

Latest renewable's developments in Morocco and the lessons learned

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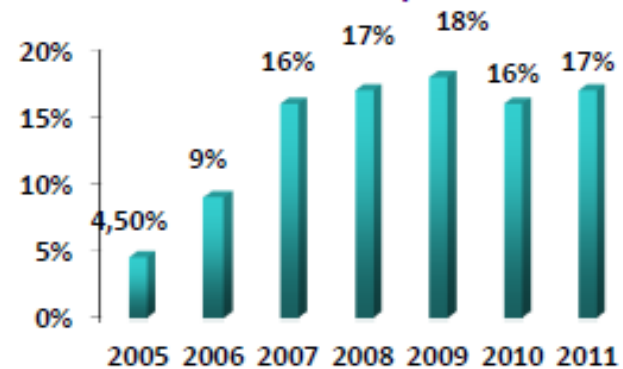
-National School of Applied Sciences-
Kenitra

-Moroccan Society of Renewable Energy
Development (SMADER)

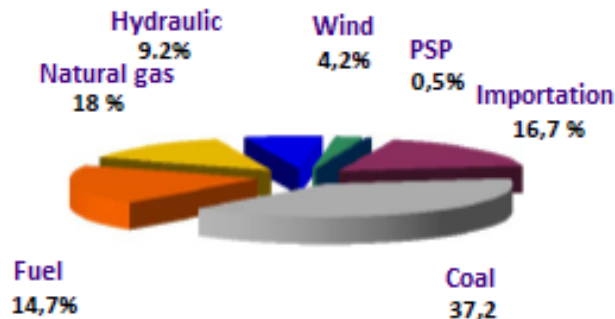
Moroccan electricity sector in 2013

- Consumed energy : 32 026 GWh
- Importation : 5 348 GWh
- Installed capacity : 6 892 MW
 - From renewables : 2 225 MW

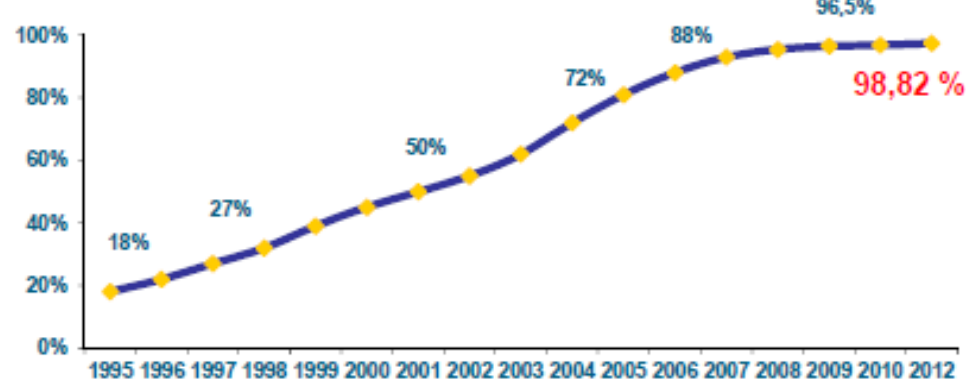
Contribution of Importations



Injected electricity by type of fuel



Evolution of the rural electrification



(Source: MEMEE, 2014)

Primary energy consumption per capita: 0.54 TOE
World average: 1.84 TOE

Electricity consumption per capita: 864 kWh
World average: 313 kWh

TAQA,

AN INTERNATIONAL ENERGY
COMPANY COMMITTED TO
DEVELOPMENT IN MOROCCO

Created in 1997, the Jorf Lasfar Energy Company (JLEC), a subsidiary of the TAQA Group, is a major player of the energy sector in Morocco. It supplies more than 50% of the national demand of electricity and 30% of the installed capacity.



