



# Emerging innovation systems for renewable energy in MENA

A comparative perspective on Egypt and Morocco

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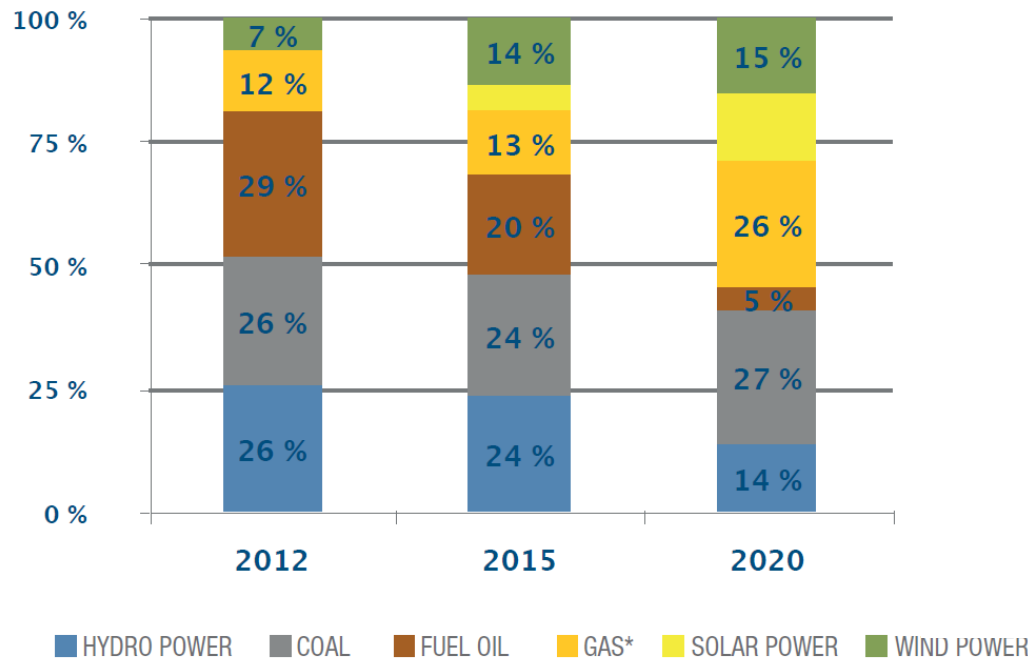


- The context for low carbon development in MENA
- The Sustainability-oriented Innovation System (SoIS) conceptual framework
- Egypt's and Morocco's renewable energy ambitions
- The emerging innovation systems in Egypt and Morocco
- Comparative perspectives

# The context for low carbon development in MENA

## ➤ Energy dependence on fossil-fuels

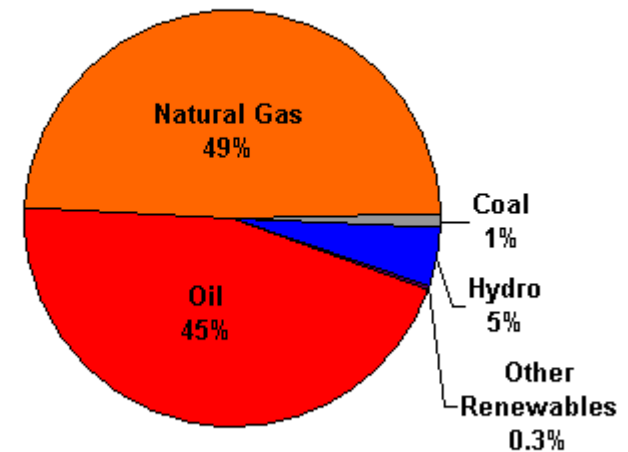
Morocco's Energy Mix, 2012



Source: MENAREC (2012)

Egypt's Energy Mix, 2008

Total Energy Consumption in Egypt, by Type (2008)

