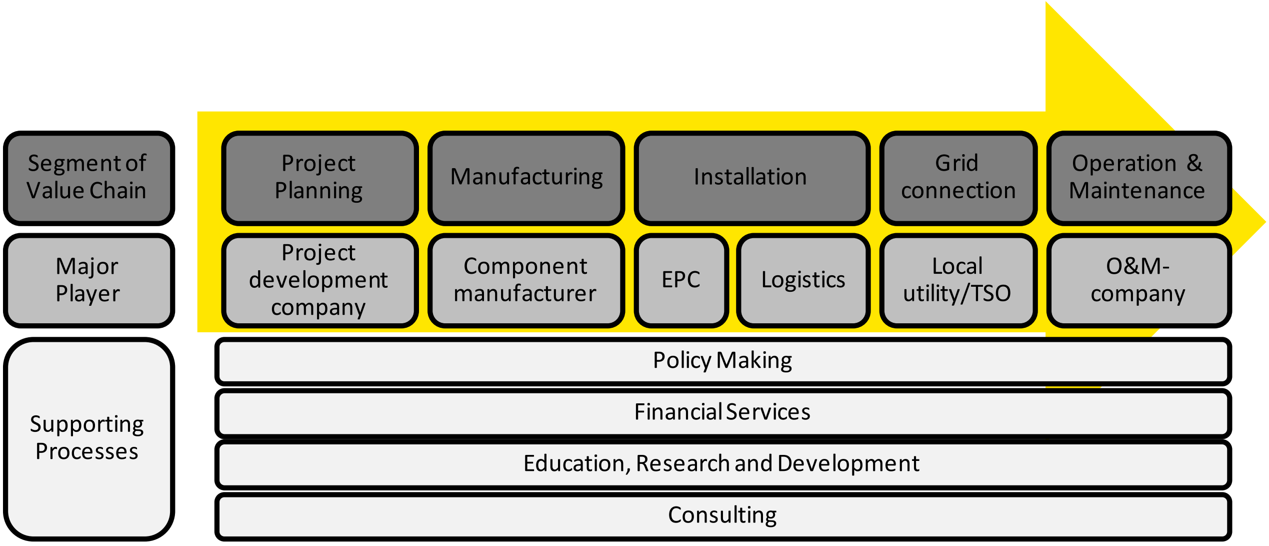

Figure 4: Typical segments of RE value chain (Based on IRENA, 2014)[26]

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[26] IRENA, The Socio-economic Benefits of Solar and Wind Energy, econValue, 2014

Along the project lifecycle, different types of companies are active, based on their experience and key focus. As the development is similar to other construction processes, the key players active are often also active in other industrial sectors and therefore not limited to the RE-industry:

- **Project development company**: This company (and more specific its project manager) is responsible for the coordination and quality assurance of all preliminary works, permits, pre-engineering and the different necessary environmental analysis. The project development company does not generally own the project, but is responsible for the project management. This company is often supported by local companies responsible for permitting processes, land use and local laws and requirements. Grid integration and grid access is developed together with local and national distribution system (DSO) and transmission system (TSO) operators.
- **EPC-company**: This company is responsible for the engineering and construction of the plant. As the EPC-company is also responsible for the quality and the performance of the plant, all component manufacturers are chosen by this company.
- **Component manufacturer**: As the RE-plant consists of several different components, many component manufacturers based in different industrial sectors are active along the value chain of the plant. Either as complete product manufacturer (e.g. gear boxes for wind), as manufacturer under license (e.g. PV-support structures) or even as sub supplier for specific parts (e.g. steel tubes for the absorber tubes of CSP).
- **Logistics and construction companies**: For the preparation of the infrastructure and the site of the plant construction companies are required. During the construction phase of the plant a lot of raw and semi-finished material and prefabricated components must be delivered to the side, requiring companies with logistic experience and local know-how.
- **Operation and maintenance:** This company is responsible for the operation and maintenance of the plant over its whole lifetime. The O&M company is often supported by local service providers.

All technologies regarded in this report have an extended worldwide track record. The already build plants have proven the technical and economic feasibility of each technology and especially for solar PV and onshore wind a wide range of possible supplier exists. Especially components with a high value for the performance of the plant need a high accuracy and a long lasting durability. In case of a failure, the component supplier must be able to offer sufficient and precise information about the production process of the component, including all sub-supplier. Therefore the traceability of all sub-components and components is very important. Such systems are well known in other industrial sectors (e.g. automotive) but require an additional implementation effort.

With the next chapter, the industrial view on the value chain of the three different RE-technologies considered in this analysis is presented. These chapters are structured as follow:

- General description of the value chain and detailed description of the most **critical components**, representing the highest value share of the plant. To quantify the influence of the value chain on the local industry, public available figures for the job creation potential of each technology are presented. The used sources are selected based on their level of detail (quantifying component manufacturing, construction and O&M) and their currency.
- For each technology, a selection of the **main international players** is given. This selection is based on their international importance (all technologies) and their experience in the MPCs (solar CSP and wind).
- The industrial view closes with a general overview on the **local content potential** of each technology. This overview is kept on a high level and is further detailed in the country reports. The potential local share is estimated based on experiences from other developing and emerging markets, public studies and own researches.

Solar PV value chain

Critical components

The solar PV (photovoltaic) value chain offers several possibilities for companies from different industrial sectors, although the main value of the value chain is created along the solar panel manufacturing process. A general overview of the value chain for solar photovoltaic is given with the following figure, showing the key manufacturing steps and the necessary components.

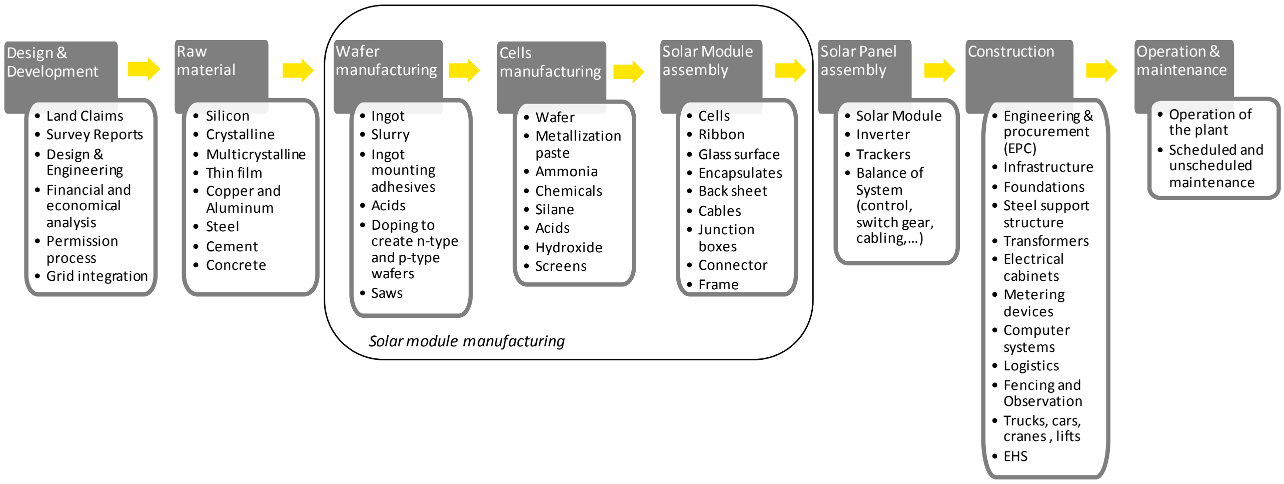

Figure 5: Solar PV value chain (Enolcon, 2014)

As the wafer manufacturing and the module assembly usually represent the highest value of the installation costs (around 60 %), the manufacturing process is described in detail.

- **Wafer production**: Based on the used technology, the crystalline (mono or polycrystalline) structure is growing and forming an ingot. The resulting structure is cut into blocks, cropped and afterwards sawed into the wafer. Wafers are doped in order to create n-type and p-type wafers.
- **Cell manufacturing**: The solar cell is built together as a sandwich structure, using the different doped wafer layers and a glass as top surface and a waterproof sheet as bottom surface. In order to provide a high efficiency of the glass surface, so called "solar glass" is necessary which needs low iron sand as raw material. The sandwich structure is equipped with the necessary electrical contacts and an anti-reflective coating is applied on the glass surface. In general, the solar cell manufacturing plants are capital intensive, resulting in a centralized production facility serving a whole region.
- **Module manufacturing**: Several solar cells are soldered together. This cell string is laminated between toughened glass on the top and a polymeric backing sheet on the rear. Additional frames are applied to allow for mounting in the field. The assembly of cells to modules is mostly carried out in the cell plant, but can be done in smaller plants closer to the end market as cells are relatively inexpensive to transport compared to modules. The capital costs for the module manufacturing are lower than for the cell manufacturing process.
- **Final assembly**: Mechanical and electrical integration of the different modules can be located at the site. This process step is not very capital intensive but labor intensive and therefore an important component of job creation effects. During final assembly, the basements and the support structure for the solar modules are installed and afterwards the PV modules are mounted. All necessary electronic components (inverter, grid connection, etc.) are installed and the cables for the PV modules are installed.

Along the value chain, different jobs are created to produce, build and operate the solar PV-plant. Direct jobs are created at the PV production site, at inverter manufacturers and at construction companies. At the wafer and solar cell/module manufacturing companies, these jobs also includes workers from all levels and skills from manufacturing workers, engineers to senior executives and administrative jobs. Indirect jobs are created by providing more general components like the steel structure for the module frames, raw material suppliers and electrical devices[27] For the United States an indicative job creation potential is assumed with 16.8 FTE[28]/MW for the Installation and Construction phase, 11 FTE/MW for the solar module manufacturing (including wafers and cells), 0.3 FTE/MW for the operation and maintenance phase and 3 FTE/MW for other components[29].

Based on projections[30], the total amount of FTE/MW during manufacturing and construction could be reduced to a range between 18.5 and 20.4 FTE/MW until 2020 and 2025, as the industry evolves rapidly towards higher labour productivity.

Main companies

The international key players active along the value chain are divided in two different categories: wafer manufacturers and cell/module manufactures. For each category, the international leading players are mentioned.

Based on the high overcapacity, the market is expected to see consolidation. In 2014 the expected global PV module production capacity of more than 62.7 GW exceed the global demand of about 45-55 GW[31].

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[27] Source: EPIA, Sustainablility of PV Systems: Job Creation, 2012

[28] Full-time equivalent employment is the number of full-time equivalent jobs, defined as total hours worked divided by average annual hours worked in full-time jobs. Source: OECD, Glossary of statistical terms, OECD website

[29] BlueGreen Alliance, Overview of the Solar Energy Industry and supply chain, 2011

[30] IRENA, Renewable Energy and Jobs, 2013

[31] ITRPV, International Technology Roadmap for PV (2013 Results), Revision 1, 2014

The Top producers of high purity polysilicon and wafer manufacturer worldwide are based in Asia, Germany and the United States. During the last years, the market is dominated by the Asian companies.

- GCL-Poly (wafer manufacturer/high purity polysilicon) is a Chinese company producing solar wafers and polysilicon. The manufacturing facilities are based in China. GCL-Poly is leading the wafer and the polysilicon market in China and worldwide
- Wacker Chemie (high purity polysilicon): is a German chemical company, producing polysilicon and wafers for the solar PV industry. In 2013 Wacker was the second largest manufacturer of polysilicon worldwide.
- Hemlock Semiconductor (high purity polysilicon): belongs to the US chemical company Dow Corning, producing high purity polysilicon for the wafer production. The manufacturing facilities are based in the US. In 2013 Hemlock was third largest supplier of polysilicon worldwide.

The PV-cell market is dominated by Asian cell producers. Price pressures have driven a number of manufacturers into bankruptcy (e.g. Evergreen solar (US) or Solon (Germany). Even the amount of Chinese manufacturers is decreasing. A selection of the Top 10 solar cell / solar modules manufacturers of the year 2013 based on Bloomberg[32] is given below. The Top 10 manufacturers account to a total market share of nearly 50% with 9 Asian and one US company.

- Yingli Green energy (wafer, cell and module manufacturer): is a Chinese solar module manufacturing company. Yingli is covering the whole PV value chain of PV modules in house starting from the polysilicon production, the wafer, cells and module manufacturing. The company has several manufacturing facilities in China and was 2013 ranked first with a market share of 8.3%
- Sharp (cell and module manufacturer): is a Japanese solar cell and module manufacturer. Sharp has a worldwide market share of around 5.4%, ranking third in the list of suppliers. Sharp closed it production capacities in the United States and Europe. The remaining facilities are located in Japan
- First Solar (module manufacturer): is an American manufacturer of PV modules (CdTe-Thin Film) with production capacities in the United States and Malaysia. With more than 8 GW installed worldwide, the First Solar could be considered as leading player. With a market share of 4.2% in 2013 the ranked 7th in the global supplier list. The company was acting as EPC for the Mohammed bin Rashid Al Maktoum Solar Park.

There are also smaller companies offering solutions for turnkey delivery of small scale solar facilities:

- JVG Thoma (module manufacturer) : German solar company offering turnkey solar facilities, formed a joint venture in 2012 with the company Tunisia Green Panel Tech and is building two module manufacturing facilities near Tunis with a production capacity of 30 MW (mono- and polycrystalline).

General local content potential

Based on the experiences from other countries in Europe (e.g. Italy, Germany or France) or in the US, the localization potential of solar PV is quite high, if a significant market size is available.

Due to the fact, that especially the first stages of the value chain (wafer production and cell manufacturing) requires a huge investment in the manufacturing facility, the annual outcome of these facilities must be very high to secure the investment. In order to be competitive against the big suppliers from China, new manufacturers need to focus on niche technologies, like thin film, requiring highly skilled workers and a close cooperation with national and international R&D partners.

If the market size is limited, it is more likely that a local value chain starts with the building of module manufacturing facilities. The development in smaller markets like Tunisia shows this behavior. Module manufacturing nearby the local market reduces significantly the transportation costs but requires the investment into new facilities and production lines.

Nearly all works during the construction, installation and system integration of the PV plant could be performed with local workers. Even if a foreign EPC-company is in charge, mainly local worker are employed if available. Other components like the steel structure for the module frames, basements and electrical cabling could be manufactured locally by already established companies. With increasing experience and improved track record, nearly all of these components could be manufactured locally.

Due to the low job potential during the O&M-phase, large scale PV-plants have a limited local content potential during the operational phase. In opposite, for small scale applications, like rooftop installations, a significant local content potential is given. Small and local companies can offer all required services from installation to maintenance of small scale systems[33].

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[32] Bloomberg New Energy Finance, "PV Production 2013: An all-Asian Affair", Solar Insight-Research Note, 2014

[33] IRENA, Renewable Energy and jobs, 2013

Solar CSP value chain

Critical components

The Solar CSP (concentrated solar power) value chain includes many different industrial sectors. The CSP-plant consists of three main parts: the solar field with the mirrors and the solar receiver, the thermal storage system as buffer storage for a heat surplus and the power block for the electricity production. The three main technologies (tower, parabolic trough and linear-Fresnel) show differences along the value chain, nevertheless it is possible to create a common version, shown below.

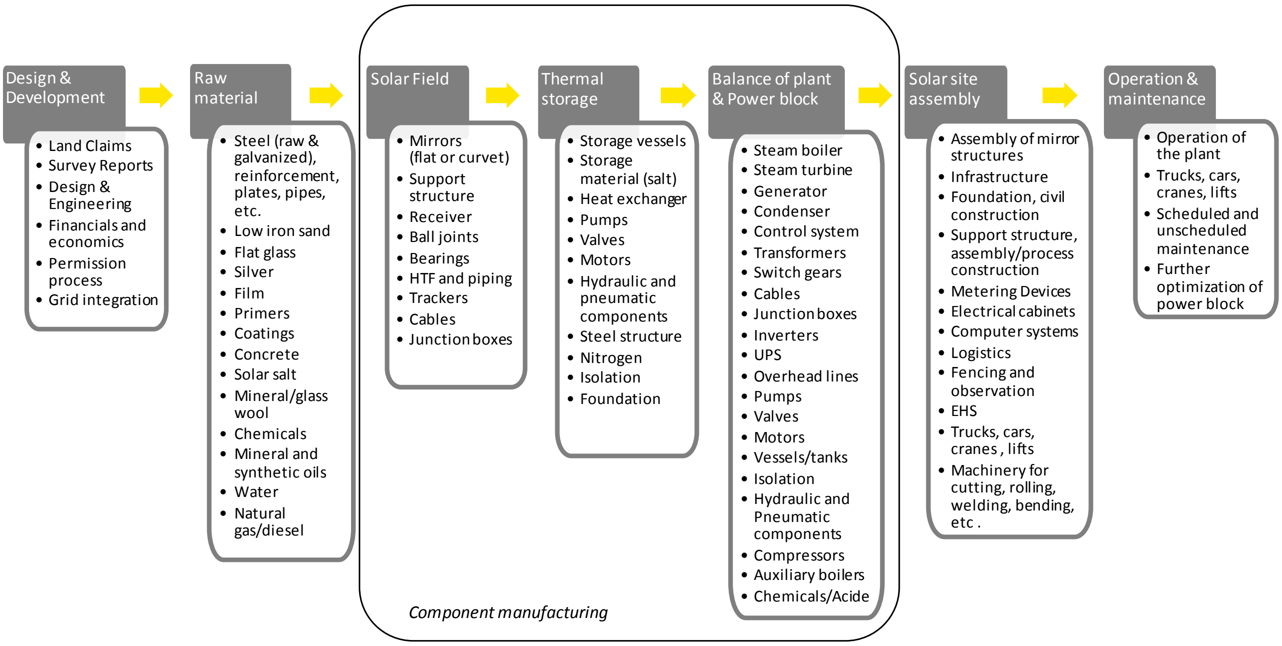

Figure 6: Solar CSP value chain (Enolcon, 2014)

The three different main components are described in more detail below, representing the main value of the CSP-plant with the solar field (around 50%), thermal storage system (around 13%) and the power block (around 20%).

- **Solar field**:

  The solar field represents the biggest value share of the CSP-plant. It consists of a considerable amount of mirrors that are mounted on a support structure made of steel. Based on the used technology these mirrors are either flat or slightly curved (solar tower and linear-Fresnel) or bended (parabolic trough). The design of the mirror support structure is provided by several companies and could be manufactured under licenses. The mirrors itself consist of solar glass (raw material: low iron sand) and the silvered reflective surface. Additional coatings on the bottom and top surface are necessary. There are two key factors for the mirror production, on the one hand the high reflectivity (over 94%) and on the other hand the long term durability of the mirror. The mirrors are used to concentrate the solar irradiation on a receiver system. For line focusing systems (parabolic trough and linear-Fresnel) this receiver consist of a steel tube with a special coating placed in an evacuated glass tube. Point focusing systems like the solar tower use a central receiver to capture the heat. The receiver is the most critical part regarding the optical performance of the plant, requiring high quality standards. The concentrated irradiation at the receiver is used to heat up a heat transfer fluid (HTF) which is pumped to the storage system or the power block.

- **Thermal storage system (or thermal energy storage)**:

  Thermal storage system is a key element of CSP-plants offering the dispatchable operation of the plant. As state-of-the art technology, molten salt thermal storage systems are built worldwide. The thermal storage system consists of the storage vessels and the heat exchangers, transferring the heat from the solar field to the storage material, a special salt mixture (60% of Sodium nitrate and 40% of Potassium nitrate) also named « Solar Salt ». Except of the solar salt, which is only available in certain regions (e.g. Chile or China), all components could be manufactured locally. Especially for the heat exchanger special know-how is necessary.

- **Power block**:

  Main part of the power block is the water-steam cycle, usually driven by a heat exchanger, transferring the heat from the solar field to the water-steam cycle. For technologies with direct steam generation, this heat exchanger is not necessary. The steam is used to drive a steam turbine. All necessary auxiliary equipment (called “Balance of Plant”) is also included. The requirements on the main components of the power block are similar to conventional power plants and could therefore be provided by companies active in the energy sector. Especially components like the piping system could be easily provided by local companies.

- **Operation & Maintenance**:

  Similar to a conventional power plant, the operation of a CSP-plant requires a staff of people during operation. Typically a 24/7 team is necessary for operation of the solar field, the thermal storage and the power block. Additional staff is required for regular maintenance like the cleaning of the mirrors. The training of the staff is provided by the O&M-company.

Most value of the CSP-plant is generated with the construction and preparation of the solar field. Nearly half of this value is not dedicated to the equipment costs but based on labour work, offering a great local content potential. The job creation potential of a current state of the art CSP-plant with parabolic trough technology and molten-salt thermal storage could be divided in direct jobs and indirect jobs. Based on existing experience and projects**Error! Bookmark not defined.**, it is estimated that within the construction phase approx.10 FTE jobs per MW installed capacity are created. At the component manufactures approx.4 FTE/MW are created. During operation approx. 0.8 FTE/MW are created. Indirect and induced jobs are arising from the greater demand along the value chain and such as training for employees along the value chain or due to the consumption of goods and services on working sites or at the component facilities. For every direct job, more than 1.2 FTE are created indirectly.

Based on these assumptions, a summarized job creation potential (without O&M-jobs) of around 33 FTE/MW is estimated. Compared to older public available numbers for Spain (2009 – 2012) of slightly more than 40 FTE/MW, these assumptions fit quite well to the current state of the art.[34]

Main companies

For most segments of the value chain, several international key players are active. These companies are also investing in production capacities in different countries worldwide. An overview of some selected companies (not exhaustive) representing the main components of the value chain and already experienced in the MPC countries is given below.

- Flabeg: is a mirror manufacturing company based in Germany. Flabeg delivered over 7 million mirrors to CSP project worldwide, including the mirrors for the Kuraymat project in Egypt. In 2013, the CSP mirror sector of Flabeg was bought by ACWA.
- Schott Solar CSP: is a German glass manufacturing company specialized in the production of solar receiver tubes (market leader). Schott Solar has a receiver facility in Spain with an annual output of 200 MW equivalents.
- Abengoa Solar: is a Spanish EPC-company, building CSP-plant and PV-plants. Abengoa is active around the world, serving every emerging market for solar power. Together with several partners, Abengoa is active in the Shams-1 project, a 100 MW plant in Abu Dhabi.
- ACWA Power: is a Saudi Arabian EPC company building CSP-plants (parabolic trough and solar tower). At the moment the company is active in the Ouarzazate project (160 MW) in Morocco.
- SQM: is a Chilean company active in the mining of the so called solar salt. The company dominates the international market with a share of more than 70 %.
- Rioglass: is a major supplier of receiver tubes and mirrors, founded in 2007 and based in Spain. Rioglass has supplied over 6 million parabolic trough mirrors worldwide.

General local content potential

Along the value chain of the CSP-plant several industrial sectors need to be included in the manufacturing process. As most of the components are not specialized and required also in other industries, already established local companies could manufacture components for CSP-plants. Especially the assembly of the solar field which must be performed at the site offers a significant local manufacturing potential. Regarding the more critical components like the mirrors or the heat exchangers, joint ventures with international market players are necessary to successful adapt already existing production lines and to achieve the necessary quality standards. Such adaptations require an initial investment in equipment and skilled workers. To justify this investment, a long and stable project pipeline in the country is required.

During the operation of the plant, local workforces are required to for operation and daily maintenance of the plant. Also local service companies are necessary for continuous maintenance of critical components. Depending on the structure of the O&M-company, nearly all relevant jobs could be occupied by local workforces.

Based on experiences with projects in Morocco (Ouarzazate) and Egypt (Kuraymat), an initial local manufacturing potential of around 40 % of the installation costs could be already achieved in the MPC. With a sufficient and long horizon pipeline, this amount could be extended to values greater than 60 %. The winning EPC company of the first CSP project in Ouarzazate (ACWA

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[34] GIZ - SASTELA, Assessment of the localization, industrialization and job creation potential of CSP infrastructure projects in South Africa, 2013

Power) stated out, that a local content of more than 40 % of the installation costs (even up to 65 %) could be possible in this project, resulting not only in a dramatically increase of the local value but also in a decrease of the installation costs[35].

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[35] CPI (Gianleo Frisari), San Giorgio Group Case Study: Ouarzazate 1 CSP Update, May 2013

Onshore Wind value chain

Critical components

Consisting of a number of different steps, the wind energy value chain is offering several possibilities for companies from different industrial sectors. A general overview of this value chain is given in the following figure along with the key products and services required through the different states.

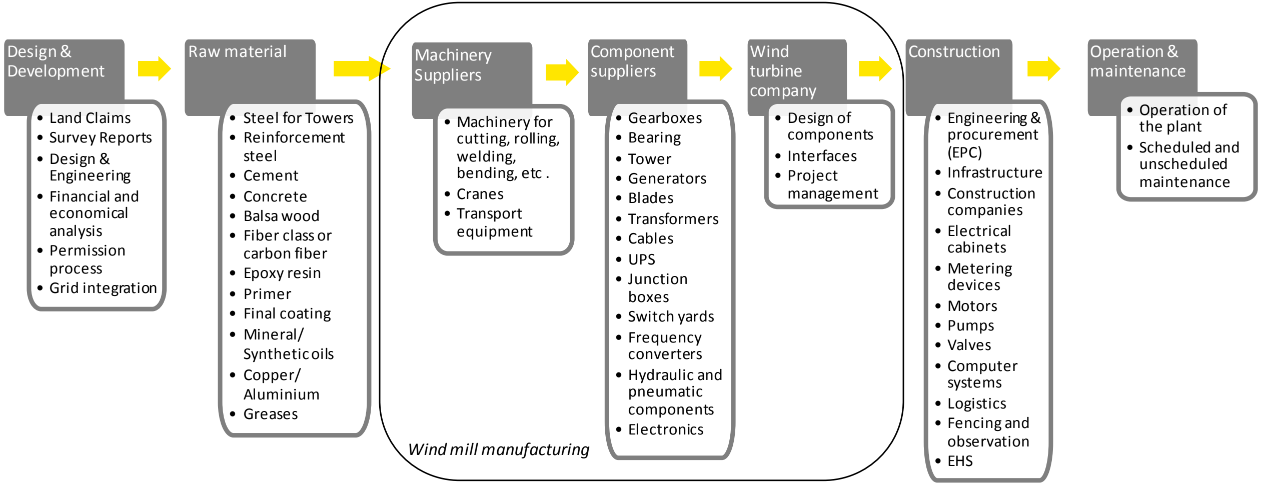

Figure 7: Onshore wind value chain (Enolcon, 2014)

At each stage of this value chain, several opportunities exist for new players except of the “wind turbine company” which is an Original Equipment Manufacturer (OEM) market, with the top players taking a large share of the market (Top 10 players share about 70% of the installed capacity during the last years). The project developer typically contracts with the OEM for the delivery of the complete turbines. The critical components are either fabricated in house by the OEM or are fabricated to the OEM’s specifications by a supplier[36]. The developer is responsible for all pre-processes like the site selection, the principal wind park layout, permits and the projects finance. During construction, the developer has a managing role in the project. The main components needed could be divided into four categories: rotor, generator and electronics, nacelle and the turbine tower.

Compared to other technologies, vertical integration of suppliers along the value chain is an important trend in the wind industry. Large wind turbine companies include the most important suppliers in house or work with long-term contracts with selected suppliers. Especially for critical components this approach helps to avoid with bottlenecks along the value chain. With the vertical integration of key suppliers, the influence of the wind turbine company on the production rises and the risk of delays or low quality product is minimized. New partners for critical components need to fulfil a longer prequalification process. After successfully passing this prequalification, the supplier could act as preferred partner.

The different manufacturing opportunities are detailed below, concentrating on the three main fields[37]:

- **Raw material production:**

  Steel is one of the key materials necessary for the wind turbine. Especially the key components of the rotor and the hub are made of steel, also the nacelle. The blades are mainly based on fiberglass, adhesive and a small amount of steel. The wind turbine tower could either made of steel or concrete. Other materials like copper, aluminum, permanent magnetic materials or ceramics are mainly needed for the generator and power electronics and the controls.

- **Component manufacturing**:

  Component suppliers provide a wide range of electrical and mechanical components. The most important components for the wind turbine are the rotors and blades, the nacelle and tower, generator and electronic components (including control) including all necessary sub-components. Especially electrical components are not limited to the use in wind turbines but also required in other industrial sectors. This allows companies with an already existing production line to enter this market (like electrical components, steel manufacturing), as long as they are able to adapt their production processes to the special needs of the wind turbine company.

- **Services**:

  During the project life cycle different services like feasibility studies, technical and legal advisory works are necessary. Besides the technical also local know-how is necessary to perform these services. Also during the construction several companies are active concerning civil engineering and logistics.

- **Operation and Maintenance**:

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[36] CGGC, Manufacturing Climate Solutions: Wind Power, 2009
[37] EAI, An Analysis of opportunities in the wind power value chain, 2013

Operation includes regular site personnel, observing and operating the turbine operation, dealing with local failure and coordinating with the utility. Maintenance includes scheduled and unscheduled services (e.g. periodic inspections of equipment, changes of consumables or cleaning). During the warranty period these services are part of the wind turbine manufacturer, afterwards the operator may perform these services on his own or special companies are subcontracted.

The wind power industry incorporates on several industrial sectors and has a potential to create and sustain many jobs along the value chain. According to public available numbers, every 1 MW of new installed wind power capacity could provide approximately 8.6 full-time equivalent (FTE) jobs in the manufacturing sector, including the component suppliers the wind turbine company and construction works and around 0.2 FTE for operation and maintenance for OECD economies. These figures have decreased during the last years with increased productivity. In emerging and developing countries, labor productivity remains considerably lower. This translates into higher FTE job figures. A South African assessment estimated 27 FTE per MW during manufacturing and construction and 0.5-1 FTE per MW for operation and maintenance[38].

In order to show the efficiency of the investments in terms of job creation, these numbers could also transformed to FTE per M€ invested. Based on public available information, the wind power industry creates in EU27 around 21 FTE per M€ invested, with around 30 % direct, nearly 50 % indirect and around 20 % of induced jobs[39]. Indirect and induced jobs are arising from the greater demand along the value chain or due to the consumption of goods and services on working sites or at the component facilities. The wind turbine consists of several critical components that have a huge influence either on the performance or on the investment costs of the whole system. Some of these components and the main manufacturing steps are detailed below.

- **Blades**: The geometry and the inner setup of the blade are crucial for the efficiency and the energy output of the wind turbine. Special design methods of the OEM companies leads to optimal behaviour with regard to noise emissions and an optimal load distribution for a longer lifetime of the blade. Typically the blades are produced with highly specialized equipment using a sandwich building method and special coatings to prevent the system from climatic influences.
- **Generator**: Based on the used method (with or without gearbox), the generator must be designed. The main demand on these components remains the same. The generator must offer a long durability, must withstand high loads and load changes. To ensure a high quality, the manufacturing of the generator is often done by the OEM company, with high quality standards.
- **Tower and Tower Basement**: Either manufactured of steel or concrete, the tower must be designed in order to withstand the high loads and load changes that occur during the operation of the wind turbine. Special design methods and experiences are necessary. The basement of the tower represents the connection between the ground and the tower of the wind turbine. Dynamic and static loads must be captured by the basement. There are several methods (e.g. raft footing or deep foundation) to build the basement, based on the specification of the OEM.

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[38] IRENA, Renewable Energy and Jobs, 2013

[39] EY, Analysis of the value creation potential of wind energy policies, 2012

Main companies

OEM companies active in the wind energy industry already experienced or active in the MPCs are listed below.

- Enercon: biggest German wind turbine manufacturer, total installed capacity (2013) over 23.4 GW with more than 22’000 wind turbines worldwide. Enercon has an office in Egypt (Cairo)
- Goldwind: is a Chinese wind turbine manufacturer, total installed capacity (2012) over 15 GW, with more than 12'000 wind turbines worldwide. In Europe Goldwind is represented by VENSYS, with an installed capacity of 3 MW in Egypt.
- Vestas: biggest wind turbine manufacturer based in Denmark, total installed capacity (2013) over 60 GW with more than 25,000 wind turbines in operation worldwide. Vestas leads the worldwide market. Vestas has installed around 50 MW capacities in Morocco and nearly 80 MW in Egypt.
- Gamesa: is a Spanish wind turbine manufacturer, with a market share of around 5.5%. Gemsa was awarded in 2011 to deliver 220 wind turbines to Egypt (Project « Gulf of El-Zayt »). Since 2003 the company has installed around 400 MW in Egypt and is also active in Morocco and Tunisia.
- SWEG: is a wind turbine component constructor and wind park operator based in Cairo, Egypt with experience in the Egyptian market.

General local content potential

Due to the fact that most of the critical components are manufactured in house of the OEM companies, the localization potential of these parts is relatively low in the first stage of the development due to the limited domestic market. However, the large size of the blades and towers favors manufacturing close to the market to reduce transportation costs. For towers, the existing manufacturing knowledge of local steel companies allows a local production. The investment in the necessary equipment for smaller wind towers could be already justified with a smaller market. There is great potential for local manufacturing companies, requiring just some adaptations of their already existing production processes. Initial knowledge transfer could be acquired by licensing technology from foreign partners.

For critical components, like blades, generators or gearboxes, joint ventures with international experienced players must be formed to ensure the know-how building. In addition, high quality standards must be implemented. In order to ensure the quality and durability requirements of the OEM company, extensive qualification processes for new sub-suppliers are necessary, which can take for simple parts around 2 or 3 months and for more complex parts more than 15 months. After successfully passing the prequalification process, the company enters a “preferred supplier” status, securing the additional production and enabling a nearly 100% share of local value.

A significant localization potential in the MPCs country is also based on the construction and operation & maintenance phase (O&M). In these phases nearly all kind of workers (low to high skilled workers, engineering and managing staff) are required, creating a significant local job creation potential.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

The purpose of this section is to assess the local manufacturing perspectives in each RE value chain.

Experiences from other countries[40] and interviews with local stakeholders from the different pilot countries have enabled to identify a set of key success factors for the development of local RE components manufacturing. This identification has also been carried out using existing literature on local manufacturing, including:

	Reference	Geographical scope	Technologies
1	Worldbank (2011), Middle East and North Africa Region: Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects	Middle East & North Africa	- Solar CSP
2	German Development Institute (2012), Building Domestic Capabilities in Renewable Energy Georgeta Vidican: A case study of Egypt	Egypt	- Solar CSP - Onshore Wind
3	German Development Institute (2012), Achieving Inclusive Competitiveness in the Emerging Solar Energy Sector in Morocco	Morocco	- Solar CSP - Solar PV
4	Desertec Industrial Initiative (2013), Desert Power: Getting Started, The manual for renewable electricity in MENA / The Economic Impacts of Desert Power: Socio-economic aspects of an EUMENA renewable energy transition	Middle East & North Africa	- Solar CSP - Solar PV - Onshore Wind
5	African Development Bank (2013), Development of Wind Energy in Africa	Africa, including MENA region	- Onshore Wind
6	GIZ (2012), Renewable energy and energy efficiency in Tunisia – employment, qualification and economic effects	Tunisia	- Solar CSP - Solar PV - Onshore Wind
7	GIZ (2013), Analyse de la chaine de valeur des technologies relatives a l'energie solaire en Tunisie	Tunisia	- Solar CSP - Solar PV

Table 4: References of literature on local manufacturing used in the course of the study (EY, 2015)

This had led to the identification of the following key success factors:

- Substantial political support aiming at creating a long-term stable market;
- Competitive local players in the global market;
- Strong industry innovation potential and skilled workforce;
- Investment capacity and strong financing infrastructures.

These four key success factors have been evaluated for the three selected countries and for each of the selected RE technology, based on the view of local companies. As it is considered that the regulation would mostly influence the whole value chain; this criterion has not been assessed for each step of the value chain.

The rating scale assessing the strength of the barriers for a future local manufacturing is defined as follows:

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[40] Further details about the international experience are available in Section 3.

Local manufacturing perspectives scoring

🟢 There is no significant barrier to the existence of this key success factor.

🟡 There might be a significant barrier to the existence of this key success factor.

🔴 There is a strong barrier to the existence of this key success factor.

The evaluation of the 4 key success factors identified enables to assess the overall local industrial capability. The rating scale is defined as follows:

Very Low	Low	Medium	High	Very High

This overall rating is calculated based on an average, taking into account the rating of each one of the key success factor assessed. Based on experiences from other countries[41], interviews with local stakeholders from the different pilot countries and existing literature, weights of each key success factor taken into account in the calculation of the overall rating has been adjusted.

Investment capacity and strong financing infrastructures

Significant investments will be required to support the development of local RE value chains in the MPCs, in order to finance new manufacturing lines, processes and training.

Thus the capacity of local players to finance these investments in the next years is highly important. This capacity depends on the ability for private actors to mobilize capital. From the point of view of industrial actors, this implies solid financial strength to provide sufficient guarantees to local banks or financing institutions, as well as a capacity to demonstrate the viability of investments.

For instance, an SME with limited financial resources may have difficulty to mobilize liquidity to invest in a new production line, whereas a medium-size or large company with strong financial assets, or a local SME supported by an international group will be more easily able to mobilize funds. This will be especially the case if there is no specific local support program dedicated to SMEs active in the field of RE.

At the same time, the challenge for the banking sector is to facilitate access to finance for industrial actors, for instance by developing lending mechanisms dedicated to RE projects. This would be facilitated by improving banks' knowledge on RE technologies and thus enable them to identify the promising technologies and judge the project risks.

Competitive local players

While the existence of a stable and long-term market is a prerequisite for the existence of a local industry, a low level of cost competitiveness compared to international players may jeopardize the development of a local RE components manufacturers.

In the next years, the capacity of MSP players to compete in the global market will be crucial, especially when compared to actors from other emerging countries such as China and India. These countries have already developed a strong RE industry over the last decade and provide components to several markets including the MENA Region.

These global leaders may benefit from several competitive advantages such as lower labor, raw material, land and energy costs when compared to the three selected pilot countries. Thus it is crucial for local companies to be able to profit from competitive advantages like the proximity of European and MENA market, low transports costs (particularly significant for large pieces such as masts in the wind industry) but also the design of components specifically adapted to local conditions (in particular high temperature, dust and humidity[42]).

Strong industry innovation

As each considered RE-technology offers a wide range of possible applications, the potential for the further development of the technology is given. Especially concerning the key part of the technologies, (e.g. for solar CSP, the solar field and the thermal storage system) the potential for new innovations or adaptations on local needs is huge.

As the RE-market is changing very quickly with new players entering the market and RE offers a great innovation potential, technology development is a must for all companies active in this market.

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[41] Further details about the international experience are available in Section 3.

[42] Effect of Dust Accumulation on Performance of Photovoltaic Solar, Ali Omar Mohamed, 2012

For local companies, this wide range of possible R&D activities offers on the one hand a very promising opportunity, providing new and especially adapted products and solutions for the local and global RE-market. On the other hand, local companies have to provide own R&D-activities in order to adapt their already existing production processes to the needs of the specific components. Without these initial adaptations, the local industry will not be able to deliver specialized components for RE-plants.

Many components of the different RE value chains require high quality standards during the whole production process, especially components that require high precision (e.g. mirrors for CSP, blades for wind energy, etc.) or a high demand of durability (e.g. receivers for CSP, glass surfaces of solar PV, etc.).

There are already some existing general international norms and quality standards for the different RE technologies, but there are also several standards under development at the moment. Nevertheless the performance of a RE plant is directly dependent on the accuracy and the quality standards of each component. To achieve a competitive market position it is essential to deliver products close to the international quality standards and afterwards to continuously improve these standards.

Regarding the qualifications of the labor force, the development of a local manufacturing industry will require a certain amount of qualified workers available to serve the demand from local actors. There are two common ways to secure the availability of skillful employees. Within the industrial sectors, special training program for already skilled workers are necessary in order to train them to the special needs of the RE value chain. Train-the-trainers programs and international cooperation are possible ways to support this development. Within the academicals sectors, specific educational programs must be established. These programs could be realized as own master programs or included in already existing programs related to “green economy”.

Stable policy support

Uncertainties about the pipeline of new RE projects and the security of potential investments represent a significant barrier for investors and are unlikely to encourage the development of local RE companies. Indeed, local entrepreneurs and companies need a predictable and stable pipeline of new RE projects to invest, as this will give them the feeling that RE business might be sustainable.

To balance the high up-front investment costs and secure investments in new production facilities over the payback period, it is crucial for investors to have a clear vision on the long-term policy framework. Therefore the political framework (e.g. renewable energy laws, funding programs, feed-in tariffs, loans, R&D-programs, LCR, subsidies, etc.) must be formulated and secured over a long time horizon.

For several components along the RE value chain, it appears that national markets might be too limited to develop local companies. A regional framework, including all MPCs in the area and describing different common goals and strategies to achieve these goals, is critical to enable a coordinated and successful development.

According to stakeholders interviewed during the study, the existence of a local market for RE components will drive the emergence and the development of local players. In addition, the existence of a strong exports potential to the MENA Region, Europe or Sub-Saharan Africa needs to be present in order to support the development of local players over a longer-term.