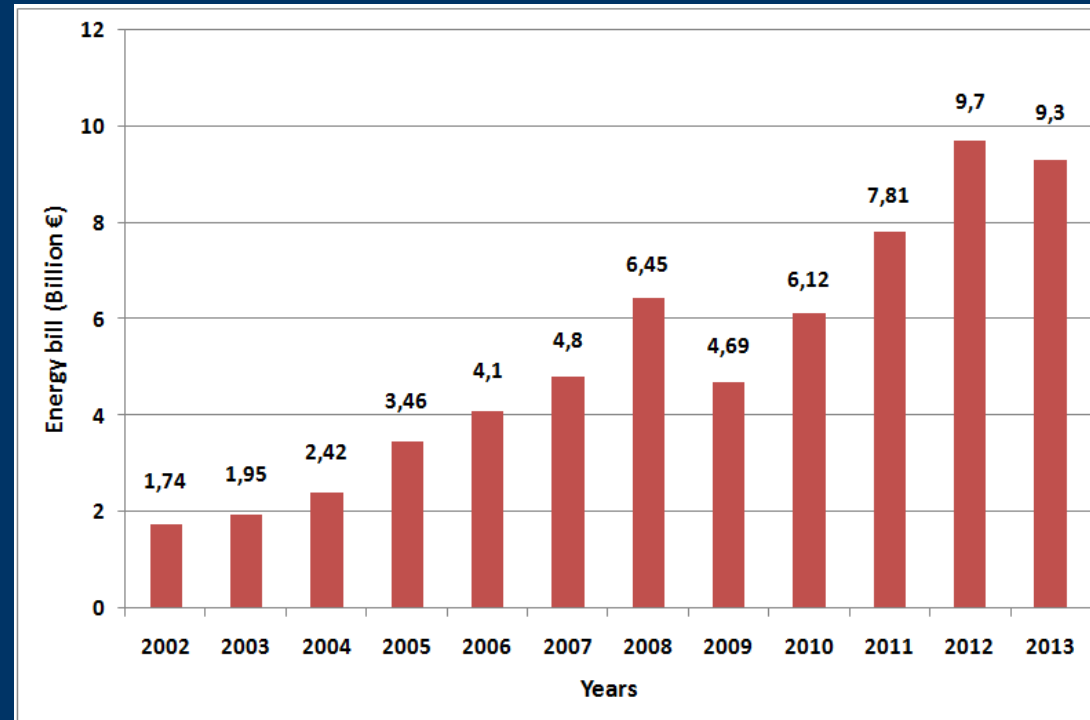
(Source: TAQA)



Moroccan energy context



Moroccan energy context

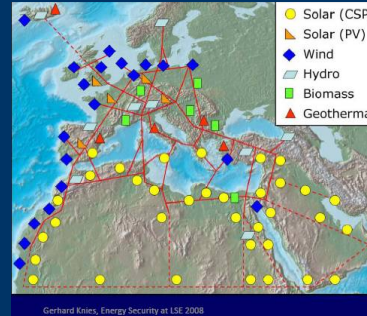


Various initiatives of renewable energy development

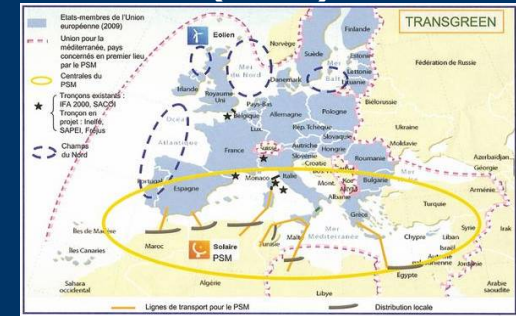
Mediterranean Solar Plan (13th July 2008)



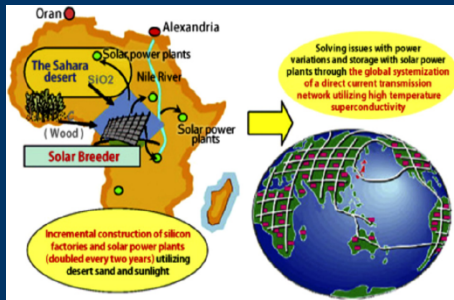
Desertec Industrial Initiative (13th July 2009)