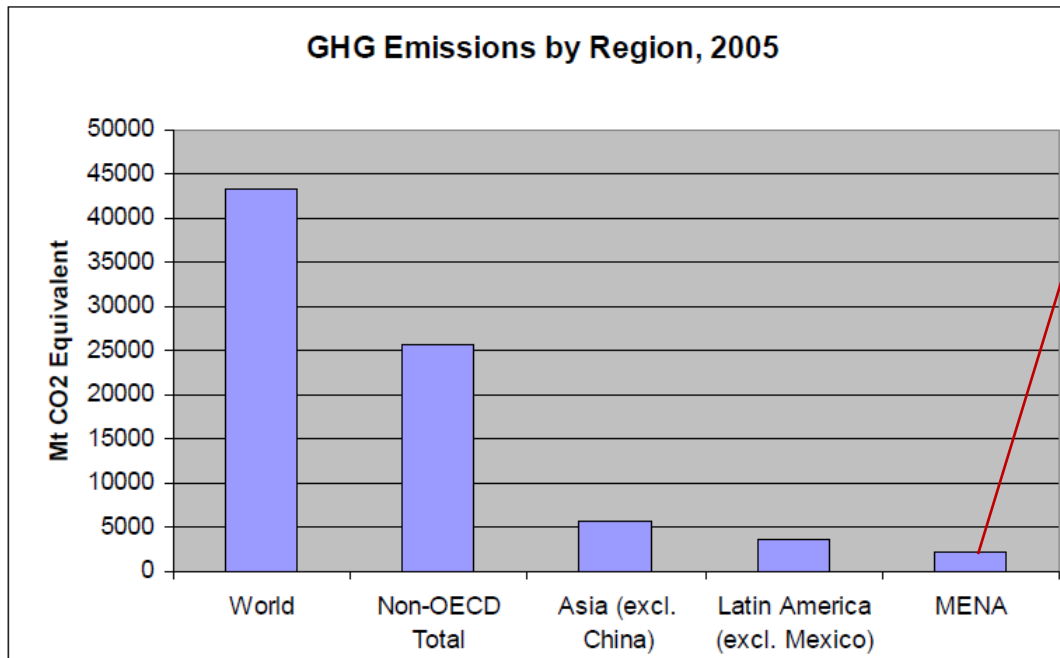


Source: EIA

# The context for low carbon development in MENA

## ➤ Climate change concerns:

- 85% of GHG emissions in the MENA region come from energy production, transformation and use (WB 2012)



Source: the IEA database

Source: WB (2008)

5% of total GHG emissions

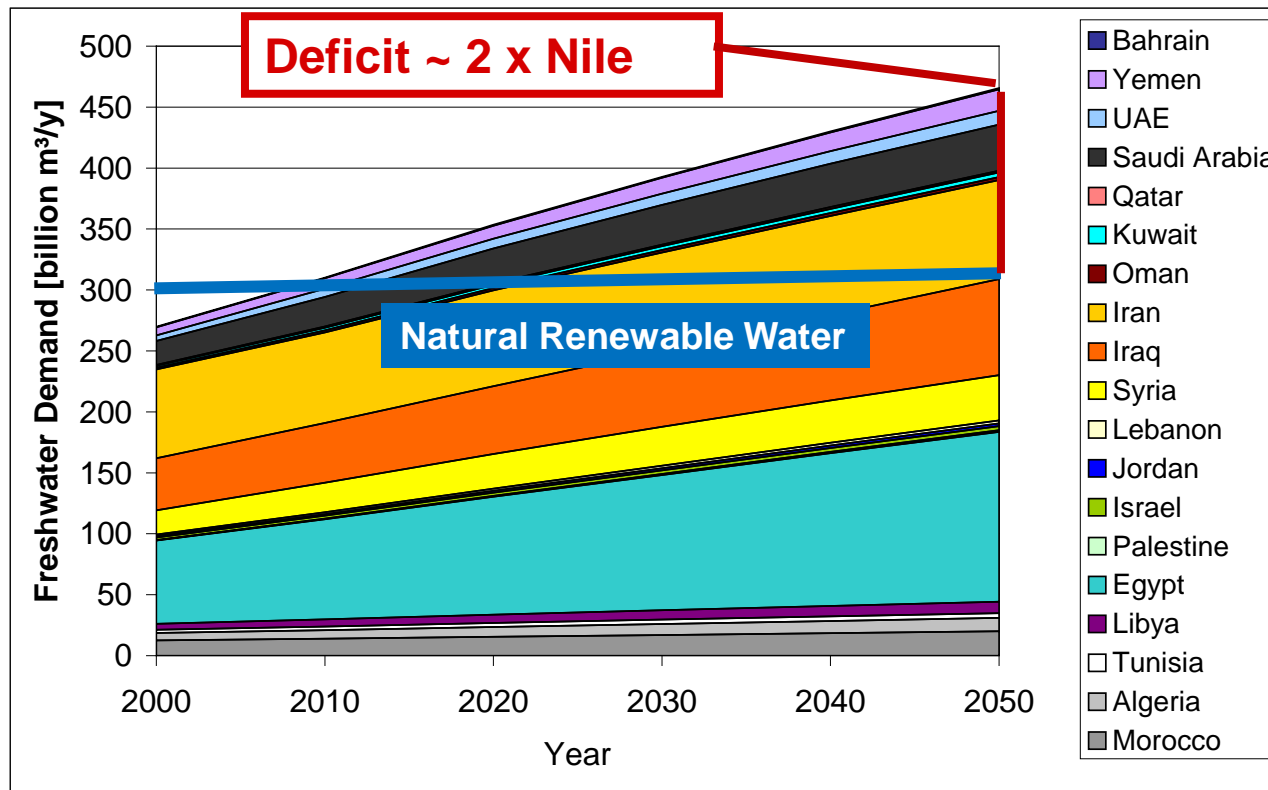
**Egypt** - 10% of total MENA GHG emissions

