Renewable potentials and power system development among the Arab countries: *Dii’s report Desert Power: Getting started*

AUE/MEDELEC/Dii Workshop hosted by STEG

Tunis, 16.04.2014

Philipp Godron
Electricity in EUMENA is a challenge & opportunity for decades to come

Demand in MENA almost doubles every ten years – Electricity consumption (TWh)

EUMENA must renew power plants and reduce emissions

Note: Calculated consumption
Source: IEA - Data Services; EIA and UDI power plant data bases
Long term: MENA and Europe perfect partners since demand as well as supply complimentary

Average summer day [TW]

Average winter day [TW]

Lessons learned for 2050

- MENA and Europe demand with seasonal fit
- MENA and Europe Wind regimes complimentary
- MENA solar power strongest when European winds weak
- Strong grids needed in any case, EUMENA grid integration ensures best payback

Source: Dii, Fraunhofer ISI
Desert Power: Getting Started (DP:GS) identifies concrete actions for RE in MENA

Desert Power 2050

June 2012

What are the benefits of an integrated, sustainable EUMENA power system?

Desert Power: Getting Started

June 2013

What needs to be done in the next 10-20 years to enable an integrated, sustainable EUMENA power system?
For DP:GS, Dii analyzed quantitative and qualitative aspects of RE development in MENA.
Already today, potential of 800 GW of attractive Solar & Wind near roads, grids and cities in MENA.
Renewable electricity at no extra cost until 2020

Expected cost of RE installations in MENA today and until 2020

[€ct/kWh]

Source: Dii  Note: RE LCOE calculated based on identified sites and country-specific Dii cost of capital estimates
Conventional generation has been estimated with 40€/MWh for Coal, 60€/MWh for CCGT, 90€/MWh OCGT for and up to 200€/MWh for oil-fired power plants.
Renewable energy capacities on the rise across EUMENA

1.2 Desertec - From vision to reality

RE projects\(^1\) operating in MENA countries today and in 2015\(^2\) [MW]

1) Grid-connected CSP, PV and Wind projects with a capacity above 1 MW; 2) The forecast takes into account projects that are in operation, under construction or have already been awarded; Subsequently, projects that are still in the tendering process or only have been announced are not included; Last update 02/2014

Source: Dii
Improved regulation required to build more RE plants

Must-haves until 2020

Secure land access
Regulated grid access
Transparent & complete permitting information
Easy access to measured wind/solar data
Direct access to (range of) customers

Reliable framework for RE

General country risk
Financing
Fiscal regulation
National / international inv. reg.
Strategic RE targets
Support mechanism

High RE Deployment possible

Labor market
Cross border electricity trade

Urgence for private sector actors
Sustainable EUMENA system will be based on RE build-up in both MENA & Europe also beyond 2020

Electricity generation mix and RE shares in EUMENA (in TWh)

**Europe**

- **2020 targets**
  - New gas
  - Biomass
  - PV
  - CSP
  - Wind off-shore
  - Wind on-shore
  - Hydro
- **2020**
  - ~4,800
- **2030**
  - ~5,150
  - ~60%
- **2040**
  - ~5,500
  - ~80%
- **2050**
  - >90%

**MENA**

- **50GW Solar and Wind**
  - Existing Gas, Coal and Oil
- **2020**
  - ~1,400
  - ~45%
- **2030**
  - ~2,150
  - ~80%
- **2040**
  - ~3,000
  - ~98%
- **2050**

Source: Fraunhofer ISI, Dii, TU Wien
Today’s fossil fuel subsidies dwarf the needed RE support

RE support expenditures\(^1\) for post-2020 RE in EUMENA [bn EUR]

IEA 2012: worldwide fossil fuel subsidies of USD550bn. 50% of that in MENA

Cumulative over 30 years: ~ €390bn.

1. Calculated based on a harmonized FiP across EUMENA
Source: Dii, Fraunhofer ISI, TU Vienna  Note: RES-E only includes PV, CSP, Wind offshore, Wind onshore
Cost optimized power system 2050 requires strong grids to match renewables and demand

Lessons learned

- Build RE in MENA and in Europe (not “or”)
- Strong increase of transmission in Europe, in MENA and in between
- MENA-Europe interconnectors used in both directions
- North-south strongest early on
- South-north gains importance with increasing RE share

Source: Fraunhofer ISI, Dii, TU Wien
Many necessary institutions and processes exist …

Source: Dii
challenge is to cooperate & prepare the ground ...
… for a common EUMENA renewables framework
Robert Schuman, 9 May 1950:
“Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity”
Thank you very much for your interest!

available online
to download free of charge at:
Cost optimized RE allocation requires grid infrastructure for EUMENA power system

Power Exchange (TWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>MENA-EU Exchange</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 TWh</td>
<td>~600</td>
<td>~1,800</td>
<td>~3,650</td>
</tr>
</tbody>
</table>

Within MENA: ~600
Within Europe: ~1,800
Share of power flows South to North: ~3,650

EUMENA Renewables and Grid 2050

Source: Fraunhofer ISI, Dii, TU Wien
REDIMENA - An innovative approach to supporting project development in MENA

**Investors:** invest total of €30M / $40M into REDIMENA, e.g. from

| Private Financial Investors | Regional Finance Institutions | Sovereign Wealth Funds | Development Finance Institutions |

**Founder / Advisors**

Establish and define investment strategy for REDIMENA, provide execution know-how to developers

**Buyers**

acquire well-developed projects from portfolio for construction

- Strategic buyers (e.g. IPPs, utilities)
- Funds
- Technology companies

**REDIMENA**

Invest €1-4M and know-how into early-stage projects, then sell at attractive multiples

**Targets:** Local entrepreneurs developing PV, Wind, CSP projects

Source: Dii

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19 February 2015
Desertec vision ‘Renewable Energy from the Deserts’ – Development phases

- **2004**
  - Great Idea!
  - Pre-phase
  - Studies on the Desertec vision by DLR (Deutsche Luft- und Raumfahrzentrum) and TREC (Trans-Mediterranean renewable energy Cooperation Studies)
  - Creation of awareness and euphoria

- **2009**
  - It works!
  - Concept phase
  - Foundation of Dii in 2009
  - System, country and technology studies by Dii supported by Dii’s industrial, research and political network (e.g. Fraunhofer, CESI, Sonelgaz)
  - Local adoption of idea
  - Preparation of services for implementation phase

- **2015**
  - First Harvest!
  - Implementation phase
  - Implementation of plans and recommendations to reach 2020 MENA RE targets of 50GW
  - Identifying and seizing concrete business opportunities
  - Expansion of international industry network and partnerships

- **2020**
  - Acceleration!
  - Scale Up phase
  - Market acceleration towards full renewable energy supply in MENA
  - Market coupling with Europe and increase of Desert Power share in European energy mix

Source: Dii
Dii is backed by an extensive industry network and numerous partnerships with major associations and institutions

1.1 Dii – An international industrial initiative

International industry network and partnerships

Dii Shareholders and Partners

Partnerships

Note: As of December 2013
RE capacity in MENA will likely double in the next two years; many additional RE projects are in the pipeline

1.2 Desertec - From vision to reality

RE project build-up in MENA\(^1\) [MW]

1) MENA includes 16 countries: Algeria, Bahrain, Egypt, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, UAE, Yemen
2) CAGR does not include announced/planned projects; 3) The forecast takes into account projects that are in operation, under construction or awarded; “Announced/planned” includes announced projects and projects that are still in the tendering phase; Last update 02/2014

Source: Dii