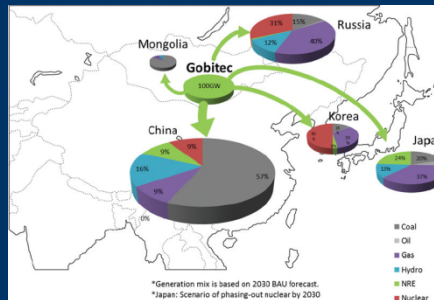
MEDGRID (2010)



Sahara Solar Breeder (2009)



Gobitec (2010)



SunShot (2011)



Major Economies Forum on Energy and Climate (MEF, 28 mars 2009)



International Renewable Energy Agency (IRENA, janvier 2009)



The year 2008



Financial crisis



Desertec Concept



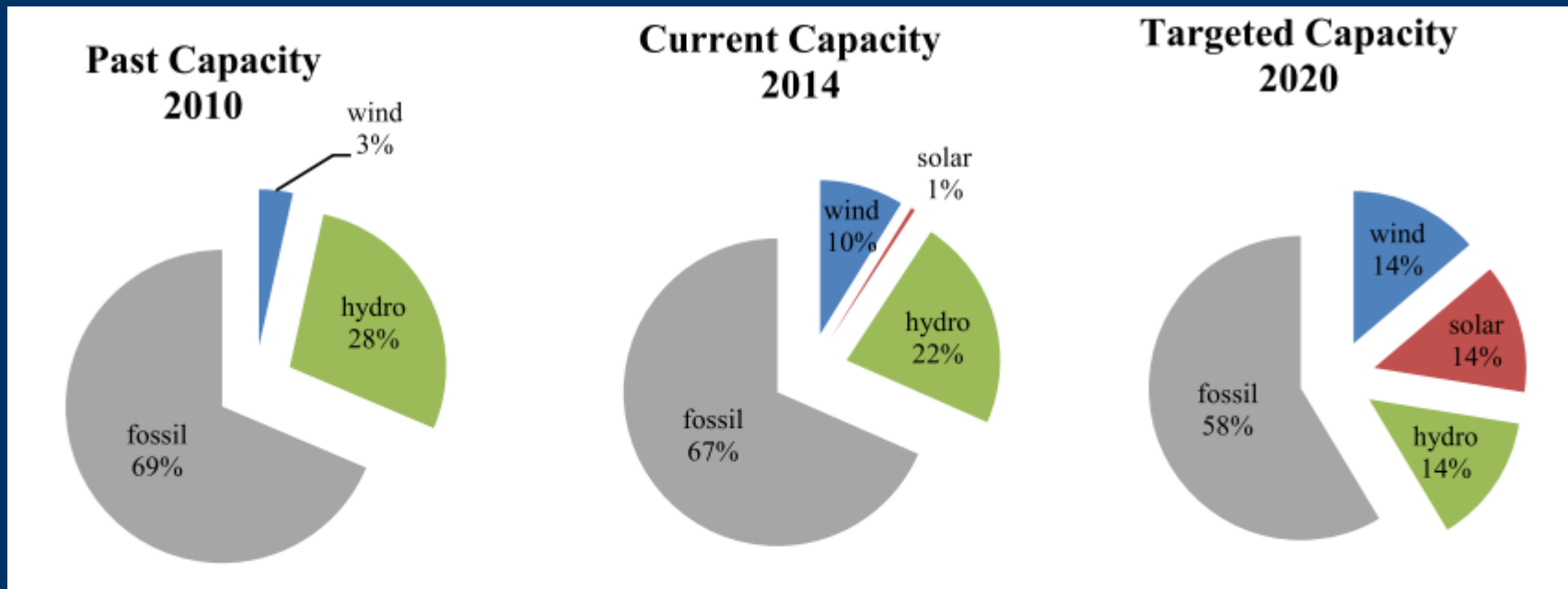
Renewable energies: a crucible of new ideas and new technologies



Innovation

Economic recovery

MOROCCAN RENEWABLE ENERGY'S STRATEGY



▪ **At the end of 2020 : 42% of the electricity capacity installed will be based on Renewable Energies**

Alhamwi, A., Kleinhans, D., Weitemeyer, S. and Vogt, T. (2015): Moroccan National Energy Strategy reviewed from a meteorological perspective. In: Energy Strategy Reviews, 6, 39-47.