**Morocco** – 3% of the total MENA GHG emissions

# The context for low carbon development in MENA

## ➤ Climate change concerns:

- Water scarcity



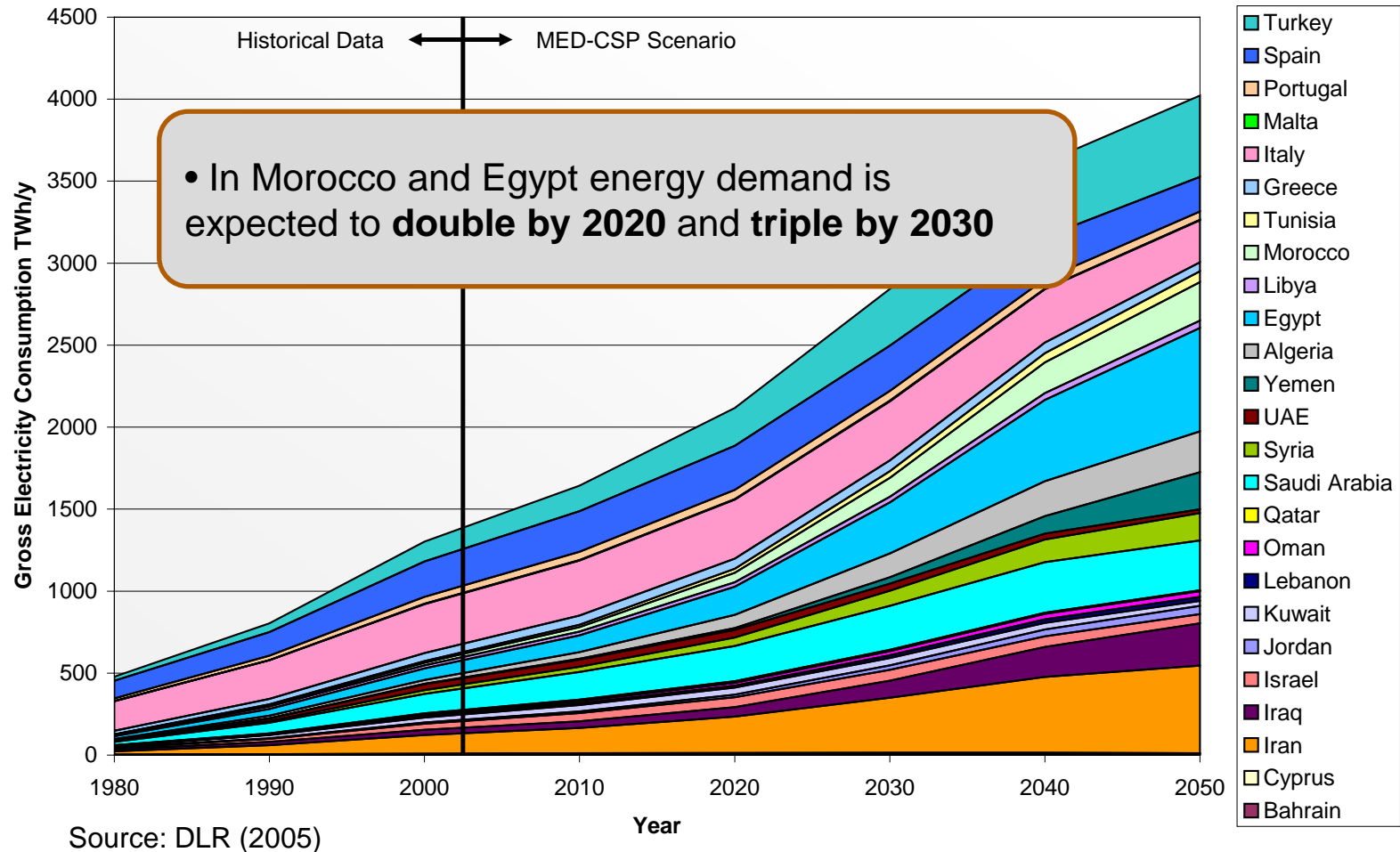
→ Hence, need for water desalination

→ But energy intensive

Source: H. Nokraschy (2011)

