

**The Regional Conference  
"Renewable Energy and Sustainable Development in Rural  
Areas of the ESCWA Region"**

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**MOROCCAN STRATEGY OF RENEWABLE ENERGY**

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Rabat, November 26<sup>th</sup>

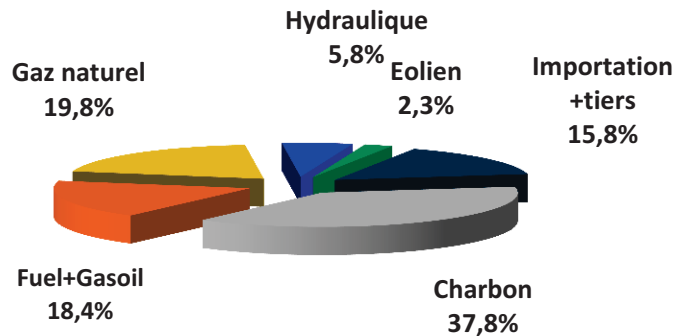
# SUMMARY

- 1. MOROCCAN ELECTRICITY FIGURES**
- 2. DEVELOPMENT PERSPECTIVES IN RENEWABLE ENERGY**
- 3. USE OF SOLAR POWER IN RURAL ELECTRIFICATION**

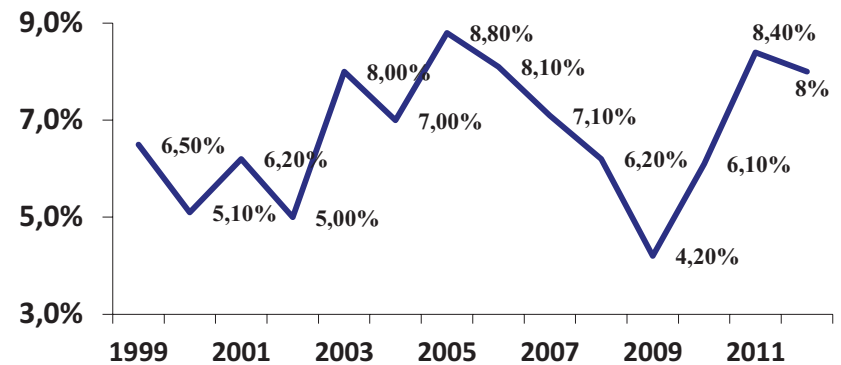
# Office National d'Electricité IN FIGURES

- Electricity Demand : 31 039 GWh
- Import : 4 839 GWh
- Installed Capacity : 6 677 MW
  - Renewable capacity : 307 MW (hors Hydro)
- Peak Load : 5 280 MW