Moroccan Renewable Energy's Program

Wind energy

- End 2014 → **1 GW**
(787 MW in operation + 200 MW under construction)
- By 2020 → **+ 1 GW**
(850 MW + 150 MW Integrated Wind Energy Program)
- Total → **2 GW**

PV

- By 2020 : **800 - 1000 MW**

CS

P

- By 2020 : **~ 1000 MW**

National support of the solar program

MASEN

Moroccan Agency of Solar Energy (2009)

SIE

Energy Investment Society (2009)

IRESEN

Research Institute on Solar Energy and New Energies (2011)

Laws related to Energy Efficiency and Renewable Energies

Law 40-08 establishing the Energy Development Fund

Law 13-09 related to renewable energies

Law 16-09 related to the Agency of E.E and Ren En development (ADEREE)

Law 47-09 related to energy efficiency

Law 57-09 establishing the Moroccan Agency of Solar Energy (MASSEN)

ONEE Laws, 16-08, 40-09, 54-14

Law 48-15 on the regulation of the electricity sector

Law 58-15 related to renewable energies

MOROCCO'S SOLAR ENERGY INTEGRATED PROJECT

**Installed capacity
by 2020**

- **2000 MW**
- **Ouarzazate : The first solar plant under operation in 2015**

Generation

- **≈ 4500 Gwh per year**

**Estimated
investment cost**

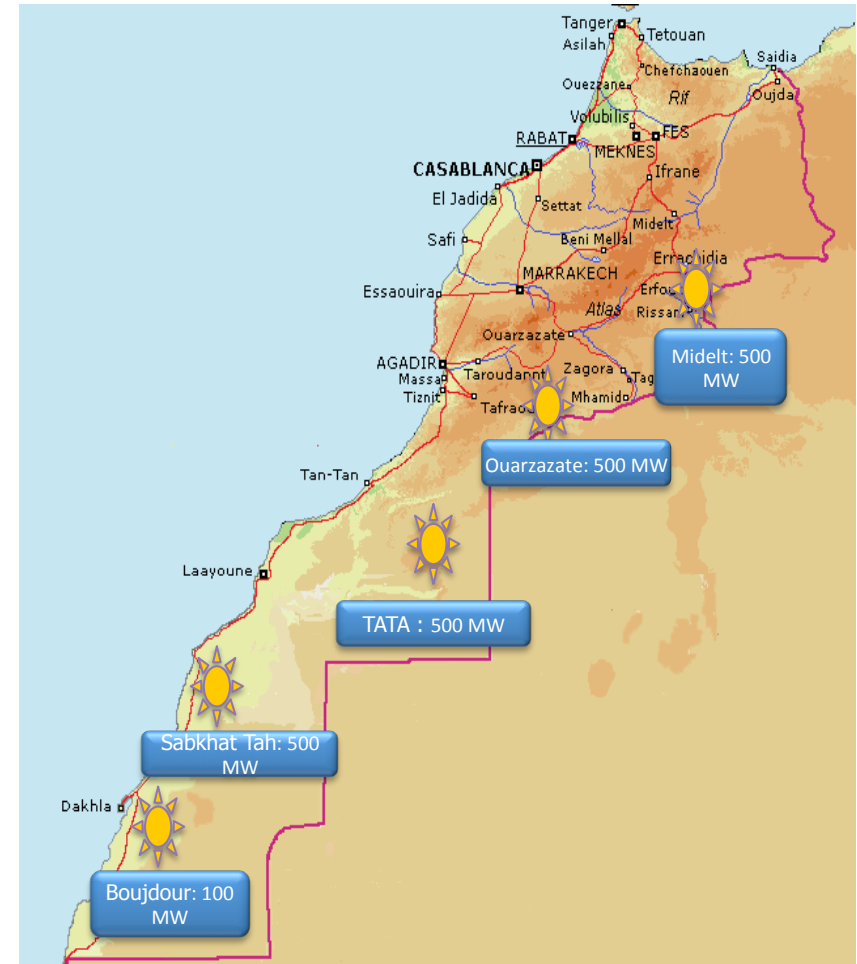
- **9 billions of US\$**

Fuel annual save

- **1 million of TOE per year**

**CO₂ emission
avoided**

- **3,7 millions Tons per year**



- Solar Radiation: 5kWh/m²/year;
- 160 MW CSP Power Plant under construction in Ouarzazate (2015, Parabolic trough)
- 350 MW CSP Power Plant Project in progress in Ouarzazate (2017 Parabolic trough and);
- A project of 400 MW PV Power Plants will be located at the end of transmission lines (2016-2018).

