Emerging innovation systems for renewable energy in MENA

A comparative perspective on Egypt and Morocco

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Outline

- 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydro Power</th>
<th>Coal</th>
<th>Fuel Oil</th>
<th>Gas*</th>
<th>Solar Power</th>
<th>Wind Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>26%</td>
<td>26%</td>
<td>24%</td>
<td>26%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>2015</td>
<td>24%</td>
<td>24%</td>
<td>20%</td>
<td>13%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>2020</td>
<td>27%</td>
<td>5%</td>
<td>20%</td>
<td>13%</td>
<td>14%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Egypt’s Energy Mix, 2008

Total Energy Consumption in Egypt, by Type (2008)

- Natural Gas: 49%
- Oil: 45%
- Hydro: 5%
- Coal: 1%
- Other Renewables: 0.3%

Source: EIA

Source: MENAREC (2012)
Climate change concerns:

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

**Graph:**

- **Egypt** - 10% of total MENA GHG emissions
- **Morocco** – 3% of the total MENA GHG emissions

**Source:** IEA database

**Source:** WB (2008)
Climate change concerns:

- Water scarcity

Hence, need for water desalination

But energy intensive

Source: H. Nokraschy (2011)
Growing electricity demand around the Mediterranean region

- In Morocco and Egypt energy demand is expected to **double by 2020** and **triple by 2030**

Source: DLR (2005)
The context for low carbon development in MENA

- But…large potential for renewable energy across the region

<table>
<thead>
<tr>
<th></th>
<th>PV – Global Horizontal Irradiance (kWh/m²/y)</th>
<th>CSP – Direct Normal Irradiance (kWh/m²/y)</th>
<th>Wind – Full Load Hours per Year (h/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morocco</td>
<td>2,000</td>
<td>2,600</td>
<td>2,708</td>
</tr>
<tr>
<td>Tunisia</td>
<td>1,980</td>
<td>2,400</td>
<td>1,789</td>
</tr>
<tr>
<td>Algeria</td>
<td>1,970</td>
<td>2,700</td>
<td>1,789</td>
</tr>
<tr>
<td>Egypt</td>
<td>2,450</td>
<td>2,800</td>
<td>3,015</td>
</tr>
<tr>
<td>Lebanon</td>
<td>1,920</td>
<td>2,000</td>
<td>1,176</td>
</tr>
<tr>
<td>Turkey</td>
<td>2,218</td>
<td>2,000</td>
<td>2,218</td>
</tr>
<tr>
<td>Spain</td>
<td>2,000</td>
<td>2,250</td>
<td>2,463</td>
</tr>
<tr>
<td>Italy</td>
<td>1,800</td>
<td>2,000</td>
<td>1,605</td>
</tr>
<tr>
<td>Greece</td>
<td>1,730</td>
<td>2,000</td>
<td>2,218</td>
</tr>
</tbody>
</table>

Source: DLR (2005)
The context for low carbon development in MENA

- Opportunities for EU-MENA energy market integration

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

Source: DESERTEC Foundation
Yet, low competitiveness and innovation potential

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

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

Source: WEF (2012)
High levels of unemployment among educated youth (2010 data)

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

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

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)
## The SoIS

- **New dimensions that the SoIS brings to the literature**

<table>
<thead>
<tr>
<th>High demands on governance</th>
<th>Policies for internalizing environmental costs</th>
<th>Divergence of national technological trajectories</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Need to overcome multiple market failures in developing and deploying technologies;</td>
<td>• Policies such as carbon tax, fossil-fuel subsidy removal;</td>
<td>• Need to take into account the specialisation paths of different countries because technology choices reflect national preferences and political settlements.</td>
</tr>
<tr>
<td>• Consensus on the overall direction of change and political settlements to compensate losers from reform;</td>
<td>• Policies to support deployment of renewables, such as feed-in-tariffs.</td>
<td></td>
</tr>
<tr>
<td>• Change under considerable time pressure;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Need to harmonise policy frameworks.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
Egypt’s and Morocco’s renewable energy plans

- **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
The emerging SoIS in Egypt

- **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 wind energy, but research focus on solar

- **Institutions**
  - No feed-in-tariff
  - Several incentives are expected with the New Electricity Law
The emerging SoIS in Morocco

- **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
Comparative perspectives

- **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.
Comparative perspectives

- **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
Concluding remarks

- 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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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**

<table>
<thead>
<tr>
<th>Type of stakeholders</th>
<th>Egypt</th>
<th>Morocco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government agency</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Private sector companies</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Industry associations</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Academia and research</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Development cooperation / international agency</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>
## The emerging SoIS in Egypt

<table>
<thead>
<tr>
<th>Inducement mechanisms</th>
<th>Blocking mechanisms</th>
</tr>
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<tbody>
<tr>
<td><strong>Guidance of the search</strong></td>
<td>- Policymaking and strategic decision-making are not transparent and are hampered by political instability.</td>
</tr>
<tr>
<td>- Commitment towards renewable energy exemplified through existing projects in wind energy and solar.</td>
<td>- Lack of opportunities for local companies to leverage the national renewable energy target for market development.</td>
</tr>
<tr>
<td><strong>Market formation</strong></td>
<td>- Lack of supportive incentives for solar and wind power.</td>
</tr>
<tr>
<td>- The New Electricity Law could offer attractive conditions for investment.</td>
<td>- Large subsidies for conventional energy.</td>
</tr>
<tr>
<td>- The national target could enable the creation of a local renewable energy market.</td>
<td>- Delays in regulatory and institutional arrangements.</td>
</tr>
<tr>
<td></td>
<td>- Unclear organisational structure for NREA, which results in delays in rolling out projects.</td>
</tr>
</tbody>
</table>
## The emerging SoIS in Egypt