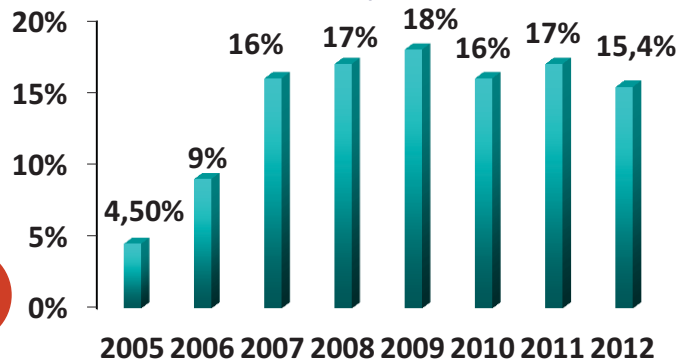
Electricity generation structure



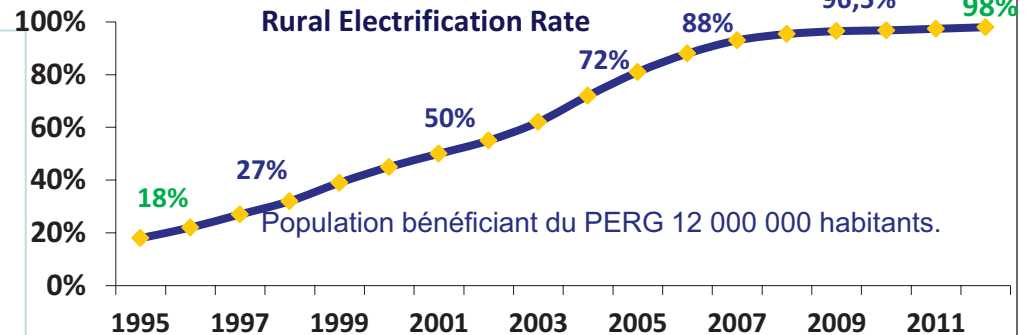
Electricity Growth