# The context for low carbon development in MENA

## Growing electricity demand around the Mediterranean region



# The context for low carbon development in MENA

➤ But...large potential for renewable energy across the region

	PV – Global Horizontal Irradiance (kWh/m <sup>2</sup> /y)	CSP – Direct Normal Irradiance (kWh/m <sup>2</sup> /y)	Wind – Full Load Hours per Year (h/y)
Morocco	2,000	2,600	2,708
Tunisia	1,980	2,400	1,789
Algeria	1,970	2,700	1,789
Egypt	2,450	2,800	3,015
Lebanon	1,920	2,000	1,176
Turkey	2,218	2,000	2,218
Spain	2,000	2,250	2,463
Italy	1,800	2,000	1,605
Greece	1,730	2,000	2,218

Source: DLR (2005)

# The context for low carbon development in MENA

## ➤ Opportunities for EU-MENA energy market integration



Source: DESERTEC Foundation

- Large investments have already been made: World Bank, KfW, EIB, ABfD, etc.
- National renewable energy targets
- Pilot projects in the pipeline



# The context for low carbon development in MENA

## ➤ Yet, low competitiveness and innovation potential

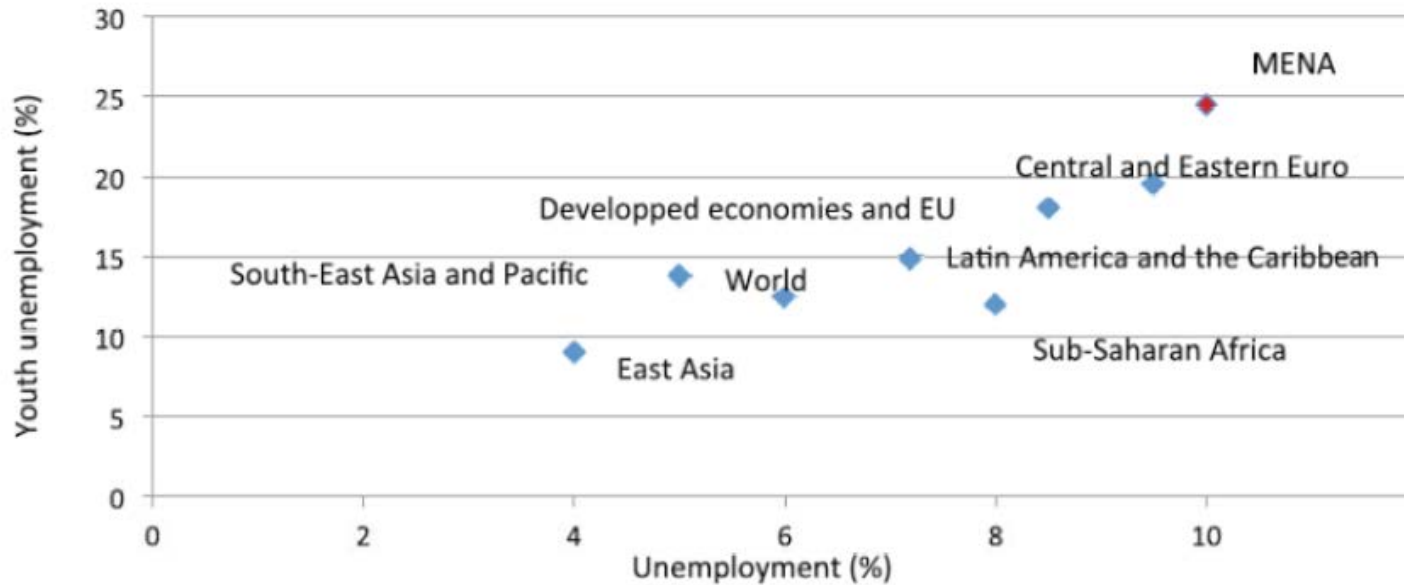
Regional differences among selected MENA countries based on relevant indicators (ranking out of 142 countries)

	MOR	ALG	TUN	EGY	TRK	LEB
Institutions	59	127	41	74	80	115
Business sophistication	80	135	52	72	58	51
Capacity for innovation	108	138	44	83	71	106
Quality of scientific research institutions	96	126	52	113	89	127
University-industry collaborations in R&D	102	136	58	128	74	111

Source: WEF (2012)

# The context for low carbon development in MENA

- High levels of unemployment among educated youth (2010 data)



Source: Ahmed, Guillaume and Furceri (2012), based on ILO and IMF data.