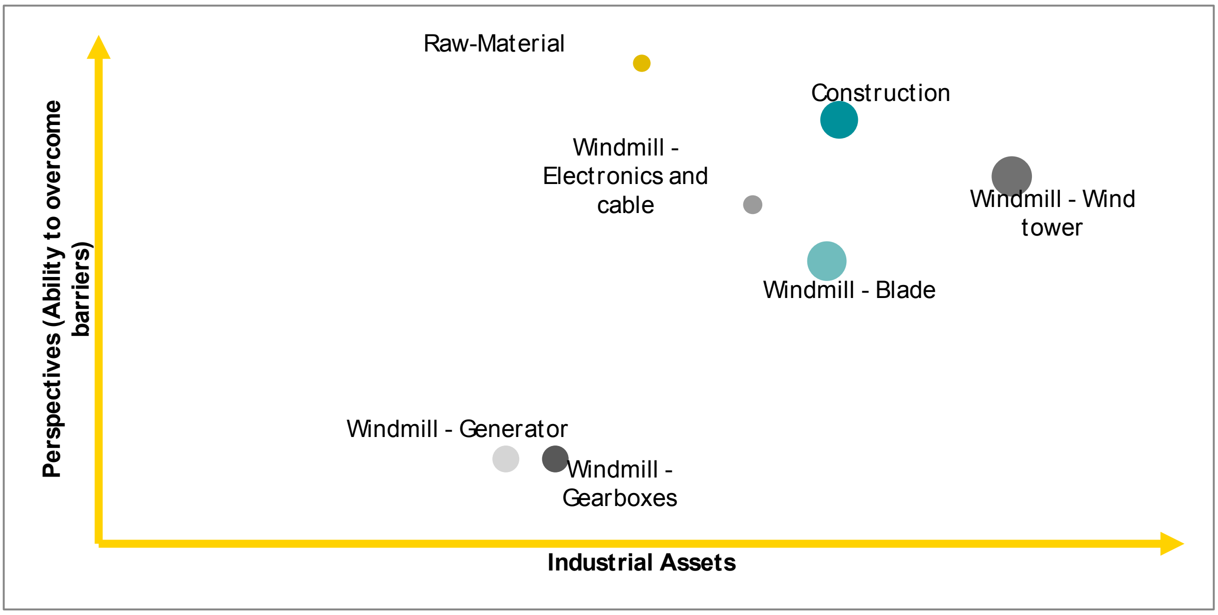
At the same time, national plans for RE manufacturing are very important to facilitate the start-up of local suppliers of RE equipment.

The detailed analysis of the policy framework for each country is available in Appendix A.

Conclusion on future local manufacturing opportunities

Based on the analysis of the industrial assets for local RE manufacturing and on the review of the key success factors for local integration, the results of our evaluation is synthetized in a clear graphical representation to conclude on future local manufacturing opportunities in Morocco, Egypt and Tunisia for the three selected technologies.

As an example, that is what the graph could look like for the wind industry:



The size of each “bubble” represents the respective weight of jobs created by industry activity per MW installed. The size of the bubble does not provide information on the local part of the production, but only gives indication on the potential of each industrial sector.

This evaluation provides a synthetic vision on the needs for improvement in the studied value chains, and constitutes a sound basis for the identification of recommendations.

3. Assessment of the local manufacturing potential in MPCs

Egypt – Country Report

Overview of the national policy framework

Renewable energy policies and targets

- To increase the overall share of renewable energies in the energy mix, targets for new installed capacities are defined:
    - 14% of primary energy from renewables by 2020
    - 20% of electricity generation from renewables by 2020: 12% from wind (equivalent to more than 7,200 MW installed), 6% from hydro and 2% from other renewables
- A feed-in tariff takes solar (both PV and CSP) and wind energy into account.
- A financing scheme for small projects has been announced.
- Qualification rules for public tenders are challenging. New players or companies with only a few references will not get qualified due to often over-loaded qualification criteria, resulting in a main barrier for local players to enter the market.
- Reimbursement of export volume if the exported products include renewable energies, reduction in customs on components imported for renewable energies.

Strategy to support RE equipment manufacturing

- Soft loans for small scale applications to support small and local investors.
- Existing technology cooperation on private company level with international players aiming to develop and improve local manufacturing.
- Loans from foreign institutions should be available in local currency (important for large scale projects).
- Existing technology cooperation on private company level with international players aiming to develop and improve local manufacturing.
- Training of local workforce thanks to international joint ventures.
- Local and regional learning centers related to renewable energies and engineering, in order to further increase the human capacities by agencies like NREA or NPO s like RCREE.
- Already existing NPOs like the RCREE are promoting the investment possibilities on international level supported by national agencies like the NREA with training programs

Technology	Previous and ongoing projects	RE policy maturity
Solar PV	• No PV project has been achieved so far • About 40 MW are in the pipeline (Kom-Ombo PV and Hurghada PV plants, 20MW each)	
Solar CSP	• The Kuraymat 140 MW CSP-Hybrid plant, including 20 MW from solar CSP, is in operation since 2011 o A local content of 55% has been achieved in this first stage project o Mirrors for this project has been manufactured in Egypt, not clear defined interfaces between the suppliers caused delays within the projects • Borg-Al-Arab, a 1.5 MWel CSP plant is currently under construction. • The Kom-Ombo 100MW CSP plant is in the pipeline. This solar tower technology is considered as the best for local manufacturing; with solar tower a local manufacturing rate of up to 75% is expected	
Wind	• The Zafarana Wind farm accounting to more than 400 MW is in operation. With the start of the commercial development the achieved local content decreased to 20%, at the moment the local content share is estimated at around 40% • The 200MW Gabal El Zayt wind park is currently under construction. With an own blade fabrication in Egypt, the local share could be increased to 70% (not yet gearboxes and motors), even up to 100%	

Synthesis of strengths, weaknesses, opportunities and threats for local manufacturing

The key findings of Egypt's renewable energy manufacturing potential are displayed in the SWOT analysis below:

Strengths

- Industry maturity
  - Broad based and competent companies available
- Technological skills
  - Enough and well educated labor available
- Economic and regulatory assets
  - Feed-in tariff published
  - Government announced large investments into distribution and transmission grid
  - Government and institution are willing to drive public and private projects
  - Tourism resorts must apply a renewable energy share of 20 %
  - Foreign financial institutions are interested in Egypt

S

W

Weaknesses

- Industry maturity
  - Market volume in Egypt and surrounding countries is not large enough
  - Local productivity level lower compared to Europe
  - To outstay political decisions, industry rely only on the visible market
- Technological skills
  - Only limited how-how transfer, limited local industrial R&D
- Economic and regulatory assets
  - Local interest rates of 9 - 11 % are quite high
  - Loans often bound to foreign currency increases exchange risks
  - Local manufacturer with high import values may have disadvantages in public tenders due to customs duties already paid on imports

Opportunities

O

- Finance
  - Foreign financial institutions willing to provide loans in local currency
- Competitiveness
  - Local manufacturing can decrease LCOE
  - Increasing export to neighbor countries
- Technology
  - Companies open for co-operations, joint ventures, know how transfer
- Regulation
  - Law under preparation that would allow for use of state owned land
  - Decreasing of subsidies on electricity to zero in the next 5 years
  - define/establish local certification criteria, limits for local manufacturing

T

Threats

- Finance
  - Foreign finance institutions not providing enough equity
- Competitiveness
  - Local manufacturing can increase LCOE
  - public tender qualification criteria too restrictive for local players
  - Limited grid capacity & long transmission distances delays market size
  - Private market not able to absorb capacities
- Technology
  - Lower local quality
- Regulation
  - Political stability and too restrictive administrative license procedures
  - Frame and boundary conditions of feed-in tariff not totally clarified
  - Government defines too ambitious limit for local manufacturing

Solar PV – Opportunities for local manufacturing

Executive Summary

Egypt is a highly promising market for the PV-market concerning solar resources. With the support of the new feed-in tariff, solar PV could be a fast track technology to increase renewable energy production locally. Although the prices for PV-module are decreasing, the PV technology is not competitive at its own at the moment, especially not against incentivized fossil fuels.

One major risk that may undermine the development of this sector would be that the government sets out a too ambitious threshold for requested local manufacturing share for solar PV projects. As component manufacturing of PV systems needs a huge and stable market potential to justify the investment in new facilities and production lines, it is recommended to ramp-up this local manufacturing share diligently. New local manufacturing companies will be able to build PV-modules locally and deliver electronic components to large PV plants. This development requires a technology transfer to Egypt for example by setting up joint ventures. Small and medium enterprises can play a large and active role providing local manufacturing in the area of the entire construction and installing of small medium and larger scale PV plants.

Strengths

- Industry maturity
  - Local installation works can lower LCOE
- Technological skills
  - Fast track technology to generate renewable energy
  - Installation, operation and maintenance skills available
  - Low technology risk profile
- Economic and regulatory assets
  - Soft loan program for projects announced, supporting small scale, mainly private dominated projects
  - Off grid solutions easily possible

S

Weaknesses

- Industry maturity
  - Trained SME's not well developed, no real local manufacturer on the ground
  - No strong increase of local manufacturing potential expected (economically not viable)
  - Very strong international manufacturing competition
- Technological skills
  - Not well established
- Economic and regulatory assets
  - Local market cannot absorb 300 MW
  - Lowest specific rate of local staff employed due to high automation in production

W

Opportunities

O

- Finance
  - broader extension of soft loan programs
- Competitiveness
  - Larger business opportunities for SME's in the area of installation and maintenance of modules
  - Joint ventures or production under license promising starting point for module manufacturing
- Technology
  - Small scale local manufacturer already on the ground
- Regulation
  - Establish of local certification criteria / institutions
  - Technology and R&D transfer

Threats

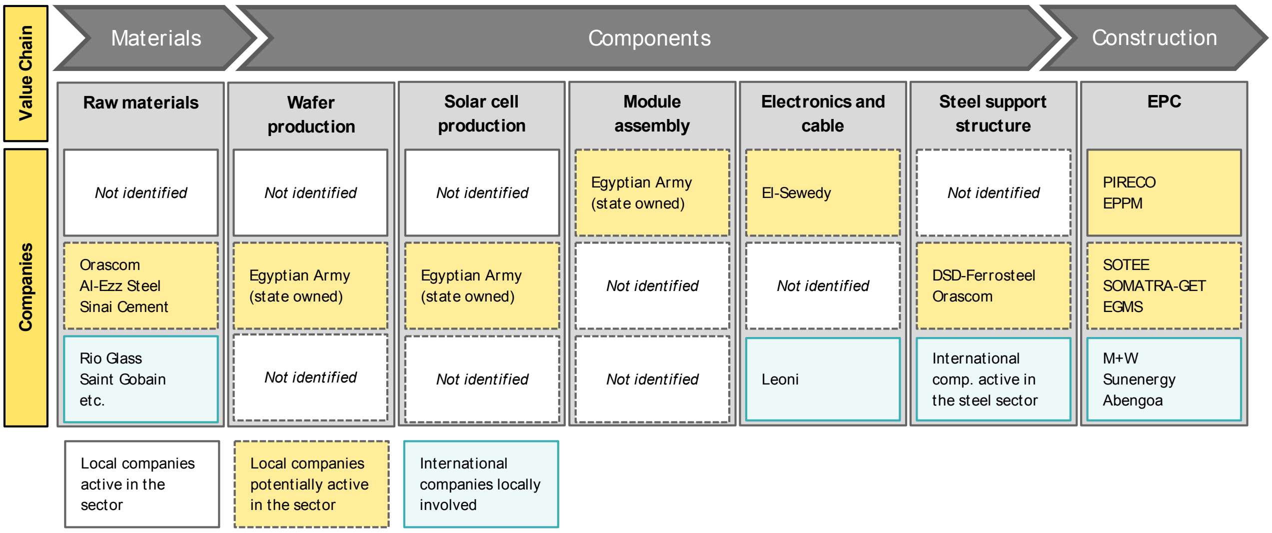
T

- Finance
  - Foreign soft loan providers reverts back
- Competitiveness
  - Market development restricted
  - No economical and sustainable increase of local manufacturing
  - Very strong international manufacturing competition, especially from Asia
- Technology
  - Rapid foreign technology innovation cycle
- Regulation
  - Capacity plan of 10.000 MW until 2020 will be delayed
  - In case of a set local manufacturing value, numbers set to high
  - Actual market potential too small, feed-in tariff is limited on 300 MW for small scale application

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for solar PV plants. The different local players identified during interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the local markets are shown additionally.



Value Chain	Materials	Components					Construction
	Raw materials	**Wafer production**	**Solar cell production**	**Module assembly**	**Electronics and cable**	**Steel support structure**	**EPC**
Companies	*Not identified*	*Not identified*	*Not identified*	Egyptian Army (state owned)	El-Sewedy	*Not identified*	PIRECO EPPM
	Orascom Al-Ezz Steel Sinai Cement	Egyptian Army (state owned)	Egyptian Army (state owned)	*Not identified*	*Not identified*	DSD-Ferrosteel Orascom	SOTEE SOMATRA-GET EGMS
	Rio Glass Saint Gobain etc.	*Not identified*	*Not identified*	*Not identified*	Leoni	International comp. active in the steel sector	M+W Sunenergy Abengoa

Local companies active in the sector

Local companies potentially active in the sector

International companies locally involved

Table 5: Egyptian companies involved in the Solar PV value chain (EY/Enolcon, 2014)

Local manufacturing assets [15]

Key assets of local industries	**Industry maturity**			**Technological skills**			**Economic assets**			**Conclusion on local manufacturing assets**
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw Material	●○○○	●●○○	●○○○	●○○○	●○○○	○○○○	●○○○	●○○○	●○○○	Low
Solar Module manufacturing[43] > Wafer production	○○○○	○○○○	○○○○	●○○○	○○○○	●○○○	●○○○	●○○○	●○○○	Very Low
Solar Module manufacturing > Solar cell production	●○○○	○○○○	○○○○	●○○○	○○○○	●○○○	●●○○	●○○○	●○○○	Low
Solar Module manufacturing > PV-module manufacturing	●○○○	●●●○	●○○○	●●○○	●●○○	●○○○	●●●○	●●●○	●●●○	Medium
PV Plant > Electronics and cable	●●○○	●●●○	●●●○	●●●○	●●●○	●●○○	●●●●	●○○○	●●○○	High
PV Plant > Steel support structure	●○○○	●●●○	●●●○	●●○○	●●●○	●●○○	●●●●	●○○○	●●●○	High
Construction	●●●○	●●●●	●●●○	●●●●	●●●○	○○○○	●●●○	●●●○	●●●○	High

The government and related agencies generally identified PV technology and its industry as a fast growing sector. As PV-plants could be developed within a short time frame, PV is considered to be a fast track to increase the share of renewable energies in Egypt. Some construction companies focus only on the development of solar projects instead of wind as they see minor grid connection issues. As wind energy is limited to special locations with huge wind potential but limited grid capacity, PV plants could be built nearby locations with sufficient grid capacity.

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[43] Only civil supply is taken into account in this analysis

Raw materials

Raw materials for the production of solar modules such as the necessary glass could be provided by international companies active in Egypt like *Saint Gobain*, which offer significant capacity. The following processing and finishing of the flat glass (like cutting, tempering, etc.) could be performed by local companies (e.g. *Dr. Greiche Glass*) covering the whole glass processing value chain. Raw materials for the construction phase like concrete or building steel could be provided by local companies already delivering raw materials to large infrastructure projects.

Solar module manufacturing

At present, there are only two solar module manufacturing companies active in Egypt, producing PV modules for the Egyptian military. These companies are state owned; the production is used to keep the Egyptian army independent from foreign products. No private company is currently producing PV modules or related components. Also no wafer production was identified for civil production.

With increasing local market size, the manufacturing of PV modules is likely to start in Egypt within the next few years. As examples from other countries (e.g. Tunisia) suggest, the development of local capacities should start at the end of the value chain and develop downstream. Several companies mentioned that setting up PV module manufacturing lines in Egypt would not be challenging if the market size justifies the investment. According to NREA, there are potential investors interested in building PV module facilities with an annual output of 200 MW.

Electronics and cable

The required cables and transformers for large scale PV plants could already be manufactured in Egypt. *El-Sewedy* is ranked the 5th largest cable manufacturing company in the world and the largest in the region and has been active for 40 years in this business. Based on this excellent market position, the supply of cables for all kind of renewable energies (PV, CSP and wind) is possible.

According to *RECREE* the market position of local players producing electrical components such as inverters and working on the grid connection issues is quite good. Transformers can be delivered also by *El Sewedy Transformers* or, for example, by *Egytrafo.*

Steel support structure

Local Egyptian steel companies are able to supply the necessary steel support structure for PV-modules, as well as the mounting of the PV-modules. For both industrial sectors, the renewable energies will be a “side market”, companies will just invest in new production capacities or training of staff if a clear and available market is foreseen (according to *DSD Ferrometalco* the time horizon must be at least 3 years).

Engineering, Procurement and Construction (EPC)

Egyptian companies like *TAQA Arabia* are able to develop their own PV projects in Egypt and are already actively participating on tenders (e.g. *TAQA* was qualified as one possible bidder for the PV Kom-Ombo project).

The construction and assembly of small scale applications for households or smaller industrial applications offers a great potential for small and medium sized enterprises to create an own business offering construction and maintenance services for rooftop installation or small-sized applications. Such companies also allow small private investors to invest and participate in the growth of renewable energies. As maintenance of installations is also required, a sustainable local business could be developed.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key success factors for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[44]	**Conclusion on future local industrial capability**
Raw material	🟡	🟡	🟡	🟡	Medium
Solar Module manufacturing > Wafer production	🔴	🔴	🔴		Very Low
Solar Module manufacturing > Solar cell production	🔴	🔴	🔴		Very Low
Solar Module manufacturing > PV-module manufacturing	🟡	🟡	🟡		Medium
PV Plant > Electronics and cable	🟢	🟡	🟡		High
PV Plant > Steel support structure	🟢	🟡	🟢		High
Construction	🟡	🟢	🟢		Very High

Potential involvement of international players in local production

As the PV market is not established in Egypt yet, no international companies are directly active in the market. With increasing market share and new manufacturing lines, international companies can enter the market offering equipment and know-how in building PV facilities.

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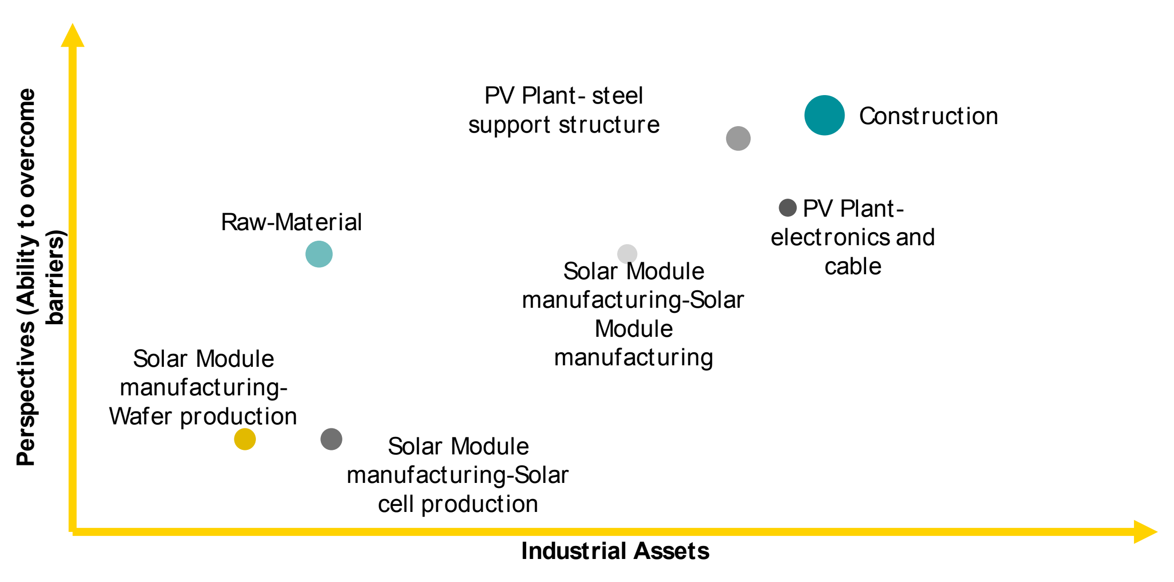
[44] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities



The following components offer very promising local capacity potential:

- Electronic components of PV plants like the cables or inverters. There are already existing local manufacturing capacities offering comparable components to the market. Necessary adaptation for the components (e.g. inverters for PV-plants) could be done using licenses from international players to avoid high upfront R&D-costs. Own developments might be too cost intensive to be competitive on the market dominated by international players (e.g. from China).
- Infrastructure like grid connection, buildings and access roads necessary for large scale PV-plants offer also a very promising local capacity. Based on the international and national experienced construction industry, all infrastructure components are expected to be sourced locally.
- Concerning small scale application, a huge potential is identified for small and medium enterprises offering roof-top installation and maintenance of their PV-systems.

Other components show potential but barriers need to be overcome to unlock this potential:

- PV module manufacturing offers a high localization potential due to its easy and robust production process. Due to the high transportation costs, local manufacturing offers a significant cost advantage. As the production is highly automated and the necessary assembly lines must be imported, the added local value is reduced. Nevertheless the investment in new manufacturing facilities requires a stable and significant market size.
- Glass sheets necessary for the PV modules could be finished by local companies and delivered to the local or regional PV module manufacturers. As the raw material for “solar glass” is not available in Egypt, the glass itself must be imported.

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- As international competition – especially for downstream components in the value chain – is quite high, the local manufacturing of components like solar cells and wafers is limited. Since 2013 there has been a significant overcapacity on the world market (mainly influenced by Chinese producers). To justify the investment in local manufacturing lines the market potential must be raised significantly and be protected against the international competition.

  Main barrier: Market size and strong international competition.

Solar CSP – Opportunities for local manufacturing

Executive Summary

Based on the excellent direct normal solar irradiation values, Egypt is a highly promising market for CSP-technology, also offering several opportunities for local companies to manufacture components such as mirrors, steel components and power plant equipment. A local manufacturing share of 55% was achieved for the first project developed in the country. Local players believe this value can rise up to 70%.

However, the framework of the new feed-in tariff does not support the development of large-scale CSP-projects (capacity limit and direct competition with PV). The further development of the technology and the related industry could only be supported in Egypt with new public tenders for CSP.

Private stakeholders remain optimistic, performing own project development on the basis of current feed-in tariff rates, and introducing a larger amount of local manufactured components. Increasing the local manufacturing capabilities requires significant technology transfer to Egypt (for example through Joint Ventures with European companies).

Strengths

- Industry maturity
    - High local manufacturing potential up to 80%
    - Plant size in multi megawatt range between 50 and 250 MW
    - First hybrid plant on the ground (strong local support by Orascom)
- Technological skills
    - Highest specific rate of local staff employed of all kind of educational levels
    - Technology can strongly stabilize the electrical grid system
    - Potential component manufacturer already on ground
- Economic and regulatory assets
    - Size dedicated for large foreign finance organization
    - CSP with storage could cover peak demand

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Weaknesses

- Industry maturity
    - In the next 5 years no separate support e.g. for peak power generation expected
    - CSP is seen as monopoly market covered by only few suppliers
    - Technology risk profile a bit higher compared to PV and wind
- Technological skills
    - CSP is not seen as mature technology
- Economic and regulatory assets
    - Same tariff for PV and CSP, peak power generation capability of CSP is not supported
    - No public projects at the horizon; local banks plays a minor role
    - Large market volume necessary

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Opportunities

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- Finance
    - Large foreign investments saves investment potential of local banks
- Competitiveness
    - High portion of local manufacturing can reduce LCOE
    - If peak load on demand would be counted CSP could be competitive already today (update Kom Ombo LCOE study)
    - Strong local players on the market (Orascom, Taqa)
- Technology
    - Experience already with local manufactured components (prototypes)
- Regulation
    - A reliable capacity master plan and a minimum limit of local manufacturing could be a booster for an increased local manufacturing

Threats

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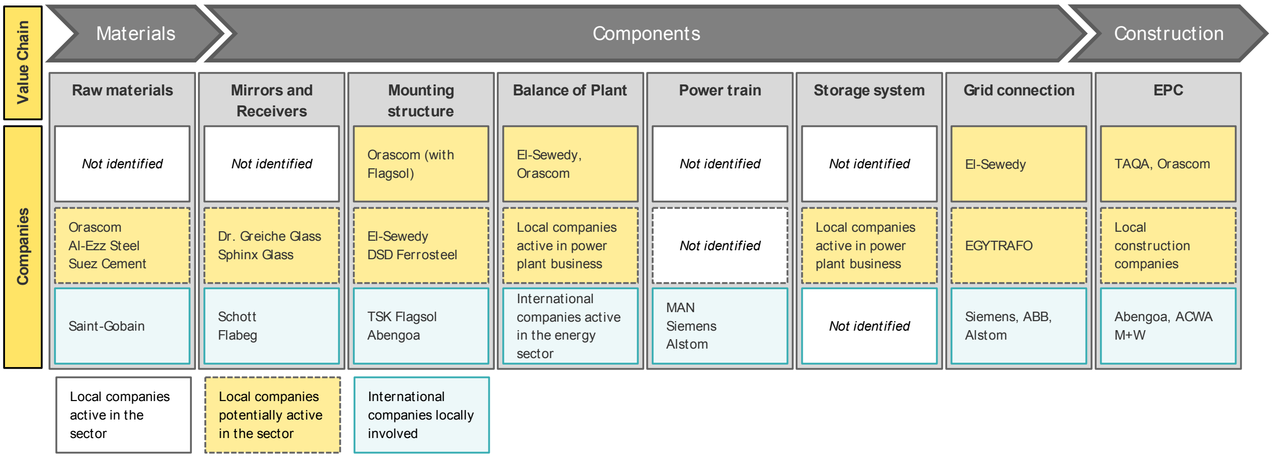
- Finance
    - Appetite of banks is limited (foreign banks) or not available (by locals)
- Competitiveness
    - CSP generation cost will not reach parity with conventional power costs
- Technology
    - Public institution are skeptical about the technology and cost competiveness of CSP
    - No feed in tariff at the horizon supporting peak power generation capability
- Regulation
    - Grid capacity limit of approx. 50 MW per access point, limits LCOE reductions by economy of scale effects

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for solar CSP plants.



Value Chain	Materials	Components						Construction
	Raw materials	**Mirrors and Receivers**	**Mounting structure**	**Balance of Plant**	**Power train**	**Storage system**	**Grid connection**	**EPC**
Companies	*Not identified*	*Not identified*	Orascom (with Flagsol)	El-Sewedy, Orascom	*Not identified*	*Not identified*	El-Sewedy	TAQA, Orascom
	Orascom Al-Ezz Steel Suez Cement	Dr. Greiche Glass Sphinx Glass	El-Sewedy DSD Ferrosteel	Local companies active in power plant business	*Not identified*	Local companies active in power plant business	EGYTRAFO	Local construction companies
	Saint-Gobain	Schott Flabeg	TSK Flagsol Abengoa	International companies active in the energy sector	MAN Siemens Alstom	*Not identified*	Siemens, ABB, Alstom	Abengoa, ACWA M+W

Local companies active in the sector

Local companies potentially active in the sector

International companies locally involved

Table 6: Egyptian companies involved in the Solar CSP value chain (EY/Enolcon, 2014)

Local manufacturing assets [45]

Key assets of local industries	**Industry maturity**			**Technological skills**			**Economic assets**			**Conclusion on local manufacturing assets**
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw Material	●●○○	●●○○	●●○○	●○○○	●●○○	○○○○	●○○○	○○○○	●●○○	Low
Solar field > Mirrors	●○○○	●●○○	●●●○	●●●○	●●○○	●●○○	●●●○	●●●○	●●●○	High
Solar field > Mounting structure	●●○○	●●○○	●●●○	●●○○	●●●○	●●○○	●●●○	●●●○	●●●○	High
Power Block > Balance of plant	●●●○	●●●○	●●●○	●●●○	●●●○	●○○○	●●○○	●●●○	●●○○	High
Power Block > Power train	○○○○	○○○○	●○○○	●○○○	○○○○	○○○○	○○○○	○○○○	○○○○	Very Low
Thermal Storage > Storage system	●○○○	●○○○	●●○○	●●○○	●●●○	●●●○	●●○○	●●○○	●●●○	Medium
Grid connection	●●●○	●●●●	●●●●	●●●○	●●●○	●●●○	●●●○	●●●○	●●○○	High
Construction	●●○○	●●●●	●●●●	●●●○	●●●○	●○○○	●●●●	●●●○	●●●●	High

Two different views on the CSP-technology were observed during the interviews. On the one hand, public stakeholders generally identified CSP-technology as too expensive compared to solar PV. Besides the high costs, the lack of international competition on

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[45] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

the market (only a few major component manufacturers dominate the market) is seen as a barrier for local component manufacturing. On the other hand, private companies identified CSP technology as an opportunity for successful business development not only for the Egyptian market but also for the neighboring countries. Orascom Construction Industries is involved in a small scale R&D-project connecting CSP, desalination and biomass.

Raw materials

The required raw and semi-finished materials for CSP plants have an important share of the value chain. Most raw materials are used during the construction phase for foundations and buildings. Steel and other metals are required for the manufacturing of support structures. Most of this material could be provided by local companies. Special materials such as thermal oil used as heat transfer fluid or the molten salt used as storage material are produced by specialized international companies.

Solar field (Mirrors and receivers)

Although necessary raw material for solar glass is available in Egypt (so called low-iron sand), no glass company is able to produce solar glass with the required high purity in Egypt, the necessary solar glass is imported. Flat mirrors necessary for solar tower and linear Fresnel plants could be produced with a high capacity by at least two companies (*Dr. Greiche Glass* and *Sphinx Glass*). Concerning the production of bended mirrors, *Dr. Greiche* has developed a first prototype, but is not able at the moment to deliver high volumes to the market. *Sphinx Glass* is expected to increase their production capacity to serve the increasing market in the Middle East. Both companies are focused on the automotive sector and architectural glass. Mirror production for CSP would be, at least for the first projects, a side market.

Solar field (Support structure)

Egyptian steel companies (like *DSD*) are able to manufacture steel structures for Heliostats used for solar tower applications. Light steel structures necessary for the support structure of parabolic trough CSP is not a market for *DSD* but other steel manufacturers in Egypt (e.g. *Egypt Steel*) are available to deliver light steel structures. *Orascom* is cooperating with the Spanish/German company *TSK Flagsol* covering the support structures and the complete solar collector field for parabolic trough plants, offering a production capacity of around 20,000 t/year.

Grid connection

The necessary parts for the grid connections including the transformer could be manufactured locally by *El-Sewedy Transformers* – who have the ability to produce transformers from 6.6 kV up to 220 kV, with an experience in the installation of sub-stations.

Steam turbine

Steam turbines are a critical component, requiring highly skilled and experienced staff during the development phase and highly specialized production processes. To justify the necessary investment in a local production facility, a high annual output over several years must be foreseen. As this market size is not realistic, no steam turbine manufacturing is likely to apply within the next few years.

Storage system

The storage system consists of two main parts, the storage material and the storage equipment like vessels, valves and additional equipment. As current state-of-the art, molten salt storage systems are used for large scale applications. The necessary material is not available in Egypt. Storage equipment is similar to conventional equipment used in the process industry or in power plants, therefore companies like *TAQA* or *Orascom* could manufacture the necessary components.

New storage solutions using other storage materials, such as packed-bed systems or storage system based on silica sands, could be developed and produced locally. Such cheaper storage solutions can also help reducing the LCOE-cost of CSP plants.

Balance of Plant & Construction

There are several energy solution providers active in Egypt (*TAQA*, *Kharafi Group*, *Orascom*) able to deliver most components necessary for the Balance of Plant (BoP), including pressure parts and tanks, piping, heat exchangers and heat recovery steam generators. Orascom has a production capacity of 40,000 t per year for pressure parts. These companies are already active in the conventional power plant business (also at global level). This knowledge could be transferred to CSP-plants. Also motors and parts for tracking systems such as electrical or hydraulic components could be served by local actors (e.g. *Orascom Trading, Lotas*).

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[46]	**Conclusion on future local industrial capability**
Raw material	🟡	🟡	🟡	🟡	Medium
Solar field > Mirrors	🟡	🟡	🟡		Medium
Solar field > Mounting structure	🟢	🟢	🟡		High
Power Block > Balance of plant, piping, electronics	🟢	🟢	🟢		Very High
Power Block > Power train	🔴	🔴	🟡		Low
Thermal Storage > Storage system	🟡	🟡	🟢		High
Grid connection	🟢	🟢	🟢		Very High
Construction	🟢	🟢	🟢		Very High

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[46] Detailed analysis of the policy framework is available in Appendix A.

Potential involvement of international players in local production

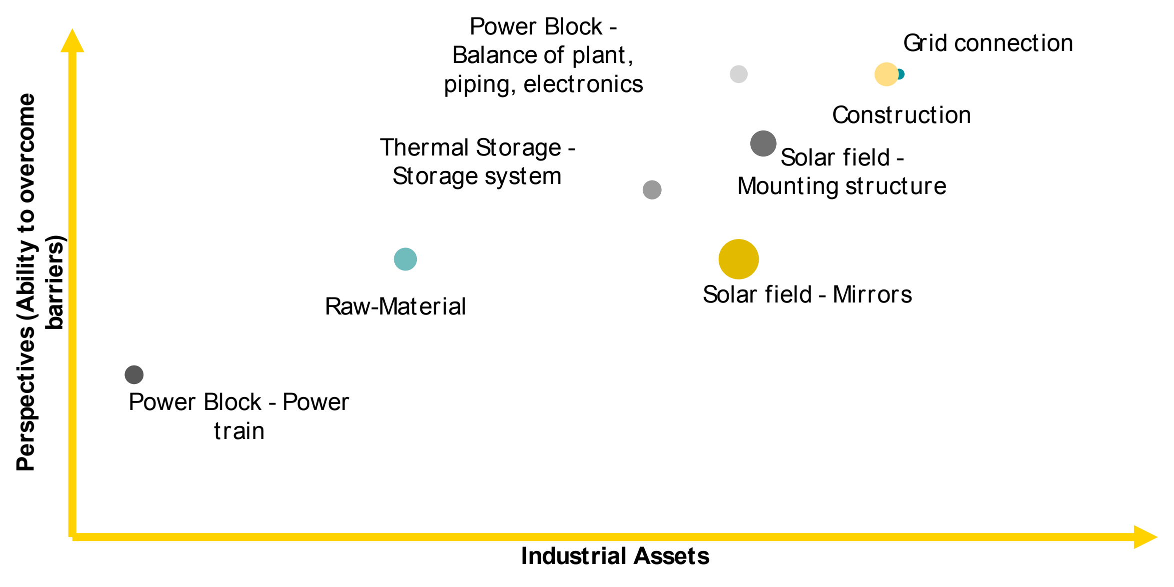
Thanks to high irradiation values, Egypt is an interesting market for international project developers and EPC companies. Nevertheless, all the international companies interviewed mentioned the political stability in Egypt as a key barrier. A stable and sustainable market must be available for at least three years. Stable market conditions were rated higher than attractive market conditions.

International leading companies producing highly specific products for CSP-plants (like Schott Solar CSP producing receivers or KSB producing pumps) indicated that the potential market size could be too small to implement specialized production facilities (for Receiver production an annual capacity of more than 200 MW is necessary). Other players providing steel structure or producing mirrors are already involved with technical cooperation or own production facilities.

Key barriers mentioned by international players are also related to the challenging regulatory framework and the required licenses. Joint ventures were indicated as a major part of business development, enabling both companies to exchange local experience and technology specific know-how.

Conclusion on future local manufacturing opportunities

Future industrial capability of the CSP manufacturing value chain is strongly correlated to the development of CSP-projects in Egypt. As current Feed-in Tariff is limited to installed capacity of 50 MW, the economies of scale allowed by large CSP plants with capacities above 100 MW are not expected in Egypt. As the feed-in tariff is formulated as “solar energy generation” CSP must compete against PV. Due to these two reasons, CSP will not be competitive under the feed-in tariff within a medium time horizon, if local manufacturing is not able to significantly lower project costs. Several companies identified CSP-technology as a promising renewable technology with a high local content potential. Based on internal studies of TAQA, the solar tower technology offers the highest localization potential with local content share up to 75%-80%. Egyptian glass companies are able to deliver the necessary flat mirror and steel companies are able to build heliostats and solar towers.



The following components offer very promising local capacity potential:

- Infrastructure like grid connection, buildings and access roads necessary for large CSP offer also a very promising local capacity. Based on the international and national experienced construction industry, all infrastructure components are expected to be sourced locally.
- Assembly of the solar collector elements at the site could be easily performed by local workforce.
- Electronic components necessary for the solar field (e.g. cable, junctions, trackers) and the Balance of plant (e.g. pumps, valves) could be delivered by already established local companies. As Egyptian manufacturers offer also pressure parts such as pipes and heat exchangers, the Balance of Plant offers a very high local manufacturing potential.

Other components show potential but barriers need to be overcome to unlock this potential:

- Local companies are able to deliver mirrors necessary for all CSP-technologies. Additional investment in new production lines and training of staff is necessary. Technology cooperation with international players already exists. Even if there is no market visible at the moment, companies are starting to develop products and projects, showing their strong interest in CSP-technology.

  Main barrier: Necessary R&D and investment in automated production requires significant market size.

- Local companies offering structural steel could also manufacture the mounting structure for the heliostats and the solar collector. Together with the solar collector development company (often the EPC-company) the necessary components are developed and then produced locally.

  Main barrier: Technology cooperation with solar collector development and market size

- The Receiver for tower systems could be manufactured by companies already dealing with high pressure parts. Additional R&D and technology cooperation is necessary.

  Main barrier: Technology transfer

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- Receivers for line focussing CSP systems are highly specialized components, requiring special production lines and in-depth knowledge. The market is dominated by only a few players with a long track record. Since 2014 an overcapacity is observed. Based on the estimated market development no linear receiver production is expected in Egypt over the next years.
- The power train for CSP-plants is a specialized component. Steam turbines are developed by only a few players worldwide, serving different applications and capacities. As the manufacturing lines require a significant annual capacity, no steam turbine manufacturing is expected in Egypt within the next years.

If public tenders for large CSP projects could be developed over the next year, a significant local share along the CSP value chain could be developed, as there are already several players developing products (such as mirrors), preparing themselves to enter the market or already developing their own projects. As the industrial sector - especially construction – is very strong in Egypt, it is likely several companies can penetrate the market on various segments of the value chain.

Onshore Wind – Opportunities for local manufacturing

Executive Summary

Wind energy is already an established technology in Egypt with more than 500 MW of installed capacity. Local companies can provide a well-established track record, especially companies producing wind towers. With a further increase of new installed wind turbines and new wind farms, local manufacturing could be further extended, including high-tech components like blades. In the wind energy sector, a potential local manufacturing content of more than 80% is thought to be realistic according to local players.

Nevertheless, the market development is limited especially regarding the grid restriction in areas with a high wind potential. Generation capacity limits included in the feed-in tariff are identified as a major barrier for the development of large scale new projects. Wind turbines with a capacity above 2 MW cannot be manufactured locally at present. If a stable and visible upcoming market for larger wind turbines accrue, new investments either for new larger manufacturing machines or in expanding the manufacturing capacity will be necessary.