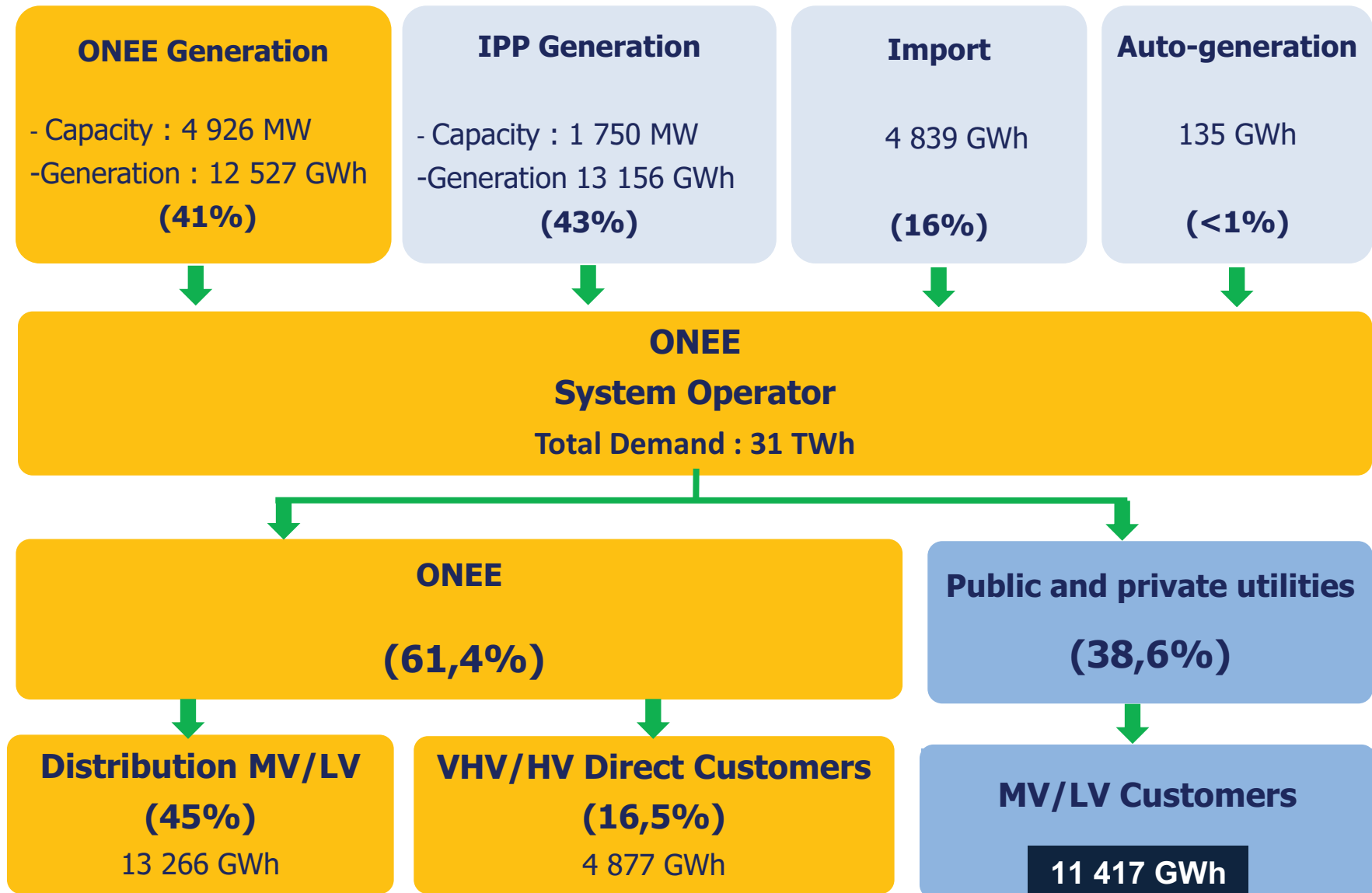
Evolution of import



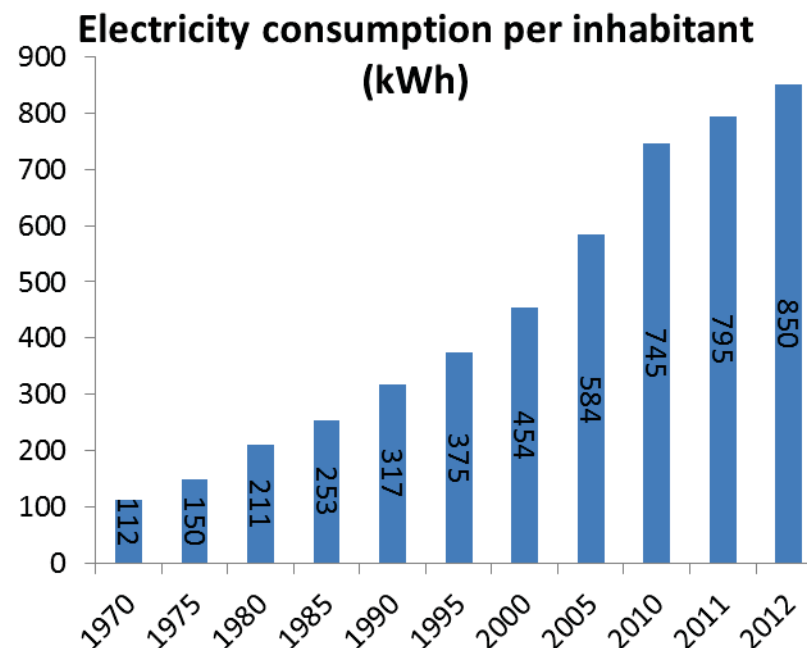
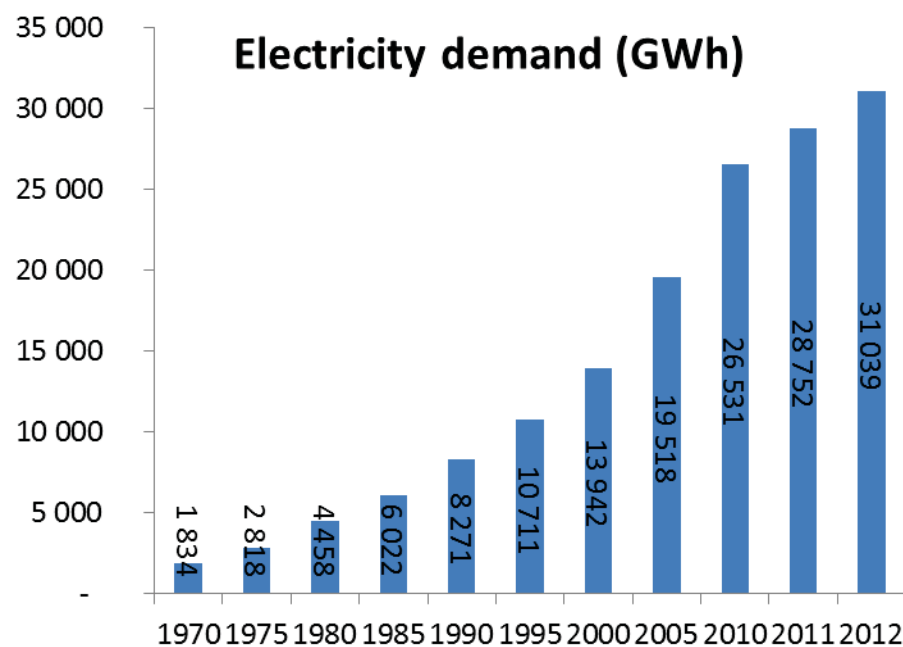
Rural Electrification Rate