- Hence, industrial integration and the development of innovation-led economy are needed for long-term competitiveness

## ➤ **Research questions:**

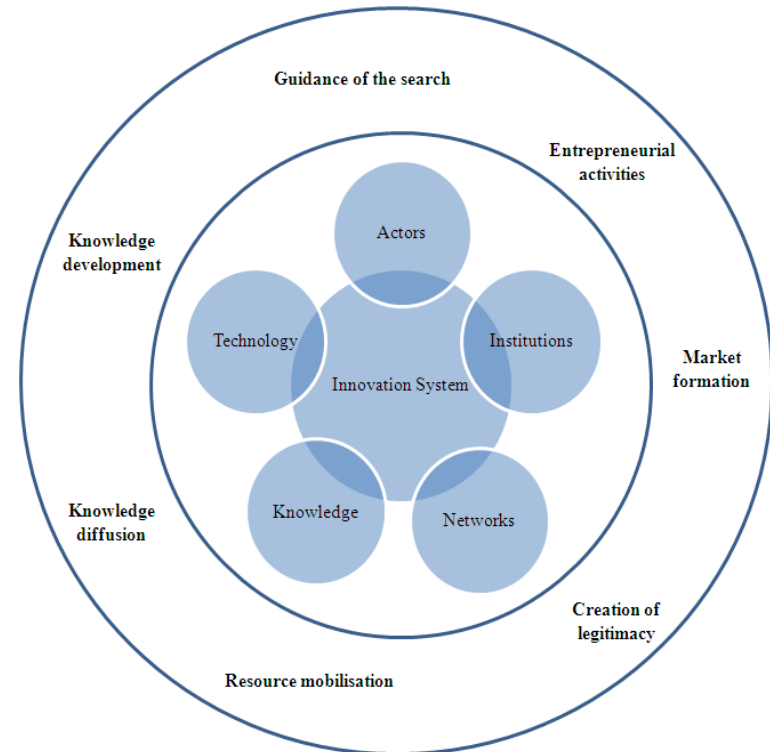
- How does the renewable energy agenda play into the emergence and functioning of the innovation system?
- What factors affect policy choices and how are different interests managed in the decision-making process?



## ➤ What is an innovation system?

“ .. the **elements and relationships** which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state.” (Lundvall, 1992)

Figure 1: Innovation System structure and functions



Note: The inner circle reflects the 'structure' of the innovation system, while the outer circle illustrates the 'functions' of the system.  
Source: Based on Bergek et al. (2008), Jacobsson and Bergek (2004), Suurs (2009).



- Sustainability-oriented Innovation System (SoIS)
  - builds on evolutionary innovation systems research (Lundvall, 1992)
  - but places stronger emphasis on governance and the sustainability transition process (Altenburg and Pegels 2012)



## ➤ New dimensions that the SoIS brings to the literature

### High demands on governance

- Need to overcome multiple market failures in developing and deploying technologies;
- Consensus on the overall direction of change and political settlements to compensate losers from reform;
- Change under considerable time pressure;
- Need to harmonise policy frameworks.

### Policies for internalizing environmental costs

- Policies such as carbon tax, fossil-fuel subsidy removal;
- Policies to support deployment of renewables, such as feed-in-tariffs.

### Divergence of national technological trajectories

- Need to take into account the specialisation paths of different countries because technology choices reflect national preferences and political settlements.

Source: Based on Altenburg and Pegels (2012)

# Egypt's and Morocco's renewable energy plans



## ➤ Egypt



- In 2008 Ministry of Electricity and Energy (MoEE) set a 20% target for RE by 2020
  - Aims to install 7.2 GW of wind energy, 100 MW of CSP, and 10 MW of PV
  - Favours wind energy technologies, with lower emphasis on solar energy
- The New and Renewable Energy Authority has been tasked with the implementation of the target



## ➤ Morocco



- In 2009 the Ministry of Energy, Mines, Water and Environment (MEME) set a 42% target for RE (including hydro) by 2020
  - Aims to install 2 GW of wind energy, and 2 GW of solar
  - The landmark project is in Oarzazate – 500 MW of CSP, the largest plant worldwide
- High commitment for green electricity exports – UfM/MSP, DII
- The Moroccan Agency for Solar Energy has been tasked with the implementation of the target and with industrial integration





## ➤ Actors and networks

- MoEE and NREA
- Private sector – dominated by large firms (Orascom, SWEG, NSF)
- Wind industry association present but provides limited assistance to local companies
- Several actors are missing (e.g. financiers, promotion agencies, research institutes)

## ➤ Knowledge and technologies

- With a few exceptions, educational programs are lacking for RE as well as close industry-academia cooperation
- Technology bias towards for wind energy, but research focus on solar

## ➤ Institutions

- No feed-in-tariff
- Several incentives are expected with the New Electricity Law



## ➤ Actors and networks

- MEMEE and MASEN
- ONE – national utility, ADEREE – national agency for promoting RE/EE
- SIE – investment fund in RE
- FENELEC and AMISOLE – industry associations for energy and RE companies
- The structure of the system is more integrated and dynamic

## ➤ Knowledge and technologies

- IRESEN – Institute for Solar Energy Research and New Energies
- The National Pact for Industrial Emergence & Moroccan Innovation Strategy
- Selected group of local universities for knowledge development

## ➤ Institutions

- No feed-in-tariff
- National Law on the framework for RE production, transmission and marketing (but only for high-voltage RE projects)
- Tentative incentives for private sector development



- Stronger **government commitments** to renewable energy in Morocco:
  - Clear responsibility and more authority into the decision-making structure;
  - New organisational structures have been created;
  - National funding agencies and agreements signed with foreign donors;
  - The energy sector has been decentralized creating more space for private investment;
  - More focus placed on building institutional capability in existing organisations.