Strengths

▶ Industry maturity

- High local manufacturing potential up to 100 % possible
- Local manufacturing of towers with already proven local track record
- Local manufacturing mandatory, local champions (El Sewedy Wind)

▶ Technological skills

- Tower local manufacturing is state of the art, also for export
- Manufacturing potential available also for blades
- Low technology risk profile

▶ Economic and regulatory assets

- Establish R&D and Know how transfer by joint ventures
- Fast track technology

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Weaknesses

▶ Industry maturity

- The market of 600 wind towers over 9 years was to small to develop broader local manufacturing
- Current market potential of 2000 MW is maybe too large for the transmission and distribution grid capacity

▶ Technological skills

- Know how to manufacture special components not really applied
- Local available production machines limits the turbine size to approx. 2 MWe

▶ Economic and regulatory assets

- Transmission and distribution grid capacity limited to 50 MW per access point

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Opportunities

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▶ Finance

- Manufacturer open for new investments for larger wind turbines
- Economical and sustainable increase of local manufacturing expected

▶ Competitiveness

- Blade manufacturing with technology providers is a realistic opportunity, already first co-operation placed

▶ Technology

- Manufacturer for the complete value chain on the ground

▶ Regulation

- Local manufacturing potential could be easily increased
- Establish R&D and know-how transfer

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Threats

▶ Finance

- Appetite of banks is limited (foreign banks) or not available (by locals)

▶ Competitiveness

- Market development restricted
- Demand of market to small for new investment by local manufacturer
- Competition in other countries of the region
- Export of towers might be too expensive

▶ Technology

- Rapid foreign technology innovation cycle

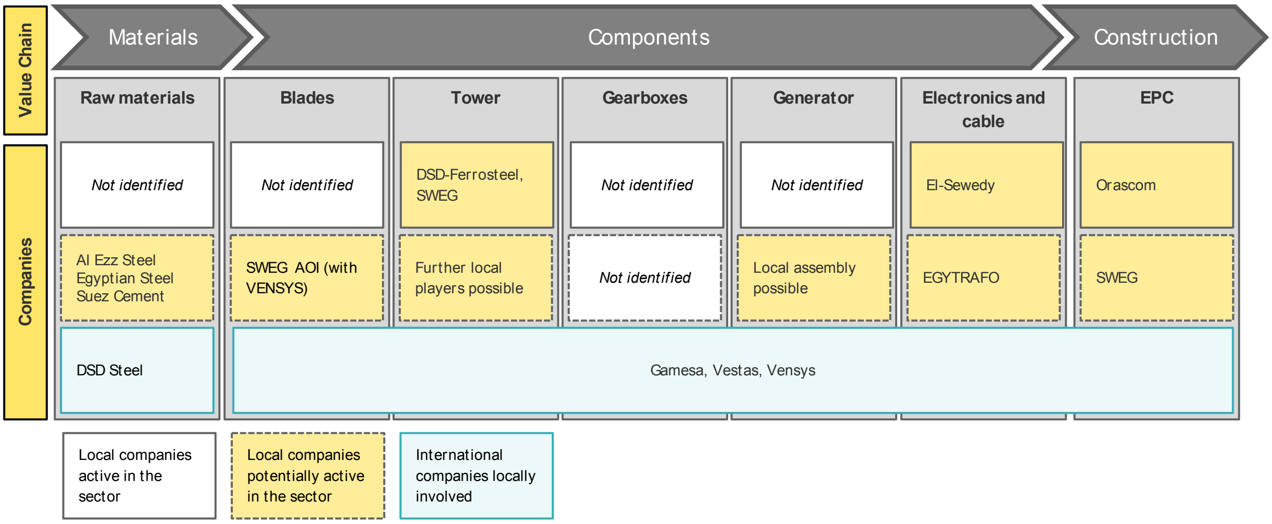
▶ Regulation

- Capacity plan until 2020 of 7.300 MW for wind will be delayed

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for the component manufacturing for onshore wind plants.



Value Chain	Materials	Components					Construction
	Raw materials	**Blades**	**Tower**	**Gearboxes**	**Generator**	**Electronics and cable**	**EPC**
Companies	*Not identified*	*Not identified*	DSD-Ferrosteel, SWEG	*Not identified*	*Not identified*	El-Sewedy	Orascom
	Al Ezz Steel Egyptian Steel Suez Cement	SWEG AOI (with VENSYS)	Further local players possible	*Not identified*	Local assembly possible	EGYTRAFO	SWEG
	DSD Steel	Gamesa, Vestas, Vensys					

Local companies active in the sector

Local companies potentially active in the sector

International companies locally involved

Table 7: Egyptian companies involved in the Wind value chain (EY/Enolcon, 2014)

Local manufacturing assets [47]

Key assets of local industries	**Industry maturity**			**Technological skills**			**Economic assets**			**Conclusion on local manufacturing assets**
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Material	●○○○	●●○○	●●○○	●○○○	●●○○	○○○○	●●●○	○○○○	●●○○	Low
Wind turbine > Wind tower	●○○○	●●●●	●●●●	●●●○	●●●●	●○○○	●●●●	●●●○	●●●●	High
Wind turbine > Blade	●●●○	●●○○	●●●○	●●●○	●●●○	●●●●	●●●○	●●●○	●●●●	High
Wind turbine > Gearboxes	○○○○	●○○○	●●○○	●●○○	●○○○	●●○○	●○○○	●○○○	●●●○	Low
Wind turbine > Generator	●○○○	●○○○	●●○○	●●○○	●○○○	●●○○	●○○○	●○○○	●●●○	Low
Wind turbine > Electronics and cable	●●●○	●●●○	●●●●	●●●○	●●●●	●○○○	●●●○	●●○○	●●○○	High
Construction	●●●●	●●●○	●●●●	●●●○	●●●○	●○○○	●●●○	●●●○	●●○○	High

The manufacturing industry for wind turbine components started in the 90s with the first demonstration plants in Egypt. With the implementation of the first large wind farms and the further extension, an industrial capacity has been established with the technical support of European partners. This industrial capacity is especially focused on the production of wind towers, cables and the construction of the wind turbinewind turbine. Nevertheless, similar industrial capacities are also present in the surrounding countries like Morocco or Tunisia.

Raw materials

Raw material necessary for the construction process of wind turbines, such as the concrete for the foundations, could be delivered by local companies. The steel necessary for the wind tower is currently imported from European countries. Steel production with more than 10 mm and specific quality is challenging for Egyptian steel producers.

Wind tower

The tower production for wind turbines could be completely performed by Egyptian companies. *DSD Ferrometalco* (a subsidy of the German company *DSD-Steel*) and the *El-Sewedy Wind Energy Group (SWEG)* dominate the market. Both companies are able to deliver towers for wind turbines with a capacity up to 2 MW. For capacities above 2 MW, new investments (e.g. rolling machines, welding machines and cranes) and technology cooperation with international players are necessary.

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[47] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

DSD Ferrometalco has a weekly production capacity of around 5 towers. Towers are only produced for the local market, because export is considered too expensive. Based on *DSD*, Jordan would be an option for export. Morocco and Tunisia would be more difficult targets as they have their own production capacities. Regarding the overall business of *DSD Ferrometalco*, the local market has no significant influence, however, a rising market for wind towers would be considered as an important market for *DSD*.

Rotor blades

Up to now, blade manufacturing is only performed by a few companies. *AOI (Arab Organization for Industrialization)* has acquired a license from the Germany company *VENSYS*, producing blades for wind energy plants. At present, they manufacture smaller blades for electricity generating capacity up to 100 kW. Studies and research efforts are underway for producing blades for wind turbines with 1 MW capacity in cooperation with international companies. Several companies active along the wind value chain indicated, that the blade manufacturing is a promising market for local companies.

Wind turbine (other components)

Electrical components and balance of system are supplied by *SWEG* to the local market. *DSD Ferrometalco* can deliver wind towers equipped with the entire cabling, supplied by subcontractors.

Construction

Several Egyptian companies are active in the construction process, from building foundations to erecting wind turbines. With further increase of turbine capacity and height of towers, new transportation and construction equipment is necessary. For the first project, this equipment could be hired from international players, but with an increasing market demand, local companies are ready to invest in new material and training of their own staff.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[48]	**Conclusion on future local industrial capability**
Raw material	🟡	🟡	🟡	🟡	Medium
Wind turbine > Wind tower	🟢	🟢	🟡		High
Wind turbine > Blade	🟢	🟡	🟡		High
Wind turbine > Gearboxes	🔴	🔴	🔴		Very Low
Wind turbine > Generator	🔴	🔴	🔴		Very Low
Wind turbine > Electronics and cable	🟢	🟢	🟡		High
Construction	🟢	🟢	🟢		Very High

Potential involvement of international players in local production

International wind companies are already active in Egypt (e.g. *Vestas*, *Gamesa*, *Vensys*), participating in public tenders for wind projects. Together with local partners, local manufacturing for several components such as the tower were developed in the past. Manufacturing of blades for the wind turbines has been identified as the next step, as a first technical cooperation has already been implemented (e.g. *AOI* together with *Vensys*).

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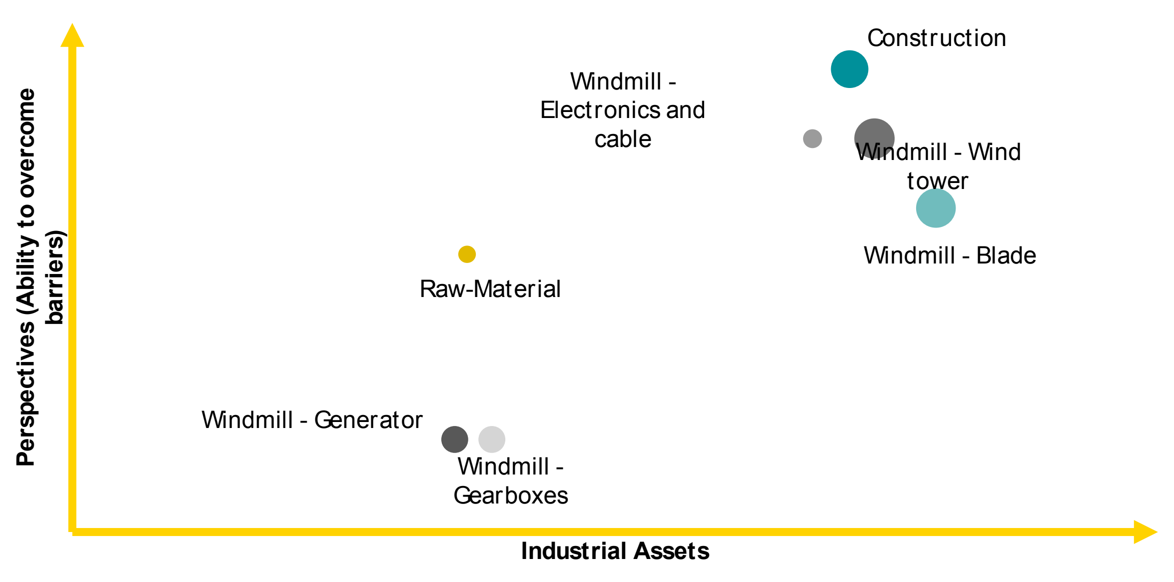
[48] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities

The future capability of manufacturing industry producing components for wind turbines is promising. Overall, a very high local value share of around 70% is estimated for wind-technology by public and private interview partners, with a possible increase of up to 100%, based on a sustainable market and technology development.



The following components offer very promising local capacity potential:

- Up to now, local manufacturing of steel towers for wind turbines is limited to a capacity of 2 MW. If the demand for bigger wind turbines is expected to rise, production capacities will adapt. Based on the current announced market potential of the feed-in tariff of 2,000 MWe, which means 1,000 turbines with a size of 2 MW, the production capacity of local suppliers for towers is limited (for example DSD produces 5 towers a week, which equals to approx. 250 towers a year). It is expected that with the actual announced capacity, developers will look either for larger wind turbines or will ask the local market to increase its manufacturing capacities. Whatever the case, both scenarios will result in an increased investment in local manufacturing capacity. Such investments could be based on already existing close technical cooperation with international companies.
- Electronic components necessary for wind turbines (e.g. cable, inverters, transformers) and the grid connection could be delivered by already established local companies.
- All necessary infrastructures including the foundation the wind tower could be delivered by local and experienced construction companies. Project development could also be performed by specialized local companies.

Other components show potential but barriers need to be overcome to unlock this potential:

- Blade manufacturing is considered as a new manufacturing potential by both public and private players. According to the local players that were contacted, required skills – such as laminating - are available in Egypt. The entrance in this industrial sector should nevertheless be supported by Joint Ventures with international players (technological cooperation). With an increasing domestic market, the local manufacturing of blades could reduce costs, but a clear and stable market demand is necessary to justify the investment.

  Main barriers: market size and technology development

- Manufacturing of generators and gearboxes is mainly based on the knowledge of original equipment manufacturer (OEM) providing the wind turbine. With approximately 1,000 wind turbines in a time period of 2 years this could be the spark for wind turbine manufacturers to start with local manufacturing of generators and gearboxes. With the further development of wind energy in Egypt and Europe, the application of the new feed-in tariff and the related constraints (limited to an installed capacity of 50 MW), a typical type of wind turbine will be established.

  Main barrier: actual available grid distribution and transmission capacity may be not enough to absorb the 2,000 MWe in *the near future resulting in a reduced market size.*

Increasing market share and development of wind turbines with higher installed capacities (over 2 MW) also influences construction companies. New and improved equipment for the erection of towers is necessary - this is also related to training of local staff. With the first projects, international companies are able to deliver the necessary equipment, but with enough market size, local companies will invest in new equipment and training of their workers.

Morocco – Country Report

Overview of the national policy framework

Renewable energy policies and targets

- Through the Moroccan Solar Plan and Morocco's Wind Energy and Hydropower Development Project, the Government has targeted the objective to have, in 2020, 42% of overall electrical power capacity covered by renewable energy plants. Solar energy, wind energy and hydropower will each represent 14%
- Law no. 13-09 establishes the principle that any renewable power producer, both public and private, has the right to be connected to the medium, high and very high voltage national electricity grid.
- According to the 13-09 Law, producers who own a renewable energy project of less than 20 kW are able to connect to the medium, high and very-high voltage national grid without any condition. However, an authorization from the national Authority is required from projects of more than 20 kW.
- The 13-09 Law does not include any possibility for the producer to be connected to the low tension network.

Strategy to support RE equipment manufacturing

- Under the Moroccan Solar Plan, bidders are encouraged to promote local manufacturing. For instance, the 160MW CSP plant near Ouarzazate (NOOR), awarded to ACWA Power, includes a 42% local content portion. Specialized energy courses have been created within the major engineering schools and universities.
- The Moroccan Association of Wind and Solar Industries (AMISOLE) was created in 1987 to promote the interests of Moroccan professionals and industries involved in the sector of renewable energy (wind and solar). AMISOLE now gathers about 50 Moroccan companies.
- Trainings of technicians in wind energy by vocational training institutes have been launched.
- The National Agency for Renewable Energy and Energy Efficiency (ADEREE) provides training programs dedicated to the development of renewable energies.
- The Research Institute for Solar Energy and Renewable Energies (IRESEN) was created to bring together fundamental R&D and applied science at national level, to develop innovation and to encourage networking.

Technology	Previous and ongoing projects	RE policy maturity
Solar PV	• No PV project has been achieved so far	🔴

Solar CSP	• The Ain Beni Mathar plant, an hybrid natural gas associated with 20 MW of CSP is in operation. Civil works and construction are undertaken by international firms that use a few subcontractors to provide basic and elementary ground breaking with local work force and their own machines
	• The Noor I project, a 160 MW CSP plant, is currently in operation and additional 300 MW are in the pipeline
	  • Includes a 42% local content portion
	  • A targeted system of local recruitment will increase the benefits to the local economy through the 1,000 local workers who will be employed during construction and 70 during operation of the plant
		🟡

Wind	• 5 major wind farms are currently under construction and many others are in the pipeline. • About 600 MW of wind energy are already in operation (Tarfaya, Tanger, Abdelkhalek Torres). • In particular, Tarfaya wind farm is the largest single farm in Africa. It reaches an overall capacity of 300 MW, 15% of the 2020 national objective for wind capacity. The field works were completed in early 2014 and the plant is already fully operational since October 2014.	🟡

Synthesis of strengths, weaknesses, opportunities and threats for local manufacturing

The key findings of Morocco's renewable energy manufacturing potential are displayed in the SWOT analysis below:

Strengths

- Industry maturity
    - Large export industry with long experience with Europe (e.g. automotive industry and aeronautics
    - High potential in local manufacturing in the BOS components
- Technological skills
    - Presence of industrial actors with relevant skills (steel, concrete, electronics, etc.)
- Economic assets
    - Low labor cost (especially for low-skilled workers)
    - Existence of structured economic sectors with very active federations (FENELEC, AMISOLE, etc.)

S

Weaknesses

- Industry maturity
    - Lack of experience in RE projects due to the absence of grid-connected installations
- Technological skills
    - Technology improvements needed to produce components for high-capacity wind turbines and solar plants
- Economic assets
    - High investments required for PV manufacturing plants

W

O

Opportunities

- Competitiveness
    - Potential to export in African countries
- Technology
    - The National Agency for Renewable Energy and Energy Efficiency (ADEREE) is very active in providing capacity building programmes in the field of RE
- Regulation
    - National RE targets (Moroccan Solar Plan)

T

Threats

- Technology
    - Training of workforce and availability of skilled workers not sufficient
- Regulation
    - No comprehensive regulatory framework for the development of grid-connected installations

Solar PV – Opportunities for local manufacturing

Executive Summary

According to international players, several barriers exist for Morocco to become a producer of solar PV on the short and medium term. Lack of financing, poor grid connection and administrative hurdles were mentioned as frequent concerns. But the highest barrier for developing local production is the lack of a clear and significant market perspective. There is no clear vision of the PV market in Morocco, which makes the market less attractive when compared to large, established markets, as there is no possibility to estimate further market growth or decline.

The highest potential for local manufacturing of PV plants on the medium term is seen in the BOS (Balance of System) components of the power plants. The mounting structure, electrical and construction works and installation are usually performed by local companies. Construction and electrical work are similar to other infrastructure and energy projects, and thus the existing local skills can be directly applied to PV plants. The installation of PV plants requires specific qualifications, and cooperation with foreign companies with experience from other PV parks might be required. The manufacturing of mounting structures might be targeted by metal-working companies with experience in the forming and welding of steel. Inverters might not be produced locally on the medium term, as the development of these components requires a high level of know-how and the market is dominated by a few European companies.

For PV modules, most agree that Morocco does not provide the necessary infrastructure of know-how for local silicon or cell production. However, the module assembly using crystalline silicone cells or the module manufacturing using turn-key production lines is thought to be feasible in Morocco in the medium term, even if this would require large-scale investments.

Strengths

- ▶ Industry maturity
  - ▪ Large export industry with long experience with Europe (e.g. automotive industry and aeronautics
  - ▪ High potential in local manufacturing in the BOS components
  - ▪ Several works in PV projects are usually done by local companies, in particular mounting structures, civil and electrical works
- ▶ Technological skills
  - ▪ Presence of industrial actors with relevant skills
- ▶ Economic assets
  - ▪ Existence of structured economic sectors with very active federations (FENELEC, AMISOLE, etc.)
  - ▪ Low labor cost (especially for low-skilled workers)

S

Weaknesses

- ▶ Industry maturity
  - ▪ High level of international competition for most of PV components
  - ▪ Lack of experience in PV projects due to the absence of grid-connected installations
- ▶ Technological skills
  - ▪ No experience/know-how in the manufacturing of solar PV cells
- ▶ Economic assets
  - ▪ High investments required for PV manufacturing plants

W

Opportunities

O

- ▶ Technology
  - ▪ Pilot project in PV is being implemented
  - ▪ The National Agency for Renewable Energy and Energy Efficiency (ADEREE) is very active in providing capacity building programmes in the field of RE
  - ▪ Possibility of technology transfer through PV pilot project
- ▶ Regulation
  - ▪ National RE targets (Moroccan Solar Plan)

T

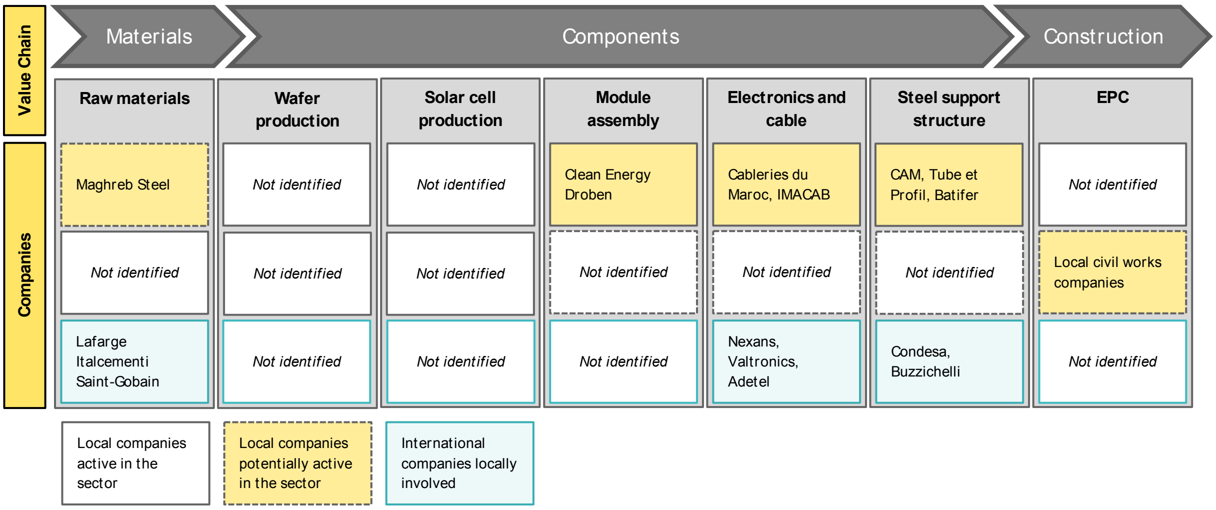
Threats

- ▶ Technology
  - ▪ Lack of a clear perspective on next projects and technologies
- ▶ Regulation
  - ▪ No feed-in tariffs
  - ▪ Regulatory framework not favorable to the development of grid-connected installations

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for solar PV plants. The different local players identified during interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the local markets are also shown.



Value Chain	Materials	Components					Construction
	Raw materials	**Wafer production**	**Solar cell production**	**Module assembly**	**Electronics and cable**	**Steel support structure**	**EPC**
Companies	Maghreb Steel	*Not identified*	*Not identified*	Clean Energy Droben	Cableries du Maroc, IMACAB	CAM, Tube et Profil, Batifer	*Not identified*
	Not identified	*Not identified*	*Not identified*	*Not identified*	*Not identified*	*Not identified*	Local civil works companies
	Lafarge Italcementi Saint-Gobain	*Not identified*	*Not identified*	*Not identified*	Nexans, Valtronics, Adetel	Condesa, Buzzichelli	*Not identified*

Local companies active in the sector

Local companies potentially active in the sector

International companies locally involved

Table 8: Moroccan companies involved in the Solar PV value chain (EY/Enolcon, 2014)

Local manufacturing assets [15]

Key assets of local industries	Industry maturity			Technological skills			Economic assets			Conclusion on local manufacturing assets
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●○○○	●●○○	●○○○	●○○○	●●●○	●○○○	●●○○	●●●○	●○○○	Low
Solar Module manufacturing > Wafer production	○○○○	○○○○	○○○○	○○○○	○○○○	○○○○	●●○○	●○○○	○○○○	Very Low
Solar Module manufacturing > Solar cell production	○○○○	○○○○	○○○○	○○○○	○○○○	○○○○	●●○○	●○○○	○○○○	Very Low
Solar Module manufacturing > PV-module manufacturing	●○○○	●○○○	●○○○	●○○○	●●●○	●○○○	●●●○	●○○○	●○○○	Low
PV Plant > Electronics and cable	●●●○	●●●●	●●●○	●●●○	●●●●	●●●○	●●●○	●●●○	●●●○	High
PV Plant > Steel support structure	●●○○	●●●●	●●○○	●●●○	●●●○	●●●○	●●●○	●●●○	●●●○	High
Construction	●●●●	●●●○	●●●●	●●○○	●●●●	●●●○	●●●●	●●●●	●●○○	Very High

The solar PV sector remains limited in Morocco, since the local market is only emerging. According to interviews with local players, most of the companies active in the sector are SMEs mainly focused on the installation of small off-grid devices, as well as on distribution and installation of imported parts and components for solar technologies.

Some of these companies have gained experience in supplying, installing and maintaining solar PV equipment through the implementation of the Moroccan PERG[49] during which small off-grid PV-kits have been provided to rural areas with no electricity access. Overall local companies have a very limited experience on large scale projects and do not have a clear view on technologies that will be preferred in future public tenders. Since the on-grid PV market is also very limited, sales options are currently very low.

The local value added and job creations remains therefore limited in this sector. There are only a few local companies active in the manufacturing of solar panels and in project development and engineering. In the last years, two manufacturers of solar panels have emerged in Morocco: Droben (10 MW / year plant near Casablanca) and Cleanergy (5 MW/year plant). Those two plants will provide modules based on imported cells. The total manufacturing capacity will be sufficient to provide modules for small projects, but the development of large scale plants would require new manufacturing capacities.

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[49] Global Rural Electrification Plan

Raw materials

Most of raw materials are imported from other countries, except concrete which is produced locally. Several international leaders are already active in the concrete industry in Morocco, such as Lafarge and Holcim. Regarding steel production for the mounting structure, there is only one steel producer in Morocco (Maghreb Steel) that produces 1 million tons per year.

Solar cell production

Although several industrial projects have been discussed for many years, there are currently no production lines for PV cells in Morocco. According to several stakeholders interviewed during the study, the crisis observed in the PV market will make it difficult for local companies to become competitive in manufacturing of PV cells.

However, several players believe that Morocco could be competitive with certain technologies. Indeed, labor costs are not preponderant in the competitiveness of turn-key solar cell production lines since most of them are fully automated and energy prices also appear to be critical. As a consequence the production of thin film might be competitive in Morocco since energy costs do not preponderate as they do for crystalline silicone. However the implementation of a thin film production line in Morocco would require a predictable regional market to reach profitable outcomes.

Module assembly

There are several manufacturers or potential manufacturers of PV modules in Morocco, either local branches of international players or local players with international partners. Two crystalline silicone PV modules assembly lines are installed in the country with a production capacity between 5 to 10 MWp. This is however not sufficient for the development of large-scale projects.

The level of international competition is very high in this sector, especially with Chinese players that benefit from low production costs and favorable financing conditions. However, production lines in this sector are semi-automatic. Therefore, although local players will have to import nearly all components and raw materials at the beginning, they may still be price competitive on the market, provided that the export market develops. On the long term, the integration of more manufacturing steps, which is quite unlikely to occur, will be critical for higher value-added manufacturing to develop.

Electronics and cables

Several companies in Morocco have experience and a proven reliability in the manufacturing of electronic components and inverters for the automotive and aircraft industry: local companies such as Cableries du Maroc, as well as foreign companies such as Nexans, Valtronics, Alstom and ADETEL, as well as the cable manufacturer Leoni (active in the automotive sector) are already producing parts and components that are relevant for the solar energy sector and that could be adapted to new solar technologies. It has to be noted that most of the companies active in this segment are subsidiaries of foreign groups and therefore have a good capacity to invest and innovate.

Regarding components that are specific to solar energy, in particular inverters and trackers, no companies with plans to enter the solar sector were identified. Taking into account the international context in this market and the high level of requirements and technological knowledge, it might be difficult to develop a local production of inverters.

Steel support structure

Several metal working companies already involved in the energy sector have the required skills in forming and welding steel and so they could potentially be involved in future large-scale PV projects. The metal working industry is active in the energy sector by supplying thermal power plants and providing pylons for transmission lines. Competences of energy technologies as well as quality standards have been obtained during these projects. However, experience in the solar sector is very limited since the mounting structures used in the PERG programs and in the Ain Beni Mathar project (CSP technology) were all imported. With a clearer vision on the future local market and technology transfer from international companies, the solar sector might become attractive for the local metal working industry.

Civil works and installation

Many local companies are already involved in ground works and land preparation for large infrastructure projects as well as conventional power plants. This knowledge is very useful to enter the renewable energy market, since the activities are quite similar. Local companies benefit from a large capacity in terms of machines, equipment and large and cheap workforce.

Regarding solar plants, the activity is currently emerging with the development of large scale projects in Morocco. Some companies have already started to collaborate with international players in the frameworks of public tenders and have a strong potential to capture market shares in this sector that is not exposed to international competition. It has to be noted that assembling and installation of PV structures might require additional qualification but according to stakeholders, installation of PV mounting structures will be soon possible with training from international partners.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key success factors for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[50]	**Conclusion on future local industrial capability**
Raw material	🟢	🟡	🟡	🟡	High
Solar Module manufacturing > Wafer production	🔴	🔴	🟡		Low
Solar Module manufacturing > Solar cell production	🔴	🔴	🔴		Very Low
Solar Module manufacturing > PV-module manufacturing	🔴	🟡	🟡		Medium
PV Plant > Electronics and cable	🟡	🟢	🟢		Very High
PV Plant > Steel support structure	🟡	🟢	🟢		Very High
Construction	🟡	🟢	🟢		Very High

Potential involvement of international players in local production

There are only a few international actors currently active in the PV market in Morocco since no large-scale PV project has been developed so far and there are no grid-connected projects. Actors interviewed during the study showed interest for this country as a production site in the medium or long-term, since Morocco is located nearby Europe (an important market for solar PV). The development of a stable local market would be critical for encouraging foreign players to invest in local manufacturing facilities in Morocco.

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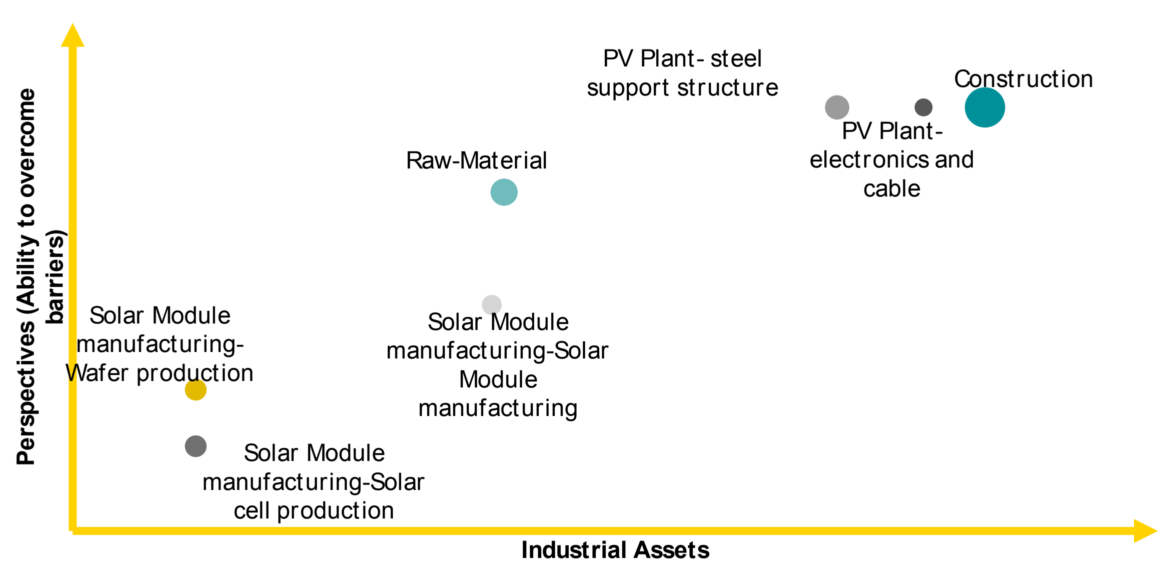
[50] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities



The following components offer very promising local capacity potential:

- Morocco can rely on solid mechanical, electrical and electronics industries, especially cable producers, which may be an asset to supply future PV plants in the short-term perspective.
- Construction also offers significant local content potential, with leading EPC companies having both the technical skills and critical sizes to provide civil, mechanical and electric engineering services.
- Local steel companies could deliver the necessary steel support structure for the PV modules provided specific equipment investment, even if PV plants are likely to remain a side market.

Other components show potential but barriers need to be overcome to unlock this potential:

- Several PV module manufacturing are already active in Morocco. In the next years, these companies may have the technical ability to engage in larger scale PV projects provided that access to finance is facilitated: the initial investment in new production lines is significant and it requires a large and stable market in order to be profitable.

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- The manufacturing of solar cells as well as the production of wafer both requires very significant investments. Taking into account the overcapacity on the world market and the international competition, it is very unlikely that the manufacturing of such components will develop in the medium-term in Morocco.

Solar CSP – Opportunities for local manufacturing

Executive Summary

The required investment and know-how are substantial for setting up manufacturing of specific CSP components, such as mirrors, receivers, tubes or power blocks. Local manufacturing would probably not be feasible on the medium-term. On the long-term, this would require knowledge transfer from abroad. Regarding pumps and pipes, several companies are currently active in this sector, but the existing competences do not seem to meet the international requirements for CSP solar plants. The majority of Moroccan companies import these products as Moroccan production capacities are not sufficient to meet current local market demand. Regarding heat storage, local competences were identified for civil engineering work and tanks. However a local supply of salt seems critical to develop a local industry.

On the long term, manufacturing and assembly of complex components would be possible in Morocco, as demonstrated in several industrial sectors such as the aircraft industry. Several conditions would have to be in place for this to happen, e.g. establishment of a local glass industry, greater local and regional market demand and increased capabilities of high-quality manufacturing.

Consequently, upcoming projects to be implemented in the framework of the Moroccan Solar Plan will be critical for know-how transfer and capacity building. On the short term, civil works, construction, manufacturing of the mounting structure, installation of collectors and some electrical installation works will be the first steps for companies. Later on, the more complex components will follow the market when the project pipeline will increase and a market is established.

Strengths

- Industry maturity
  - Large export industry with long experience with Europe (e.g. automotive industry and aeronautics)
  - Experience in CSP projects through several projects since 2010
- Economic assets
  - Low labor cost (especially for low-skilled workers)
  - Strong GDP growth over the 5 past years in all MENA countries
  - High growth in the electricity demand will require large investments in new capacities
  - Particular proximity of Europe (potential export market)

S

Weaknesses

- Industry maturity
  - Insufficient market size for creation of local manufacturing
  - Partly insufficiently developed infrastructure
- Technological skills
  - Need for strong network, business and political connections
- Economic assets
  - Administrational and legal barriers
  - Higher capital costs

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Opportunities

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- Finance
  - Attractiveness to external investors by large market demand
- Competitiveness
  - Further cost reduction of all components
- Technology
  - Possibility of technology transfer/spillover effects from foreign stakeholders in Morocco

Threats

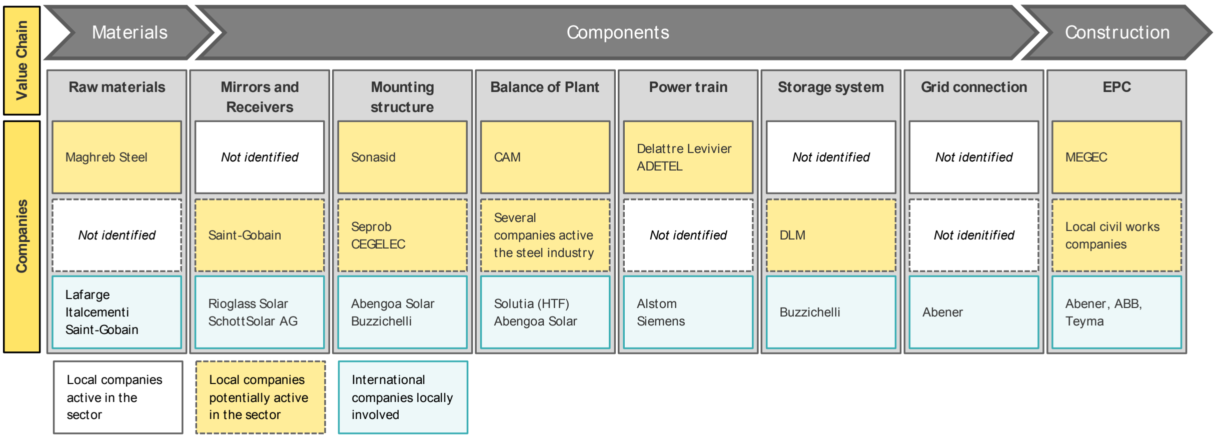
T

- Finance
  - Access to financing for new production capacities, etc.
- Competitiveness
  - Competition with foreign stakeholders on the Moroccan energy market
  - Higher transport losses/costs due to insufficient infrastructure
  - Competition with other emerging countries
- Technology
  - Training of workforce and availability of skilled workers not sufficient

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for solar CSP plants. The different local players identified during the local interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the local markets are also shown.



	Materials	Components						Construction
Value Chain	**Raw materials**	**Mirrors and Receivers**	**Mounting structure**	**Balance of Plant**	**Power train**	**Storage system**	**Grid connection**	**EPC**
Companies	Maghreb Steel	*Not identified*	Sonasid	CAM	Delattre Levivier ADETEL	*Not identified*	*Not identified*	MEGEC
	Not identified	Saint-Gobain	Seprob CEGELEC	Several companies active the steel industry	*Not identified*	DLM	*Not idenitified*	Local civil works companies
	Lafarge Italcementi Saint-Gobain	Rioglass Solar SchottSolar AG	Abengoa Solar Buzzichelli	Solutia (HTF) Abengoa Solar	Alstom Siemens	Buzzichelli	Abener	Abener, ABB, Teyma

Local companies active in the sector

Local companies potentially active in the sector

International companies locally involved

Table 9: Moroccan companies involved in the Solar CSP value chain (EY/Enolcon, 2014)

Local manufacturing assets [51]

Key assets of local industries	Industry maturity			Technological skills			Economic assets			Conclusion on local manufacturing assets
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●●○○	●●●○	●●●○	●●○○	●●●○	●○○○	●●○○	●●●○	●●●○	Medium
Solar field > Mirrors	●●○○	●○○○	●○○○	●○○○	●○○○	●●○○	○○○○	●●●○	●●○○	Low
Solar field > Mounting structure	○○○○	●●●●	●●○○	●●●○	●●●○	●●●○	●●●○	●●●○	●●●○	High
Power Block > Balance of plant, piping, electronics	●●○○	●○○○	●○○○	●●○○	●○○○	●●○○	●●○○	●●●○	●●○○	Medium
Power Block > Power train	●○○○	○○○○	○○○○	○○○○	●○○○	○○○○	●●●○	●●●○	●●○○	Low
Thermal Storage > Storage system	●●○○	●●●○	●●●○	●●○○	●●○○	●●●○	●○○○	●●●○	●●●○	Medium
Grid connection	●●○○	●●●●	●●●○	●●●○	●●●●	●●●○	●●●○	●●●○	●●●○	High
Construction	●●●○	●●●○	●●●●	●●○○	●●●●	●●●○	●●●●	●●●○	●●○○	High

Morocco sees development of renewable energy and in particular CSP as an important part of its strategy to increase ties with the power sectors of neighboring countries and generally enhance the energy integration of the region as a whole. Expanded interconnections with other countries allow for increased renewable penetration since they provide a larger market in which to sell and a larger portfolio of generating plants within which the renewable plants would operate. The EU has expressed high-level support for CSP development in North Africa, EU targets on minimum levels of renewable use by 2020 may create highly profitable opportunities to export "green electricity" to Europe. The viability of CSP and its integration in the Moroccan grid is expected largely to be achieved by exercising the export options suitably.

Morocco benefits from experience with both CSP technology as well as integrating CSP power into the national grid through the Ain Beni Mathar thermo-solar commissioned in 2010. It has to be noted that the involvement of local companies was very limited. However, as shown in similar projects such as Kuraymat in Egypt where the local share on the solar field expenditure was 60%, the local content in Morocco could possibly reach a significant level.

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[51] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

Raw materials

Several raw materials are used in CSP projects, including glass for mirrors, steel for the support structure and piping, chemicals for the heat transfer, salt for storage, concrete for collector foundations, the tower construction and the power block.

As for solar PV, materials can be either provided by international or local players. In the steel industry, several major companies could supply the demand of steel for large-scale projects, such as a 150 MW CSP plant according to local players. Solar glass lacks local demand due to the absence of experience in the CSP sector as glass for solar mirrors. As complexity and process know-how is high, mirror bending will remain a large challenge for the Moroccan industry. The market potential is also limited at the moment, since other North-African suppliers might supply the region, and energy prices are very high in Morocco and therefore local production is currently not competitive. Special materials like thermal oil used as heat transfer fluid or the molten salt used as storage material are produced by specialized international companies.

Mirrors and receivers

Due to the lack of local glass production, the current activity in the mirror industry is very limited in Morocco. High energy process, small local demand and the lack of know-how are the main barriers for market growth. International players already active in the country might be interested in implementing local production once a stable and significant market is created.

The manufacturing process of CSP receivers is very specific. Glass, steel associated with technology transfer and R&D competences are required to enter the market.

Balance of plant

The Moroccan metal working industry provides several kinds of tubes and pipes for industrial applications and different purposes. The requirements in terms of corrosion, temperature, materials, insulation and pressure are very high for CSP tubes. No local companies with the ability to produce such products have been identified.

Power train

Several international companies have extensive experience in the construction of power plants in Morocco and have representatives in the country. Most of the components of any conventional power plant are imported (except the heat exchanger and some smaller parts). These international companies also have experience in CSP projects and could be easily involved in local projects. Blocks, turbines, generators and power plant controls might not be produced in Morocco in the medium term, but local subsidiaries could be in charge of installation, maintenance and operation of CSP plants.

Storage system

Some companies have experience in the manufacturing of large tanks and silos for liquid materials in the petroleum, water or phosphorus industry and show interest in CSP plants. Until now, most of these companies have limited knowledge about the storage options that are available for CSP plants, but some of them have been contacted by European CSP technology suppliers and aim to supply the foundation and the shell of the storage tank. Concrete foundations for storage tanks could also be easily constructed by local civil works companies.

Construction

As for solar PV, local companies might be involved in future CSP projects, since a significant number of them have been involved in ground works and land preparation for large infrastructure projects as well as conventional power plants.