Noor I Ouarzazate (2015)

Technology

Parabolic Trough

Capacity

160 MW_e

Storage

3h Molten Salts

DNI

2635 kWh/m².year

Surface

480 ha

Developer



EPC



Owner's Engineer



(Source: MASEN)

Noor II and III Ouarzazate

Noor II

Parabolic Trough (200 MW)

Noor III

Solar Tower (150 MW)

Storage: 7-8h

(Source: MASEN)

Photovoltaic (0NEE)

Phase

1

Noor Tafilalt 75 – 100 MW (2016)

Phase

2

Noor Atlas 200 MW (2017)

Phase

3

Noor Argana 125 MW (2017)

MOROCCAN INTEGRATED WIND PROJECT 2000 MW

**Installed capacity
by 2020**

- 2000 MW
- Taza : The first Wind farm under operation in 2015

Generation

- ≈ 6600 Gwh per year

**Estimated
investment cost**

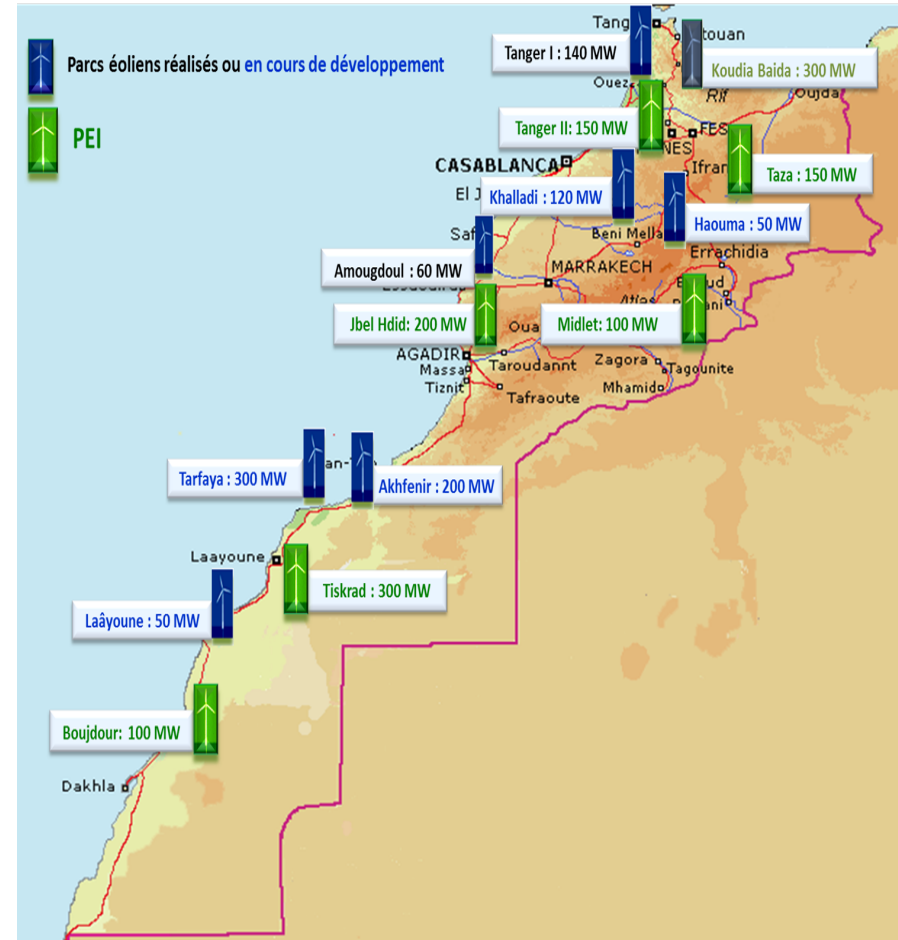
- 3.5 billions of US\$

Fuel annual save

- 1,5 million of TOE per year

**CO₂ emission
avoided**

- 5,6 millions Tons per year



- Three Wind Farms carried out by ONEE (250 MW) and five Wind Farms carried out by Private companies (237 MW) ;
- 300 MW Tarfaya Wind Farm under construction (more than 100 MW are already in operation);
- An Integrated Wind Program of 850 MW (Five sites) is under development ;
- Ongoing development of Two Private Sector Wind Farms (100 MW and 120 MW) in the regions of Akhfenir and Jbel Khalladi ;

Wind energy (ONEE)

Private operators

- Tarfaya: 300 MW (2014)
- Akhfennir: 100 MW (2013)
- Jbel Khalladi: 120 MW (2016)

Integrated Program of Wind Energy

- Taza: 150 MW (2017)
- Integrated Wind Project: 850 MW (2017-2020)

In partnership with Enel Green Power and Nareva, **TAQA** was pre-qualified for the 850 MW wind project

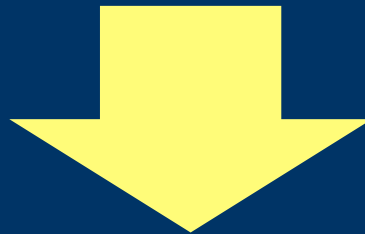
Driving forces of renewable energy development in Morocco

- > Reduction of energy dependency (97%) and energy bill (~12% GDP)
- > Knowledge and technology transfer
- > Enhancement of local content
- > Creation of employment and added value
- > Achievement of inclusive competitiveness in the emerging Ren. En. Tech.
- > Transformation of unwanted areas into useful areas
- > Acting as a hub between Europe and Africa
- > (Exportation of electricity to Europe)

The most important question



How to make the new renewable energy technologies a development lever ?



Identify the various challenges and seek possible scenarios that will overcome these challenges

Challenges to overcome

**The technological challenge
remains the most recognized and
the most studied**