- In Egypt the **governance of the innovation system** is weaker:
  - Too much control is concentrated in MoEE;
  - NREA lacks sufficient professional and organisational capabilities;
  - Weak role played by industry associations in building legitimacy for the sector;
  - Lack of a research laboratory/agency to create a platform of cooperation between private sector, academia and policy makers;
  - Information on renewable energy plans does not trickle down to the private sector.



- **Industrial integration** is critical for both countries: jobs and private sector development
  - But only Morocco has been proactive about developing a strategy
  - Local industrial base is weak in both countries – in Egypt the sector is dominated by large companies, while in Morocco, by small companies
  
- While **cooperation levels** are low in both countries, Egypt suffers from lack of platforms for cooperation within the private sector and with academia
  
- In both countries there is currently a **bias towards large-scale** renewable energy projects, with limited potential for technology transfer and job creation



- While wide gaps remain in both cases, **Morocco** is likely to better position its efforts towards **an integrated innovation system** with consideration for local industrial development.
- **Motivations are different in the two countries** (*dependence on imports, opportunities for export, commitment from higher up in the administration*)
  - ⇒ translates into different governance approaches (degrees of centralisation; perception of urgency for the energy transition; ind. dev. goals)
- **Higher political stability and stronger budgetary pressures in Egypt** are likely to stimulate stronger interest among policy-makers to speed up reforms for renewables → *opportunity to negotiate interests*



# Thank you for your attention!

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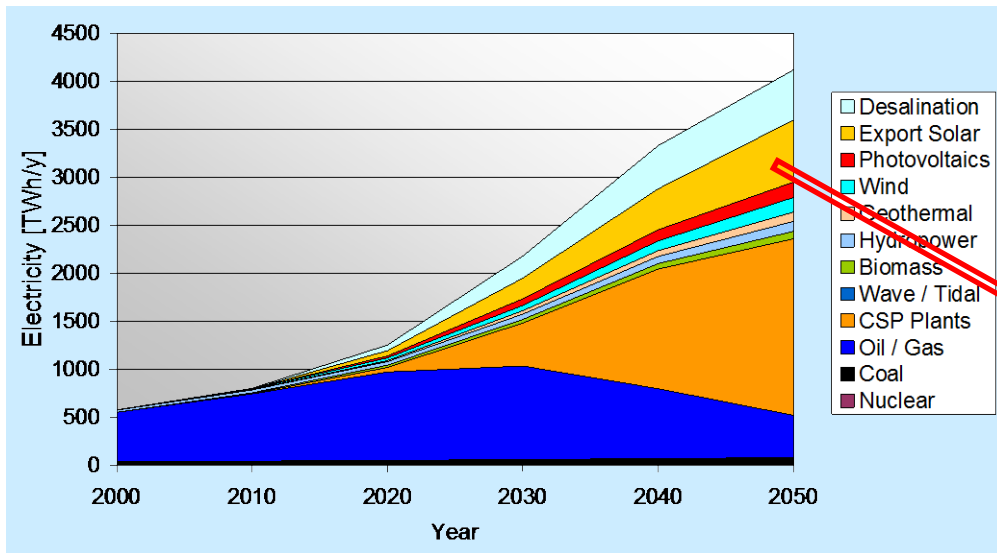
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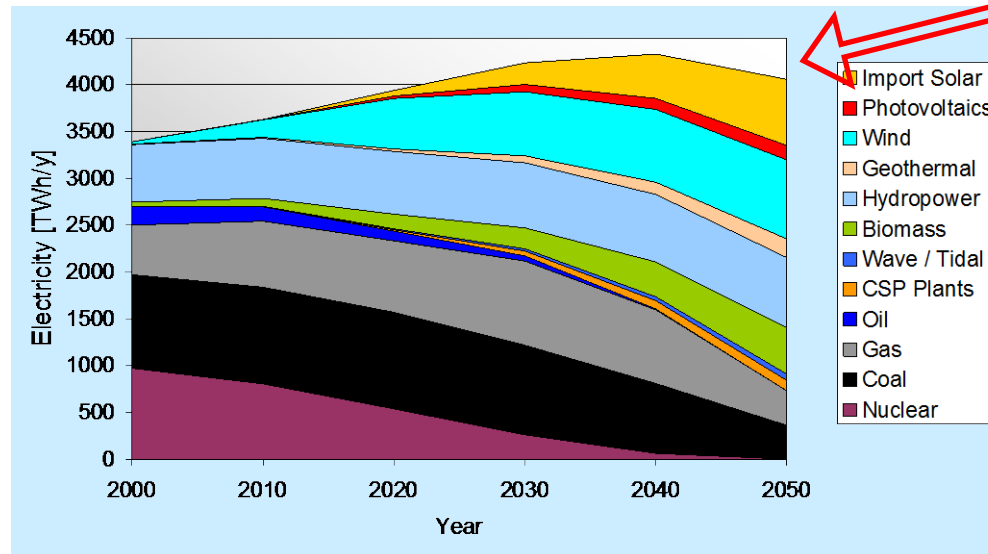
[www.die-gdi.de](http://www.die-gdi.de)