It is expected that local companies will be involved in the upcoming large-scale CSP projects that are going to be developed in Morocco in the next years, in the framework of the MSP. One company was already involved and subcontracted in the civil works of the CSP project in Ain Beni Mathar.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[52]	**Conclusion on future local industrial capability**
Raw material	🟢	🟡	🟡	🟡	High
Solar field > Mirrors	🟢	🟡	🟡		High
Solar field > Mounting structure	🟡	🟢	🟡		High
Power Block > Balance of plant, piping, electronics	🟡		🟡		Medium
Power Block > Power train	🔴	🔴	🔴		Very Low
Thermal Storage > Storage system	🟡	🟡	🟡		Medium
Grid connection	🟡	🟡	🟡		Medium
Construction	🟡	🟢	🟢		Very High

Potential involvement of international players in local production

Morocco is seen as a promising market for CSP on the medium-term, because of a strong political commitment for this technology – embodied by the NOOR project in Ouarzazate - and its proximity to Europe. The manufacturing of power blocks and solar field components in Morocco might be difficult in the medium term because this requires complex and investment-intensive production facilities as well as a small regional market. For instance receivers require a sophisticated network of suppliers, technical support and a lot of process knowledge for operation and maintenance. At the moment they are produced abroad but it appears to be a feasible option for international suppliers to produce locally if strong local market demand arises. The result regarding solar mirrors are very similar, since for both mirrors and receivers, the average factory has an annual output for CSP projects of 200-400 MW per year, hence this is the minimum market size required to motivate companies to invest in new plants.

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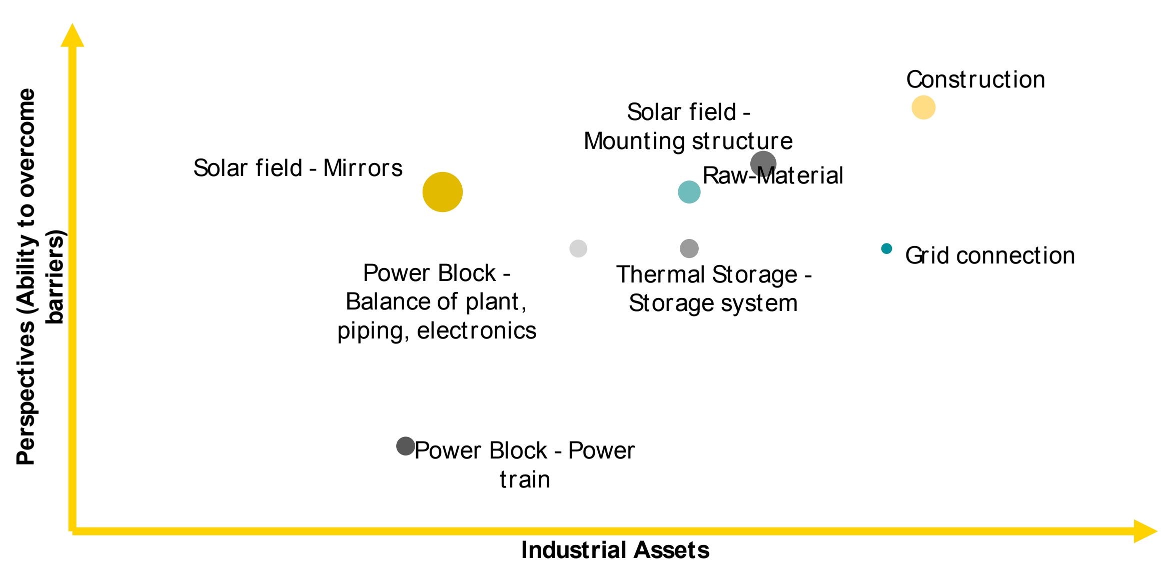
[52] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities



The following components offer very promising local capacity potential:

- There are several electrical and cables companies active in Morocco, in particular in the automotive and aircraft industry. They may provide key parts of the supply chain for large scale CSP plants (electrical control, balance, cabling, etc.).
- EPC and construction industrials (cement, concrete and steel) have the technical and financial strengths to provide civil works, mechanical and electric services for large-scale solar plants

Other components show potential but barriers need to be overcome to unlock this potential:

- Companies already active in the glass production might be interested in investing in the production of mirrors. Investments in new production lines and training of staff would be required.
- The manufacturing of storage systems could also be performed locally, given that several companies have relevant experience in the petroleum and phosphorus industry. Partnerships with international companies could be implemented in the next years to improve the technical ability of local firms in this specific field.
- The balance of plants could be delivered by local companies in the medium term, with a sufficient increase of local skills and R&D investments.

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- The power train for CSP-plants is a specialized component. Steam turbines are developed by only a few players worldwide, serving different applications and capacities. As the manufacturing lines require a significant annual capacity, no steam turbine manufacturing is expected in Morocco within the next years.

Onshore Wind – Opportunities for local manufacturing

Executive Summary

Morocco has a strong potential for local manufacturing of wind turbine components. Several companies have been involved in the last decade in wind projects and have developed know-how in this sector. This is the case for companies involved in the production of steel towers. These companies will need to invest in new production lines to increase their production capacity and build-up the necessary know-how to produce larger wind turbines.

Companies from the automotive and aircraft industries will be able to produce main electrical components, cables and parts of the generator in the short or medium-term. Transport, civil engineering work and foundations will be performed by local players in upcoming projects, even if further investment will be needed for the erection of towers. Local stakeholders consider the production of blades as the next step in the manufacturing of wind turbines components since Moroccan companies have a great capacity for innovation and are used to develop partnerships and technological cooperation with international companies.

The consortium involved in the Tarfaya project is committed to reach 35% of local content in their project, but this ratio might increase in upcoming projects, with the development of a significant and stable local market. In the framework of the 850 MW tender launched by the ONEE, the five bidding consortiums are currently developing industrial plans in cooperation with local industries. The objective of these plans is to prove the ability of project developers to achieve the target of 55% local content that the ONEE is likely to encourage. The winning consortium should be publically announced in the next months. This information– along with the communication of the selected industrial plan elaborated by the winning consortium –will largely condition the expected evolution of Moroccan actors' manufacturing capacity in the coming years.

Strengths

- ► Industry maturity
  - Previous experience in wind power projects
  - Several players involved in the manufacturing of towers
- ► Technological skills
  - Strong innovation capacity linked to experience in automotive and aircraft industry
  - Presence of skilled workforce
- ► Economic assets
  - High level of competitiveness for local production of several components (high transport costs)

S

Weaknesses

- ► Industry maturity
  - Local market might not be sufficient to develop a local turbine industry
  - Limited production capacity (towers, electrical components, etc.) to support the whole Moroccan market
- ► Technological skills
  - Technology improvements needed to produce towers and components for high-capacity towers

W

Opportunities

O

- ► Competitiveness
  - Potential to export in African countries
- ► Regulation
  - Stable and significant local market in the upcoming years through the Moroccan Wind Energy Project
  - Strong willingness from the Government to involve local companies in future projects

T

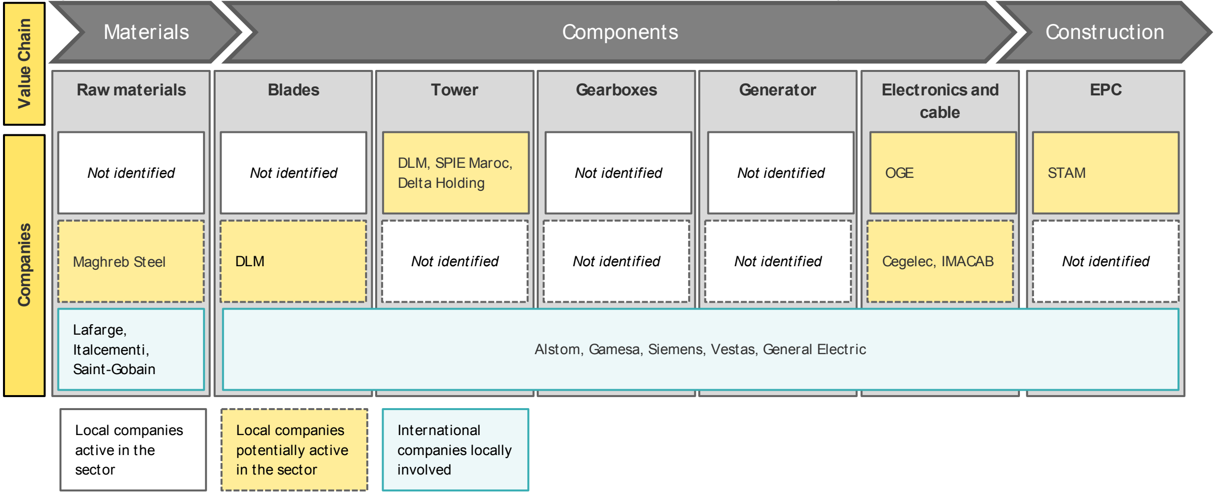
Threats

- ► Finance
  - Limited financing ability to invest in new production lines
- ► Competitiveness
  - Increasing competition with regional industrial players from mature markets such as Europe or growing markets such as Egypt

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for onshore wind turbines:



Value Chain	Materials	Components					Construction
	Raw materials	Blades	Tower	Gearboxes	Generator	Electronics and cable	EPC
Companies	*Not identified*	*Not identified*	DLM, SPIE Maroc, Delta Holding	*Not identified*	*Not identified*	OGE	STAM
	Maghreb Steel	DLM	*Not identified*	*Not identified*	*Not identified*	Cegelec, IMACAB	*Not identified*
	Lafarge, Italcementi, Saint-Gobain	Alstom, Gamesa, Siemens, Vestas, General Electric					

- Local companies active in the sector
- Local companies potentially active in the sector
- International companies locally involved

Table 10: Moroccan companies involved in the Wind value chain (EY/Enolcon, 2014)

Local manufacturing assets [53]

Key assets of local industries	Industry maturity			Technological skills			Economic assets			Conclusion on local manufacturing assets
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●○○○	●●○○	●●○○	●○○○	●●○○	●●○○	●●●○	●●●○	●●○○	Medium
Wind turbine > Wind tower	●●○○	●●●●	●●●●	●●●○	●●●●	●●●○	●●●●	●●●○	●●●●	Very High
Wind turbine > Blade	○○○○	●●○○	●●●○	●●●○	●●○○	●●●●	●●●○	●●●○	●●●●	High
Wind turbine > Gearboxes	○○○○	●○○○	●○○○	●●○○	●○○○	●●○○	●●●○	●●●○	●○○○	Medium
Wind turbine > Generator	○○○○	●○○○	●●○○	●○○○	○○○○	●○○○	●●●○	●●●○	●●○○	Low
Wind turbine > Electronics and cable	●●○○	●●●○	●●●●	●●●○	●●●○	●○○○	●●○○	●●●○	●●○○	High
Construction	●●●○	●●●○	●●●●	●●●○	●●●○	●○○○	●●●○	●●●○	●●○○	High

Raw materials

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[53] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

Concrete for the construction of foundations could be delivered by international companies, already active in Morocco. Steel used for towers is currently mostly imported, since the local steel provider (*Maghreb steel*) cannot fulfill thickness requirements for sheet metal needed to manufacture towers for large-capacity wind turbines.

Blades

Blades are currently manufactured by international players. Even though several actors – such as *DLM* – are considering the possibility to produce blades in the coming years, required skills– such as laminating - are still missing in the country for the time being.

Tower

Several companies already have experience in the manufacturing of towers from previous projects conducted in Morocco. These companies will have to increase their production capacity in order to meet the demand in future projects. Moreover, investments in new production lines and technology transfer will be necessary to produce towers for high capacity turbines. With the development of the Moroccan market, this segment has strong potential for local manufacturing, since transport costs are significant.

Construction

Several Moroccan companies have already been involved in civil works for extraction works and the construction of foundations. With further increase of turbine capacity and height of towers, new transportation and construction equipment is necessary. For the first project, this equipment could be partly hired from international players, but with an increasing market demand, local companies are ready to invest in new material and training of their own staff.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[54]	**Conclusion on future local industrial capability**
Raw material	🟢	🟢	🟢	🟡	Very High
Wind turbine > Wind tower	🟡	🟢	🟡		High
Wind turbine > Blade	🟡	🟡	🟡		Medium
Wind turbine > Gearboxes	🔴	🔴	🔴		Very Low
Wind turbine > Generator	🔴	🔴	🔴		Very Low
Wind turbine > Electronics and cable	🟡	🟡	🟢		High
Construction	🟡	🟢	🟢		Very High

Potential involvement of international players in local production

International companies have been involved in wind energy projects in Morocco, in particular in the 140 MW wind power project in Tangier. In previous projects, several components were manufactured in Morocco such as towers and several electrical components.

The implementation of the Moroccan Integrated Wind Energy Project and the development of a capacity of 2 GW created conditions for a stable local market and made Morocco attractive for international players. The Moroccan Government has the will to involve local companies in the development of these future projects, and local companies will be significantly involved in future projects through subcontracting or joint-ventures.

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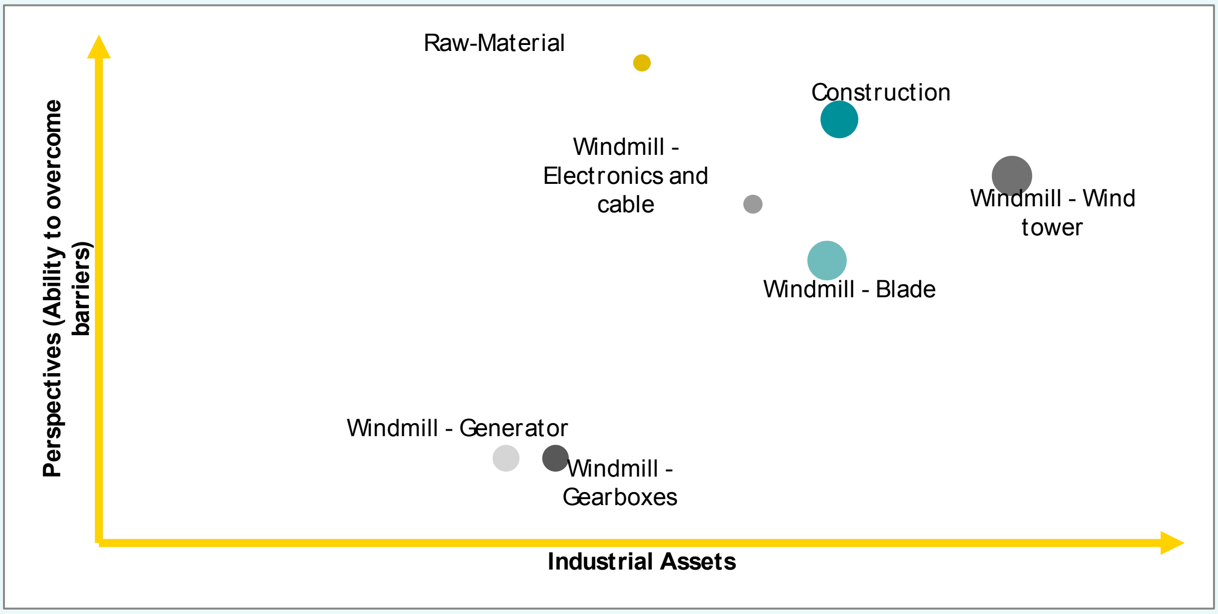
[54] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities



The following components offer very promising local capacity potential:

- Electronic components necessary for wind turbines (e.g. cable, inverters, and transformers) could be delivered by already established local companies.
- Wind towers offer promising local content enhancement in case of future wind farm development since several companies already have experience in the manufacturing of towers from previous projects conducted in Morocco.

Other components show potential but barriers need to be overcome to unlock this potential:

- Even though no blade manufacturing capacity was identified, a few locally established companies are considering the possibility to produce structures used for wind towers and blades if foreseeable national and regional markets emerged.

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- Other high value-added activities (wind generators, nacelle assembly) are currently provided by specialized international companies and the market will remain difficult to access for local industries due to technological gaps and market potential.

Tunisia – Country Report

Overview of the national policy framework

Renewable energy policies and targets

- In 2009, the Government launched the Tunisian Solar Plan (TSP) which aims to fund around 40 renewable projects, including 17 solar and 3 wind projects. The TSP is expected to reach the following objectives:
    - 11% of electricity generation and 16% of installed capacity from RE by 2016, representing 1,000 MW;
    - 25% of electricity generation and 40% of installed capacity from RE by 2030, representing 4,700 MW.
- The following laws are likely to support the development of RE:
    - Introduction investment aids for the realization of electricity production projects from renewable energy sources.
    - Any institution or group of establishments engaged in the industrial, agricultural or tertiary sector to produce renewable power for their own use. The law also gives producers the ability to sell up to 30% of power generated to STEG at a price equivalent to HT prices
    - Producers are allowed to use the national grid to transport power from the production plant to the consumer on payment of a transport fee. This fee is determined by order of the Minister of Energy.

Strategy to support RE equipment manufacturing

- The government has set up tax incentives in order to strengthen local firms competitiveness:
    - Exemption from VAT for locally manufactured raw materials and semi-finished products entering into the production of equipment for EE and RE;
    - Exemption from VAT for equipment manufactured locally and used in the field of energy conservation or of renewable energies.
- Academic institutions have specialized courses in order to meet the requirements of the business sectors;
- The ANME is in charge of the promotion of training in energy efficiency and renewable energy technologies.
- The *Programmes de Recherche Fédérés* (PRF - common research programs) aim at improving the national R&D system by mobilizing skills and establishing partnerships between research establishments and the public and private operators concerned;
- The Research and Technology Center of Energy (CRTEn), in operation since 2006, is a R&D organization operative under the supervision of the Ministry for Higher Education and Scientific Research (MESRS).

Technology	Previous and ongoing projects	RE policy maturity
Solar PV	• Solar rooftops within the PROSOL-ELEC program already in operation • No large scale PV project has been achieved so far	🟨
Solar CSP	• No CSP project has been achieved so far • All projects have been delayed with first deliveries expected in 2016.	🟥
Wind	• About 250 MW already in operation: ○ Sidi Daoud farm (54MW) ○ Bizerte farm stage (120MW) ○ Bizerte farm stage (70MW) • 250 MW to 300 MW in the pipeline within the EGCE Program and the Sidi Daoud extension	🟨

Synthesis of strengths, weaknesses, opportunities and threats for local manufacturing

The key findings of Tunisia's renewable energy manufacturing potential are displayed in the SWOT analysis below:

Strengths

- Industry maturity
  - Strong local industries (cables, electrical works, EPC, construction materials) and large export industry (automotive, aeronautics)
- Technological skills
  - Skilled workforce availability (engineers, technicians)
- Economic and regulatory assets
  - Relatively low labor costs
  - Sustainable growth in the electricity demand requiring investments in new capacities
  - Strong and sustainable GDP growth

S

W

Weaknesses

- Industry maturity
  - Few large scale RE projects achieved (or in the pipeline)
  - Limited supply chain experience on key items of the value chain
- Technological skills
  - Limited know-how on high value-added components (wafers, PV cells, float glass, inverters, receivers, rotor blades, etc.)
  - Lack of product quality control, certification and test facilities
- Economic and regulatory assets
  - Limited involvement of local banks restraining investment in new production capacity
  - Lack of a clear and stable regulatory framework for RE
  - High fossil energy subsidies

Opportunities

O

- Finance
  - Successful financing schemes from STEG/ANME may be replicated
- Competitiveness
  - LCOE reduction resulting from local manufacturing
  - Export potential (proximity with Europe)
- Technology
  - Emerging industries on high added-value items (e.g. composites)
  - Capacity building and spillover effects from foreign involvement
- Regulation
  - New law on the production of electricity through renewable energy sources recently approved
  - Decreasing fossil energy subsidies

T

Threats

- Finance
  - No clear financing schemes foreseen, especially for SMEs
- Competitiveness
  - High international competition, especially on high-added value components
  - Emerging regional competition (Morocco, Egypt)
- Technology
  - Limited public and private R&D investments
- Regulation
  - Forthcoming political elections might be game changers

Solar PV – Opportunities for local manufacturing

Executive Summary

Tunisia has strong assets in several parts of the solar PV value chain. A strong industrial capacity has emerged in Tunisia regarding electrical equipment and cable production for the European automotive market, indicating that most of the required cables and transformers for large scale PV plants could be manufactured in Tunisia in the medium-term, provided necessary R&D and equipment investment. Construction also offers significant local content potential, with leading companies having both the technical skills and critical sizes to provide civil works, mechanical and electric services for large-scale solar plants. Raw materials for the construction phase such as cement and concrete or steel could easily be provided by local companies already delivering raw materials to large infrastructure projects. Local steel companies could also deliver the necessary steel support structure for PV modules provided specific equipment investment, even if PV plants are likely to remain a side market.

However, the local capacity remains limited on other high value-added components such as wafers, cells, and glass or electric inverters. The development of solar roof projects in Tunisia has strengthened local skills in module manufacturing, with several PV module encapsulation companies already active in the country and focusing on niche markets (e.g. building integration). These companies may have the technical capability to increase their production capacity provided that access to finance is facilitated. Besides, PV modules produced in Tunisia still need to face sharp international competition and suffer from the lack of quality control and certification.

Raw materials for the production of solar modules like the necessary glass are currently imported. Several local companies already have glass treatment facilities, but specific investments would be required to address the PV market (e.g. float glass process). Such investments would be determined by easier access to finance and sufficient national and regional markets.

Electrical inverters, which require high quality standards to meet the high-voltage PV technology requirements, cannot be produced locally at the moment. Low and medium voltage manufacturers may increase their skills if provided relevant technology transfer and new equipment investment.

Strengths

S

- ► Industry maturity
  - Rising PV module manufacturing industry
  - Strong local industries (cables, electrical works, EPC)
- ► Technological skills
  - Skilled workforce availability
- ► Economic and regulatory assets
  - Low labor costs
  - Rapid low-voltage PV development (PROSOL-ELEC)

Weaknesses

W

- ► Industry maturity
  - No industry in key items of the value chain (wafer, cells)
- ► Technological skills
  - Limited know-how on high value-added components (wafers, cells, glass, inverters)
  - Lack of product quality control and certification
- ► Economic and regulatory assets
  - Limited involvement of local banks / limited access to financing for new production capacity
  - Lack of fiscal, institutional and regulatory framework for RE development

Opportunities

O

- ► Competitiveness
  - Expected LCOE reduction
  - Export potential (proximity with Europe)
- ► Technology
  - Possibility of technology transfer and spillover effects from foreign stakeholders (Soitec, Conergy, JVG Thoma, etc.)
- ► Regulation
  - New law on the production of electricity through renewable energy sources recently approved
  - Decreasing energy subsidies

Threats

T

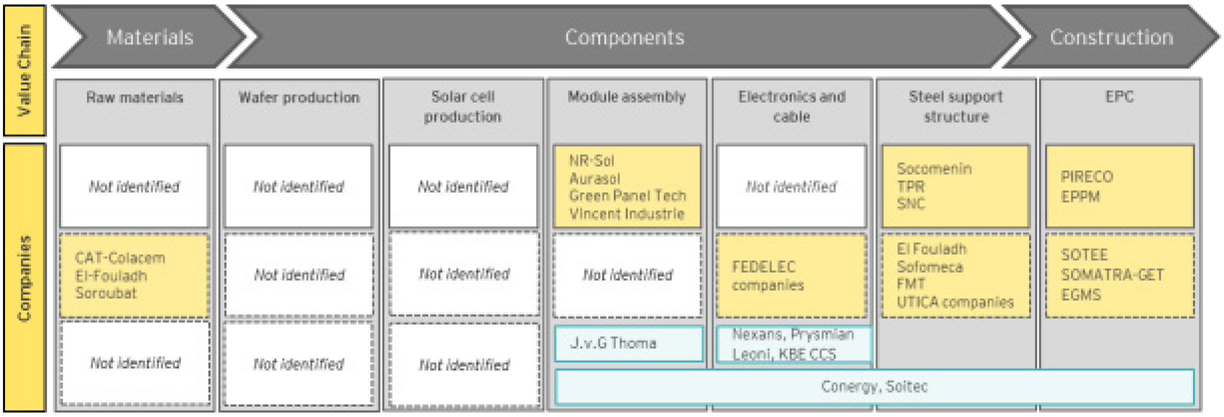
- ► Finance
  - No clear signal of local banks involvement or financing schemes for SMEs
- ► Competitiveness
  - High international competition, especially on PV cell and module manufacturing
  - Emerging regional competition (Morocco, Egypt)
- ► Regulation
  - Forthcoming political elections might be game changers

Local value chain and industrial assets

Identification of actors involved in the value chain

Following the PROSOL-Elec program for the installation of micro photovoltaic plants connected to the national grid, the Tunisian market has seen a significant increase in low-voltage installations, accounting for nearly 5 MWp installed capacity at the end of 2013. However, no industrial medium-voltage (100 kWp to 1 MWp) or high-voltage power plants (> 1 MWp) have been developed so far, mainly due to a lack of market transparency and clear regulatory framework.

The figure below provides an overview of the value chain for component manufacturing for solar PV plants. The different local players identified during the local interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the local markets are also shown.



Value Chain	Materials	Components					Construction
	Raw materials	Wafer production	Solar cell production	Module assembly	Electronics and cable	Steel support structure	EPC
Companies	*Not identified*	*Not identified*	*Not identified*	NR-Sol Aurasol Green Panel Tech Vincent Industrie	*Not identified*	Socomenin TPR SNC	PIRECO EPPM
	CAT-Colacem El-Fouladh Soroubat	*Not identified*	*Not identified*	*Not identified*	FEDELEC companies	El Fouladh Sofomeca FMT UTICA companies	SOTEE SOMATRA-GET EGMS
	Not identified	*Not identified*	*Not identified*	J.v.G Thoma	Nexans, Prysmian Leoni, KBE CCS		
				Conergy, Soitec			

Table 11: Tunisian companies involved in the Solar PV value chain (EY/Enolcon, 2014)

Local manufacturing assets [15]

Key assets of local industries	**Industry maturity**			**Technological skills**			**Economic assets**			**Conclusion on local manufacturing assets**
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●●○○	●●○○	●●○○	●●●○	●●○○	●●○○	●●●○	●●●○	●●●○	High
Solar Module manufacturing > Wafer production	○○○○	○○○○	○○○○	●○○○	○○○○	●○○○	●○○○	●●○○	●○○○	Very Low
Solar Module manufacturing > Solar cell production	○○○○	○○○○	○○○○	●○○○	○○○○	●●○○	●○○○	●●○○	●○○○	Low
Solar Module manufacturing > PV-module manufacturing	●●○○	●●○○	●○○○	●●○○	●○○○	●●○○	●●○○	●●○○	●●○○	Medium
PV Plant > Electronics and cable	●●●○	●●●●	●●●●	●●●○	●●●○	●●○○	●●●●	●●○○	●●●○	High
PV Plant > Steel support structure	●●○○	●●●○	●●●○	●●●○	●●○○	●●○○	●●●○	●●○○	●●○○	High
Construction	●●●●	●●●○	●●●○	●●●○	●●○○	●●○○	●●●○	●●○○	●●●○	High

Construction materials

Raw materials for the construction phase such as cement (CAT-Colacem, Carthage Cement), concrete (Soroubat, Polybéton, Afrique Béton) and steel (El Fouladh) could be provided by local companies already delivering raw materials to large infrastructure projects.

Component materials

Raw materials for the production of solar modules such as the necessary glass are currently imported, and no local or international company has the production facility to provide large-scale PV plants in Tunisia in the short-term. The following processing and finishing of the flat glass (like cutting, tempering, etc.) could be performed by local companies (ex: Siala, Sotuver) provided a sufficient market size is reached.

Photovoltaic cells also require crystalline silicon but no industrial facility currently operates in Tunisia.

Solar module manufacturing

The development of solar roof projects in Tunisia has strengthened local skills in module manufacturing. Several PV module encapsulation companies are currently active with production facilities in Tunisia (NR-Sol, Aurasol, Green Panel Tech, Vincent Industrie). Even though these companies essentially target the local domestic market, most of them have the technical and financial capability to increase their production capacity if significant PV projects were to be developed in Tunisia. Aurasol, one of the PV module manufacturing companies in Tunisia, currently produces nearly 2MWp/year essentially for the Tunisian market and could provide up to 15 MWp/year if needed.

Electronics and cable

A strong industrial capacity has emerged in Tunisia regarding electrical equipment and cable production for the European automotive market. This market consists of both small export-oriented players (Chakira Cable, Tunisie Cables), several major cable groups (Nexans, Leoni or Corning Cable Systems) and a few joint-ventures (Auto Cables Tunisia, JV between Prysmian Group and Tunisia Cables). A few international cable groups such as Nexans, Prysmian or Leoni are leading the high-voltage North-African market, and most of them have production facilities in Tunisia.

Therefore, most of the required cables and transformers for large scale PV plants could already be manufactured in Tunisia in the medium-term. Chakira Cable (Energy and Telecom division of Group Elloumi) or Tunisie Cables also have significant production facilities in Tunisia, mainly targeting the automotive and aeronautics sectors. Based on this local knowledge and industrial capacity, the supply of cables for all kind of renewable energies can be considered.

Interviews also revealed that no industrial players had the ability to provide transformers and inverters for high voltage installations. In case a profitable market emerged, local companies already active in low-voltage and medium-voltage ranges could serve the high-voltage market in the medium-term perspective.

Steel support structure

Local Tunisian steel companies can deliver the necessary steel support structure for PV modules, as well as the mounting of the PV modules. However, renewable energies are likely to remain a side market, in which companies may invest only if national and regional demands increase.

Engineering, Procurement and Construction (EPC)

PIRECO and EPPM are two leading integrated EPC contractors active both in the domestic and foreign markets (Algeria, Libya, Irak). The construction and assembly of small scale applications for households or smaller industrial applications have also allowed small and medium sized enterprises to offer construction and maintenance services. Such companies could be involved in future large-scale PV plants as local suppliers for national utilities (*STEG, Carthage Power Company*), national construction companies (*PIRECO, EPPM*) or international EPC providers already involved in conventional power plants in Tunisia (*SNC-Lavalin*, *Ansaldo Energia*, etc.)

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key success factors for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[55]	**Conclusion on future local industrial capability**
Raw material	🟡	🟡	🟡	🟡	Medium
Solar Module manufacturing > Wafer production	🟡	🔴	🔴		Low
Solar Module manufacturing > Solar cell production	🟡	🔴	🟡		Low
Solar Module manufacturing > PV-module manufacturing	🟡	🟡	🟢		High
PV Plant > Electronics and cable	🟢	🟢	🟢		Very High
PV Plant > Steel support structure	🟢	🟢	🟢		Very High
Construction	🟢	🟢	🟢		Very High

Potential involvement of international players in local production

The German solar equipment manufacturer J.v.G. Thoma is the first international firm to partner with a local PV module manufacturer (Green Panel Tech) and establish a joint venture (Green Panel Technology Jurawatt Tunis SA). If successful, this partnership may pave the way for future foreign investment. Overall, the lack of regulatory framework has restrained international involvement in larger-scale PV projects to limited self-production initiatives (ex: 210 kWp for groundwater desalination operated by Conergy). Forthcoming change in the regulatory framework should enable private companies to produce and sell electricity from renewables and therefore foster international involvement.

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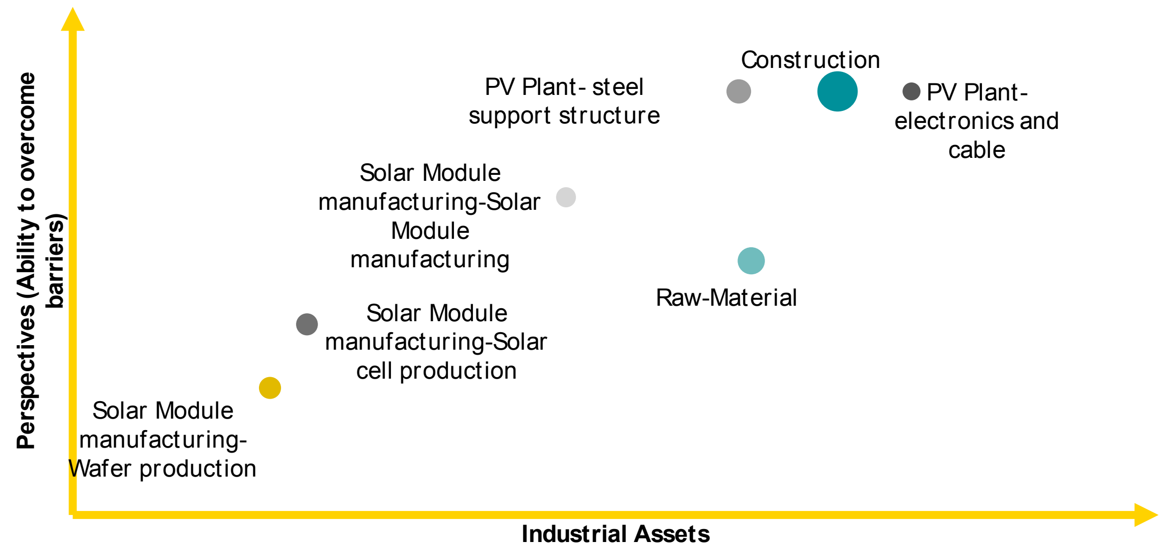
[55] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities



The following components offer very promising local capacity potential:

- Tunisia can rely on solid mechanical, electrical and electronics industries, especially cable producers, which may be an asset to supply future PV plants in the short-term perspective.
- Construction also offers significant local content potential, with leading EPC companies having both the technical skills and critical sizes to provide civil, mechanical and electric engineering services.
- Raw materials for the construction phase such as cement, concrete and steel could easily be provided by local companies already delivering raw materials to large infrastructure projects.
- Local steel companies could deliver the necessary steel support structure for the PV modules provided specific equipment investment, even if PV plants are likely to remain a side market.

Other components show potential but barriers need to be overcome to unlock this potential:

- Five PV module encapsulation companies are already active in the country and mainly focusing on niche markets (e.g. building integration, customized products). These companies may have the technical ability to address both the low-voltage PV market and increase their production capacity to engage in potential larger scale PV projects provided that access to finance is facilitated. Nevertheless, PV modules produced in Tunisia still need to face sharp international competition and suffer from the lack of quality control, certification and test installations.
- Raw materials (e.g. glass) are currently imported, and even though local companies already have glass treatment facilities, specific investments will be required to address the PV market (e.g. high quality float glass process). Such investments would be determined by easier access to finance, skill capacity building and sufficient national and regional markets.
- Other electronic components such as inverters could be produced by existing local manufacturing companies, provided that incentives (sufficient market size, technology transfer) lead them to invest in new production lines and staff training.

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- Considering the significant market sizes required for a profitable investment in solar cell and wafer production and the current estimation of the market development, it is estimated unlikely that a local company will invest in such production facilities in the medium-term.
- Photovoltaic cells also require crystalline silicon with no industrial facility currently operated in Tunisia. According to the Ministry of Industry, mining activities could become an asset for Tunisia in the long-term perspective if a larger national and regional PV markets were to develop, since Tunisian soils contain silicon (especially in the Kairouan region).

Solar CSP – Opportunities for local manufacturing

Executive Summary

The conducted interviews reveal that CSP technology is not considered a promising option for renewable energy development in the short-term perspective in Tunisia. Most private and public stakeholders do not identify CSP as a competitive technology compared to solar PV or wind energy. The lack of a promising market forecast and an unclear regulatory framework are also seen as key barriers restraining CSP project implementation.

Nevertheless, certain parts of the solar CSP technology (as well as PV and wind) supply chain offer promising potential. The strong electrical and cable industries may provide key parts of the supply chain for large scale CSP plants, provided necessary R&D and equipment investment. EPC and construction raw material industrials (cement, concrete or steel) have the technical and financial strengths to provide civil works, mechanical and electric services for large-scale solar plants.

No local company producing float glass with high purity was identified in Tunisia. The potential for local manufacturing will be determined by the ability to increase local skills, empower R&D investment and foster market dynamism. Already active companies could also focus on niche markets such as glass transformation activities (cutting, tempering). Although the leading international composite materials players are not active in Tunisia, a few locally established companies may rapidly acquire the necessary know-how to produce support structures for CSP plants.

However, the local capacity remains limited on other high value-added components (thermal storage, power train) and strong barriers will have to be overcome to foster future local manufacturing. Specific materials, such as the heat transfer fluid or the molten salt, are produced by specialized international companies and the market will remain difficult to access for local industries due to a lack of know-how and market potential. Local activities will be highly dependent on the capacity to ensure high quality products through technology transfer, to invest in new complex and expensive production facilities and guarantee profitability through a sufficient project pipeline.

Strengths

- Industry maturity
  - Strong local industries (cables, electrical works, EPC)
  - Large export industry (e.g. automotive and aeronautics)
  - Successful low-voltage rooftop solar thermal development (PROSOL)
- Technological skills
  - Skilled workforce availability
- Economic and regulatory assets
  - Low labor costs

S

Weaknesses

- Industry maturity
  - High CAPEX costs / Low LCoE perspective
  - CSP is not considered as mature technology
  - No project achieved so far
- Technological skills
  - Lack of know-how on high value-added components (float glass, receivers, power train)
- Economic and regulatory assets
  - Lack of fiscal, institutional and regulatory framework for RE development
  - High energy subsidies

W

Opportunities

O

- Competitiveness
  - High local integration potential (up to 60%) likely to reduce the LCoE
- Technology
  - Potential of technology transfer/spillover effects (e.g. high-quality float glass manufacturing)
- Regulation
  - New law on the production of electricity through renewable energy sources recently approved
  - Decreasing energy subsidies

Threats

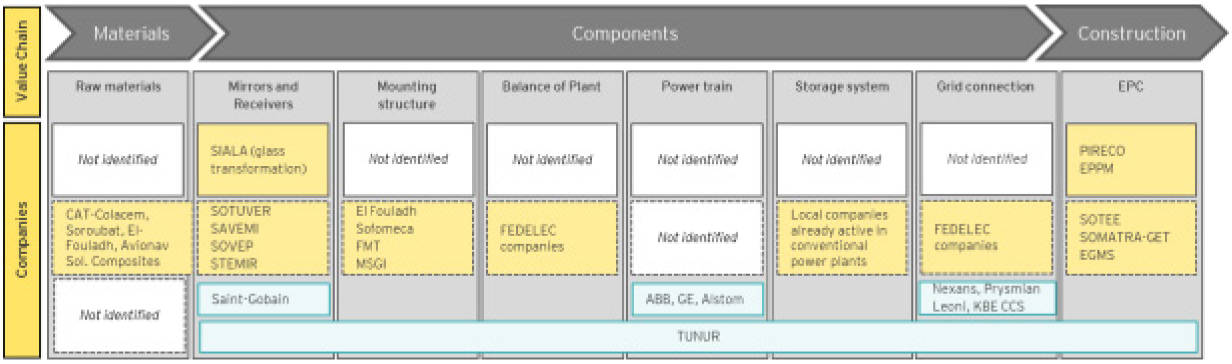
T

- Finance
  - Limited local banks involvement / limited access to financing for new production capacities
- Competitiveness
  - Skepticism about the LCoE competitiveness
  - Emerging international regional competition (South Africa, Morocco, Egypt)
- Regulation
  - Forthcoming political elections might be game changers

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for solar CSP plants. The different local players identified during the local interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the local markets are also shown.



Value Chain	Materials	Components						Construction
	Raw materials	Mirrors and Receivers	Mounting structure	Balance of Plant	Power train	Storage system	Grid connection	EPC
Companies	*Not identified*	SIALA (glass transformation)	*Not identified*	*Not identified*	*Not identified*	*Not identified*	*Not identified*	PIRECO EPPM
	CAT-Colacem, Soroubat, El-Fouladh, Avionav Sol. Composites	SOTUVER SAVEMI SOVEP STEMIR	El Fouladh Sofomeca FMT MSGI	FEDELEC companies	*Not identified*	Local companies already active in conventional power plants	FEDELEC companies	SOTEE SOMATRA-GET EGMS
	Not identified	Saint-Gobain			ABB, GE, Alstom		Nexans, Prysmian Leoni, KBE CCS	
		TUNUR						

Table 12: Tunisian companies involved in the Solar CSP value chain (EY/Enolcon, 2014)

Local manufacturing assets [56]

Key assets of local industries	Industry maturity			Technological skills			Economic assets			Conclusion on local manufacturing assets
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●●○○	●●○○	●●○○	●●○○	●●○○	●●○○	●●●○	●●●○	●●●○	Medium
Solar field > Mirrors	●○○○	●●○○	●●○○	●●○○	●○○○	●●○○	●●○○	●●●○	●●○○	Medium
Solar field > Mounting structure	●●○○	●●○○	●●○○	●●○○	●○○○	●●○○	●●●○	●●●○	●●○○	Medium
Power Block > Balance of plant, piping, electronics	●●●○	●●●○	●●●○	●●●○	●●○○	●●○○	●●●○	●●●○	●●○○	High
Power Block > Power train	●○○○	●○○○	●○○○	●○○○	●○○○	●●○○	●●○○	●●●○	●●○○	Low
Thermal Storage > Storage system	●○○○	●●○○	●○○○	●●○○	●○○○	●●○○	●●○○	●●●○	●●○○	Medium
Grid connection	●●○○	●●●○	●●●○	●●○○	●●○○	●●○○	●●●○	●●●○	●●○○	High
Construction	●●●●	●●●○	●●●○	●●●○	●●○○	●●○○	●●●○	●●●○	●●●○	High

Interviews with public and private stakeholders reveal that CSP technology is not considered as a promising option for renewable energy development in the short-term perspective in Tunisia. These stakeholders do not identify CSP as a competitive technology compared to solar PV or wind energy. Besides the issue of manufacturing costs in particular, the lack of a promising market forecast and regulatory framework are seen as key barriers for both international players and local component manufacturers.