# BALANCE OF SUPPLY-DEMAND IN 2012

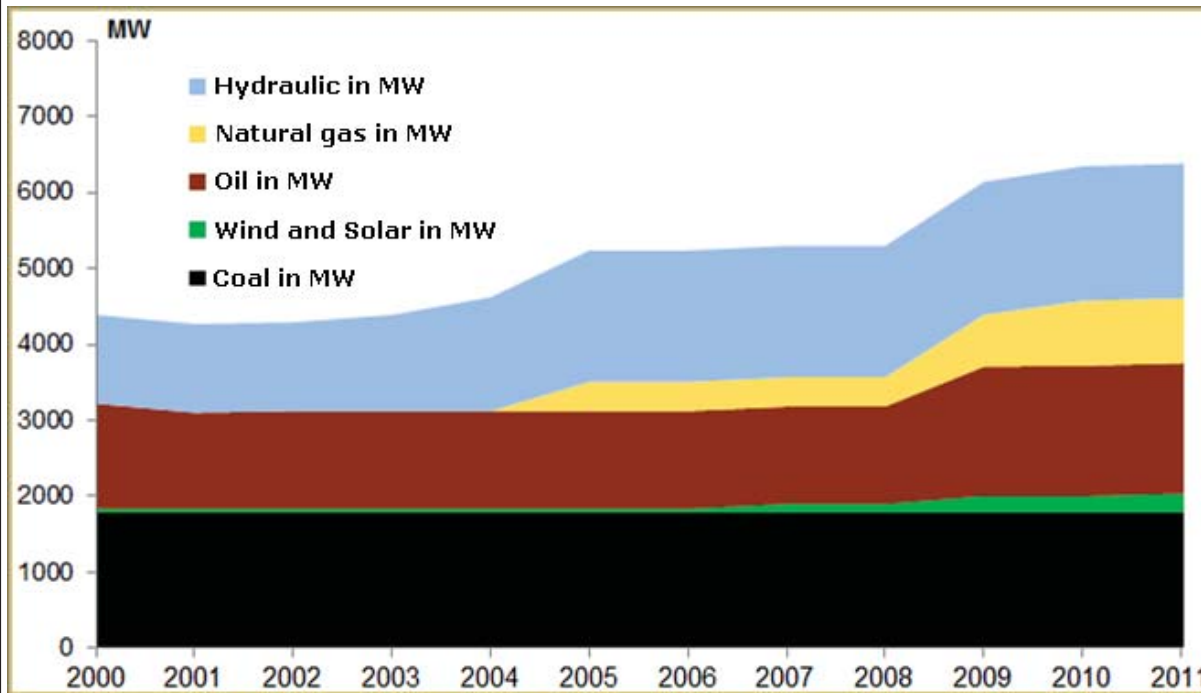


# ELECTRICITY DEMAND IN MOROCCO



- About 7% demand average increase.
- Resulting from sustained economic and social growth in Morocco :
  - ✓ Widespread access to electricity (in rural and urban areas) ;
  - ✓ Development of major projects across the Kingdom (infrastructures, industry, etc.) ;
  - ✓ Improved population standard of living (in particular due to INDH : The National Initiative for Human Development), etc.

## EVOLUTION OF THE POWER MIX



Thermal Steam Coal	1 785
Thermal Steam oil	600
Combined Cycle (Tahaddart)	384
Solar thermal&Combined Cycle Ain Béni Mathar	470
Gaz Turbines	1118
Hydraulic	1 306
Wind	250
Pump-Turbine	464
<b>TOTAL</b>	<b>6 377</b>

Growth of Installed Capacity by 50% highlighting particularly the introduction of natural gas and renewable energy