**However, the not least challenges are also financial,
regulatory, skills training, R & D, governance,
cooperation ...**

**But also socio-economic and
environmental**

Which technology would be chosen?

Making the Right Choice by Asking the Right Questions

- **Which parts of the value chains of PV, CSP and wind technologies are transferable to local industries ?**

- **Which parts of the above are suitable for local manufacturing ?**

**If the local industry is not
involved in this transition, no
transition can happen**

Some weaknesses of the renewable energy industry's localization of the in Morocco

- > Lack of will in technology and knowledge transfer
- > Technological complexity of a few value chains of PV
- > Weak industrial base
- > Lack of skilled work force in the field of CSP and in a few value chains of PV
- > Lack of education and R&D infrastructure in universities

Would these weaknesses block
any opportunities for the
localization of these industries in
Morocco ?

Demonstrated ability to achieve major projects



Tangiers Med



Casablanca and Rabat Tramway



High Speed Train



Renault is developing a mega siteCenter in the North Area of Morocco

"The most competitive site of the Group"

Aeronautic industry in Morocco

In the span of 10 years, Morocco has succeeded in bringing a qualitative and competitive aviation base in the extension of Europe. 100% oriented towards export, the sector, composed of a hundred companies, employs 10,000 people and is engaged in the production, services and engineering which are the main components of the global aerospace value chain.

China is now launching the Comac C919 to compete with the Boeing 737 and the Airbus 320.

2/3 of its equipment are manufactured by companies based outside of China, of which many are based in Morocco.

Another reason to co-localize Ren. En. Industry in north Africa

**Africa is a future big market but it can not emerge in
the dark**

57% of the African population had no access to electricity
Moreover, the economies of many African countries is heavily
handicapped by the quality and quantity of electricity available. In
Tanzania and Uganda, for example, power outages would lose
each year to the economy of these countries between 4% and 6%
of their GDP

In the only buoyant construction electrification of the continent,
multiple opportunities are to grasp.



Thank you