# The context for low carbon development in MENA



Transition Mix 2000-2050

in MENA,  
including 20% export to  
Europe and power  
for desalination



in EU-25, incl. 15%  
import from MENA

By clean power from  
deserts **EU gets clean  
firm capacity and may  
win 10-15 years in the  
fight against climate  
change.**

Source: H. Nokrashy (2011)





*Table 2: Summary of interviews by type of stakeholders*

<b>Type of stakeholders</b>	<b>Egypt</b>	<b>Morocco</b>
Government agency	8	3
Private sector companies	14	9
Industry associations	1	1
Academia and research	7	3
Development cooperation / international agency	10	7
<b>Total</b>	<b>40</b>	<b>22</b>

# The emerging SoIS in Egypt



	<b>Inducement mechanisms</b>	<b>Blocking mechanisms</b>
<b>Guidance of the search</b>	<ul style="list-style-type: none"> <li>-National target of 20% renewable energy by 2020.</li> <li>-Commitment towards renewable energy exemplified through existing projects in wind energy and solar.</li> </ul>	<ul style="list-style-type: none"> <li>-Policymaking and strategic decision-making are not transparent and are hampered by <b>political instability</b>.</li> <li>-<b>Lack of a national strategy</b> for industry and technology development.</li> <li>-<b>Lack of opportunities for local companies</b> to leverage the national renewable energy target for market development.</li> </ul>
<b>Market formation</b>	<ul style="list-style-type: none"> <li>-The New Electricity Law could offer attractive conditions for investment.</li> <li>-The national target could enable the creation of a local renewable energy market.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Lack of supportive incentives</b> for solar and wind power.</li> <li>-<b>Large subsidies</b> for conventional energy.</li> <li>-<b>Delays</b> in regulatory and institutional arrangements.</li> <li>-<b>Unclear organisational structure</b> for NREA, which results in delays in rolling out projects.</li> </ul>

# The emerging SoIS in Egypt



	<b>Inducement mechanisms</b>	<b>Blocking mechanisms</b>
<b>Entrepreneurial activities</b>	-The investment potential of large national companies can trigger the creation of a local industry.	-Lack of <b>start-up finance</b> . - <b>Mistrust amongst actors</b> due to clientelistic business relations. - <b>Lack of technical standards</b> and quality control. - <b>Limited opportunities for SMEs</b> to enter the new industry.
<b>Knowledge development (learning)</b>	-Collaborations with foreign universities and research institutes. -New training programs at universities and for professionals in the area of renewables.	- <b>Limited R&amp;D funding</b> to support technological adaptation. - <b>Lack of national research laboratories</b> , testing and certification centres.
<b>Knowledge diffusion</b>	-Various international workshops and conferences organised locally.	- <b>Lack of collaborations</b> between actors (including those from government and academia). - <b>Lack of dissemination</b> of information on renewables to the larger population.

# The emerging SoIS in Egypt



	<b>Inducement mechanisms</b>	<b>Blocking mechanisms</b>
<b>Resource mobilisation</b>	<ul style="list-style-type: none"> <li>-Availability of extensive solar and wind energy resources.</li> <li>-Financing from international donors for existing projects.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>High pressure on the national budget</b> due to political instability, economic crisis and subsidies.</li> <li>-<b>Underdeveloped human capital</b> (lack of renewable energy experts and skilled workforce).</li> <li>-<b>Lack of knowledge</b> on (and hence confidence in) renewables on the part of investors and banks.</li> </ul>
<b>Creation of legitimacy</b>	<ul style="list-style-type: none"> <li>-Reference projects, such as Kuraymat power plant have been implemented.</li> <li>-International visibility by adhering to DESERTEC's vision and cooperating with UfM in the development of the Mediterranean Solar Plan.</li> <li>-Hosting the regional centre RCREEE.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Vested interests</b> in fossil fuels.</li> <li>-<b>High levels of fossil fuel subsidies.</b></li> <li>-<b>Lack of strong lobby groups</b> for renewables.</li> <li>-<b>Low confidence</b> in and awareness about renewable energy.</li> <li>-<b>Limited curricula on renewables</b> in schools at different levels and few training programs for professionals.</li> </ul>