Construction materials

Raw materials for the construction phase such as cement, concrete and steel could be provided by local companies already delivering raw materials to large infrastructure projects.

Component materials

Specific materials such as the thermal oil used as a heat transfer fluid or the molten salt used as storage material are produced by specialized international companies, and the market will remain difficult to access for local industries due to a lack of know-how and market potential.

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[56] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

Composite materials are widely used for wind turbines and masts as well as in the aeronautic and automotive industries. They could be used to form support structures for CSP plants. Although the leading international players (*Toray*, *Teijin*, *Owens Corning*) are not active in Tunisia, a few locally established companies such as *Solutions Composites* or *Avionav* have the necessary know-how to produce such structures.

Solar field (Mirrors and receivers)

The glass and mirror industry in Tunisia essentially focuses on food and beverage container glass, and to a lesser extent on glass for buildings and automotive glass. Float glass, which is of direct interest for CSP technology, needs to be either transformed into flat mirrors (solar tower or linear Fresnel technologies) or bent (parabolic trough technology).

No local company producing solar float glass with a high purity was identified in Tunisia. Tunur, which is one of the few stakeholders conducting CSP projects in Tunisia, expect to import float glass from Algeria and have it transformed by *Siala*, a local glass manufacturer company with expandable production capacity. Following this example, other local glass manufacturers (*Sotuver, Sovep, Savemi, Stemir)* could focus on glass transformation activities to provide high quality mirrors, provided that a sustainable market emerges. Among international players, Saint-Gobain is already active in Algeria, Egypt and Morocco and has already shown signs of interest in the Tunisian market through a takeover bid on *Sotuver* in 2008.

Solar field (Support structure)

The Tunisian iron and steel industry is composed of nearly 70 companies with significant production capacities. *El Fouladh* is a state-owned leading steel producer in Tunisia, and *Sofomeca* and *Fonderie Moderne de Tunisie* represent nearly 70% of national cast iron production. Concerning support structures for CSP applications, Tunisian leading players could manufacture the steel structure for the heliostats used for solar tower applications. Light steel structures necessary for the support structure of a parabolic trough CSP could also be delivered by small sized companies.

Grid connection

Even though no local company with the ability to provide transformers and inverters for high voltage installations was identified during the interview phase, companies already active in the low-voltage and medium-voltage ranges could be able to provide the high-voltage market in the medium-term perspective if a profitable market was created.

Steam turbine

Steam turbines are a critical component, requiring high skilled and experienced staff during the development phase and highly specialized production process. To justify the necessary investment in a local production facility, a high annual output over several years must be foreseen. Therefore, no steam turbine manufacturing is likely to develop in Tunisia in the long-term perspective.

Storage system

The storage system consists of two main parts, the storage material and the storage equipment such as vessels, valves and additional equipment. As current state-of-the art, molten salt storage systems and the required materials used for large scale applications have not been identified in Tunisia. The storage equipment is similar to conventional equipment used in the process industry or in power plants; therefore companies already active in such markets could manufacture the necessary components.

Balance of Plant & Construction

STEG is the main utility active in Tunisia. They are able to deliver directly or indirectly most components necessary for the Balance of Plant (BoP), including pressure parts and tanks, piping, heat exchangers and heat recovery steam generators. Other integrated international companies (ABB, Alstom, General Electric) already active in the conventional power plant business may also be interested in contributing to BoP for future CSP plants. Nevertheless, local contribution could be brought by PIRECO or EPPM, which already provide construction services for domestic and international projects (power plants, industrial plants, water treatment stations).

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[57]	**Conclusion on future local industrial capability**
Raw material	🟢	🟡	🟡	🔴	Medium
Solar field > Mirrors	🟢	🟡	🟡		Medium
Solar field > Mounting structure	🟢	🟢	🟢		High
Power Block > Balance of plant, piping, electronics	🟢	🟡	🟢		Medium
Power Block > Power train	🟡	🔴	🟡		Low
Thermal Storage > Storage system	🟢	🔴	🟡		Low
Grid connection	🟢	🟢	🟢		High
Construction	🟢	🟢	🟢		High

Potential involvement of international players in local production

Despite a promising market potential for solar CSP technology (average annual DNI of 1,814 kWh/sqm[58] and peaks at 2,123 kWh/sqm), no local or international players has engaged plant construction as of today and all projects (Akarit, Tunur, El-Borma) have been delayed with first deliveries expected in 2016.

Interviews with major stakeholders reveal that the ROI uncertainty remains a key barrier for project development. Beyond the high LCoE-cost issue which restrain heavy investments, the interviews confirmed that the potential market size could be too small to implement specialized production facilities in Tunisia, meaning that a sustainable export market must be guaranteed to justify investment in CSP technology. For instance, a viable receiver manufacturing factory would require an annual capacity of more than 200 MW.

Key barriers mentioned by international players are also related to the challenging regulatory framework and the required licenses to operate in Tunisia. The outcome of the new expected regulatory framework (feed-in-tariff, procurement framework, etc.) will be critical to foster foreign involvement in the near future. Considering their historical involvement in conventional power plants in Tunisia, international leading energy companies (ABB, GE, Alstom) may also be interested in contributing to future CSP projects, by providing power train solution or integrated energy services.

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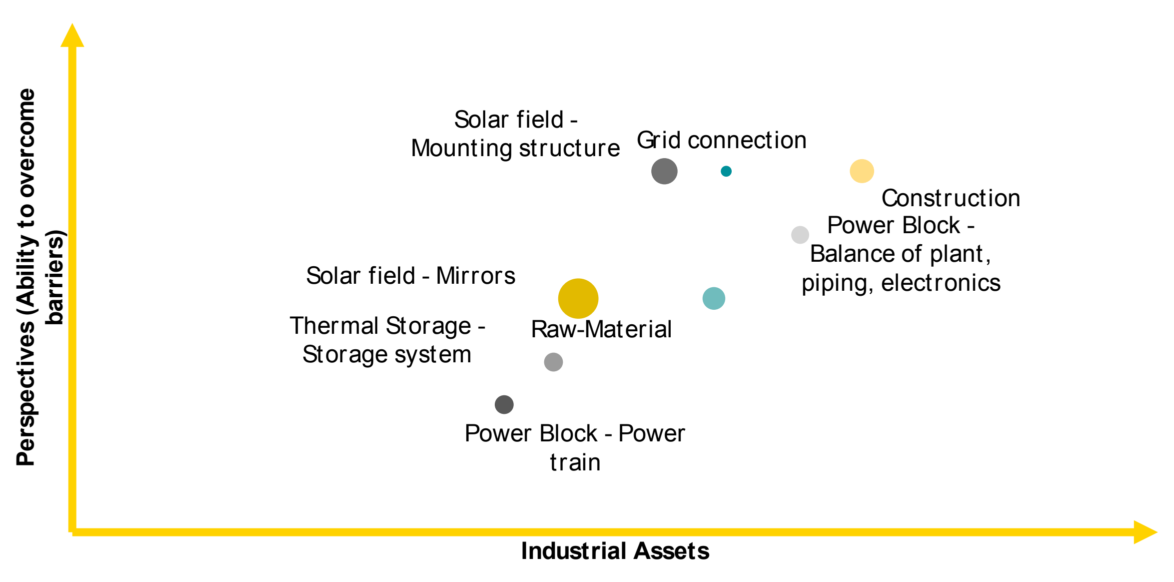
[57] Detailed analysis of the policy framework is available in Appendix A.
[58] SolarGIS 1994-2010

Conclusion on future local manufacturing opportunities

The future industrial capability of CSP manufacturing in Tunisia is highly correlated to the actual development of pilot projects. Indeed, the current lack of market transparency, unclear regulatory framework and high LCoE are strong entry barriers which restrain CSP project implementation. However, CSP technology offers promising local manufacturing potential. Several dynamic and competitive industrial sectors have the potential to integrate significant links in the CSP value chain. According to a study by Tunur, CSP tower technology could guarantee up to 60% of local integration.



The following components offer very promising local capacity potential:

- The strong local electrical and cable industries may provide key parts of the supply chain for large scale CSP plants (electrical control, balance, cabling, etc.) provided necessary R&D and equipment investment
- EPC and construction raw material industrials (cement, concrete and steel) have the technical and financial strengths to provide civil works, mechanical and electric services for large-scale solar plants
- Local steel companies could deliver the necessary steel support structure provided specific equipment investment, even if CSP plants are likely to remain a side market

Other components show potential but barriers need to be overcome to unlock this potential:

- The potential for local manufacturing of CSP mirrors will be determined by the ability to increase local skills, empower R&D investment and foster market dynamism in order to be able to compete with regional and international players. Already active companies could also focus on niche markets like glass transformation activities (cutting, tempering)
- Although the leading international composite materials players are not active in Tunisia, a few locally established companies already have or may rapidly acquire the necessary know-how to produce support structures for CSP plants

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- Other high value-added components (thermal storage, power train) are currently produced by specialized international companies and the market should remain difficult to access for local industries due to a lack of know-how and market potential.

Onshore Wind – Opportunities for local manufacturing

Executive Summary

The implementation of two large-scale wind farms has enabled local contributors to gain technical expertise and demonstrate their production capacity. Indeed, cables, electrical works, mechanical lifting as well as construction material and services can rely on solid industries in Tunisia, offering promising local content enhancement in the case of future wind farm development.

All Sidi Daoud and Bizerte wind towers were produced locally, indicating that future integration should be guaranteed. However, no local manufacturing capacity was identified for other key electrical and mechanical components. Even though no blade manufacturing capacity was identified, a few locally established companies have or may rapidly acquire the necessary know-how in high value-added materials used in the aeronautics sector (carbon fiber, composite) to produce structures used for wind masts and blades if foreseeable national and regional markets emerged. Increasing local content will also require specific focus on other high value added electrical and mechanical components. Indeed, capacity building, R&D support and quality assurance may be critical to enable already established industries to product gearboxes, power converters or transformers meeting high performance and reliability requirements.

Strengths

- Industry maturity
  - Experience gained from achieved projects (244MW)
  - Strong local industries (materials, steel, cables, electrical works, EPC)
  - Local "champions" (Socomenin, Pireco)
- Technological skills
  - Local capacity building achieved through technology transfer in previous projects
- Economic and regulatory assets
  - Low labor costs
  - Competitive LCoE

S

Weaknesses

- Industry maturity
  - No local manufacturer in key items of the value chain (rotor blades, generator, converter, gearbox)
- Technological skills
  - Limited know-how on high value-added component (rotor blades, generator, converter, gearbox)
- Economic and regulatory assets
  - Lack of fiscal, institutional and regulatory framework for RE development
  - High energy subsidies

W

Opportunities

O

- Competitiveness
  - Significant local integration potential (> 40%) likely to reduce the LCoE by up to 25%
- Technology
  - Potential of technology transfer/spillover effects (e.g. power train manufacturing or nacelle assembly)
  - Emerging industries on specific items (e.g. composite materials)
- Regulation
  - New law on the production of electricity through renewable energy sources recently approved
  - Decreasing energy subsidies

Threats

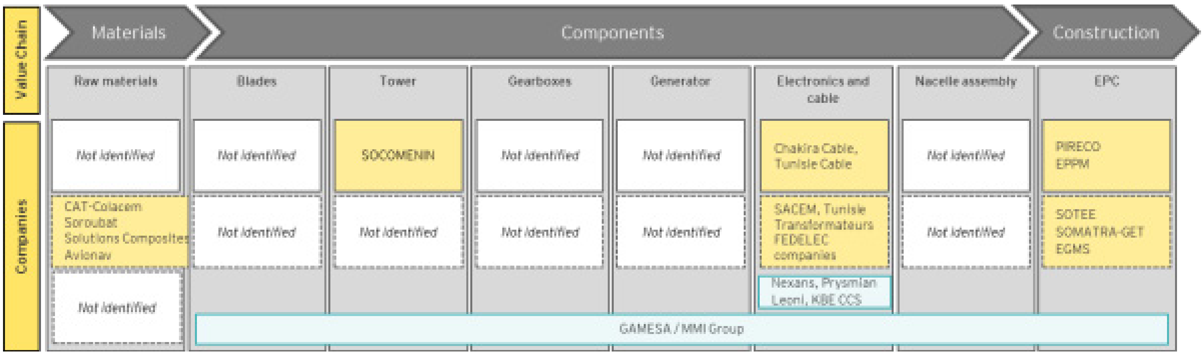
T

- Finance
  - Limited local banks involvement / limited access to financing for new production capacities
- Competitiveness
  - Well established foreign stakeholders
  - Emerging regional competition (Morocco, Egypt)
  - Wind potential may have been overestimated (to be confirmed in a forthcoming updated wind atlas)
- Regulation
  - Forthcoming political elections might be game changers

Local value chain and industrial assets

Identification of actors involved in the value chain

The figure below provides an overview of the value chain for component manufacturing for onshore wind plants. The different local players identified during the local interviews are positioned along the value chain, depending on their ability and willingness to produce different components. Selected international players active in the different markets are also shown.



Value Chain	Materials	Components						Construction
	Raw materials	Blades	Tower	Gearboxes	Generator	Electronics and cable	Nacelle assembly	EPC
Companies	Not identified	Not identified	SOCOMENIN	Not identified	Not identified	Chakira Cable, Tunisie Cable	Not identified	PIRECO EPPM
	CAT-Colacem Soroubat Solutions Composites Avionav	Not identified	Not identified	Not identified	Not identified	SACEM, Tunisie Transformateurs FEDELEC companies	Not identified	SOTEE SOMATRA-GET EGMS
	Not identified					Nexans, Prysmian Leoni, KBE CCS		
		GAMESA / MMI Group						

Table 13: Tunisian companies involved in the Wind value chain (EY/Enolcon, 2014)

Local manufacturing assets [59]

Key assets of local industries	Industry maturity			Technological skills			Economic assets			Conclusion on local manufacturing assets
	Presence of active local companies	Level of industry structuring	Presence of local suppliers	Skilled workforce availability	Product quality	R&D capacity	Manufacturing cost competitiveness	Regulatory framework	Financial health	
Raw material	●●●○	●●○○	●●○○	●●●○	●●○○	●●○○	●●●○	●●○○	●●●○	High
Wind turbine > Wind tower	●●○○	●●○○	●●○○	●●●○	●●●○	●●○○	●●●○	●●○○	●●○○	High
Wind turbine > Blade	○○○○	●○○○	○○○○	●●○○	○○○○	●○○○	●●○○	●●○○	●●○○	Low
Wind turbine > Gearboxes	●○○○	●●○○	○○○○	●●○○	○○○○	●●○○	●●●○	●●○○	●●○○	Medium
Wind turbine > Generator	○○○○	●○○○	○○○○	●○○○	○○○○	●●○○	●●○○	●●○○	●●○○	Low
Wind turbine > Electronics and cable	●●●○	●●●●	●●●●	●●●○	●●●○	●●○○	●●●●	●●○○	●●●○	High
Construction	●●●●	●●●○	●●●○	●●●○	●●○○	●●○○	●●●○	●●●○	●●●○	High

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[59] The Socio-economic Benefits of Solar and Wind Energy, IRENA, 2014

The first wind turbine project was developed by *STEG* and *GAMESA* in Sidi Daoud (2009) followed by the Bizerte farm (2011–2012). With the implementation of these large-scale wind farms and further planned extension, local contributors have gained technical expertise and demonstrated their production capacity, especially in wind tower manufacturing, cables, electrical works, mechanical lifting and construction services.

Construction materials

Raw material necessary for the construction process of the wind turbine, such as the concrete for the foundations or the steel for the wind tower, could be delivered by local companies.

Component materials

Composite materials are widely used for wind masts as well as in the aeronautic and automotive industries. Those specific materials could also be produced locally. *Solutions Composites*, a leader in the North African market, has a large production site in Tunisia. Besides, *Avionav* (a subsidiary of Italian Stormcraft) is also established in Tunisia and could contribute to future wind farms projects.

Wind tower

SOCOMENIN is a Tunisian steel manufacturer that produced 125 wind towers for the farms in Sidi Daoud and Bizerte. The company can produce up to 150 towers per year up to 6000 mm in diameter and supplies leading wind turbine manufacturers (Gamesa, Leitwind, Vergnet, Acsa) for export to Italy, UK, France and Bulgaria.

Rotor blades

No local blade manufacturer was identified during the interviews. According to the contacted local players, the required skills for rotor blade manufacturing – such as laminating - are currently not available in Tunisia. Blades from Sidi Daoud and Bizerte wind farms were imported by GAMESA.

Wind turbine (other components)

According to ANME, a few local transformer manufacturers (*SACEM, Tunisie Transformateurs)* have the technical capacity and know-how to adapt their technology to wind turbines. No specific manufacturing capacity was identified for other key electrical (generator, power converter) or mechanical (bearings, rotor hub, screws, yaw and pitch systems, nacelle assembly) components during the interview phase. Wind turbines from the Sidi Daoud and Bizerte wind projects were imported and assembled by GAMESA. Local electric companies do not have the required technical know-how yet to produce or assemble wind turbines and are unlikely to enter this market in the short-term perspective.

Construction

PIRECO participated in the construction of the Sidi Daoud and Bizerte wind farms in Tunisia, providing civil work, mechanical lifting and electrical work services. The company also has extensive experience in conventional power plant construction for both STEG and international leading companies (GE, SNC Lavalin, ENI, Ansaldo). Other local EPCs (EPPM, SOTEE, SOMATRA-GET) may also enter the wind energy market if a profitable pipeline of projects was created in the future.

Assessment of the perspectives for local RE manufacturing

Analysis of the key success factors for future local manufacturing

Key barriers for future local manufacturing capability	Investment capacity and strong financing infrastructures	Competitive local players	Strong industry innovation	Stable policy support[60]	**Conclusion on future local industrial capability**
Raw material	🟢	🟡	🟢	🟡	High
Wind turbine > Wind tower	🟢	🟢	🟢		Very High
Wind turbine > Blade	🟡	🟡	🟢		High
Wind turbine > Gearboxes	🟡	🟡	🟡		Medium
Wind turbine > Generator	🟡	🟡	🔴		Low
Wind turbine > Electronics and cable	🟢	🟢	🟢		Very High
Construction	🟢	🟢	🟢		Very High

Potential involvement of international players in local production

The two wind farms in Tunisia were developed by the leading Spanish wind turbine manufacturer GAMESA. According to STEG ER, local integration reached nearly 40% through local subcontracting regarding wind tower manufacturing, cables and electronics, mechanical and electrical setup and EPC services. No other international integrated company was involved in other projects in Tunisia. Nevertheless, the new regulatory framework and the significant wind potential (up to 8 GW according to ANME) are likely to attract international investment in the near future.

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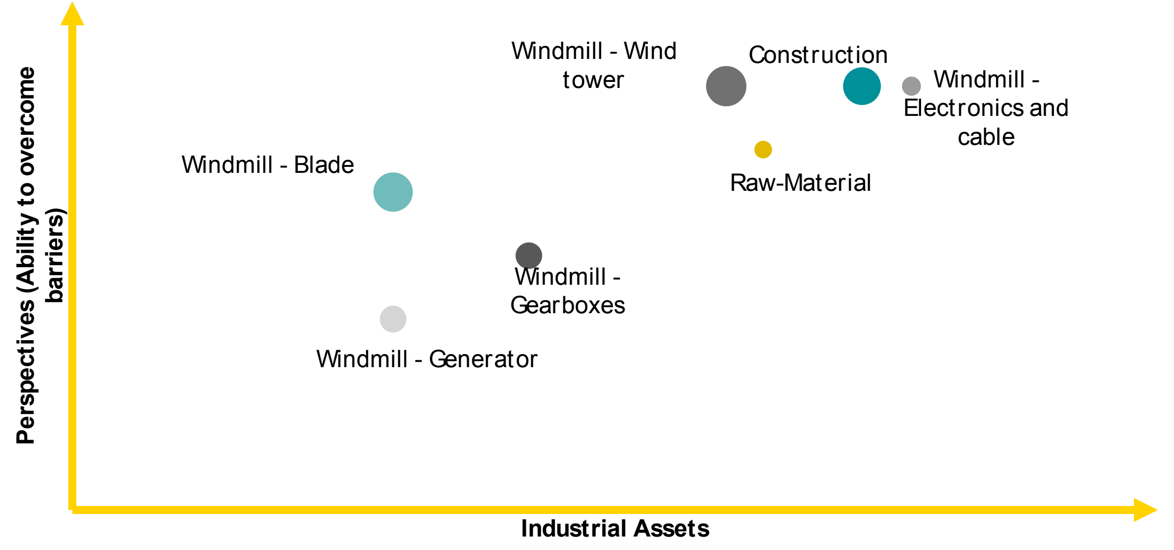
[60] Detailed analysis of the policy framework is available in Appendix A.

Conclusion on future local manufacturing opportunities

STEG has developed the first large-scale renewable energy projects in Tunisia with nearly 250 MW of installed capacity, providing interesting case studies for local integration analysis in Tunisia. The agreement with GAMESA has allowed national authorities and utility stakeholders to gain expertise and local companies have demonstrated their capacity to contribute to large-scale projects in several key parts of the value chain. A study by IRENA [61] on the wind turbine cost breakdown reveals that the components likely to be produced by local players would account for nearly 30% of the total cost (*i.e.* beside materials and construction). In order to increase the local manufacturing contribution to the whole value chain, specific focus will have to be made on high value added components likely to be produced by existing industries.



The following components offer very promising local capacity potential:

- Cables, electrical work, mechanical lifting as well as construction material and services can rely on solid industries in Tunisia, offering promising local content enhancement in case of future wind farm development.
- Sidi Daoud and Bizerte wind towers were produced locally, indicating that future integration should be guaranteed.

Other components show potential but barriers need to be overcome to unlock this potential:

- Even though no blade manufacturing capacity was identified, a few locally established companies have or may rapidly acquire the necessary know-how in high value-added materials used in the aeronautics sector (carbon fiber, composite) to produce structures used for wind towers and blades if foreseeable national and regional markets emerged
- Increasing local content will also require specific focus on other high value added electrical and mechanical components. Indeed, capacity building, R&D support and quality assurance may be critical to enable already established industries to product gearboxes, power converters or transformers meeting high performance and reliability requirements

The local capacity is likely to remain limited in the medium-term on the remaining parts:

- Other high value-added activities (wind generators, nacelle assembly) are currently provided by specialized international companies and the market will remain difficult to access for local industries due to technological gaps and market potential.

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[61] IRENA, Renewable energy technologies : cost analysis series (July 2012)

4. Achieving local manufacturing potential - Policy recommendations

This section presents a detailed list of recommendations applicable at national level to enhance the development of the local manufacturing capacities in the three selected pilot countries for the technologies covered by the study.

These recommendations are aimed at supporting the organizations which play a key role for the development of industrial capacities in the renewable energy sector in the three pilot countries, such as public authorities, business associations, financers, etc.

The recommendations suggested for each country do not constitute a detailed action plan, for which further discussions with national stakeholders should be conducted. They should rather be seen as a general roadmap for action and a supportive tool for these national actors to elaborate their strategy and action plans.

All the recommendations suggested in this section stem from a critical analysis conducted on the basis of the discussions held with the stakeholders met in the three pilot countries. They were elaborated in response to the main difficulties and expectations expressed by these actors and with the objective to raise the key barriers currently identified. They also capitalize upon the feedback received from other countries and other industrial sectors that have developed after facing similar challenges in the first place.

They are linked to the 4 success factors (A, B, C; D) detailed in Section 2 of this report.

	A	B	C	D
Success factors	Substantial political support aiming at creating a long-term stable market	Competitive local players in the global market	Strong industry innovation potential and skilled workforce	Investment capacity and strong financing infrastructures
Classes of recommendations	*Formulate a long term RE strategy with national targets*	*Conduct awareness raising initiatives*	*Support research and development*	*Encourage local banks to implement low interest loans and grants*
	Define an extensive RE regulatory framework	*Assess the feasibility of production line upgrades*	*Educate and train high-skilled workforce*	*Implement investment support mechanisms for adaptation or creation of production lines*
	Define a national plan for RE equipment manufacturing	*Foster business linkages in particular through JV with international companies*	*Implement upgrading programs targeting specific industrial actors*	*Implement price, tax and other incentives*
	Reform fossil-fuel subsidies	*Support the structuring of the sector*	Identify niche technologies and set-up national centres of excellence	

This section details our recommendations on a country by country basis, using the classification based on the four key success factors identified in Section 2. For each country, the following elements are presented for each success factor:

- A chart summarizing our analysis of both current state and priority level for each type of recommendations;
- A focus on high priorities, with further explanations and details to provide options about how these recommendations can be translated into action.

Egypt – Identified gaps and recommendations

A

EGYPT
***Success factor**: Substantial political support aiming at creating a sustainable market*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Formulate a long term RE strategy with national targets	🟢	-	🟡	High	🟢	-
Define an extensive RE regulatory framework	🟡	High	🟡	High	🟢	Medium
Define a national plan for RE equipment manufacturing	🔴	High	🔴	High	🟡	High
Reform fossil-fuel subsidies	🔴	High	🔴	Medium	🔴	Medium

Focus on high priorities

Define a national plan for RE equipment manufacturing

Market barrier

At the moment, there are only a few incentives implemented supporting the local renewable energies industry in Egypt. To enable a secure investment environment for the industry, reliable frame conditions for the implementation of new production lines or the investment in new equipment is necessary.

Recommendation: develop an overall master plan to support RE component manufacturing industry in Egypt

This master plan should include already existing supporting mechanisms and develop further steps covering all relevant RE technologies, with a main focus on the local energy/electricity market and an additional view on the export to the regional markets. The master plan should be divided into the different technologies and focus on their particular needs.

For solar PV the industrial value chain must be developed starting from the end (installation of systems and module manufacturing).

For wind the further development must be based on the already existing and competitive manufacturing capability. The priority is to strengthen the existing industrial capacity and to additional component manufacturing (e.g. blades) must be developed. The recent announcement made by Siemens of a blade manufacturing facility in Egypt is an example of how this strategy can lead to foreign direct investments.

For solar CSP, companies already started to develop own products and put effort in research and development. Based on the master plan, these companies could establish first serial production of their components.

Other countries like South Africa, Brazil are operating by defining a minimum required limit of local manufacturing. Such mechanisms could be also taken into account even if the long term benefits are not yet proven, and as they also pose difficulties to equipment manufacturers and raise questions on the application of WTO rules.

Define an extensive RE regulatory framework

Market barrier:

The already existing regulatory framework does not make distinctions between the solar technologies, PV and CSP, while these technologies present different electricity generation costs and also different dispatchability.

Recommendation:

Review of the existing RE regulatory framework regarding the possibility of including a supporting scheme for energy storage system (either thermal or electrical). The different existing methods (e.g. Feed-In Premium Tariffs, Two/Three-tiered Tariffs) should be reviewed and the application on the Egyptian electricity market and the integration into the existing framework should be evaluated. A possible adaptation of the regulatory framework could be included within the next review of the tariff structure (end of 2016 latest).

Reform fossil-fuel subsidies

Identified gap:

On the long term the reduction of subsidies for fossil fuels will create a transparent energy/electricity market with a true competition between all electricity generating technologies. The technologies which are currently the most cost-competitive (PV and wind) can enter this “open market” in the short term. As CSP-plants with storage offer the same production characteristics as fossil driven technologies, they are also able to act on this “open market” offering peak- and mid-load as well as base-load capacity.

Recommendation:

The announced target to eliminate subsidies for fossil fuels over a 5 years period should be achieved, and monitored, for instance by meeting intermediary targets. This approach should be combined with strong support to energy efficiency and demand-side management.

B

EGYPT
Success factor: Competitive local players in the global market

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Provide information on market size and opportunities of production adjustments	🟨	High	🟨	High	🟩	-
Assess the feasibility of production line upgrades	🟥	High	🟨	High	🟩	-
Foster business linkages in particular through JV with international companies	🟥	High	🟨	Medium	🟩	-
Support awareness-raising initiatives	🟨	High	🟨	Medium	🟨	Medium
Support the structuring of the sector	🟨	High	🟨	Medium	🟨	Medium

Focus on high priorities

Inform on market size and feasibility of production lines concerning CSP and PV

Market barrier:

In the case of wind, a clear and stable pipeline of projects has enabled an industrial capacity to emerge. Although there is no existing project pipeline, different industrial companies are starting to invest into PV and CSP-activities. Nevertheless, both solar technologies should be supported by creating a common understanding about maturity, costs and technology on industrial and public level.

Recommendation: improve visibility on the market potential for selected technology applications

This market analysis and feasibility study should include a detailed state-of-the-art analysis of the different CSP- and PV-technologies, an actually cost estimation as well as an energy yield analysis (based on the defined sites and used storage technologies) and a local impact assessment. The aim would be to inform potential supply-chain entrants of the main growth opportunities for their sector.

Conduct awareness-raising initiatives

Market barrier:

Additional efforts must be taken into account to support the local manufacturing industry for PV-systems.

Recommendation:

Based on the high investments necessary downwards the value chain, it is recommended to establish supporting mechanism upwards the value chain. Awareness-raising initiatives especially focused on small and medium enterprises active in the manufacturing, installation and maintenance of electrical systems. Those companies could develop new business with small scale PV-system or roof-top installation. Larger companies could invest in new production lines for PV-module manufactures. Due to the large competition within the PV sector local initiatives directly supporting the industry downwards the value chain must be designed diligently considering the international market and competition conditions in order to prevent not sustainable investments.

C

EGYPT
***Success factor**: Strong industry innovation potential and skilled workforce*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Support research and development	🟡	High	🟡	High	🟢	-
Educate and train high-skilled workforce	🟡	High	🟡	High	🟢	-
Implement upgrading programs targeting specific industrial actors	🔴	Medium	🔴	Medium	🟡	Medium
Identify niche technologies and set-up national centers of excellence	🔴	High	🟡	High	🟡	High

Focus on high priorities

Support research and development

Market barrier:

Local R&D-development is a key factor to strengthen the local industry innovation potential and to provide skilled workforces. The already existing R&D-potential on academically and industrial level should be extended, coordinated and clustered to ensure an optimal use of the existing resources in Egypt. As the Operation & Maintenance of the different RE-plants offers a significant potential for local workforce, it must be also highlighted during education and training of local workforce.

Recommendation:

Cooperated development (with participating of public authorities, industrial and academic representatives) of a national R&D-plan to support the technology development of renewable energies in Egypt. This R&D-plan should include

- a long term framework for provision of public and private R&D-funds to support new and also ongoing basic research related to all kind of renewable energies in Egypt. National and international exchange programs for students and senior researcher should be established and supported by R&D-funds to provide a broad access to the current state-of-the Art and developments in the renewable energy sector;
- a R&D specific industrial platform to identify common goals of the academic and industrial sector;
- a training platform to ensure an adequate training of all skill-levels (academic researcher, technical management, technicians) and to provide the necessary training infrastructure (e.g. master courses, training-on-the-job, training centers). This training should include manufacturing specific skills as well as the necessary knowledge for operation and maintenance of different renewable energies.

This cooperated development could lead to a national “Cluster of renewable energies in Egypt” combining all R&D-developments in Egypt concerning renewable energies.

Identify niche technologies

Market barrier:

As renewable energies based on solar PV and wind are a fluctuating source of electricity they will have a huge influence on the grid stability of the Egypt transmission network. Furthermore, most potential sites, especially for onshore wind are placed in locations with weak connection to the transmission network. Therefore gird stability will be a major issue for Egypt with increasing share of renewable energies.

Recommendation:

To provide adapted energy generation units to force this problem could be a promising R&D-topic for Egypt, developing solutions for the national and international electricity market. Possible areas of interest are:

- Hybrid plants as combining fossil fuels with PV, CSP (like the Kuraymat ISCC-plant) or wind;
- Low cost electricity or energy storage options, adapted to the Egyptian market and environment;
- Optimized grid integration concepts.

D

EGYPT
***Success factor**: Investment capacity and strong financing infrastructures*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Encourage local banks to implement low interest loans and grants	🟡	High	🔴	High	🟡	High
Implement investment support mechanisms for adaptation or creation of production lines	🟡	High	🟡	High	🟡	High
Implement price, tax and other incentives	🟢	Medium	🟡	Medium	🟢	Medium

Focus on high priorities

Encourage local banks to implement low interest loans and grants

Market barrier:

The solar feed in tariff can be structured basically in two sections, section I capacity smaller than 500 kW supported by soft loans and section II for plants > 500 kW until 50 MW for private/foreign financing. As the local interest rate is influenced by macroeconomic factors of the country itself the local banks will play on the project level for the larger scale PV projects only a minor role. Local banks will mainly be involved in financing small scale PV projects (up to 500 kW) supported by the soft loan program implemented in the Feed-In Tariff (at the moment caped to 300 MM). If no further soft loan programs will follow up an increase of the capacity above 300 MW is not expected due to the current high local interest rates. For the plants especially in the range of several MW up to 50 MW such projects will be in the interest of IFI's.

Recommendation:

It is recommended to extent the soft load program for domestic and roof top application with a capacity smaller than 500 kW in case the overall installed capacity have reached the 300 MW to generate a real market volume.

Market barrier:

As solar CSP are normally large scale projects with a quite high investment demand such projects are mostly supported by IFI's with a major share and local institutions with a minor share.

Recommendation:

Encouragement of local banks soft loan programs could be considered. As local banks will rank CSP with a higher risk potential compared to PV and onshore wind local banks could be encouraged if risk sharing and backing mechanism could be placed by IFI's or insurance companies.

Market barrier:

As wind projects are attractive starting with a capacity of few MW up to wind farms with a total capacity of 50 MW and wind onshore has a quite low technology risk profile onshore wind projects could be quite attractive for local banks. Wind projects are also mostly supported by both, IFI's and local institutions.

Recommendation:

To encourage local banks soft loan programs could be considered also for smaller wind project applications in the range of only a few MW.

Implement investment support mechanisms for adaptation or creation of production lines

Market barrier:

In order to support the implementation of investment supporting mechanism for adaption or creation of new production lines, local banks are interested to invest into productions lines of local manufacturer if a sustainable local market is observable. In addition, IFI could support or back local banks and/or local manufacturer's investments. However a stable, large and reliable market volume must be available.

Support mechanisms by institutions like additional grants for the land, for the infrastructure, etc. could be considered. However the international competition especially triggered by a huge overcapacity in China must be considered and taken into account especially for PV. For CSP the main barrier at the moment is a reliable and long term local market volume that must be clearly visible.

At the moment, only the onshore wind technology offers with the current announce market size of 2,000 MW significant market size to support the demand of local manufacturing. However the time limit of the feed in tariff of two years can be a clear bottle neck to significantly increasing the investment in local manufacturing because the pay back periods for such investments are approximately 3 years.

Recommendation:

As the announcement of the government for wind is in total of 7,200 MW the long term perspective is visible and therefore the investment environment should be in place to create local manufacturing investments. The review of the Feed-In tariff latest in 2016 should be taken into account the support of the local production facilities.

Review and conclusion on the existing Feed-In Tariff structure

Market barrier:

For solar PV the announced feed in tariff should be attractive enough for the larger scale application in the range of 500 kW until 50 MW. For the smaller scale less than 500 kW the soft loan approach supports the development to get such smaller applications on the ground.

Due to the fact that the actual solar feed in tariff does not distinguish between solar power technologies (with and without storage), no large scale CSP-applications are expected under the current Feed-In structure. A dedicated price or incentive for peak power generation could be implemented via public tenders to attract developers, investors and IFI's for large CSP projects which are normally in a capacity range of 50 – 250 MW.

For wind the announced feed in tariff should be attractive enough to achieve the 2000 MW capacities in the medium term. First projects are expected to be developed and announced on short term.

Recommendation:

It is recommended to observe the market behaviour based on the current Feed-In Tariff in the first as well as in the second year. The review should be focused on two points:

- Development of new renewable energies projects in Egypt
- Development of the renewable manufacturing industry in Egypt and its influence on the used RE-technology

Based on the experiences and observations gained during the first period of the Feed-In Tarff, the framework can be adjusted and improved, with respect on the influence of new build capacity in the manufacturing industry.

In summary – key actions

Based on the detailed recommendations presented in this section, a summary of key actions that could be initiated in the short-term (in the upcoming 12 months) are listed below.

- Review of the existing RE regulatory framework regarding the possibility of including a supporting scheme for energy storage system (either thermal or electrical)
- Develop an overall master plan to support RE component manufacturing industry in Egypt
- Conduct feasibility study for a selection of most relevant sites in different regions within Egypt for the implementation of CSP- and PV-plants
- Awareness-raising initiatives especially focused on small and medium enterprises active in the manufacturing, installation and maintenance of electrical systems
- Develop a national R&D-plan to support the technology development of renewable energies and the identification of niche technologies
- Extend the soft load program for domestic and roof top application with a capacity smaller than 500 kW

Morocco – Identified gaps and recommendations

A

MOROCCO
***Success factor**: Substantial political support aiming at creating a sustainable market*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Formulate a long term RE strategy with national targets	🟩	High	🟩	-	🟩	-
Define an extensive RE regulatory framework	🟨	High	🟩	-	🟩	-
Define a national plan for RE equipment manufacturing	🟥	Low	🟨	High	🟨	High
Reform fossil-fuel subsidies	🟥	Medium	🟥	Medium	🟥	Low

Focus on high priorities

Define a national plan for RE equipment manufacturing

Market barrier:

A new provision in the Public Procurement Contracts Code entered into force in the early 2014 in order to promote SMEs in tenders launched in Morocco. The latest open tender procedures launched by the ONEE, both for solar and wind farms, include the principle of national preference. At the same time, MASEN is working with industrial actors to accelerate the industrial integration in solar projects, especially through the Solar Cluster launched in April 2014.

Despite the different initiatives that have already been launched, a number of improvements could be performed in the next years, especially by detailing the legal framework for national preference, and by going further in supporting RE equipment manufacturing industry in both solar and wind energy sectors.

Recommendation:

According to actors interviewed during the study, it is difficult to give a clear interpretation of the scope of the principle of national preference included in the Public Procurement Contracts Code, which mentions 20% of public contract amounts shall be awarded to Moroccan SMEs (*Art. 156 du décret n° 2-12-349 du 8 joumada I 1434 (20 mars 2013) relatif aux marchés publics*). It also seems that the concrete application of this rule is difficult and industrial stakeholders wonder how public authorities will measure and control it.

In terms of national policy, the strategy for the solar industry sector should be refined, in coordination with MASEN by targeting and investing more specifically in subsectors that have been identified as offering the most promising local capacity potential, for instance, electronics and cables for PV, or mounting structures for CSP. In the wind energy sector, there is currently no institution comparable to the Solar Cluster in Morocco. Such an organization could help promoting industrial integration, with the identification of R&D or specific training needs in particular (see detailed analysis in Country reports provided in Section 2).

Define an extensive RE regulatory framework

Market barrier:

Morocco has already set ambitious renewable energy targets and defined quite an extensive regulatory framework for solar CSP and wind energy. The national plan for solar PV has just been presented in November 2014, but implementation instruments are still pending.

Recommendation:

Several significant regulatory texts are expected in the next months, to complete the national plan for solar PV that just has been announced. More specifically, stakeholders are expecting the decree approving the conditions and rules governing the opening of the medium voltage and the definition of zones reserved for the development of large and medium generation plants. Above all, several industrial actors have highlighted the need for amendments of law 13-09 aiming at opening the low voltage market. Such a measure would help actors to seize the economic potential of solar PV connected to the low voltage distribution network, estimated at 4.5 GW by 2030, according to the Ministry of Energy[62].

Indeed, several small-scale solar PV applications such as solar-pumping and water heating systems could represent viable niche markets for industrial actors, on the same level as large-scale projects, with great opportunities on the export market, including for SMEs.

B

MOROCCO
***Success factor**: Competitive local players in the global market*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Provide information on market size and opportunities of production adjustments	🟡	High	🟡	High	🟡	High
Assess the feasibility of production line upgrades	🟡	Medium	🔴	Medium	🟡	High
Foster business linkages in particular through JV with international companies	🟡	High	🟡	Medium	🟡	High
Support awareness-raising initiatives	🟢	-	🟡	Medium	🟡	High
Support the structuring of the sector	🟢	-	🟢	-	🟡	High

Focus on high priorities

Provide information on market size and opportunities of production adjustments

Market barrier:

International players interviewed during the study expressed the need for a better understanding and visibility of both national and regional market potential, costs and regulation in the field of RE. As far as solar PV is concerned, besides large-scale projects driven by public tenders, there are several niche markets, representing potential opportunities for international investors. A detailed business case is needed for each of these markets.

Recommendation:

In the framework of the Solar Cluster launched by MASEN in 2014, a significant work is in progress, in partnership with industrial actors, in order to identify potential market opportunities in the solar PV sector. Several technologies have been selected for a deeper analysis, including solar pumping, solar water heaters and air conditioning systems. This work must continue in order to size these potential market opportunities and above all spread the information to both national and international players interested by implementing local production capacities.

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[62] Statement by Dr. Abdelkader AMARA, Minister in charge of Energy, Mines, Water and Environment, November 2014

Foster business linkages in particular through JV with international companies

Market barrier:

The development of several segments of both solar and wind value chain is threatened by significant technological barriers and the need for high transfer knowledge.