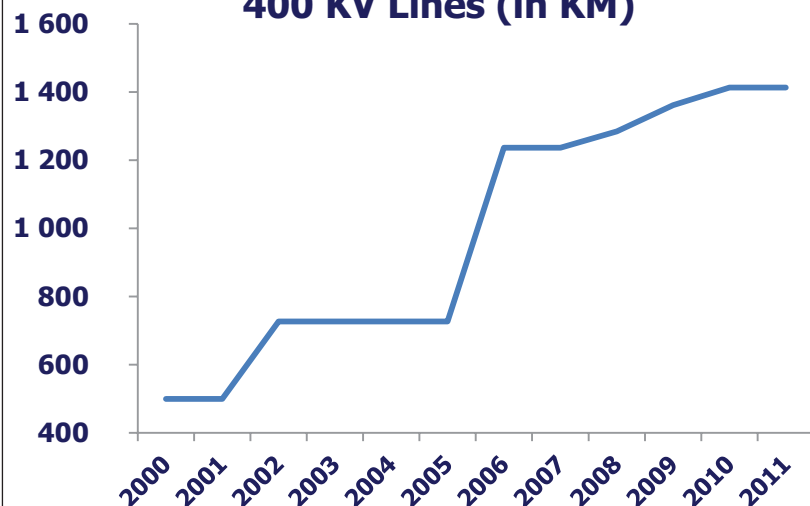
Tangier Wind farm



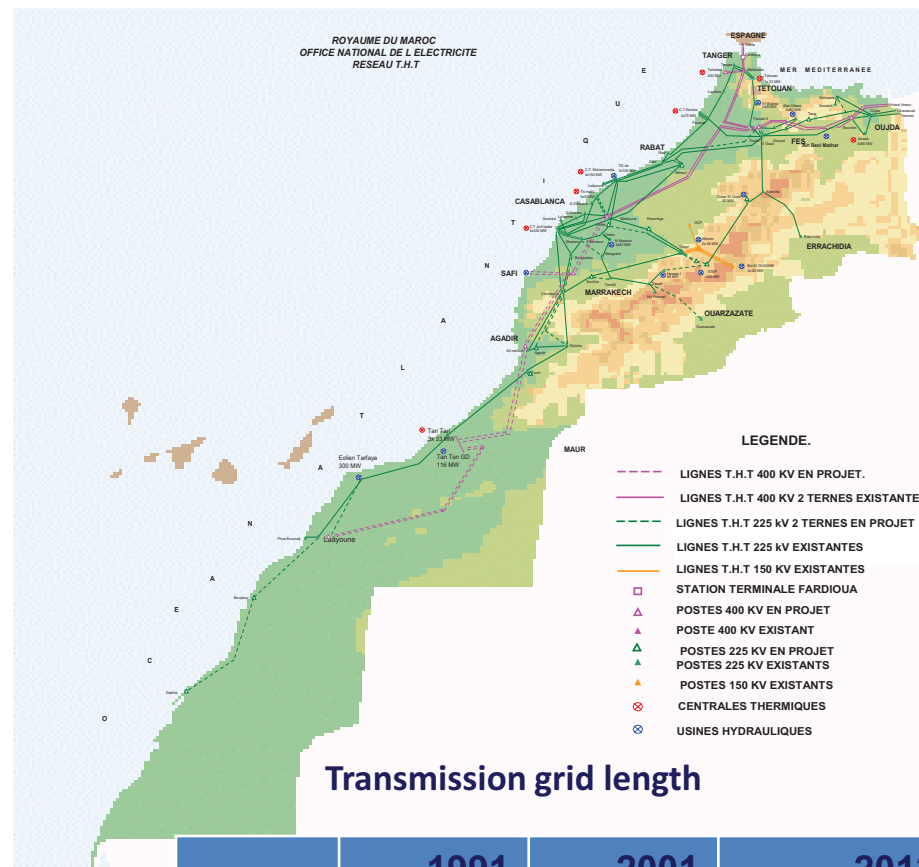
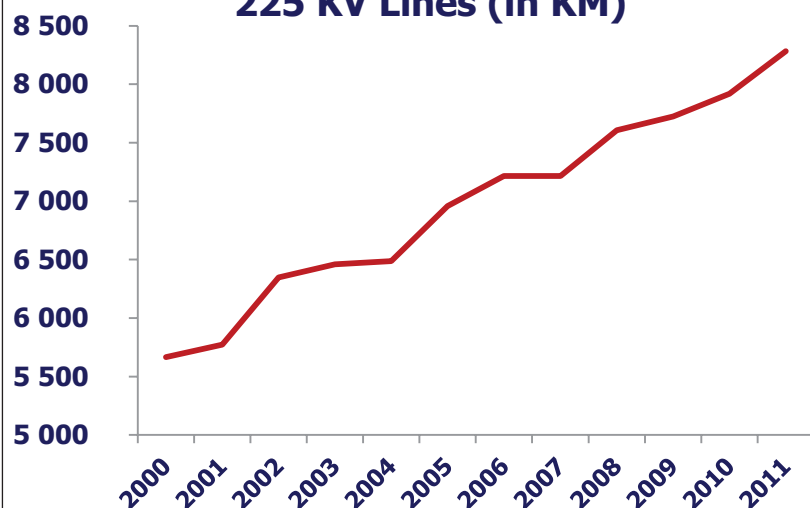
Ain Beni Mathar thermo solar power plant