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

<table>
<thead>
<tr>
<th>Inducement mechanisms</th>
<th>Blocking mechanisms</th>
</tr>
</thead>
</table>
| **Resource mobilisation** | **-High pressure on the national budget** due to political instability, economic crisis and subsidies.  
**-Underdeveloped human capital** (lack of renewable energy experts and skilled workforce).  
**-Lack of knowledge** on (and hence confidence in) renewables on the part of investors and banks. |
| -Availability of extensive solar and wind energy resources.  
-Financing from international donors for existing projects. |  |
| **Creation of legitimacy** | **-Vested interests** in fossil fuels.  
**-High levels of fossil fuel subsidies.**  
**-Lack of strong lobby groups** for renewables.  
**-Low confidence** in and awareness about renewable energy.  
**-Limited curricula on renewables** in schools at different levels and few training programs for professionals. |
| -Reference projects, such as Kuraymat power plant have been implemented.  
-International visibility by adhering to DESERTEC’s vision and cooperating with UfM in the development of the Mediterranean Solar Plan.  
-Hosting the regional centre RCREEE. |  |
## The emerging SoIS in Morocco

<table>
<thead>
<tr>
<th>Guidance of the search</th>
<th>Inducement mechanisms</th>
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</tr>
</thead>
</table>
|                        | - National target of 24% renewable energy by 2020 (2 GW solar energy and 2 GW wind energy).  
- Commitment towards renewable energy reflected by projects such as Ouarzazate and several national initiatives to support the implementation of the national renewable energy target (i.e. MASEN, IRESEN, ADEREE). | - A comprehensive national level strategy is currently lacking, for industrial and technology development.  
- The market for small and medium scale solar projects is not yet enabled. Hence, local companies cannot leverage the national renewable energy target. |

<table>
<thead>
<tr>
<th>Market formation</th>
<th>Inducement mechanisms</th>
<th>Blocking mechanisms</th>
</tr>
</thead>
</table>
|                  | - The national target and commissioning of upcoming projects, such as the 500 MW of solar energy and 850 MW of wind energy.  
- ONE has implemented the fixed tariff structure for renewable energy from large-scale producers.  
- A legal framework to enable the creation of a local market for large-scale renewable energy projects. | - Lack of a FIT for solar and wind.  
- Closed market for small and medium size solar projects, which prevents local SMEs from entering the market.  
- Unpredictable market growth beyond the 2 MW solar energy and 2 MW wind energy. |
## The emerging SoIS in Morocco

<table>
<thead>
<tr>
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<th>Blocking mechanisms</th>
</tr>
</thead>
</table>
| **Entrepreneurial activities** | - The existing investment funds for energy projects offer a window for entrepreneurial activities.  
- Attractive national innovation strategy and planning of CleanTech cluster development, which could spur entrepreneurship. |
| - Lack of start-up finance.  
- Lack of technical standards and quality control.  
- Limited opportunities for SMEs to enter the new industry. |
| **Knowledge development (learning)** | - The establishment of IRESEN is likely to stimulate knowledge development and R&D.  
- Collaborations with foreign universities and research institutes.  
- New training programs at universities and for professionals in the area of renewables. |
| - Limited R&D funding to support technological adaptation.  
- Lack of a cooperative culture in technology development and R&D.  
- Scattered research activities on technology adaptation. |
| **Knowledge diffusion** | - Various international workshops and conferences organised locally. |
| - Limited dissemination of information on renewables to the larger population.  
- Limited opportunities for technology transfer due to lack of low content rules in existing renewable energy projects (with the exception of solar water heaters). |
The emerging SoIS in Morocco

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</tr>
<tr>
<td>-Availability of extensive solar and wind energy resources.</td>
<td>-Limited knowledge of (and hence confidence in) renewables on the part of investors and banks.</td>
</tr>
<tr>
<td>-Financing from international donors for existing projects as well as from SIE.</td>
<td></td>
</tr>
<tr>
<td>-Studies have been conducted to identify the human resources needs associated with the planned renewable energy developments.</td>
<td></td>
</tr>
<tr>
<td><strong>Creation of legitimacy</strong></td>
<td><strong>Lack of a clear road-map for industrial and technology development.</strong></td>
</tr>
<tr>
<td>-Reference projects, such as Ain Beni Mathar power plant and rural electrification programs have been implemented.</td>
<td>-Low confidence in and awareness about renewable energy.</td>
</tr>
<tr>
<td>-International visibility by adhering to DESERTEC´s vision and cooperating with UfM in the development of the Mediterranean Solar Plan.</td>
<td>-Limited curricula on renewables in schools at different levels and few training programs for professionals.</td>
</tr>
<tr>
<td>-Strong industry association lobbying for the needs of local companies.</td>
<td></td>
</tr>
</tbody>
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