# The emerging SoLS in Morocco



	Inducement mechanisms	Blocking mechanisms
<b>Guidance of the search</b>	<ul style="list-style-type: none"> <li>-National target of 24% renewable energy by 2020 (2 GW solar energy and 2 GW wind energy).</li> <li>-Commitment towards renewable energy reflected by projects such as Oarzazate and several national initiatives to support the implementation of the national renewable energy target (i.e. MASEN, IRESEN, ADEREE).</li> </ul>	<ul style="list-style-type: none"> <li>-A comprehensive <b>national level strategy</b> is currently lacking, for industrial and technology development.</li> <li>-The <b>market for small and medium scale solar projects is not yet enabled</b>. Hence, local companies cannot leverage the national renewable energy target.</li> </ul>
<b>Market formation</b>	<ul style="list-style-type: none"> <li>-The national target and commissioning of upcoming projects, such as the 500 MW of solar energy and 850 MW of wind energy.</li> <li>-ONE has implemented the fixed tariff structure for renewable energy from large-scale producers.</li> <li>-A legal framework to enable the creation of a local market for large-scale renewable energy projects.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Lack of a FIT</b> for solar and wind.</li> <li>-<b>Closed market for small and medium size</b> solar projects, which prevents local SMEs from entering the market.</li> <li>-<b>Unpredictable market growth</b> beyond the 2 MW solar energy and 2 MW wind energy.</li> </ul>

# The emerging SoIS in Morocco



	<b>Inducement mechanisms</b>	<b>Blocking mechanisms</b>
<b>Entrepreneurial activities</b>	<ul style="list-style-type: none"> <li>-The existing investment funds for energy projects offer a window for entrepreneurial activities.</li> <li>-Attractive national innovation strategy and planning of CleanTech cluster development, which could spur entrepreneurship.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Lack of start-up finance.</b></li> <li>-<b>Lack of technical standards</b> and quality control.</li> <li>-<b>Limited opportunities for SMEs</b> to enter the new industry.</li> </ul>
<b>Knowledge development (learning)</b>	<ul style="list-style-type: none"> <li>-The establishment of IRESEN is likely to stimulate knowledge development and R&amp;D.</li> <li>-Collaborations with foreign universities and research institutes.</li> <li>-New training programs at universities and for professionals in the area of renewables.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Limited R&amp;D funding</b> to support technological adaptation.</li> <li>-<b>Lack of a cooperative culture</b> in technology development and R&amp;D.</li> <li>-<b>Scattered research activities</b> on technology adaptation.</li> </ul>
<b>Knowledge diffusion</b>	<ul style="list-style-type: none"> <li>-Various international workshops and conferences organised locally.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Limited dissemination of information</b> on renewables to the larger population.</li> <li>-<b>Limited opportunities for technology transfer</b> due to lack of low content rules in existing renewable energy projects (with the exception of solar water heaters).</li> </ul>

# The emerging SoIS in Morocco



	<b>Inducement mechanisms</b>	<b>Blocking mechanisms</b>
<b>Resource mobilisation</b>	<ul style="list-style-type: none"> <li>-Availability of extensive solar and wind energy resources.</li> <li>-Financing from international donors for existing projects as well as from SIE.</li> <li>-Studies have been conducted to identify the human resources needs associated with the planned renewable energy developments.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Less developed human capital</b> (lack of renewable energy experts and skilled workforce).</li> <li>-<b>Limited knowledge</b> of (and hence confidence in) renewables on the part of investors and banks.</li> </ul>
<b>Creation of legitimacy</b>	<ul style="list-style-type: none"> <li>-Reference projects, such as Ain Beni Mathar power plant and rural electrification programs have been implemented.</li> <li>-International visibility by adhering to DESERTEC's vision and cooperating with UfM in the development of the Mediterranean Solar Plan.</li> <li>-Strong industry association lobbying for the needs of local companies.</li> </ul>	<ul style="list-style-type: none"> <li>-<b>Lack of a clear road-map for industrial and technology development.</b></li> <li>-<b>Low confidence</b> in and awareness about renewable energy.</li> <li>-<b>Limited curricula on renewables</b> in schools at different levels and few training programs for professionals.</li> </ul>