Recommendation:

Regarding the manufacturing of a number of high-technology components (in the CSP value chain in particular), the development of joint-ventures may offer the advantage of a potentially high knowledge transfer from international leaders. This is particularly true in Morocco, which is often mentioned by foreign investors as the country in the areas offering the most favorable conditions, especially regarding regulatory framework (with positive feedback from the automotive and aeronautics industries) and political stability (compared to other countries in the area that were more strongly impacted by the Arab spring).

Thus, the production of these components within the recipient country or region would become feasible, which may have otherwise not been possible without the cooperation. In this context, for a number of identified sub-components, the creation of joint ventures between existing manufacturers and potential regional newcomers should be promoted.

For components with high technological barriers, and whose provision by independent local players or joint ventures is not possible in the foreseeable future, subsidiaries of international companies should also be fostered.

C

MOROCCO
***Success factor**: Strong industry innovation potential and skilled workforce*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Support research and development	🟡	Low	🟡	Low	🔴	Low
Educate and train high-skilled workforce	🟡	Medium	🟡	High	🟡	High
Implement upgrading programs targeting specific industrial actors	🟡	Medium	🟡	Medium	🟡	High
Identify niche technologies and set-up national centers of excellence	🟡	Medium	🔴	Low	🔴	Low

Focus on high priorities

Educate and train high-skilled workforce

Market barrier:

The Environmental Agency ADEREE, in partnership with the Ministry of the Environment, has already implemented training programs on RE targeted at professionals from the electric sector for instance: for instance regarding the installation and maintenance of individual solar panels.

Recommendation:

In a context of development of solar PV applications, and the development of a local solar and wind manufacturing industry, the need for qualified engineers and high-skilled workforce will increase significantly. Dedicated education programs will have to be defined to support the expected development of a local industry in both solar and wind sectors. In this context, co-operation programs with European environmental agencies could be implemented through associations such as MEDENER for instance.

Implement upgrading programs targeting specific industrial actors

Market barrier:

There is a number of initiatives in Morocco targeting SMEs and aiming at modernizing the industry. For instance a number of investments have been made in the electric equipment sector, in the framework of the development of both aircraft and automotive industries. However, so far there is no upgrading program aiming at upgrading specifically the RE components manufacturing industry.

Recommendation:

It is crucial to direct investments and implement dedicated upgrading programs in most promising subsectors in both solar and wind sectors, for instance through the provision of a strategic fund for upgrading of targeted production capacities. Such fund could be financed by diverse institutions representing the Government (e.g. Ministry of Industry) and private actors (Business associations such as FIMME, Fénélec or the Solar Cluster). The objective would be to produce locally high quality products, in conformity with international standards.

D ***MOROCCO***
***Success factor**: Investment capacity and strong financing infrastructures*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Encourage local banks to implement low interest loans and grants	🔴	High	🔴	Medium	🔴	High
Implement investment support mechanisms for adaptation or creation of production lines	🟡	High	🟡	Low	🟡	High
Implement price, tax and other incentives	🔴	Low	🔴	Low	🔴	Low

Focus on high priorities

Implement investment support mechanisms for adaptation or creation of production lines

Market barrier:

There is currently no investment support mechanism to facilitate the creation or the adaptation of production lines in the field of RE components in Morocco. Several SMEs interviewed during the study would be interested in penetrating the RE market but do not have sufficient funds to finance new facilities.

Recommendation:

Several mechanisms could be implemented in order to support investments in RE components production lines and overcome existing barriers regarding upfront investments in the short term. By doing so, these mechanisms would facilitate the development of industrial capacities that would be beneficial to local companies on the long term. For instance, public authorities could propose soft loans for new investments in the field of RE. Foreign investments could also be facilitated in the framework of joint-ventures, with specific tax and regulatory incentives and assistance in administrative matters, which remains a crucial issue in Morocco. As an example, obtaining all required permits and authorizations remains a long and difficult process for many actors in the country.

Encourage local banks to implement low interest loans and grants

Market barrier:

According to Moroccan players, investments in RE is still seen as a risky investment by local banks. Opportunities related to renewable energy components remain unclear for the banking sector. This limits access to finance, in particular for local SMEs that are willing to invest in the RE sector.

Recommendation:

The Ministry in charge of Energy and ADEREE should promote the commercial viability of renewable energy projects among Moroccan banks. International Financing Institutions already active in Morocco such as the European Investment Bank, the European Bank for Reconstruction and Development or the International Finance Corporation could also propose awareness actions for financial actors and implement dedicated credit lines enhancing the financing of new production capacities among SMEs, along with technical assistance in cooperation with local banks.

In summary – key actions

On the basis of our recommendations detailed above, this box presents a summary of key actions that could rapidly be initiated or implemented at national level – with the support of public authorities and other sector local stakeholders - to promote the development of industrial capacities in Morocco:

- Amend law 13-09 to allow the opening of the low voltage market
- Pursue the ongoing work carried out by MASEN and the Solar Cluster to size the markets of key solar applications
- Estimate the appetite of a limited selection of international leaders manufacturing high technology components (especially in the solar CSP value chain) for the establishment of a Joint Venture company in Morocco
- Design dedicated education programs to support the expected development of a local industry in both solar and wind sectors
- Propose a soft loan regime for new investments in the field of RE
- Facilitate foreign investments through Joint Ventures by implementing specific tax and regulatory incentives, and administrative assistance

Tunisia – Identified gaps and recommendations

A

TUNISIA
***Success factor**: Substantial political support aiming at creating a sustainable market*

Key measures	*State assessment / Priority level*					
	Solar PV		*Solar CSP*		*Wind onshore*	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Formulate a long term RE strategy with national targets	🟢	-	🟢	-	🟢	-
Define an extensive RE regulatory framework	🟡	High	🟡	High	🟡	High
Define a national plan for RE equipment manufacturing	🔴	High	🔴	Medium	🟡	High
Reform fossil-fuel subsidies	🔴	Medium	🔴	Medium	🔴	Medium

Focus on high priorities

Define an extensive RE regulatory framework

Market barrier:

Tunisia has a centralized electricity connection, transmission and distribution system run as a monopoly by STEG, which remains the sole transmission network manager in Tunisia and thus the only partner for any generator willing to connect a power station to the national grid. The terms and conditions of access to the transmission network are still determined by a decree dating back from 1964 [63]. However, the Tunisian legislative framework for the implementation of a national energy and electricity from renewable energy has opened in 2009 [64] to private investment opportunities through different schemes (Independent Power Producers operating under government licence, Autoproducers and Cogeneration producers generating electricity from gas under hydrocarbon operating licences). Though this scheme turned out to be successful to develop auto-production based on conventional energy sources (especially in high-consuming industries such as cement works), it has failed to create a sustainable pipeline of RE projects. Indeed, the conditions of electricity production (transmission, purchase price and surpluses, upper limits) have contributed to restrain local and international private operators to enter the market.

Recommendation:

In this context, the new regulatory framework for renewable energies currently being drawn up [65] and scheduled to come in early 2015 might be a game changer and shape the future RE market in Tunisia. The introduction of customized economic frameworks such as Feed-in-Tariffs or authorization regimes through forthcoming decrees and operational implementation will be essential to foster both market development and local manufacturing. Increased stability and predictability of institutional and regulatory frameworks must be ensured to regain investors' confidence and conduct them to engage in projects for which payback period can exceed three years.

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[63] Decree No. 64-9 of 17 January 1964
[64] Law No. 2009-7 and its Implementing Decree No. 2009-2773 of 28th September 2009
[65] Law no No 74/2013 of 18th September 2014 regarding electricity production from renewable energy

Define a national plan for RE equipment manufacturing

Market barrier:

Only few RE-specific incentive tools favoring local manufacturing have been implemented so far. The government has set up tax incentives in order to strengthen local firm competitiveness, such as exemption from VAT for locally manufactured raw materials and semi-finished products entering into the production of equipment used in the field of EE or RE.

Recommendation:

Following the recently updated regulatory framework for renewable energies, the issue of local content requirement will have to be discussed in light of experience gained from other countries (India, South Africa, Canada, Brazil) and country specific features. A differentiated breakdown by technology taking into account the strengths identified in the solar and wind value chains and the feasibility to reach high local-content would be essential to reach full policy efficiency. For example, local initiatives directly supporting the PV industry downwards the value chain must be designed diligently considering the large competition within the sector.

B

TUNISIA
***Success factor**: Competitive local players in the global market*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Provide information on market size and opportunities of production adjustments	🟨	Medium	🟨	Low	🟨	Medium
Assess the feasibility of production line upgrades	🟩	-	🟥	Low	🟩	-
Foster business linkages in particular through JV with international companies	🟨	Medium	🟨	Medium	🟥	Medium
Support awareness-raising initiatives	🟨	High	🟥	Medium	🟨	High
Support the structuring of the sector	🟨	High	🟥	Medium	🟨	High

Focus on high priorities

Support awareness-raising initiatives

Market barrier:

The interviews conducted with Tunisian SMEs have demonstrated that efforts could be made to increase awareness and confidence concerning RE market potential and business opportunities, especially among non-specific component manufacturers (cables and electronics, power balance, mechanical parts, etc.). The lack of market transparency (project pipeline and pricing) combined with technical, regulatory and cost uncertainties entail skepticism among potential private stakeholders. However, the value chain analysis has highlighted the unfulfilled local content potential of large-scale solar and wind projects. For example, wind turbine electrical and mechanical parts likely to be produced locally with reasonable facility adjustments could account to more than 70% [66] of wind turbine costs.

Recommendation:

Firm-level awareness could be achieved through empowering regional and national RE agencies and associations. These institutions could act as information relay concerning market opportunities, R&D progress or manufacturing options. Key data for the production of components should be disclosed, such as critical output volumes, threshold quantities, quality standards, certification procedures or competitive advantages. Such initiatives would also help supporting the structuring of the supply chains (priority 4). Following the PROSOL-Elec program, the low voltage RE industries (solar PV and water heaters) have gained maturity. Awareness-raising activities could therefore build on this maturity with a focus on high-power plant special features, such as quality expectations, technology lifespan, maintenance or tendering issues.

Support the structuring of the sector

Recommendation:

Regrouping and structuring SMEs along the RE value chains may be essential to form competitive consortiums likely to face sharp global competition in international bids. The development of low-voltage domestic solar installations (SWH and PV) started in the early 2000s have reached maturity and enabled the settlement of well-structured industries supported by business associations (CSNER, ATEE, FEDELEC) and dedicated agencies (ANME). These institutions could be assisted in broadening their scope to reach other local companies likely to contribute to high-voltage solar projects. Supporting existing energy clusters (*Technopole Borj Cedria*, *Cluster Mecatronic Tunisie*) and facilitating their linkage with local SMEs are also interesting paths to address this priority.

C

TUNISIA
***Success factor**: Strong industry innovation potential and skilled workforce*

Key measures	***State assessment / Priority level***					
	Solar PV		**Solar CSP**		**Wind onshore**	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Support research and development	🟡	Medium	🔴	Low	🟡	Medium
Educate and train high-skilled workforce	🟢	-	🟢	-	🟢	-
Implement upgrading programs targeting specific industrial actors	🟡	High	🔴	Low	🟡	High
Identify niche technologies and set-up national centers of excellence	🟡	Medium	🔴	Medium	🟡	Medium

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[66] Based on IRENA, Wind Power Cost Analysis, 2012 and considering that Tower, Rotor blades, Gearbox, Main frame, Pitch system, Main shaft, Rotor hub, Nacelle housing, Brake system, Yaw system, Rotor bearings, Screws and Cables are or could be produced locally provided reasonable facility adjustments.

Focus on high priorities

Implement upgrading programs targeting specific industrial actors

Market barrier:

Well-qualified staff for R&D activities is considered widely available[67] in Tunisia, intellectual property rights are well protected and the quality of research institutes is acknowledged. Despite these assets, upgrading programs are necessary for local companies to move from low-value to relatively high-value activities.

Recommendation:

A study by the ICTSD [68] has demonstrated that it is easier to move up in the value chain where firms already have some knowledge in that particular technological domain (e.g. solar PV) as compared to moving to newer products for which no production facility exists (e.g. solar CSP). Targeting policy measures should therefore prioritize industries where knowledge upgrading can be achieved with limited efforts:

- *Solar PV*: module assembly, electronics and cables, steel support structure, installation and maintenance
- *Onshore Wind*: tower, main frame, electronics and cable, EPC

Capacity upgrading could include financial support, consulting services on strategy, marketing and training aspects or networking facilitation.

Identify niche technologies and set-up national centers of excellence

Market barrier:

International competition on high value-added components (PV modules, float glass, heat transfer fluid, salt, power generator, etc.) is likely to limit the capacity of local players to enter new markets and therefore to create local value on these parts of the value chains.

Recommendation:

Supporting **t**echnological specialization may enable local players to address niche markets. Region-dependent features such as climate conditions (sand exposure, ranges of temperature) or geographic location (isolated areas, export potential to Europe) offer promising areas of specialization. For example, interviews with PV module manufacturers have revealed that on-demand module customization (color, size, technical specifications) could drive future market growth.

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[67] Tunisia ranks 10th among 128 countries on « Availability of scientists and engineers" in the Global Competitiveness Report 2013-2014 (WEF, 2014)

[68] ICTSD, Unpacking the International Technology Transfer Debate: Fifty Years and Beyond, Paper No. 36, 2012

D TUNISIA
Success factor: *Investment capacity and strong financing infrastructures*

Key measures	***State assessment / Priority level***					
	Solar PV		***Solar CSP***		***Wind onshore***	
	Current state	*Priority*	*Current state*	*Priority*	*Current state*	*Priority*
Encourage local banks to implement low interest loans and grants	🟡	High	🟡	Low	🟡	High
Implement investment support mechanisms for adaptation or creation of production lines	🔴	High	🔴	Low	🔴	High
Implement price, tax and other incentives	🟡	Medium	🟡	Low	🟡	Medium

Focus on high priorities

Encourage local banks to implement low interest loans and grants

Market barrier:

Several credit lines encouraging the development of energy efficiency and renewable energy have been implemented in the past (AfD, World Bank) and involved local banks (Attijari Bank, Amen Bank, Banque de l'Habitat, BFPME, BTK). Under the PROSOL program, the residential solar sector has seen rapid growth thanks to tax incentives, investment subsidies and bank credits via STEG. Though the AfD credit line was renewed in December 2014 and extended to 100M€[69], no similar mechanism was initiated for medium and high voltage sectors, limiting the financing capacity of local SMEs involved in the RE industry.

Recommendation:

Beyond credit line renewal, the involvement of local commercial banks needs to be widened and strengthened. Potential future credit lines will have to take into account the special features of the banking sector in Tunisia. Attention will have to be drawn on local bank expectations and concerns in order to ensure acceptability. The interviews conducted in Tunisia have revealed that local banks had limited knowledge of the commercial viability of renewable energy projects and sustainable business opportunities. Building their knowledge financing capacity will be critical to help SMEs extend their production facility and meet the volume and quality standards. This could be achieved through trainings, workshops and consulting dedicated to marketing and awareness-raising activities, establishment of lists of eligible equipment and suppliers, follow-up of sub-borrowers, etc.

Implement investment support mechanisms for adaptation or creation of production lines

Market barrier:

The *Fund for Energy Transition* (formerly *National Fund for Energy Management* or FNME) aims at promoting energy efficiency and renewable energy in Tunisia. This mechanism has been successful to help developing low-voltage solar installation through direct subsidies and bank credit loans under the PROSOL and PROSOL-Elec programs. Most interviewed SMEs have confirmed their technical ability to rapidly increase their production capacity provided that access to finance is facilitated. However, the lack of market transparency and economic austerity restrain their investment capacity. Indeed, commercial banks have started to reduce their leverage and long-term assets[70], which has a direct negative impact on the financing of new RE projects, 70 to 80% of which involve medium- or long-term borrowing on average 15 to 20 years [71]. Besides, the usual processing times to handle applications through ANME vary from 6 to 18 months, which is often seen as a strong barrier for SMEs which cannot afford such long timeframes.

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[69] The AfD credit line will be dedicated to ANME, ANPE et local commercial banks

[70] in accordance with targets set by the Basel III Agreement which came into force in 2013

[71] GIZ, Analysis of the regulatory framework governing network access for producers of electricity from renewable energy sources in Tunisia, 2014

Recommendation:

Financial support of at least part of the necessary investments needed to upgrade production facilities is fundamental to foster local manufacturing. Such support could consist of innovation financing tools, such as long-term low-interest loans for companies willing to invest in new production lines (e.g. Green Investment Bank in UK, Kreditanstalt für Wiederaufbau in Germany). Facilitation of local and foreign investments by simplification of bureaucracy and reduction of application processing timeframes is also critical.

In summary – key actions

On the basis of our recommendations detailed above, this box presents a summary of key actions that could rapidly be initiated or implemented at national level – with the support of public authorities and other sector local stakeholders - to promote the development of industrial capacities in Tunisia:

- Define more specifically local content expectations taking into account the strengths identified in the solar and wind value chains
- Increase awareness concerning RE market potential and business opportunities, especially among non-specific component manufacturers (cables and electronics, power balance, mechanical parts, etc.)
- Set up raising awareness campaigns and trainings destined to local banks to allow them to get a better knowledge of the commercial viability of RE projects and facilitate access to finance for SMEs and help them extend their production facility and meet the volume and quality standards

Summary of recommendations addressed

This section summarizes the main areas for action which are common to all three countries covered by the study. By analyzing the country-specific recommendations through the lens of the four success factors identified in Section 2 of this report (1- political support; 2-competitiveness of the local industry; 3- innovation potential and skills development; 4- investment capacity), this section highlights a number of areas where joint efforts at the regional level could have a strong leverage effect and ensure the consistency of local initiatives to develop a significant renewable energy industry.

A - Substantial political support aiming at creating a sustainable market size

Formulate a long term RE strategy with national targets

To invest in new manufacturing processes, investors need to have a clear vision on the medium to long-term size of RE markets. Building RE targets is the very first step, but public authorities need to define precisely the contribution of each technology (PV, CSP, Wind), and the limits (total installed capacity) for each technology.

Industrial actors need to have a clear vision for the next decade but also by 2030 and beyond. At the same time, measures in terms of financial support and investment incentives need to be part of a long-term strategy. Since the solar and wind infrastructure market is mainly driven by the existence of public support policies, the existence of a clear vision and strategy with detailed targets is a crucial prerequisite to establish a stable investment environment.

Define an extensive RE regulatory framework

A clear vision on the national strategy is not sufficient for the development of a local RE market. The regulatory, technical and economical frameworks need to be further detailed; especially concerning key points such as administrative processes, grid connection permits or use of financial incentives (tax abatements, preferred loan rates, etc.).

For instance, conditions to access the grid at different tension levels must be made explicit to facilitate the development of small scale solar PV plants or rooftop installations and enhance the development of SMEs (installers, designers, etc.) in this sector.

Regulatory frameworks must be designed with extreme care to ensure they respond to the expectations of both project developers and financers, without generating unsuitable situations (e.g. excessive financial incentives burdening public finance) that generally result in revisions of these frameworks. Stability and long term visibility of RE regulatory frameworks constitute key elements to ensure the development of a local market and stimulate the takeover of local industrial capacities in the sector.

Several small-scale solar PV applications such as solar-pumping, water heating systems or roof-top PV panels could represent viable niche markets for industrial actors, on the same level as large-scale projects, with great opportunities on the export market.

Morocco provides a good example of the importance of the regulatory framework, as several actors have highlighted the need for opening the low voltage market (for example through amendment of Law 13-09). Such a measure would help SMEs to play a more significant part in the takeover of the RE local market – seizing the economic potential of solar PV connected to the low voltage distribution network.

Define a national plan for RE equipment manufacturing

Countries can implement specific plans to promote the start-up or the development of local suppliers of RE equipment and enhance domestic labour force by implementing a series of measures.

For instance, local content can be set as key criteria in the evaluation and selection process of project tendering bids; or subsidies can be awarded to energy developers with a high level of domestic workforce, as under the Saudi legislation[72]. Such measure - which implementation requires the involvement of public actors (Ministry of industry in the first place) – has been thoroughly analyzed and corresponding socio-economic benefits have been detailed in the literature[73].

It should be kept in mind that specific local content requirements constitute additional constraints for project developers and increased risks for financers. **According to interviews performed during the study**, IFIs can be reluctant to support projects

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[72] KA CARE White Paper, February 2013

[73] IRENA - CEM, The Socio-economic Benefits of Solar and Wind Energy, 2014

when they consider these constraints excessive, and project developers can face difficulties to propose competitive solutions if these local content expectations are set too high.

Reform fossil fuel subsidies

The selling price of fossil fuels in the MPCs remains a major obstacle to the development of RE technologies and consequently restrains the setting up of a viable long-term local market. To reduce energy insecurity and provide social support, fossil fuel is highly subsidized in several countries of the Mediterranean area. This situation significantly undermines competitiveness of renewable energies in comparison with fossil fuels.

The falling price of oil observed since the end of 2014 should be seen as an opportunity for national public authorities in these countries to reform these subsidies – or at least to strengthen control of allocation of these subsidies - without generating drastic impacts on the selling price of oil products.

This fall provides an optimum timing for action as it prevents the risk of social unrest that generally arises from such subsidies cuts[74].

B - Competitive local players in the global market

Conduct awareness-raising initiatives

The interviews conducted in the MPCs have revealed a low level of awareness and information concerning RE technology and market potential among industries. Potentially active companies show skepticism about the future development of RE projects due to technical, regulatory and cost uncertainties, especially on less mature technologies such as solar CSP.

This company-level awareness could be achieved through empowering regional and national RE associations or chambers of commerce. These institutions could act as information relay concerning market development, manufacturing options and technology progress, and thus help scaling up awareness among private actors who may find economic interest in developing activities in the RE sector (manufacturing components or proposing services).

Key information for SMEs should be made easily available. Such information includes the potential of RE industries, critical output volumes and threshold quantities, competitive advantages and key requirements for the production of components (e.g. capital investments, infrastructure, required skills, etc.). Interaction with international associations and regional co-operation between MPC countries should be encouraged.

For example, detailed case studies can be elaborated focusing to identify precisely the local and regional market potential of most promising RE components for a given country. Providing such case studies to industries who could be interested in manufacturing this component can facilitate investments.

Assess the feasibility of production line upgrades

Industrial companies with good understanding of the RE market and associated development perspectives for their activities can need technical and organizational assistance to seize the opportunity to upgrade their production processes to manufacture RE components and be able to tackle these new markets.

This assistance can be provided by public authorities or external technical experts through assistance in the elaboration of business plan and go-to-market strategy.

Foster business linkages in particular through JV with international companies

With the development of a local and regional RE market, international companies might be interested in implementing manufacturing or assembling facilities in the MPCs. Creating joint-ventures is an opportunity to attract global leaders and develop local skills and facilitate technology transfer. The organization of networking events or platforms and business fairs are examples of general action to facilitate the creation of industrial partnerships.

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[74] Several studies have been conducted aiming at evaluating the impact of reforming energy subsidies (for instance: UNEP, Reforming Energy subsidies - Opportunities to Contribute to the Climate Change Agenda, 2008)

Support the structuring of the sector

In spite of existing national focal points to foster the introduction of RE technologies in the MPC (NREA, ADEREE, ANME), the structuring of actors manufacturing key components or providing services at diverse steps of the value chains of the studied technologies need to be reinforced to foster coordination of these actors and encourage cooperation or experience sharing.

Already active agencies and associations have focused on small-scale applications (e.g. rooftop PV or solar water heaters) and could be assisted in broadening their scope to reach other local companies likely to contribute to larger scale projects.

Regrouping and structuring SMEs along the RE value chains may be essential to form competitive consortiums that are able to face sharp international competition. Interviews also revealed that the lack of quality standards and industrial certification could be a barrier preventing local SMEs to meet the required specifications in large-scale international RE projects and therefore hinder high local content integration.

C - Strong industry innovation potential and skilled workforce

Support research and development

To enable local companies to enter high value-added markets requiring strong technical skills (e.g. solar cells, receivers, glass, power trains, etc.), a strong focus on early R&D activities related to RE technologies is necessary. Research activities paving the way to intellectual property in this field are critical to ensure competitiveness and sustainability of local industries over the long term.

Strong co-operation with international companies and experienced research facilities will be required. Research facilities, such as universities and technology clusters, must be either created or strengthened in order to help local players face fierce competition with international market leaders (e.g. Chinese solar cell manufacturers, Spanish and German EPC and wind turbine manufacturers, etc.).

Educate and train high-skilled workforce

Investments in the education and training of engineers and other high-skilled workforce will be critical to build local company capacity in RE technologies. Agencies and associations already active in such initiatives (RCREE, ADEREE, ANME, etc.) have been driving the development and dissemination of energy policies, research activities and training on low and medium power RE applications (rooftop PV, solar water heaters, water pumping, etc.). Similar efforts will be required to offer to interested parties insights into the technical requirements and complexity of larger-scale projects. The role played by European associations (Protermosolar in Spain, RENAC in Germany) and MPC agencies (OEP/ECEP in Egypt on energy efficiency) provides relevant examples on efficient development of local RE industries.

Targeted policies enabling education and training, inclusion of RE in educational programs and strategic planning to meet the required skills needs will also be necessary. Other countries (such as Malaysia) have successfully implemented this type of policies, including RE into technical and tertiary program and developing institutes and centers of excellence. Empowering students with practical experience and extending apprenticeship – which combines theoretical knowledge and practical application during internships in companies - is also a key solution to address the needs of emerging industries.

Implement upgrading programs targeting specific industrial actors

Industrial upgrading programs can become strong assets to strengthen local-firm capabilities. These programs aim at enhancing the technological capabilities of SMEs by enabling them to capture value from RE investments and facilitate closer linkages with business partners. Such programs also help foster the business relationships between SMEs and suppliers, which is key to ensure and retain the sourcing of components and services locally.

Experience in Morocco has shown that customized interventions either from national governments or international donors regarding access to financing, training, quality control or management issues were critical to address the actual needs of SMEs.

Identify niche application and set up national centers of excellence

Technological specialization may offer promising opportunities for regional and local players. This specialization may build on regional assets (electronics, mechanics, construction, etc.) and special features (climate conditions, geographic location, export potential) to develop extensive skills in manufacturing selected components of the value chains.

The development of centers of excellence would go beyond the general support of R&D activities as it would embody the willingness of national public authorities and national business associations to position themselves on the manufacturing of chosen, innovative, high added value components of solar and wind technology supply chains.

The choice of niche applications - either based on specific technologies or market usages, and mostly chosen depending on domestic and regional market potential - would be a prerequisite to the development of such centers, increasing chances of successfully return on investment.

D - Investment capacity and strong financing tools

Encourage financial institutions to implement low interest loans and grants

Financial services provided are also crucial to develop both domestic wind or solar electricity production capacities and RE components manufacturing facilities. Interviews have revealed that financial actors – especially local commercial banks - have limited knowledge of the viability of renewable energy projects and of the potential for investment in industrial assets to manufacture RE components locally.

Building their financing capacity is necessary to help SMEs extend their production assets and meet the volume and quality standards required in high-voltage RE projects, especially when the ambition is to export part of these components on regional and international markets.

Capacity building mechanisms will depend on country-specific conditions. For instance; the initiatives led by the ANME through the PROSOL-Elec in Tunisia are an interesting example of incentive measures, including the granting of an investment premium through a national fund or the possibility to subscribe to bank loans with favorable terms on the credit line for energy management.

Implement investment support mechanisms

In order to attract investors to the sector, investment support mechanisms are essential to overcome existing financing barriers and increase the financial feasibility of renewable energy projects. These mechanisms may include regulatory and incentive measures likely to direct investment towards renewable energy (for the development of both projects and industrial manufacturing assets).

Targeted interventions could help maximize the leverage of additional investments by unlocking existing barriers. This could be achieved through lending risk mitigation, loan softening programs, project debt financing or grants for project development costs.

Implement price, tax and other incentives

Economic incentives targeting investors and potential local manufacturers can take various forms including feed-in tariffs, generation-based incentives; renewable portfolio obligations; capital subsidies; accelerated depreciation, tax incentives, tax relief, subsidies and advisory services, credit guarantees, soft credit or exemption from duties.

The development of free trade zones is an interesting option to alleviate the burden of taxes on manufacturing activities and attract both local and foreign investments to develop industrial assets. This scheme presents the advantage to encourage the installation of diverse activities on the same geographic area, which also responds to the necessity to favor cooperation and cross-fertilization between actors positioned at diverse steps of the value chain.

For instance, the Tangier Free Zone (TFZ) inaugurated in 1999 and operational in 2000 provides a good feedback on the benefits and costs resulting from the development of a free trade zone. In the 10 years following its inception, the industrial users of the free zone have invested some €500 million in their facilities, contributing to the creation of about 40,000 jobs[75].

Enhancing regional collaboration for industrial development

Given the market dynamics observed in the RE sector in the MPCs, it remains indispensable to ensure measures and actions implemented in these countries are consistent at regional level. For instance, all international private actors interviewed within the frame of this study emphasized on the fact that the development of RE manufacturing components facilities in the MENA area must be coordinated at regional level.

The analysis of local manufacturing capacity in Egypt, Morocco and Tunisia shows that although each country has set ambitious renewable energy targets and plans, individual local markets might still not be large enough to be attractive for local and international private companies to develop industrial capacities. Besides, all raw materials and manufacturing capabilities needed for wind and solar energy components may not be available in all MPCs. Cooperation and access to a larger regional renewable energy market and manufacturing capacities is a key to attracting investments to the entire region. This is the approach used in the Africa Clean Energy Corridor initiative (which includes Egypt).[76]

This section of the report focuses on the need for coordination at regional level to accelerate development of local manufacturing potential of wind and solar technologies through increased regional cooperation and collaboration.

Coordinate national renewable energy plans and policies

Stable political environments, energy subsidy reforms, deregulating the energy sector and consistent long-term renewable energy plans and implementation are all key to attracting investors and establishing a local RE manufacturing capacities in individual countries. This could be further complimented by coordinating national renewable energy plans and policies with neighboring countries as many of the areas with greatest wind and solar potential are situated close to borders.

The lessons learnt from international experience show that in order for countries to benefit from investments in renewable energy infrastructure, renewable energy policy measures should be integrated within an industrial development strategy and implemented in a systemic manner. National governments should therefore assess their local manufacturing capabilities in relation to regional manufacturing capabilities, and then precisely define which renewable energy manufacturing sectors would be most competitive and should be the focus of support.

The inclusion of RE components within the scope of bilateral and multilateral treaties and agreements in the MENA area would also contribute to better coordinating national policies at regional level and enhance the emergence of regional leaders for relevant subsectors.

When reforming national energy subsidy schemes, in particular fossil fuel subsidies, governments should ensure that these are not undermined by policies in neighboring countries. A common regional approach to fossil fuel subsidy reform is important for explaining its rationale as well as successful implementation.

Finally, policy makers in the MPCs could benefit from learning about the effectiveness of existing renewable energy policies and programs, and identify good practices for supporting the local manufacturing potential.

Optimize development of renewable energy resources and manufacturing capacities

As mentioned, many of the areas with greatest wind and solar potential in the MPCs are situated close to borders and each country has different strengths in manufacturing of renewable energy technology. Physical proximity and experience in operating in

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[75] Source: OECD

[76] IRENA (2013) Working Together to Build an East and Southern African Clean Energy Corridor. International Renewable Energy Agency.

similar cultural and socio-economic contexts are advantages when developing renewable energy technologies. Instead of all MPCs attempting to develop their own resources and manufacturing capacities, a coordinated approach driven by all national governments could be more cost-efficient. The objective of such approach would be to ensure that priority subsectors are well identified by each country in the area, and that these countries agree on a common roadmap in line with their respective assets and avoiding overlaps. This would also be more attractive for foreign investors and international companies. While it is important to have an integrated approach to developing renewable energy technologies and increasing the technology content of localized manufacturing and associated services, a regional perspective should be considered and not just a national perspective.

Cross-border trade and R&D collaboration

If properly managed, opening up national electricity generation sectors to neighboring power producers would introduce stronger competition and be more effective in developing renewable energy across the region. Allowing more cross-border trade across the region would foster business linkages and encourage not just regional, but also international, technology transfer. Access to bigger markets would allow local and international companies to reach the critical production size to ensure economic viability required to develop local production assets.

This study has identified the potential for more collaboration between private companies and local research centers and universities. By pooling R&D investments, regional research projects involving companies and academia may be a more effective approach to enhancing regional innovation capabilities than purely nationally sponsored projects.

Establish a regional financial framework and financing facility

Government, developers, and industry need to work together to create a financial and regulatory environment that supports investment in renewable energy facilities, manufacturing and R&D. A regional financial framework and financing facility could reduce the cost of capital for financing renewable power projects as well as the development of new local manufacturing assets. This should be based on an evaluation of the financial structures and credit guarantee mechanisms for renewable energy projects in MPCs to determine which are most efficient in delivering capital at reasonable cost. Again a broad regional approach would make it more attractive for cleantech investors compared to narrow investments in individual MPCs.

As an example, mention can be made of various initiatives - such as IRED (Initiative Régionale pour l'Energie Durable - being conducted in West Africa by the West African Economic and Monetary Union (WAEMU) to promote the development of RE projects in the area. This organization pooled financial resources of its 8 Member States to launch various facilities with the support of the West African Development Bank to facilitate access to capital investment for RE project developers.

5. Appendices

Appendix A: Annex to the country reports

Egypt

Economic overview

Besides South Africa, Egypt is the most industrialized country in Africa. The most important sources of income are the export of fossil fuels (oil, natural gas), tourism and the fees from the Suez Canal. One Egyptian out of three works in the agricultural sector. Due to the need for irrigation, population density is high in the Nile Valley and the Nile Delta. With a total population of about 80 million people, the GDP per capita is USD 3,160 (2013), with a stable growth of 2-3 % in the last years. The national deficit is about 82% of the GDP. One reason for such a deficit is that Egypt spends more than 10% of GDP on subsidies mostly destined to the energy market and access to food. Cutting these subsidies will be difficult as 40% of the population lives below the poverty line and youth unemployment is at about 34%. The key statistics for Egypt based on the World Bank database are summarized below.

Population	***GDP***	***GDP per capita***	***GDP growth***	***GDP by sector***	***Trade balance*** *(% of GDP)*	***SMEs contribution to GDP*** *(%)*[77]	***Unemployment rate*** *(%, Jul. 2014)*[78]
82.06 millions	$ 272 billion	$ 3,160	2.4%	Services: 48% Manufacturing and non-manufacturing industries: 37.5% Agriculture: 14.5%	-1.9%	25%	12.3%

Table 14: Key statistics in Egypt (World Bank/IFC, 2012)

The EU is the most important trading partner of Egypt, accounting for about 30% of imports (mostly agricultural products) and 40% of exports (mostly fuels). The trade balance was highly negative in the last years. Key industrial sectors are the petrochemical sector, the automotive sector, the textile industry and the construction industry. Because of its economic situation described above, Egypt needs for domestic and foreign investments. However, the investment ratio recently dropped from 22.4 % in 2007/2008 to 16.7 % in 2012/2013 due to the unstable political conditions the country has faced since the Arab spring of 2011. Egypt's attractiveness for foreign investments lies in its diverse economy, the largest labor pool in the region and its competitive labor costs.

Energy outlook

Energy profile

In northern Africa, Egypt is the country with the highest energy consumption. Energy consumption grew by 6.5 % per year in average over the past 40 years. This growth is expected to continue around 4% per year till 2030. The projected demand of electricity is expected to rise faster than the demand of other energies, resulting in a need of an increase of electricity production capacity of at least 2,000 MW annually. Egypt struggles to cope with this growing demand, resulting in increasingly more blackouts during summer. The main reasons for this growing demand are the economic and demographic growth combined with rising living standard. Households represent the greatest share of electricity consumption (43% of national consumption), followed by industry (32 %). Electrical losses within the transmission and distribution network accounts for nearly 14%. In 2011 (latest figures available before the Arab spring), installed electricity production capacity was 29,074 MW, whereof 2.4% were from new renewable energy sources like wind or solar and 9.6% from hydroelectric power[79]. Energy consumption based on fossil fuels had a share of 94.4% of the total energy mix (2012), whereas hydro power and other renewable energy sources accounted for 5.6%. In rural areas diesel generators are the main electricity source, due to high subsidies for diesel.

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[77] IFC, Overcoming Constraints to SME Development in MENA Countries and Enhancing Access to Finance, 2012

[78] Trading Economics Online (www.tradingeconomics.com)

79 German-Arab Chamber of Industry and Commerce, Wind energy and grid integration, 2014

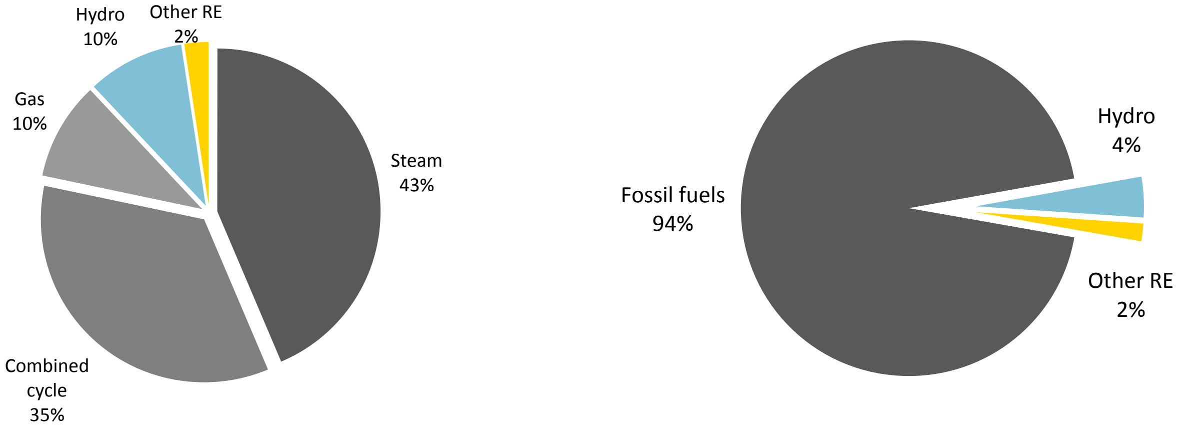

Figure 8: Installed electric capacity (left) and production (right) in Egypt in 2012 (AHK Arab, 2014)

In 2014 blackout events increased rapidly in Egypt due to the increased demand which reached a record load in August of 27,700 MW which is very close to the installed capacity of 29,074 MW and approx. 20% more than power stations could provide (100% of the installed capacity is not normally available. Therefore it is an essential need to increase the installed electrical capacity in Egypt to cover the future demand and country growth. The government recently announced an expansion of electricity generation capacity to 30 GW by 2020. However due to the ongoing political and social unrest, the governmental plans to expand power generation capacity have slowed down.[80]

Besides the investment in new capacity, Egypt is also aiming to increase energy efficiency. With an energy intensity of 201 toe/M$$_{GDP}$ Egypt has a significant potential for increasing energy efficiency (Germany: 164 toe/M$$_{GDP}$).

The electricity network of Egypt has interconnections to Jordan (550 MW), the Palestinian Territories (150-200 MW) and Syria. An additional connection to Saudi Arabia is under construction, the official agreement was signed in June 2013[81]. In April 2010, an interconnection test between Tunisia-Libya was performed, to evaluate the possibility to connect the LEJS (Libya, Egypt, Jordan and Syria) to the European ENTSO-E electricity network. The connection between countries was possible but lapsed before the official end of the test period due to several difficulties encountered. Successful completion of this test would have been the precondition for further tests of the LEJS synchronous area in island mode and in trial parallel interconnection with the continental European synchronous area. Further tests of the Tunisia-Libya connection are, as a consequence and for the time being, suspended.

The Egyptian Electricity Holding Company (EEHC) is the main actor in the Egyptian energy market. The EEHC consists of seven holding companies, each with their own electricity production units and networks. Each holding company sells its electricity to the Egyptian Electricity Transmission Company (EETC). Up to now only the EETC distributes the electricity over the grid.

Presentation of the national RE context

The public framework related to renewable energies includes also the Ministry of Electricity and Energy (MoEE), responsible for the electricity network and the power generation units. There are several agencies of the MoEE, responsible for the different energy generation technologies. The New and Renewable Energy Agency (NREA), established in 1986, is responsible for the development of renewable energies in Egypt.

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[80] U.S. EIA, Country analysis brief: Egypt, 14. August 2014

[81] Shuja Al-Baqmi, Saudi Arabia and Egypt sign historic electricity exchange agreement, Asharq Al-Awsat, 4. June 2013

The projected goal of Egypt's government is to achieve a share of20% renewable energy by 2020, whereof wind energy will be 12% and hydro and solar energy will be 8% together. As the actual share of renewable electricity production is approximately 10% based on installed capacity, i.e. at approximately 30 GW, the present renewable electricity production share is about 3 GW. Assuming the increase of the total capacity up to 60 GW and a share of 20% until 2020 this means that an additional installation of new renewable electricity production of approximately 9 GW is needed until 2020 (this scenario considers the actual installed hydro capacity). The announcement of the Egyptian government to install by 2020, 7.2 GW in wind and approximately 2.3 GW in solar power, the goal of 20% by 2020 is feasible. With the actual announced capacities under the framework of the new feed-in-tariff system with a solar capacity of 2.3 GW and a capacity in wind of 2.0 GW, a major step forward has been made by the government to promote renewable energies.

One significant condition to point out especially in Egypt (similar to Morocco, but different to Tunisia because the day peak load is during the day) is that electricity peak load over the day is in the evening and night in the period between approximately 7 p.m. and midnight. In this period PV cannot contribute to the required capacity and wind only with a certain portion but also not on a reliable demand basis. An estimation of the future behavior is given in Figure 9. This analysis[82] was performed in 2005, the maximum load from 2014 already overcomes the estimated 2020 behavior.

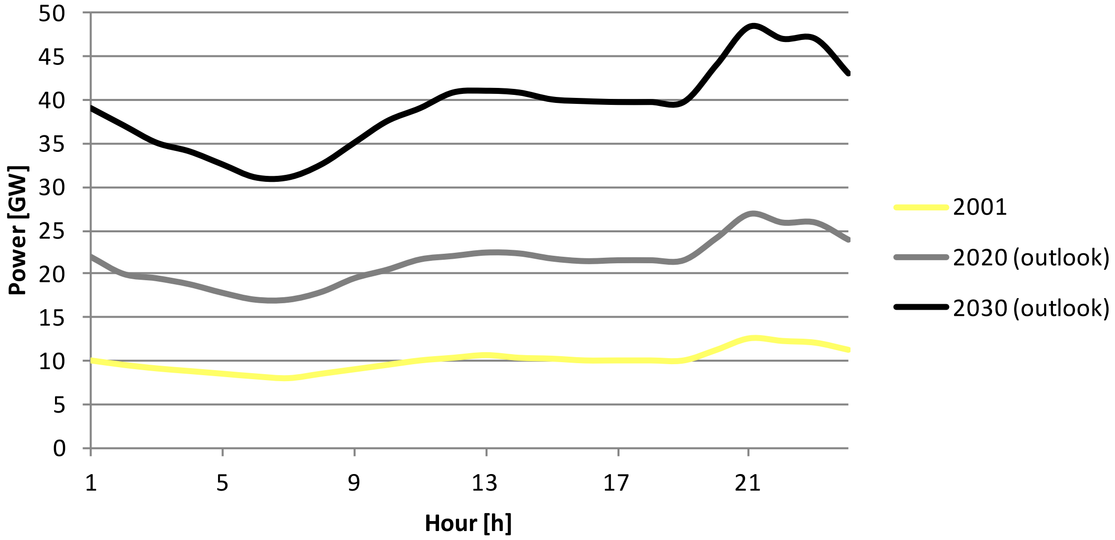

Figure 9: Typical daily electricity load in Egypt and future generation scenarios for Egypt (Trieb, 2005)

CSP with thermal storage is the only system that is able to contribute to peak load power generation reliably and can dispatch electricity at night.. As the actual feed-in-tariff system does not distinguish between the electricity generation during day or night/peak load time in the evening, CSP has to compete against PV and wind without getting any premium for the storage. It is expected that under such a framework CSP will play only a minor role in solar electricity generation in Egypt, if CSP is not supported by low cost financing structures or by significant reduced capital expenditure that apply local manufacturing and local resources.

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[82] Trieb, F et al, Concentrating Solar Power for the Mediterranean Region, DLR and BMU, 2005, Germany

RE potential in Egypt

As mentioned above, renewable energy accounted for only 5.6% of the energy mix in 2012. The projected goal is to achieve a share of 20% renewable energy within the next 6 years until 2020. As the potential of hydro energy is almost exhausted - all promising sites are already in use - wind and solar energy will be promoted. The potential for both technologies is presented in the figures below detailing wind potential and the annual sum of the solar irradiation.

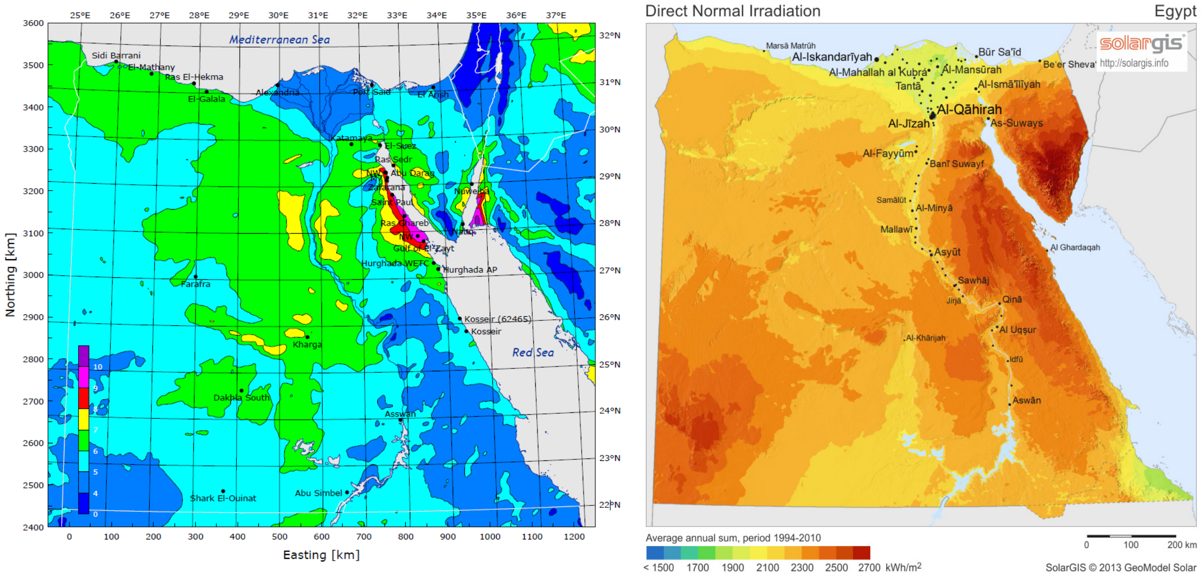


Figure 10: Renewable energy resources in Egypt: Wind speed (left, TUD), DNI (right, SolarGis)

The potential for wind energy in Egypt is very high thanks to high and steady wind velocities in the Suez and Gulf region with a high amount of available land. The western part of the Suez region, with wind velocities up to 10 m/s, has other advantages such as the vicinity of load and transmission centers. On the longer run, the Gulf of Suez and the Gulf of Aqaba are the most promising sites for offshore wind projects. The existence of non-operated oil platforms in the Gulf of Suez could help to cut costs for erecting offshore wind farms.

The potential for solar energy in Egypt is high as well. It has been estimated to be a potential of 74 billon MWh/a. The direct normal irradiation (DNI) varies between high values of 2,000 and 2,600 kWh/m², with a sunshine duration of about 2,400 h/a. The mostly flat areas of Egypt are ideal for solar power plants, both PV and CSP. In the MENA region, Egypt is the country with the best meteorological and geographical conditions for solar energy. Besides solar plants for electricity generation, solar thermal desalination of sea water will play an important role due to increasing shortage of water in the MENA region in the future.

Current exiting transmission and distribution network was based on the use of centralized, conventional power stations. Between the areas of high population density along the Nile the main high voltage power transmissions are located. The rural area and some tourist areas at the seaside cover their demands mainly with fuel powered isolated operators.

As shown in Figure 10, the high potential areas, especially for wind energy are located at the seaside. To transport the produced electrical energy to the load centers along the Nile, additional grid extensions are necessary. In addition, isolated solutions for the integration of renewable energies into large tourist centers are necessary.

For a successful and sustainable development of renewable energies in Egypt, the national transmission network and regional distribution system must be extended in parallel to the increase of new installed renewable energy capacities.

Focus on the national RE policy framework

Assessing the perspectives for local RE manufacturing requires to identify the current state of the country regarding four key success factors: investment capacity and financing infrastructures (i), competitiveness of local players (ii), industry innovation capacity (iii) and stable policy support (iv).

This chapter aims at focusing on the policy support (iv) framework which provides key information to assess the likeliness of RE project development. This assessment is based on three reviews:

- National RE support policies
- National plans for RE equipment manufacturing
- Previous and ongoing projects in the country

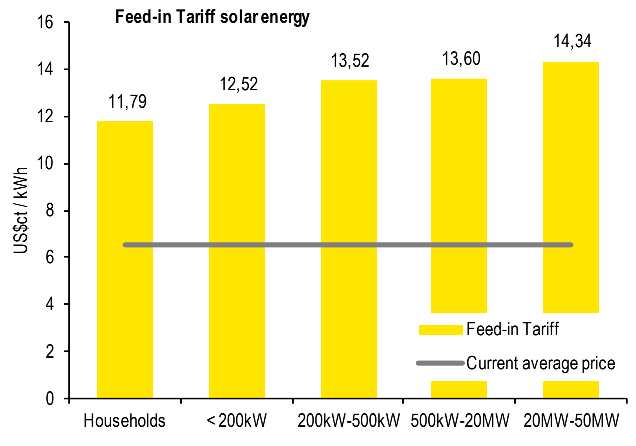
Review of RE support policies

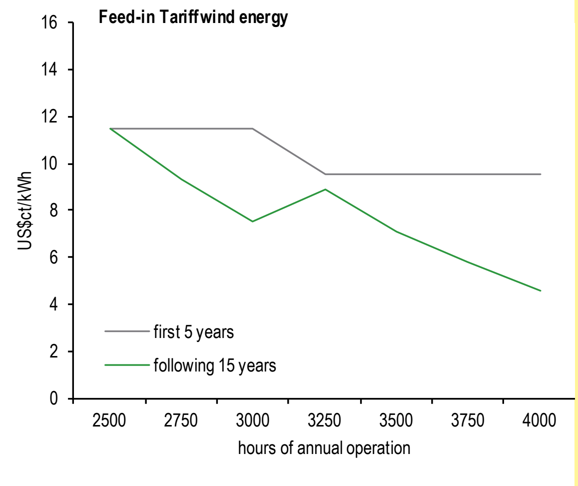
RE support policy situation		
Regulatory policies and targets	**RE targets**	**YES,** to increase the overall share of renewable energies in the energy mix, targets for new installed capacities are defined: • 14% of primary energy from renewables by 2020 • 20% of electricity generation from renewables by 2020: 12% from wind (equivalent to more than 7,200 MW installed), 6% from hydro and 2% from other renewables The MoE&RE has announced an interim target for the first regulatory period (2015-2017) is to contract 4300 MW of both solar and wind energy, its breakdown is as follows: • 300 MW for small solar systems • 2000 MW of Medium and large size of solar plants • 2000 MW of Medium and large size of Wind plants
	Legal Framework	The New Electricity Law, which is currently in the process of ratification by the People's Assembly aims to: • Establish a liberalized electricity market with various market participants, regulated by EEUCPRA, • Improve the conditions for renewable energy, cogeneration and demand side management in the electricity sector, • Provide some rules for electricity consumption and includes measures to encourage renewable energy electricity production. In particular, a feed-in-tariff addressed to small and medium size projects up to 50 MW will be implemented. With regard to renewable energy electricity generation, the law foresees that the private sector builds, owns and operates the projects and sells the electricity to the transmission company (EETC) under long term Power Purchase Agreements (PPA). Non-renewable energy based Independent Power Producers (IPPs) conclude bilateral purchase agreements with consumers.
	Feed-in tariffs	The overall framework for the new Feed-in tariff was published in late September 2014 to enable private investors to participate in the development of renewable energies. The Feed-in tariff takes two different technologies into account: Solar and wind energy. There is no difference between CSP and PV. The details of the tariff are outlined below. The main points of the tariff are: • Duration: The feed-in tariff accounts for 20 years (wind) and 25 years (solar) • The project size is limited to 50 MW, although the government can increase this limit • The Feed-in tariff could be reviewed after 2 years or 2000 MW of new installed capacity, whichever comes first Most interviewees from the private sector considered the new tariff as a good driver. The capacity limit of 50 MW is nevertheless seen as a barrier to develop cost competitive large-scale projects especially for CSP and wind technology.

	Subsidies, loans or grants	In parallel to the Feed-in tariff, a financing scheme for small projects has been announced: • For installations below 200 kW (small industrial applications and household), 4% soft loans are granted • For installations between 200 kW and 500 kW (industrial applications), 8% soft loans are granted. The loans will be provided by two different banks (National Bank of Egypt and Banque Misr), the program is organized by the Egyptian Businessmen's Association (EBA). To secure the further development of the distribution grid, the government secured an EGP (Egyptian pounds) 2 billion loan. Large scale projects need foreign finance, due to the high local loan rate of 10% or more. The risk of foreign exchange rates for local investors is very high, therefore it is necessary that loans from foreign banks are available in the local currency. The IFC has already identified this barrier and will create adapted products.
Public financing	**Tendering / Auctions**	Public tenders are based on strict procurement guidelines with most decision value on the EPC-price. The Ministry of Finance announced a tender of 8 GW renewable energies capacity by 2020. The NREA is acting as promoters. The projects are promoted using auctions or projects within a BOO (build/own/operate) option. Qualification rules for public tenders are challenging. New players or companies with only a few references will not get qualified due to often over-loaded qualification criteria, resulting in a main barrier for local players to enter the market.
Fiscal incentive	**Tax reduction**	The Ministry of Industry grants an incentive of 1% reimbursement of export volume if the exported products include renewable energies. Within the new Feed-in tariff scheme, a reduction in customs on components imported for renewable energies on 2% is included.

Focus on the Feed-in Tariff structure

The feed-in tariff for solar applications (PV and CSP) has been divided into 5 different categories, each defined by the project size. Small projects (< 500 kW of installed capacities) have a fixed feed-in tariff defined in the local currency (Egyptian pound). Due to the fact, that most of the large scale projects (between 0.5 and 50 MW) will be financed with the support of foreign investors or banks, the feed-in tariff was defined in US$. Nevertheless, produced electricity will be paid in EGP. The exchange rate will be defined with the "time of payment". The feed-in tariff is shown in the left part of the following figure, expressed in US$ to allow an easier comparison of the different figures. The tariff is guaranteed for 25 years. The price for each project category is above the current average price the government pays to produce energy. According to the Ministry of Electricity, the prices announced are appropriate to encourage private sector actors to invest in renewable energy as "prices are attractive for investors".





For wind energy, the feed-in tariff has been correlated to the number of hours in operation. The guaranteed period of 20 years has been divided into two different tariff periods, one for the first 5 years and the second for the following 15 years. Similar to the solar tariff for large projects, the feed-in tariff is defined in US$, the numbers are shown in the right part of the figure above. To adapt to the current costs of technology, the feed-in tariff will be reviewed after a defined period. Based on the feedback from other countries (e.g. Germany) this period will be 2 years unless the amount of new installed capacity reaches defined targets first (2000 MW for large solar projects and wind energy, and 300 MW for small PV projects). With this approach, an adaptive market system is being introduced, which allows to adapt the feed-in tariff to the real market developments.

The private investors ready to develop or invest in their own renewable energy projects recognized the new regulatory framework as a good driver for the development of renewable energies. Nevertheless there are still several details to clarify like guarantees, grants for land use, the necessary licenses, etc. As the component manufacturers don't rely on the feed-in tariff but just on the development of the market, their view on the new feed-in tariff is restrained. As the regulatory framework is challenging, component manufacturers will start to invest into new production capacities if a clearly visible and stable market is established. First stage projects using the feed-in tariff will not represent a realistic local share.

Review of the plans for RE equipment manufacturing

Egypt supports the development of the national industry with several programs. For pure Egyptian financed projects, local manufactures are granted a cost advantage. Besides the regional agencies, also local agencies like NREA are focusing on education and training for local experts.

RE equipment manufacturing planning situation	
LCR	**Not yet agreed on final local content requirements.** • Existing law for pure Egyptian public financed projects: Egyptian producers could be offered 15% higher prices at the same quality level. For funding on EU-level this rule could not be applied. • Local content requirements of 40% in the automotive sector. • Projects with local content requirements are not eligible for most Development Finance Institutions financing products.
Investment Promotion and technology transfer	• Soft loans for small scale applications to support small and local investors • Loans from foreign institutions should be available in local currency (large scale projects) • Existing technology cooperation on private company level with international players aiming to develop and improve local manufacturing • Already existing NPOs like the RCREE are promoting the investment possibilities on international level supported by national agencies like the NREA with training programs
Strengthening firm-level capabilities	• Extending and strengthening of capabilities will be mainly focused on the market demand. Investment in new equipment and the related necessary training of local staff is based on market demand.
Education and training	• Training of local workforce within an international joint venture often performed at the international player • Local and regional learning centers related to renewable energies and engineering, in order to further increase the human capacities by agencies like NREA or NPO s like RCREE.
Research and innovation	• Local testing and certification center could be applied in order to establish a common quality standard, including local technology development, quality certificates for products and services and performance control. • Local labeling for renewable technologies like “Shamci certificate” for solar heating, developed as an Arab label by RCREE. This quality certification scheme provides a common standard for the Arabian region. • Egyptian companies and agencies participating on several projects related to renewable energies funded by the European Union via the FP7 and the Horizon2020 research framework programs.

Review of previous and ongoing projects

This chapter provides an overview of the country's maturity in terms of RE policy framework based on their impact on previous and ongoing projects:

Renewable Energy	Project name	Overview	Main findings
Solar PV	**In operation**		
	None identified		Up to now, only two PV-module manufacturing lines are in operation in Egypt, producing exclusively for the Egyptian Army
	Under construction / preparation		
	Kom-Ombo PV plant	20 MW	• Local construction companies (like TAQA) are involved in the tendering process and bidding for the projects.
	Hurghada PV plant	20 MW	• A start in the value chain could be the production of PV modules and the assembly of small (roof-top) applications.
	Other projects		• A local share of around 20% – 30% is expected by private companies for first stage projects
	In the pipeline		
	None identified		
Solar CSP	**In operation**		
	Kuraymat (2011)	CSP-Hybrid plant with 140 MWel (20 MW of the total 140 MW are generated by the solar field)	• A local content of 55% has been achieved in this first stage project • Financing was performed by World Bank (grant for 50 M$), JICA (soft loan 190 M$) and the NREA for local currency portion (100 M$) • Mirrors for this project has been manufactured in Egypt, not clear defined interfaces between the suppliers caused delays within the projects • Dr. Greiche Glass already delivered prototypes of shaped mirrors to the Kuraymat-plant, the necessary low-iron glass was imported
	Under construction		
	Borg Al-Arab	CSP plant with desalination (MED) with approx. 1.5 MWel	• EU-funded demonstration plant using CSP and multi effect desalination (MED) • Project started in 2011 • Construction shall be completed approx. 2015 • Project is coordinated by ENEA (Italy)
	In the pipeline		
	Kom-Ombo CSP plant (100 MW)	100 MW	The solar tower technology is considered as the best for local manufacturing; with solar tower a local manufacturing rate of up to 75% is expected
	Other projects		Several glass and mirror companies are active in Egypt, with international cooperation (Saint Gobain and Sphinx Glass)

Wind	**In operation**		
	Several pilot and demonstration projects (1988 – 1996)	Different technologies and sizes accounting to 5.5 MW	• Some components were manufactured locally, including tower and blades, electronic components and parts of the construction works • A local content share of around 40% could be achieved with this first demonstration projects • ·Wind turbines from several European manufacturers
	Zafarana Wind farm (2000-2001)	Wind-park with 60 MW installed capacity (96 wind turbines with around 660 kW)	• Local companies are producing for large European OEMs like Vestas or Gamesa for projects in Egypt • Market of 600 towers in the last 9 years was not enough to develop a local manufacturing with exception of tower manufacturing which must be local due to logistics · • Existing local capacities can cover wind towers with a capacity of 2 MW, for larger towers additional investment necessary. • Maintenance of the wind parks is currently done by foreign companies • COWI (Denmark) acting as leading development company and wind turbines from Nordex and Vestas
	Zafarana Wind farm (further extensions until 2013)	> 470 wind turbines with 850 kW accounting to more than 400 MW	• With the start of the commercial development the achieved local content decreased to 20%, at the moment the local content share is estimated at around 40% • Wind turbines installed by Gamesa,
	Under construction		
	Gabal El Zayt (ongoing)	Wind park with 200 MW, (100 wind turbines of 2 MW by Gamesa)	With an own blade fabrication in Egypt, the local share could be increased to 70% (not yet gearboxes and motors), even up to 100%
	In the pipeline		
	None identified		

Morocco

Economic overview

Key sectors of the Moroccan economy include agriculture, tourism, phosphates, textiles, apparel and subcomponents. Despite economic progress, the country suffers from high unemployment (9.2% in 2013 - IMF), poverty and illiteracy, particularly in rural areas[83].

Population	**GDP**	**GDP per capita**	**GDP growth**	**GDP by sector**	**Trade balance** (% of GDP)	**SMEs contribution to GDP** (%)[84]	**Unemployment rate** (%, Jul. 2014)[85]
32.6 million	$ 100.3 billion	$ 3,072	4.5%	Services: 55% Industry: 30% Agriculture: 15%	-7.4%	40%	9.6%

Table 15: Key statistics in Morocco (World Bank/IFC, 2012)

The trade deficit remained around MAD 18 billion ($2.2 billion), due to rising expenses for energy imports. The dominant sector is the tertiary sector, followed by industry and agriculture. Further imported products are processed food, textiles, fossil fuels and other raw materials.

The main trade partners are France, Spain, China, USA, Italy, Germany, Saudi-Arabia and Russia, as they import food and textile products from Morocco. Raw materials and basic components are generally imported, especially metals such as copper, aluminum, steel and electronic components as there are no local suppliers. Moroccan companies even claimed that around 95% of Moroccan products are assembled solely using imported materials and components.

The proportion of the working population is about one third of the total population, i.e. ten million people. Due to a rising amount of women entering the labor market this number is expected to grow. At the moment, the working population consists of 75% men. Morocco’s current overall unemployment rate is at 9.2%, with unemployment in urban areas significantly exceeding the rate for rural areas. This is caused by the fact that 45.1% of the working population is employed in the agricultural sector. Many of them are classified as free family assistance and thus do not receive a fixed wage. The proportion of qualified employees lies at 16%. As jobs for unqualified workers constitute more than half of jobs in Morocco, unemployment rates rise with higher education and are currently close to 24% for academics. Businesses claim that Moroccan universities do not sufficiently adjust to their needs and demands. Regarding salary structures, more than half of the workforce is employed at the official minimum wage of 12 MAD per hour, equal to 1,872 MAD per month. The salary of qualified technicians or engineers starts at 8,000 MAD per month, for engineers it often exceeds 10,000 MAD. Executives receive about the same amount as in Europe (Jaidi, 2010).

The Moroccan investment climate is better than in most African countries. Nevertheless, the “Arab Spring” has alienated investors as further events are suspected and long-term political directions cannot be foreseen. With a credit rating in the mid-range, between BB and BBB+, access to finance on the international market is rather complicated or expensive. The World Economic Forum rates the access to financing as the most important obstacle to conducting business in Morocco, according to its “Global Competitiveness Report” (World Economic Forum, 2011).

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[83] CIA World Factbook, 2014
[84] IFC, Overcoming Constraints to SME Development in MENA Countries and Enhancing Access to Finance, 2012
[85] Trading Economics Online (www.tradingeconomics.com)

Energy outlook

Energy profile

Driven by the rise in energy demand, primary energy supply has been steadily rising in Morocco over the last decade, and reached 17 283 ktoe in 2011 according to the International Energy Agency (IEA). With currently no proven gas or oil reserve, Morocco heavily relies on fossil fuel imports, which represent 95% of the total primary energy supply. In 2010, crude oil accounted for 34% of the primary energy supply, coal 22%, petroleum products 36% and gas 4%. The only non-marginal primary energy resource is the production of renewable electricity (mainly wind and hydroelectric power).

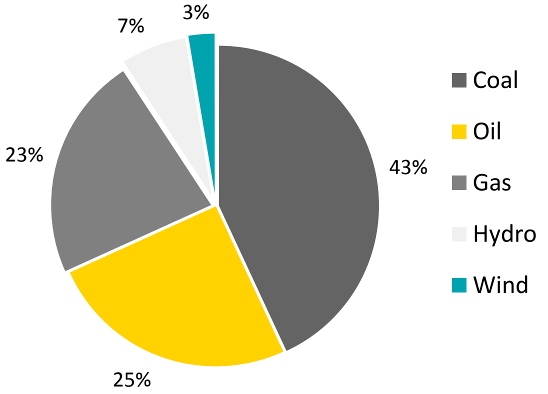

Figure 11: Electricity production mix in Morocco, (IEA, 2012)

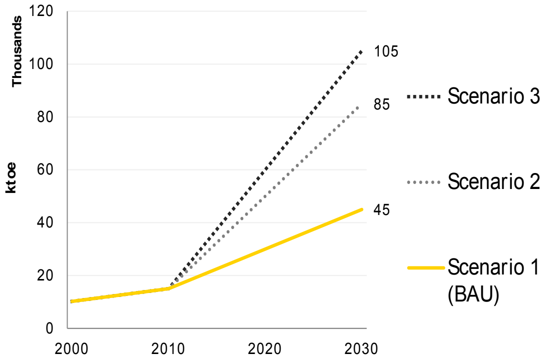

Figure 12: Evolution of energy consumption in Morocco – prospect 2000-2030 (HCP, 2007)

As a consequence of Morocco's strong energy dependence, the national energy bill currently amounts to approximately 11% of national GDP. The energy bill has increased from $1.81 billion (Dh 20 billion) in 2002 to $11.1 billion (Dh 90 billion) in 2011 and is expected to remain a significant burden for the economy in the next years. In addition, as end-consumer energy prices are subsidized by the national "compensation fund" (Caisse de Compensation), the subsidy allocated to oil-based products reached 5% of GDP in 2011 (Dh 43 billion). Adding both the energy bill and the subsidies on oil-based products, this represents an overall 16.4% of the Moroccan GDP (compared to 5% in 2002).

Energy demand in Morocco is expected to continue the rapid growth it has experienced in the last decade. The underlying factors explaining this increase are economic and industrial development, demographic growth, improved access to electricity (improving from 18% in 1995 to 98.5% in 2013[86]) and the diffusion of household appliances.

In the framework of the Morocco 2030 prospective program, several scenarios have been elaborated to estimate energy consumption until 2030. In a baseline scenario with no energy efficiency policy, **energy consumption is expected to at least double by 2030** [87].

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[86] Programme d'Electrification Rurale Global, ONEE, 2013

[87] Etude prospective de la demande d'énergie à l'horizon 2030, Direction de l'Observation et de la Programmation du Maroc, 2013.

Presentation of the national RE context

A national strategy for the development of renewable energy

Morocco's dependence on increasingly more expensive imported fossil fuels has long been a source of concern for the Government. Energy mix diversification is a priority area for policy to alleviate such dependency, notably by developing local renewable energy resources. Through the Moroccan Solar Plan and Morocco's Wind Energy and Hydropower Development Project, the Government has set the ambitious objective to have, in 2020, 42% of overall electrical power capacity covered by renewable energy plants. Solar energy, wind energy and hydropower will each represent 14%.

The regulatory context has also been adapted to support the development of renewable energy: in 2009, the Moroccan Renewable Energy Law 13-09 was passed. This law aims to encourage renewable energy projects by permitting electricity to be produced and exported by private entities. The text establishes the principle that any renewable power producer, both public and private, has the right to be connected to the medium, high and very high voltage national electricity grid. However, the 13-09 Law does not include any possibility for producers to be connected to the low tension network.

Dedicated programs to achieve ambitious objectives

To meet this objective, Moroccan authorities launched in 2009 the Moroccan Solar Program (PSM), which aims at establishing by 2020 a capacity of 2,000 megawatts. This production capacity was – at the time – estimated to represent 14% of electric power in Morocco by 2020. The PSM is now the main framework for the development of renewable energy within the country. This program – which targets five sites through the country – has made significant progress over the past years with the development of the Ouarzazate project (see insert).

Regarding wind, the Moroccan Integrated Wind Energy Project, spanning over a period of 10 years with a total investment estimated at 31.5 billion dirhams, will enable the country to bring the installed capacity, from wind energy, from 280 MW in 2010 to 2,000 MW in 2020.

The development of 1,720 MW of new wind energy farms are planned as follows[88]:

- 420 MW under development in, Akhfenir (200 MW), Bab El Oued-Laayoune (50 MW), Haouma (50 MW) and Jbel Khalladi (120 MW)
- 1000 MW planned in 5 new sites chosen for their great potential: Tanger2 (150 MW), El BaidaKoudia in Tetouan (300 MW), Taza (150 MW), Tiskrad Laayoune (300 MW) and Boujdour (100 MW).

Focus on major projects under development: Ouarzazate CSP plant (NOOR) and Tarfaya wind farm

Upon completion, **NOOR** will be the largest CSP plant in the world with a 500 MW capacity. The first phase of the project (160 MW) has been attributed to a consortium led by the Saudi ACWA – who teamed with the Spanish companies Aries IS and TSK EE – and is expected to start commercial operations in the second half of 2015. The feasibility study for the project NOOR Midelt solar will start in early 2015. NOOR Midelt shall be carried out in two programs: a CSP program, representing 80 - 85% of the whole capacity, and a PV Program representing 15 – 20% of total capacity (the final capacity has not been defined yet). The program shall be developed through an IPP scheme.

Tarfaya wind farm is the largest single farm in Africa. It reaches an overall capacity of 300 MW, 15% of the 2020 national objective for wind capacity. The field works were completed in early 2014 and the plant is already fully operational since October 2014. The project has been led by Morocco's energy firm Nareva Holdings and French utility GDF Suez.

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[88] Invest in Morocco, June 2014

Focus on the national RE policy framework

Assessing the perspectives for local RE manufacturing requires to identify the current state of the country regarding four key success factors: investment capacity and financing infrastructures (i), competitiveness of local players (ii), industry innovation capacity (iii) and stable policy support (iv). This chapter focuses on the policy support (iv) framework which provides key information to assess the likeliness of RE project development and local manufacturing capacity. This assessment is based on the three following reviews.

Review of RE support policies

Morocco's dependence on increasingly more expensive imported fossil fuels has for long been a source of concern for the Government. Energy mix diversification is a priority area of intervention to alleviate such dependency, notably by developing local renewable energy resources. In consequence, the Government has set the ambitious objective to have 42% of overall electrical power capacity covered by renewable energy plants by 2020.

To meet this objective, Moroccan authorities launched in 2009 the Moroccan Solar Program (PSM), which aims at establishing by 2020 a capacity of 2,000 megawatts. This production capacity was – at the time – estimated to represent 14% of the electric power by 2020. The PSM is now the main framework for the development of renewable energy within the country. This program – which targets five sites through the country – has made significant progress over the past years with the development of the Ouarzazate project (see table below).

Regarding wind, the Moroccan Integrated Wind Energy Project, spanning over a period of 10 years with a total investment estimated at 31.5 billion dirhams, will enable the country to bring the installed capacity from wind energy from 280 MW in 2010 to 2,000 MW in 2020.

In 2009, the Moroccan Renewable Energy Law 13-09 was passed. This law aims to encourage renewable energy projects by permitting electricity to be produced and exported by private entities. The text establishes the principle that any renewable power producer, both public and private, has the right to be connected to the medium, high and very high voltage national electricity grid. However, the 13-09 Law does not include the possibility for the producer to be connected to the low tension network.

RE support policy situation

Regulatory policies and targets	**RE targets**	YES Through the Moroccan Solar Plan and Morocco's Wind Energy and Hydropower Development Project, the Government has targeted the objective to have, in 2020, 42% of overall electrical power capacity covered by renewable energy plants. Solar energy, wind energy and hydropower will each represent 14%: • The Moroccan Solar Plan (MSP) aims to build 2000 MW of solar capacity by 2020 in five major sites. These 2000 MW will consist in both CSP and PV. The MSP will require an estimated investment of $9 billion. This program will increase by 14% the role of solar energy in total electricity capacity by 2020. • Moroccan Integrated Wind Energy Project (MIWEP) will bring installed wind capacity to 2000 MW by 2020. 31.5 billion dirhams (USD3.6 billion) are expected to be spent over a period of 10 years. The target of 2000 MW corresponds to 26% of the current electricity generation.
	Legal Framework	• Law no. 13-09 with regards to renewable energies aims to encourage the renewable energy projects by permitting electricity to be produced and exported by private entities. The text establishes the principle that any renewable power producer, both public and private, has the right to be connected to the medium, high and very high voltage national electricity grid. • According to the 13-09 Law, producers who own a renewable energy project of less than 20 kW are able to connect to the medium, high and very-high voltage national grid without any condition. However, an authorization from the national Authority is required from projects of more than 20 kW. • The 13-09 Law does not include any possibility for the producer to be connected to the low tension network.
	Feed-in tariffs	NO
	Subsidies, loans or grants	NO

Public financing	**Tendering / Auctions**	YES The development of 1,720 MW of new wind energy farms are planned as follow: • 420 MW under development, Akhfenir (200 MW), Bab El Oued-Laayoune (50 MW), Haouma (50 MW) and Jbel Khalladi (120 MW) • 1000 MW planned in 5 new sites chosen for their great potential: Tangier2 (150 MW), El BaidaKoudia in Tetouan (300 MW), Taza (150 MW), Tiskrad Laayoune (300 MW) and Boujdour (100 MW). In order to reach the 2000 MW objectif, the MSP initially planned the construction of 5 major plants as follows: Ouarzazate (500 MW), Aïn Beni Mathar (400 MW), Sebkha Tah (500 MW), Foum El Oued (500 MW) et Boujdour (100 MW). Some of the projects mentioned are already under development: • The first phase of the Ouarzazate CSP Plant (NOOR) project (160 MW) has been attributed to a consortium led by the Saudi ACWA – who teamed with the Spanish companies Aries IS and TSK EE – and is expected to start commercial operations in the second half of 2015. • Tarfaya wind farm is the largest single farm in Africa. It reaches an overall capacity of 300 MW, 15% of the 2020 national objective for wind capacity. The field works were completed in early 2014 and the plant is already fully operational since October 2014. The project has been led by Morocco's energy firm Nareva Holdings and French utility GDF Suez.In addition, Morocco has set up two funds in order to develop and promote RE and EE: • The Energy Development Fund (FDE), established in 2010, contains a capital of 1 billion USD: 200 million USD from Hassan II fund, USD 300 million from United Arab Emirates and USD 500 million from Saudi Arabia. This fund intends to support the development of production of electricity from RE and EE • The Energy Investment Corporation Fund (SIE), established in February 2010, contains a capital of 1 million dirhams endorsed by the state (71%) and the Hassan II Fund for Economic and Social Development (29%). It was created specifically to support the national plan for renewable energy development by investing in projects contributing to the increase of energy production capabilities.
Fiscal incentive	**Tax reduction**	NO

Review of the plans for RE equipment manufacturing

Morocco aims at supporting the development of its PSM through the development of a national industrial capacity. In order to increase the local content of RE projects in Morocco, both the Government and MASEN has, in the framework of public calls for tender, encouraged bidders to promote local manufacturing. Morocco is also improving its knowledge and technology as institutions like the National Agency for Renewable Energy and Energy Efficiency (ADEREE) develop training programs and supports R&D activities.

RE equipment manufacturing planning situation	
Local Content Requirements	• Under the Moroccan Solar Plan, the government encourages bidders to promote local content in their bids. For instance, the 160MW CSP plant near Ouarzazate (NOOR), awarded to ACWA Power, includes a 42% local content portion. This is also the case in the calls for tenders within the Wind Energy Program. However local content is not a requirement as such since most of international financial institutions would not finance RE projects under these conditions. • Wind project developers are strongly encouraged to include a plan to develop a domestic manufacturing and/or an assembly industry for wind components[89]
Investment Promotion and technology transfer	• The Moroccan National Federation of Electricity and Electronics (FENELEC) set a goal to actively participate in the animation of the local electrical and electronic sector and lead the work enabling companies to support the mutation of the Moroccan economic landscape. FENELEC continues the action plans already undertaken by the private sector to help Moroccan companies to manage its upgrade and thus be able to compete given the globalization of markets. Electronics is managed by a Board of 22 members; it is animated by a board of 15 members. The FENELEC brings together professionals from the electrical and electronic sector. • The Moroccan Association of Wind and Solar Industries (AMISOLE) was created in 1987 to promote the interests of Moroccan professionals and industries involved in the sector of renewable energy (wind and solar). AMISOLE now gathers about 50 Moroccan companies.
Strengthening firm-level capabilities	No specific initiative
Education and training	• The National Agency for Renewable Energy and Energy Efficiency (ADEREE) provides training programs dedicated to the development of renewable energies. • Specialized energy courses have been created within the major engineering schools and universities. • Trainings of technicians in wind energy by vocational training institutes have been launched.
Research and innovation	• The National Agency for Renewable Energy and Energy Efficiency (ADEREE) leads R&D activities in the RE and EE sectors • The Research Institute for Solar Energy and Renewable Energies (IRESEN) was created to bring together fundamental R&D and applied science at national level, to develop innovation and to encourage networking. IRESEN is also responsible for ensuring the definition of areas of research, as well as produce, finance and manage R&D projects. IRESEN is gradually developing its infrastructure to expand its scope of intervention and to be in line with demand and need for R&D, since it will ensure a support to university research.

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[89] IRENA (2013), Renewables Status Report: http://www.ren21.net/Portals/0/documents/activities/Regional%20Reports/MENA_2013_lowres.pdf

Review of previous and ongoing projects

Renewable Energy	Project name	Overview	Main findings
Solar PV/CSP	**In operation**		
	ISCC, Ain Beni Mathar	• Hybrid Natural Gas associated with CSP • Total capacity of 470 MW of which 20 MW from CSP	• Plant inaugurated in May 2011 • The solar field counts on a reflecting surface of more than 180,000 m² • Equipment and components are mainly imported from European countries such as Spain, France, and Turkey • Civil works and construction are undertaken by international firms that use a few subcontractors to provide basic and elementary ground breaking with local work force and their own machines
	Under construction		
	Noor I, Ouarzazate	• Expected to start commercial operations in the second half of 2015 • Max. capacity of 160 MW CSP	• NooR I CSP parabolic 160 MW with storage • Attributed to a consortium led by the Saudi ACWA who teamed with the Spanish companies Aries IS and TSK EE • Includes a 42% local content portion • A targeted system of local recruitment will increase the benefits to the local economy through the 1,000 local workers who will be employed during construction and 70 during operation of the plant • Newly constructed road might bring tourists more easily to Ouarzazate, and hence boost the tourism industry
	Airlight Energy, Ait Baha	Maximum capacity: 3 MW	• Private owners: Cimar, Italcementi • Project developer: Airlight Energy • Operation & Maintenance: Cimar, Italcementi
	In the pipeline		
	Noor II, III, IV Ouarzazate	Maximum capacity of 580 MW (mixed CSP/PV power)	• Noor Ouarzazate will have in total 580 MW • NooR II CSP parabolic 200 MW with storage, • NooR III CSP parabolic 150 MW with storage • NooR IV PV with 70 MWp. • Noor I has been attributed in September 2012 and NOOR II & III in December 2013
	Foum Al Oued	Max. capacity: 500 MW	• For these 3 projects led within the MSP, the technology which will be in use (CSP or PV) has not been communicated yet • Specific information about these projects is not available yet. However, both the Government and MASEN have, in the framework of public calls for tender, encouraged bidders to promote local manufacturing.
	Boujdour	Max. capacity: 100 MW	
	Sebkhat Tah	Max. capacity: 500MW	

Wind	**In operation**		
	Abdelkhalek Torres	• Max. capacity: 50 MW	
	Parc Eolien modèle	• Max. capacity: 3.5 MW	
	Lafarge	• Max. capacity: 30 MW • Private wind farm	
	Amogdou	• Max. capacity: 60 MW	
	Tarfaya	• Max. capacity: 300 MW • Expected to be fully operational by the end of 2014 • Expected to be the largest single farm in Africa • Will represent 15% of the 2020 national objective for wind capacity	• Project funded by three Moroccan banks: Attijariwafa bank, Banque Centrale Populaire and Banque Marocaine du Commerce Exterieur • Project led by Morocco's energy firm Nareva Holdings and the French utility GDF Suez • Electrical infrastructure and turbines supplied by Siemens The commitment was made to reach at least 35% of local content through the project development
	Under construction		
	Akhfenir	• Max. capacity: 200MW	• Project developed by Energie Eolienne du Maroc • Wind turbines supplied by GE
	Bab El Oued-Laayoune	• Max. capacity: 50MW	☐
	Haouma	• Max. capacity: 50MW	☐
	Jbel Khalladi	• Max. capacity: 120MW	☐
	In the pipeline		
	Tanger 2	• Max. capacity: 150MW	• For projects developed within the Moroccan Integrated Wind Energy Project, developers must include a plan to develop domestic manufacturing and/or an assembly industry for wind components when responding to calls for tender • The Wind Plan is expected to create a significant number of green jobs. About 700 direct permanent jobs in maintenance of the wind farms, as well as over direct 4200 one-year jobs in construction expected • Local manufacturing of the equipment is estimated to create additional jobs. In accordance with international research about 4-5 permanent jobs per MW, implying about 4000-5000 total green jobs created though WEP

Tunisia

Economic overview

Tunisia's economic growth relies mainly on oil, phosphates, agribusiness, automotive manufacturing and tourism. The country has been following a program of economic liberalization and structural adjustment supported by the International Monetary Fund (IMF), the World Bank and the European Union (EU) since 1996. The EU is the largest trading partner of Tunisia, with France, Italy and Germany accounting for 59% of import and 47% of export volumes.

Tunisia is historically well integrated into global value chains (GVCs), notably in three industrial sectors:

- textiles and clothing;
- agro-industry;
- mechanical, electrical and electronics industries, especially automotive and aeronautics components with exports progressing by an average 18% per year from 2000 to 2012.

The country ranked 6th in Africa and 83rd globally in the last Global Competitiveness Report released by the World Economy Forum[90]. Following the political and security crisis in 2011, Tunisia's economy recovered its former growth level (3.7% in 2012) and is now expected to accelerate with the calmer climate brought about by the adoption of a new constitution and the formation of a transitional technocratic government.

Population	***GDP***	***GDP per capita***	***GDP growth***	***GDP by sector***	***Trade balance*** *(% of GDP)*	***SMEs contribution to GDP (%)***[91]	***Unemployment rate*** *(%, Jul. 2014)*[92]
10.8 millions	$ 45.6 billion	$ 4,236	3.6 %	Services: 61% Manufacturing:16% Non-manufacturing industries: 14% Agriculture: 9%	-13.4 %	55%	15.2%

Table 16: Key statistics in Tunisia (World Bank/IFC, 2012)

Energy outlook

Energy profile

With an energy production exceeding a domestic final consumption mainly driven by the transport, industry and residential sectors, Tunisia has recovered a positive energy balance since 2007. However, nearly 40% of its annual natural gas consumption remains imported from Algeria to meet the electricity generation demand.

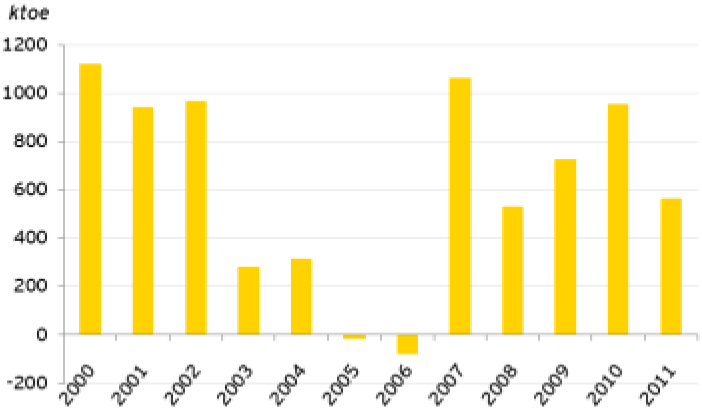

Figure 13: Energy balance evolution in Tunisia, (IEA, 2014)

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[90] Source : World Economy Forum, Global Competitiveness Report 2013-2014

[91] IFC, Overcoming Constraints to SME Development in MENA Countries and Enhancing Access to Finance, 2012

[92] Trading Economics Online (www.tradingeconomics.com)

Indeed, Tunisia's electricity mix heavily depends on gas, with nearly 98% [93] of the electricity generation coming from gas-fired power stations. Tunisia also generates a small amount of power from renewable sources, such as wind and hydro. Electricity production reached 13.7 TWh in 2012, most of which was covered by the industrial, residential and commercial sectors.

The electricity transmission grid of Tunisia, run by the *Société Tunisienne d'Electricité et du Gaz* (STEG), has been extended constantly throughout recent years. The grid is connected to the European grid via Algeria and Morocco, and the country aims at establishing a North African interconnected grid that would extend via Libya through Egypt, Jordan and Syria. The constantly growing economy, rising living standards and energy subsidization policies have led to a significant increase of electricity consumption resulting in saturation of the grid. According to STEG [94] and GIZ/ANME[95], electricity demand is expected to grow by 6% per year and will therefore exceed 20 TWh by 2020 and 33 TWh by 2030. In addition, some power plants and facilities are no longer appropriate to the actual load of the network. Regular incidents and maintenance operations have led to occasional power cuts. In 2009 the African Development Bank (AfDB) approved a loan of 48 million EUR to support the rehabilitation and restructuring of the national grid.

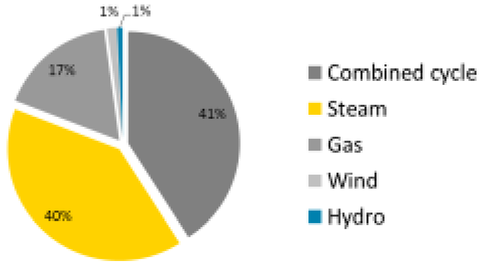

Figure 14: Electricity production mix in Tunisia, (STEG 2012)

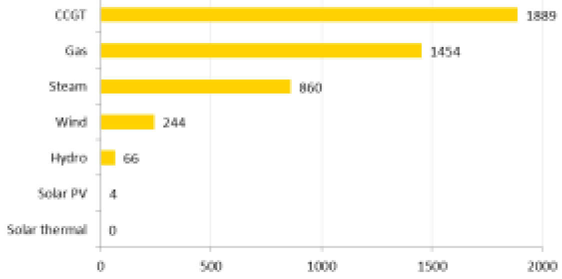

Figure 15: Electricity MW capacity mix in Tunisia (STEG 2013)

Presentation of the national RE context

Tunisia is one of the few renewable energy (RE) and energy efficiency (EE) early adopters among MENA countries, with proactive policies since the mid-1980s. These policies were strengthened in the mid-2000s with rising international oil prices and growing energy deficit, resulting in ambitious programs designed to meet energy efficiency targets:

The three-year sustainable energy program (2005-2007)

Following the creation of the *Fonds National pour la Maîtrise de l'Energie* by law in 2005 (scheme to finance solar water heaters and energy efficiency projects, the three-year program was designed to focus on mature industries. It resulted in significant EE contracts in the industrial, tertiary and transportation sectors, along with the installation of cogeneration facilities (10 MW) and solar water heaters in the residential sector. Indeed, Tunisia initiated the PROSOL program in 2005 to disseminate solar water heater (SWH) systems by engaging local financial institutions to provide credit lines to consumers. The overall program achievements include accumulated energy savings of around 770 ktoe, representing 8% of national annual consumption.

The four-year sustainable energy program (2008-2011)

During this period, the Tunisian government set an ambitious goal to reduce annual energy intensity by 3%, maintain moderate energy demand growth and bring the share of RE in primary energy mix up to 4% by 2011. The program resulted in significant achievements: development of solar collectors, distribution of energy-saving lamps, roof thermal insulation development (PROMO-ISOL program), installation of wind energy capacity (180 MW) and cogeneration facilities (70 MW); and consolidation of former EE contracts.

The Tunisian Solar Plan (Plan Solaire Tunisien – PST)

The PST consists in a framework for Tunisia's sustainable energy development and integration into the Mediterranean area for the 2010-2016 period. The framework goes beyond solar power reinforcement and provides support for other sustainable energy policies, from wind energy development to energy efficiency implementation. Several ambitious targets have been set within the PST:

- Strong penetration of RE in the electricity mix
  - 11% of electricity generation and 16% of installed capacity by 2016 (representing 1,000MW, i.e. an additional capacity of 480 MW including 140 MW for CSP and 280 MW for wind power)
  - 25% of electricity generation and 40% of installed capacity by 2030 (representing 4,700 MW)
- Energy efficiency enhancement with savings expected to reach 23% of the primary energy demand by 2016
- Interconnection with the European power grid through Italy, with an export capacity expected to reach 1,000 MW by 2016, including 800 MW from fossil fuels and 200 MW from renewable energy.

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[93] Source : STEG 2012

[94] Energy Days Tunisia 2013, STEG

[95] "Renewable energy production in Tunisia, perspectivesand opportunities until 2030", GIZ/ANME, 2010

Energy source	Installed capacity in 2012 (MW)	Forecasted capacity by 2016 (MW)	Forecasted capacity by 2030 (MW)
Fossil fuels	3 819	5 250	7 050
Renewables	224	1 000	4 700
Wind	*154*	*430*	*1 700*
Hydroelectric	*66*	*390*	*700*
Solar PV	*4*	*140*	*1 500*
Solar thermal	-	-	*500*
Biomass	-	*40*	*300*
Total capacity	4 043	6 250	11 750
RE share (%)	*6%*	*16%*	*40%*

Table 17: Installed and forecasted RE capacity in Tunisia (RCREEE, 2012)

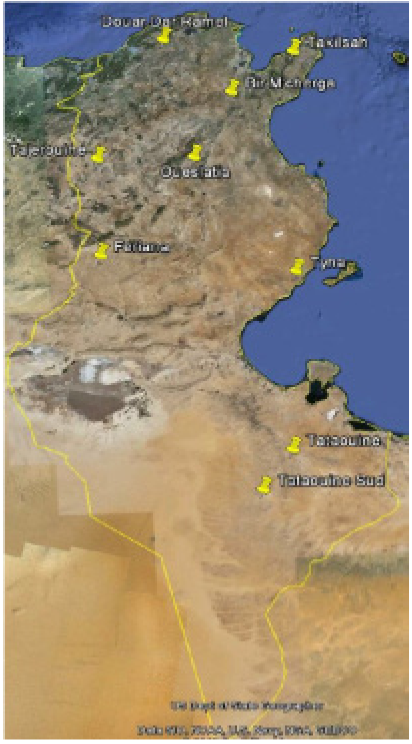
RE potential in Tunisia

In a target scenario where renewable sources would represent 16% of total capacity installed by 2016 and 40% by 2030, the total capacity development would reach 6250 MW by 2016 and 11 750 MW by 2030.

Based on standard international ratio in terms of capacity per surface and 1% occupation of the national land area, the rough potential for wind energy was estimated at 8 GW[96]. Regions with high wind energy potential are mainly in the northern part of Tunisia. In northern and north-eastern areas, wind measurements revealed wind speeds between 7 and 10 m/s (Jebel Sidi Abderrahmane, Bizerte, Nabeul, South Kaserine).

With an average annual DNI of 1,814 kWh/sqm[97] (max. 2,123 kWh/sqm), Tunisia has solid assets for solar energy development and CSP technology in particular. Indeed, EY ranked Tunisia 10th among 40 countries in a study[98] focusing on solar CSP attractiveness.

Tunisia's RE capacity has experienced strong growth over the last five years, with wind power capacity increasing eightfold from 2008 to 2012. However, political instability and the lack of incentive schemes continue to remain barriers to investment. Tunisia saw declining investment following the Arab Spring and due to the scarcity of stable, long-term transparent policies. A GIZ/STEG-ER study [99] led to the identification of suitable sites for installing renewable energy power plants with a capacity of up to 1 GW. These sites are represented in the following map.



RE technology	Site	Capacity MW	
PV	Bir M'Cherga	50	300
	Tataouine	50	
	Oueslatia	50	
	Tyna	50	
	Tajerouine	50	
	Feriana	50	
CSP	Tataouine Sud	250	400
	Feriana	150	
Wind	Bir M'Cherga	60	300
	Douar Dar Ramel	60	
	Douar Dar Ramel	60	
	Tataouine	60	
	TOTAL		**1000**

Table 18: Identified sites (GIZ/STEG-ER, 2013)

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[96] ANME, Potentiel et scenarios de développement de la production d'électricité renouvelable en Tunisie, 2010

[97] SolarGIS 1994-2010

[98] RECAI Renewable energy country attractiveness indices, Feb 2013

[99] GIZ - STEG ER, Study on the renewable energy potential for electricity generation for national consumption in Tunisia and export to the EU, 2013

Focus on the national RE policy framework

Assessing the perspectives for local RE manufacturing requires to identify the current state of the country regarding four key success factors: investment capacity and financing infrastructures (i), competitiveness of local players (ii), industry innovation capacity (iii) and stable policy support (iv). This chapter focuses on the policy support (iv) framework which provides key information to assess the likeliness of RE project development and local manufacturing capacity. This assessment is based on the three following reviews:

Review of RE support policies

RE support policy situation		
Regulatory policies and targets	**RE targets**	YES In 2009, the Government launched the Tunisian Solar Plan (TSP) which aims to fund around 40 renewable projects, including 17 solar and 3 wind projects. The TSP is expected to reach the following objectives: • 11% of electricity generation and 16% of installed capacity from RE by 2016, representing 1,000 MW; • 25% of electricity generation and 40% of installed capacity from RE by 2030, representing 4,700 MW. The total investment required to implement the Tunisian Solar Program plan have been estimated at $2.5 billion, including $175 million from the National Fund and $530 million from the public sector.
	Legal Framework	• **Law N°2004-72 of 2nd August 2004** on energy conservation, allowing the publication of new laws and regulations to support energy conservation actions. • **Law N°2005-82 of 15th August 2005** which created the National Fund for Energy Conservation (FNME), a tool for sustainably funding the energy conservation field. • **Decree N°2005-2234 of 22nd August 2005** fixing the rates and amounts of premiums of actions regarding the FNME and modalities to grant them. • **Law N°2009-7 of 9th February 2009** modifying and completing law N°2004-72 of August 2nd, 2004 which introduced important elements for promoting renewable energies, in particular for the production, transmission and sale of electricity. • **Decree N°2009-362 of 9th February 2009** modifying and completing the decree N°2005-2234 of 22nd August 2005, introducing in particular investment aids for the realization of electricity production projects from renewable energy sources. • **Law No. 2009-7** of 9th February 2009 amending and completing Law No. 2004-72 of August 2nd, 2004 allows any institution or group of establishments engaged in the industrial, agricultural or tertiary sector to produce renewable power for their own use. The law also gives producers the ability to sell up to 30% of power generated to STEG at a price equivalent to HT prices • **Decree No. 2009-2773** of 28 September 2009 establishes the conditions for power transport, allowing producers to use the national grid to transport power from the production plant to the consumer on payment of a transport fee. This fee is determined by order of the Minister of Energy.
	Feed-in-Tariff	NO
	Subsidies, loans or grants	Credit lines dedicated to renewable energy projects are led by international funds such as the Agence Française de Development (AFD) or the World Bank. A credit line was also initiated by STEG/ANME for small-scale RE projects.
Public financing	**Tendering / Auctions**	YES Among the 40 projects included in the TSP, 5 will be publicly-led[100]. Among all the projects that are in the pipeline, under construction or already in operation, the following are publicly-led: • Sidi Daoud Wind Farm: 54 MW in operation since 2009; • Bizerte Wind Farm Stage A & B : 190 MW in operation since 2012 • STEG PV power plant: 10 MW in the pipeline.[101]

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[100] Tunisia Energy Country Report, Focus on electricity sector and renewable energy policies, GSE, 2013

[101] Review of current and projected RE projects in Tunisia, RCREEE, 2012

Fiscal incentive	**Tax reduction**	YES Current direct financial incentives are aimed mainly at water heating and small-scale energy substitution, but tax incentives do exist for renewable energy: • Reduction of customs duties to the minimum rate of 10% (from a general rate of 18%) and exemption from VAT for imported equipment used for EE or RE, for which no similar equipment is manufactured locally; • Reduction of customs duties and exemption from VAT for imported raw materials and semi-finished products entering into the production of RE/EE equipment[102].

Review of the plans for RE equipment manufacturing

While Tunisia is working towards the achievement of its RE targets, the country has set up tax incentives in order to encourage the development of a local RE industry. Tunisia also developed its knowledge as several academic institutions have set up specific courses and R&D programs. On the other hand, Tunisia is not yet encouraging project developers to promote local manufacturing.

RE equipment manufacturing planning situation	
LCR	NO
Investment Promotion and technology transfer	NO
Strengthening firm-level capabilities	YES The government has set up tax incentives in order to strengthen local firms competitiveness: • Exemption from VAT for locally manufactured raw materials and semi-finished products entering into the production of equipment for EE and RE; • Exemption from VAT for equipment manufactured locally and used in the field of energy conservation or of renewable energies.[103]
Education and training	YES • Academic institutions have specialized courses in order to meet the requirements of the business sectors; • The ANME is in charge of the promotion of training in energy efficiency and renewable energy technologies.
Research and innovation	YES • The *Programmes de Recherche Fédérés* (PRF - common research programs) aim at improving the national R&D system by mobilizing skills and establishing partnerships between research establishments and the public and private operators concerned; • The Research and Technology Center of Energy (CRTEn), in operation since 2006, is a an R&D organization operative under the supervision of the Ministry for Higher Education and Scientific Research (MESRS).

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[102] Role of ANME in the promotion of renewable energy in Tunisia, EMIS FORUM / SOLAR ENERGY & ENERGY EFFICIENCY (FORSEE), Tunis, 25-26th June 2012

[103] Role of ANME in the promotion of renewable energy in Tunisia, EMIS FORUM / SOLAR ENERGY & ENERGY EFFICIENCY (FORSEE), Tunis, 25-26th June 2012

Review of previous and ongoing projects

Technology	Project name	Overview	Main findings
Solar PV	**In operation**		
	PROSOL-ELEC rooftops	4 MWp (1800 solar roofs)	• Loan granted by STEG /Attijari Bank • Funded by the National Fund for Energy Conservation (FNME)
	Om Somaa	20 kWp CPV	• Project own by STEG / developed by SOITEC • Water pumping in Om Somaa, Kebili
	Under construction		
	Tozeur (2015)	10 MWp in Tozeur	• Project owned by STEG
	Ben Guardane (2015)	210 kWp PV in Ben Guardane	• Developed by Takaoka Eng / Conergy • Groundwater desalination facility • First medium-size PV project developed by private stakeholders for self-production
	AEROLIA	550 kWp	• Self-production
	In the pipeline		
	None identified		
Solar CSP	**In operation**		
	None identified		
	Under construction		
	None identified		
	In the pipeline		
	Akarit (2016)	5O MW CSP Parabolic through	• Project owned by STEG / Feasibility study by Lahmeyer International • Funded by the World Bank and the AfDB • 25% expected local manufacturing
	El Borma (2015)	5 MW ISCC	• IPP owned by STEG / SITEP (Italy) and developed by NEDO (Japan) • Total power 43 MW ISCCS with solar input into steam cycle (max 5 MW) • From 500 to 1,000 estimated employment opportunities
	Tunur (first stage in 2016)	2 GW CSP Tower in Rejim Maatoug	• Interconnection with Europe through Italy • From 15,000 to 23,000 direct and indirect estimated employment opportunities • Local content expected to be around 60%

Wind	**In operation**		
	Sidi Daoud farm (2009)	54 MW	• Owned by STEG / developed by MADE-GAMESA • Public loan for 30 years (interest rate of 1.5%) • 40% of estimated local integration: studies, civil works, tower manufacturing, cables, mechanical and electrical erection, transportation
	Bizerte farm stage A (2011)	120 MW	
	Bizerte farm stage B (2012)	70 MW	
	Under construction		
	SCG Kechabta	45 MW	• Self-production project owned by Société des Ciments de Gabes (SCG) • Phase 1 (24 MW) / Phase 2 (21 MW)
	In the pipeline		
	EGCE program	60 – 120 MW	• Self-production for significant industrial electricity consumers (EGCE) • Cement industry (CIOK Oum Kelil, Bizerte, SOTACIB, Gabes Enfidha, CAT, etc.) • Steel industry (El Fouledh) • Mining industry (CPG) • Plastics industry (PEC)
	Sidi Daoud extension (2017-2019)	80 MW (2O17) 110 MW (2019)	• STEG projects to extend the Sidi Daoud wind farm with additional 190 MW • GAMESA is expected to provide 143 turbines for the first stage

Appendix B: Country interview lists

Egypt

Company / Institution name	Private/Public	Participants and Position	Contact details	Homepage (if available)
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		Resident Loan Officer, EIB Regional Office for the Near East		
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		Rizk Ahmed M. *Project Manager*	arizk@imc-egypt.org	
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Morocco

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NAREVA HOLDING	Private	**SEBTI MOHAMED** - *Energy Pole Director*	m.sebti@nareva-ona.com	
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Tunisia

Company / Institution name	Private/Public	Participants and Position	Contact details	Homepage (if available)
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Appendix C: Methodological notes

Definition of the criteria used in the assessment of the industrial assets for local RE manufacturing

Presence of local suppliers: the ability of the manufacturing firm to source its components and/or raw materials locally is a key factor strengthening the local market.

Product quality: the ability of the form to manufacture products in accordance with international quality standards. This may reinforce the international competitiveness of the firm.

Manufacturing cost competitiveness: the ability of the firm to manufacture a production unit at a low cost. This includes the cost of the workforce, the prices of energy and utilities, the cost of the production lines, etc.

Regulatory framework: the stability and clarity in legal, regulatory and fiscal policies offering a long term vision to the firm (e.g. existence of a stable feed-in tariff).

Existence of a structured value chain: the existence of strong players all along the value chain (from the raw materials to the maintenance services) contributes to the development of an attractive market segment.

Innovation capacity: the ability of an industrial sector to develop innovative components or equipment and its ability to access the best available technology contributes to its competitiveness at the international scale.

Education and training: the existence of training programs dedicated to the renewable energy contributes to the availability of local skills that can meet the industrial requirements.

Access to finance: the ability of firms to have an easy access to efficient financing tools may encourage them to invest in ambitious projects and contribute to the development of a dynamic local market.

RE targets: the existence of clear and ambitious RE targets in a given country may encourage the emergence of a local market and, if it is associated with a strong and stable regulatory framework, may reinforce foreign investments in RE projects.

Feed-in tariffs: under such policies, eligible renewable electricity generators are guaranteed a standard purchasing price for the electricity they produce, and are normally guaranteed priority dispatch. Feed-in tariffs can further increase the profitability of RE projects, and contribute to market uptake in Mediterranean countries, even for technologies that can already be competitive compared to other electricity sources.

Public investments, loans or grants: they aim to help reduce system investment costs associated with developing renewable energy projects and purchasing equipment. They can also be used to facilitate access to finance through concessional loans for renewable energy projects.

Tendering / Auctions: auction schemes involve governments announcing bids to install a certain capacity, or produce a certain quantity, of renewable-based electricity. Project developers submit offers which are evaluated based on selected criteria, including the price per unit of electricity. Selected bidders typically enter into power purchase agreements.

Tax reduction: tax exemptions or reductions are generally used as supplementary support policies. For instance, renewable energy project developers and electricity generators are exempted from taxes (or a portion of taxes) in order to facilitate the creation of a level playing field with the conventional energy sector. For instance, in Tunisia, there is an exemption from VAT for locally manufactured raw materials and semi-finished products entering into the production of equipment for EE and RE.

Investment Promotion and technology transfer: investment-promotion mechanisms are being adopted to overcome existing financing barriers and to attract investors into the sector. In the absence of a well-developed local financial market, these mechanisms aim to facilitate foreign investments, including foreign private sector investments. Aside from employment creation and the development of new sectors, the latter may also contribute to technology transfer and the enhancement of domestic capabilities.

Strengthening firm-level capabilities: the ability of a firm to acquire, use and adapt technology and therefore maximize value from its activities depends on its capacity to gain an overview of the technological components on the market, assess their value, select which specific technology is needed, use it, adapt and improve it and finally develop technologies oneself.

Education and training: one channel for technology transfer is education and training, which is linked to the acquisition of technical equipment, the employment of local workers in international firms, and participation in trade fairs or workshops.

Research and innovation: research, technological development and innovation activities are becoming increasingly vital for value creation and economic growth. They are crucial for sustained development and improvement of existing technologies, and offer opportunities for enhanced adaptability, improved efficiency and reduced costs. This can lead to increased deployment of renewables, thereby positively affecting value creation.

Definition of the criteria used in the assessment of the key barriers for future local manufacturing capability

Finance: Low capital levels, the difficulty of companies to have an easy access to finance and the absence of a bank capacity building may be key barriers for the development of a local manufacturing capability. Indeed, it would lower their capability to invest in R&D or innovative means of production and thus would lower their international competitiveness.

Competitiveness: The development of the local manufacturing may be restrained by, for instance, the existence of a tough international competition or supplier agreements.

Technology: A low rate of upfront R&D investments or the absence of skills capacity building may lower the innovation capacity of local companies as well as their capability to reach international standards requirements.

Regulation: The absence of LCR or of education and training facilitations is likely to slow down the development of local companies and lower their capability to have an access to a local skilled workforce. However, Projects with local content requirements are not eligible for most Development Finance Institutions financing products.

Appendix D: Key stakeholders and initiatives in the RE sector in the region

There are number of initiatives undertaken in the MENA region to facilitate the deployment of renewable energy. The key initiatives are presented hereafter [104] :

- **The Mediterranean Solar Plan (MSP)** established in 2008 as one of the main initiatives of the Union for the Mediterranean (UfM). A target of 20 GW of new electricity production capacities using low-carbon technologies by 2020 has been set. The MSP is not restricted to any technology, and is expected to reach this target through the development of numerous projects using various renewable energy technologies (mainly CSP, solar PV and wind).
- **the Mediterranean Renewable Energy Program (MEDREP)** involving the International Energy Agency (IEA), the Observatoire Méditerranéen de l'Energie (OME) and the Mediterranean Association of the National Agencies for Energy Conservation (MEDENER). The key objectives of MEDREP Finance are to investigate different approaches for positively influencing finance flows to renewable energy companies and projects in target countries, to structure various support mechanisms that help lenders and investors scale up financing to this clean energy sector, and to help establish a regional RET market in the Mediterranean region. Tunisia, Morocco, and Egypt are the first three Mediterranean countries to be reviewed for the program.
- **The MEDGRID** is a large industrial project planned in North Africa, which aims to promote and develop a Euro-Mediterranean electricity network that would provide North Africa & Europe with inexpensive renewable electricity, mostly from solar. The goal is to install 20GW of generating capacity, with 5GW being devoted for exports to Europe.
- **The ReGrid initiative** which is a capacity building program dedicated specifically to the integration of large amount of renewable energies in MENA's electricity network.
- **The Renewable Energy Solutions for the Mediterranean (RES4MED)** initiative aims at creating a dialogue with other Mediterranean Initiatives, adding value to their lessons learned. Therefore, RES4MED represents a meeting point to compare strategies, discuss project outcomes, and connect experiences and knowledge in the Mediterranean area. RES4MED intends to play the role of a "network of networks", while offering its members expertise, knowledge and experience.
- **The Mediterranean Ring (MedRing)** project aims to provide interconnection of electric power transmission grids among the countries that encircle the Mediterranean Sea in order to increase energy security and enable more efficient power flows at lower costs in the area.

International and regional institutions come first among the key stakeholders playing a role in the development of renewables in MENA. Major regional and international institutions active in the region include:

- **The International Renewable Energy Agency (IRENA)**, an intergovernmental organization that supports countries in their transition to a sustainable energy future and serves as the principal platform for international cooperation, a center of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA's headquarters are located in Abu Dhabi;
- The League of Arab States headquartered in Egypt, which carries out a series of energy activities;
- The Regional Centre for Renewable Energies and Energy Efficiency (RCREEE) in Egypt. Through its solid alliance with the League of Arab States, RCREEE is committed to enable and increase the adoption of renewable energy and energy efficiency practices in the Arab region;
- The Mediterranean Renewable Energy Center (MEDREC), based in Tunisia, is committed to develop regional competencies through the transfer of technologies, the training of human capacities, the dissemination of information in the field of renewable energies.
- The Observatoire Méditerranéen de l'Energie (OME), which counts 32 leading Mediterranean energy companies from 14 countries, aims at promoting cooperation and collaboration with major energy companies operating in the Mediterranean region, making of energy an element for regional integration.
- The Mediterranean association of national agencies for energy efficiency and development of renewable Energy (MEDENER) brings together 12 organizations from both shores of the Mediterranean in charge of energy efficiency and renewable energy development policies. It aims at exchanging experiences, know-how and best practices.
- The Union for the Mediterranean (UfM) aims at increasing the potential for regional integration and cohesion among Euro-Mediterranean countries, with one of its priorities on alternative energies with the Mediterranean solar plan.
- Other national institutions, such as the King Abdullah City for Atomic and Renewable Energy (K.A.CARE) in Saudi Arabia, the Masdar initiative in Abu Dhabi and the Qatar Foundation also participate in stimulating the renewable energy sector in the region. As an example the recently launched Solar Test Facility (STF) at Qatar Science & Technology Park (QSTP), a joint

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[104] More information is provided in the country reports

venture between QSTP tenants, Chevron and Qatar and Qatari renewable energy company GreenGulf whose objective is to test and evaluate current and emerging solar technologies.

Other key players are the International Financial Institutions (IFIs) who remain an important source of funding for renewable energy projects in the region, with EIB, KfW (Kreditanstalt für Wiederaufbau), AFD (Agence Française de Développement), the World Bank, the United Nations Development Program (UNDP), and the African Development Bank (AfDB) playing a significant role.

Collaboration between IFIs is crucial to support the deployment of renewable energy in the region by providing project finance and technical cooperation. Several initiatives have been launched recently involving several IFIs.

- As an example, the World Bank Group and the AfDB are in the process of applying to the Clean Technology Fund (CTF) Trust Fund Committee for use of USD 750 million of concessional funds for the MENA CSP Scale-up, especially in Algeria, Egypt, Jordan, Morocco and Tunisia. This initiative will aim at:
    - supporting deployment of about 1 gigawatt of CSP generation capacity;
    - leveraging public and private investments for CSP power plants and other related projects for over USD 4.85 billion;
    - supporting transmission infrastructure in the Maghreb and Mashreq for domestic supply and exports as part of Mediterranean grid enhancement;
    - supporting energy security, industrial growth and diversification, and regional integration in the MENA region.

The Investment Plan is designed around deployment of about 10–12 commercial scale power plants to be constructed over a 3–5 year time-frame. In Morocco, USD197 million in CTF funding is co-financing the world’s largest CSP initiative, Ouarzazate I CSP project. Ouarzazate I is the first phase of the 500 MW Ouarzazate solar complex project, financed by the EIB, KfW, AFD and AfDB. CTF is also involved in the financing of Egypt’s wind energy program targeting 2GW by 2020 for another USD125 million.

- Another example is the AfDB’s Sustainable Energy Fund for Africa (SEFA) which provides grants and equity to small-scale renewable energy and energy efficiency project. Over the first half of 2012, AfDB approved USD 800 million in loans to spur private investments in Morocco's renewable energy sector.
- More recently, the EIB and Abu Dhabi's green energy firm Masdar signed an agreement to partner in the development and financing of renewable energy projects in MENA. The framework agreement was signed during the Abu Dhabi Sustainability Week, ending January 25, 2014. The collaboration between EIB and Masdar is expected to create technical and financial synergies in the identification, evaluation and development of green power projects. In addition, the cooperation includes an internship program for the training of workforce.
- The Ouarzazate solar power complex is a major recent example of collaboration between International Financial Institutions

Appendix E: Lessons learnt from international experience

This section consists of an in-depth literature review showing how local companies managed to capitalize on favorable market conditions and regulatory framework to thrive and build a competitive industry in the RE sector or other industrial domains. The studies were chosen based on market and framework similarities with the pilot countries and the potential reproducibility of relevant international initiatives.

Experience in the MENA region

Reference	Geographical scope	Technologies addressed	Outlines of the report	Main conclusions
World Bank (2011) Middle East and North Africa Region: Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects	Middle East & North Africa	Solar CSP	► Provide an overview of manufacturing processes and cost analysis for key CSP components ► Assess the potential in the MENA region for building and developing a CSP component manufacturing industry ► Propose an action plan to develop the potential of locally manufactured CSP components in the existing industry and of new market entrants ► Analyze potential economic employment benefits of developing a CSP manufacturing industry	**Industrial Capacity** ► Several industrial sectors (glass, cable, electrical and electronic industries) that have the potential to integrate the CSP value chain in the MENA region are dynamic and competitive ► The shift of MENA CTF industries towards higher technology content will require investment in new production lines based on highly automated processes for the mounting structure and in white glass production as well as adaptation of techniques for coating and bending. **Non-technologic concerns:** ► The success of these industries is enhanced by the development of joint ventures between large international companies and local firms, but also by the local implantation of subsidiaries of international players ► The shift of MENA CTF industries towards higher technology content will require an increased international cooperation **Socio-economic impacts:** By 2020, the cumulated total jobs (one-year) for construction, manufacturing and Operation and Maintenance would increase to over 180,000 in an optimistic scenario and at least 33,000 jobs would be created in a conservative one.

German Development Institute (2012) Building Domestic Capabilities in Renewable Energy: A case study of Egypt, Georgeta Vidican	Egypt	▶ Solar CSP ▶ Wind Power	▶ Perform a critical assessment of local capabilities in renewable energy (CSP and wind), both in terms of production (of parts and components) and of project execution capabilities ▶ Assess why the potential has not yet been fully met and discuss solutions for overcoming problems of implementation ▶ Identify policy recommendations for policy-makers in Egypt, as well as for German international cooperation.	**Institutional framework:** ▶ Disseminate a new narrative emphasizing the irrationality of the energy subsidy regime, which is as a basic barrier to the deployment of renewable energy ▶ Policy action in several areas: developing a renewable energy strategy and a technology roadmap; reforming the fossil-fuels subsidy regime; unbundling the services of the New and Renewable Energy Authority (NREA); developing the supply chain; expanding education and training in renewable energy; expanding renewable energy R&D **Non-technologic concerns:** Mobilize alliances between different interest groups and types of stakeholders: technical experts, financiers, academics, the private sector and civil society;
German Development Institute (2012) Achieving Inclusive Competitiveness in the Emerging Solar Energy Sector in Morocco	Morocco	Solar power including: ▶ Concentrated Solar Power ▶ Photovoltaic ▶ Solar water heaters ▶ Solar water pumps	▶ Identify the main challenges and opportunities for achieving inclusive competitiveness in the emerging solar energy sector in Morocco ▶ Highlight policies and resources that are needed for supporting the development of business linkages ▶ Explain how the strategic approach that Morocco's policy-makers are following in order to identify the most effective way to develop the solar energy sector could be improved	**Institutional framework:** Small-scale PV, SWH and SWP implementation require policy interventions related mainly to reforming energy subsidies, improving quality standards and identifying financing mechanisms to support consumers **Non-technical concerns:** The study highlights that the following conditions are necessary for achieving inclusive competitiveness in the emerging solar energy sector: ▶ Creating a market for both small and large-scale solar projects and application ▶ Developing an integrated strategy that aligns industrial policy with education and R&D policy, offering targeted measures for industrial upgrading and business linkages. ▶ For large-scale CSP and PV long-term market development, export opportunities and the enhancement of knowledge and R&D capabilities through business linkages are critical;

Desertec Industrial Initiative (2013) Desert Power: Getting Started, The manual for renewable electricity in MENA / The Economic Impacts of Desert Power: Socio-economic aspects of an EUMENA renewable energy transition	Middle East & North Africa	All Renewable Energies with a focus on: ▶ Concentrated Solar Power ▶ Photovoltaic ▶ Wind Power	▶ Provide an overview of the different RE support frameworks that exist today in the EU Member States and the MENA region ▶ Analyze the macro-economic and employment impacts of renewables deployment ▶ Provides further details on industrial policy measures that can contribute to maximizing the local benefits of renewables in MENA	**Institutional framework:** An RE socio-economic development plan should aim to coordinate, and encourage collaboration between, the responsible political actors. **Industrial capacity:** MENA industry has already acquired local manufacturing capacity in a number of RE components. It can greatly expand this industry capability by focusing on the components that have the potential to be manufactured locally in the short term. **Non-technologic concerns:** ▶ Local firms in MENA countries should be provided with the resources necessary to acquire internationally recognized certification in key components ▶ Existing and new science and technology (S&T) parks should follow market-friendly principles to encourage R&D, particularly in the private sector, as well as to promote know-how transfer ▶ Exchange programs should be founded to encourage the exchange of students at all levels between the EU and MENA ▶ A marketplace for private-sector, for profit vocational training should be enabled in RE-relevant subjects in the MENA region.
African Development Bank (2013) Development of Wind Energy in Africa	Africa, including MENA region	Wind power (off-shore and on-shore)	▶ Provide a mapping of wind energy potential and projects developed on the continent so far ▶ Identify impediments hindering further development of wind energy markets on the continent.	**Institutional framework:** ▶ The following policy recommendations emerge from the study: ▶ The designation of a national entity dedicated to the promotion of renewable energy should be encouraged ▶ Private investors are willing to invest in the sector as long as a clear regulatory framework is in place and wind resources are geo-referenced to gauge feasibility. **Non-technologic concerns:** ▶ Only countries which could develop large, robust and 'smart' grids, i.e. with high self-adjustment capacity, are poised to fully capture the benefits of wind-based electricity; ▶ Countries with sizeable wind energy markets such as Egypt, Morocco and South Africa, should design and implement robust policies to encourage local manufacturing of wind turbine components.

GIZ (2012) Renewable energy and energy efficiency in Tunisia – employment, qualification and economic effects	Tunisia	Solar power including: ► Concentrated Solar Power ► Photovoltaic ► Solar water heaters ► Solar water pumps Wind Power	► Analyze the prerequisites and frameworks for successful implementation of the PST (Tunisian Solar Plan) based on international experiences ► Analyze the future opportunities from the PST and other measures of sustainable energy promotion.	**Institutional framework:** International experience shows that a stable policy framework and transparent support mechanisms are the most important prerequisites for the successful development of renewable energy and the energy efficiency sector. **Non-technologic concerns:** ► To become successful in international markets, renewable energy products need to maintain high quality standards and be certified; ► Financing and support from international finance institutions, the European Union and individual European countries, international carbon-based funds and further international funds is expected. **Socio-economic impacts:** ► Increasing capacities of renewable energy to a 30% share of electricity generation as well as increasing solar water heaters to 700 MW will increase GDP by almost 0.4%; ► Although imports will increase, the overall effects will be positive, with exports increasing by 0.1% and employment by 0.2%.

Experience in other regions

Reference	Geographical scope	Technologies addressed	Outlines of the report	Main conclusions
International Renewable Energy Agency (2014) The Socio-economic Benefits of Solar and Wind Energy	Not applicable	▶ Solar Power ▶ Wind Power	▶ Present the conceptual framework for analyzing value creation of renewable energy ▶ Analyze policies that stimulate deployment and aim at building a domestic industry ▶ Present an overview of the different methods that can be used to assess socio-economic impacts of renewable energy.	**Socio-economic impacts:** ▶ Analyzing socio-economic value creation of renewable energy: measure using macroeconomic variables such as value added, gross domestic product, welfare and employment ▶ Adopting the right policy mix to maximize value creation: encourage investment and technology transfer, strengthening capabilities, promoting education and training ▶ Gathering data and estimating value creation.
Energy Sector Management Assistance Program (2013) Development of Local Supply Chain: The Missing Link for Concentrated Solar Power Projects in India	India	▶ Concentrated Solar Power	▶ Assessment of the competitive position of industries in India to support the development of CSP technologies ▶ Evaluation of short-, medium-, and long-term economic benefits of the creation of a local manufacturing base ▶ Provide an action plan to stimulate local manufacturing of CSP components and equipment.	**Institutional framework:** ▶ Create a financial and regulatory environment that supports investment in R&D ▶ Establish of financial and political incentives for sustainable development. **Non-technologic concerns:** ▶ Lower the effective financial risks for investors, while factoring in the positive impacts on the environment, improvements in health, the natural habitat, and the quality of life that are associated with renewable energy in general and solar thermal technologies in particular.
German Development Institute (2013) Exploring the effectiveness of local content requirements in promoting solar PV manufacturing in India	India	▶ Photovoltaic	▶ Give an overview of the opportunities and challenges associated with localizing solar PV manufacturing; ▶ Explore the controversy over Local Content Requirements (LCRs) as a policy tool for localizing solar PV manufacturing and develops a framework for analyzing their effectiveness ▶ Evaluates LCR policy for solar PV technology in India.	**Institutional framework:** ▶ LCRs must be limited in duration and incorporate planned evaluation phases ▶ LCRs must focus on technologies and components for which technical expertise is available and global market entry barriers are manageable ▶ LCRs must be linked to additional mechanisms, such as training and promotion of business linkages and measures to support other stages of the value chain and wider services that are integral to success of renewable energy industries. ▶ However, Projects with local content requirements are not eligible for most Development Finance Institutions financing products.

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This document presents the findings of a study commissioned and jointly financed by the European Investment Bank (EIB), under the Facility for Euro-Mediterranean Investment and Partnership (FEMIP) Trust Fund, and the International Renewable Energy Agency (IRENA).

The study aims at assessing the capability of a selection of Mediterranean Partners Countries (MPCs) to develop local renewable energy manufacturing industries in the Mediterranean Partner Countries with a special focus on three pilot countries: Morocco, Tunisia and Egypt. The study provides also recommendations on the basis of the discussions held with stakeholders met in the three pilot countries. They were elaborated in response to the main difficulties and expectations expressed by these actors and with the objective to overcome the key barriers identified. They also capitalize upon the experience from other countries that have successfully developed RE manufacturing capacities.