# TRANSMISSION NETWORK

## 400 KV Lines (in KM)



## 225 KV Lines (in KM)



	1991	2001	2012
400 kV	-	500 Km	1 693 Km
225 kV	3 393 Km	5774 Km	8 389 Km
150 kV	762 Km	762 Km	147 Km
60 kV	7 699 Km	9263 Km	11 603 Km
Total	11 854 Km	16 299 Km	21 832 Km

## *Challenges of Moroccan Electrical Sector*

Morocco is facing a real challenge in securing its energy supply due to:

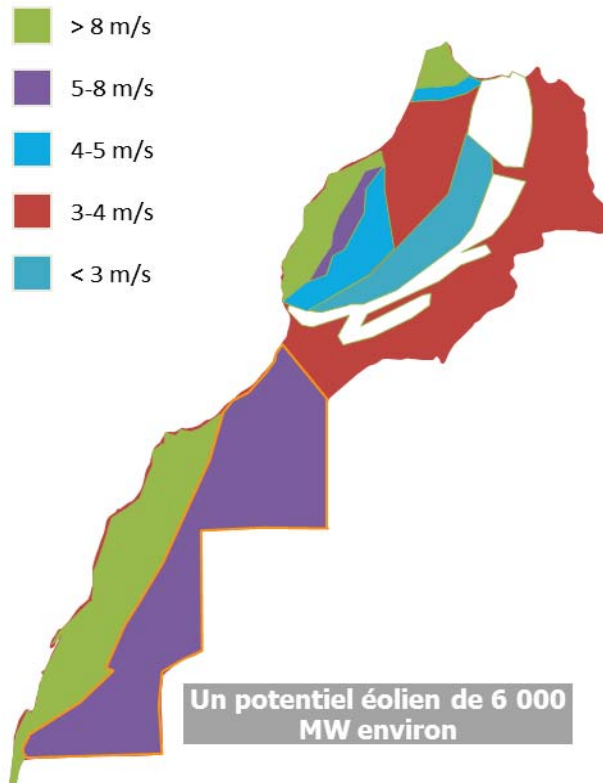
- ❑ Continued growth in demand(doubling at 2020 and quadrupling at 2030)
- ❑ High dependency on foreign energy and fossil fuels (more than 97 % of Moroccan energy needs are imported) ;
- ❑ Increase in Fuel prices and volatility trend in world markets ;
- ❑ Environment preservation as a strategic choice ;
- ❑ Economic competitiveness and preservation of citizen purchasing power.



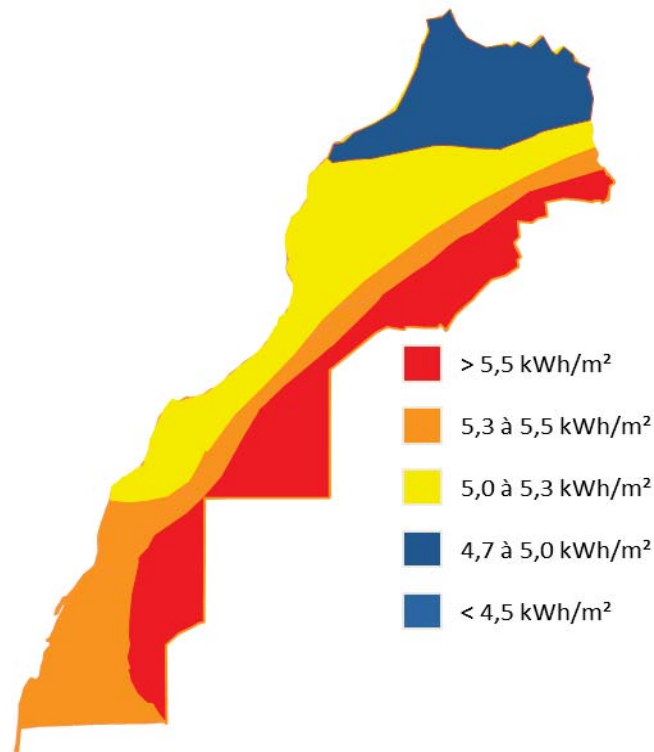
## Strengths of Morocco

☐ Morocco has a huge potential of Renewable Energy utilization (wind, solar, hydro):

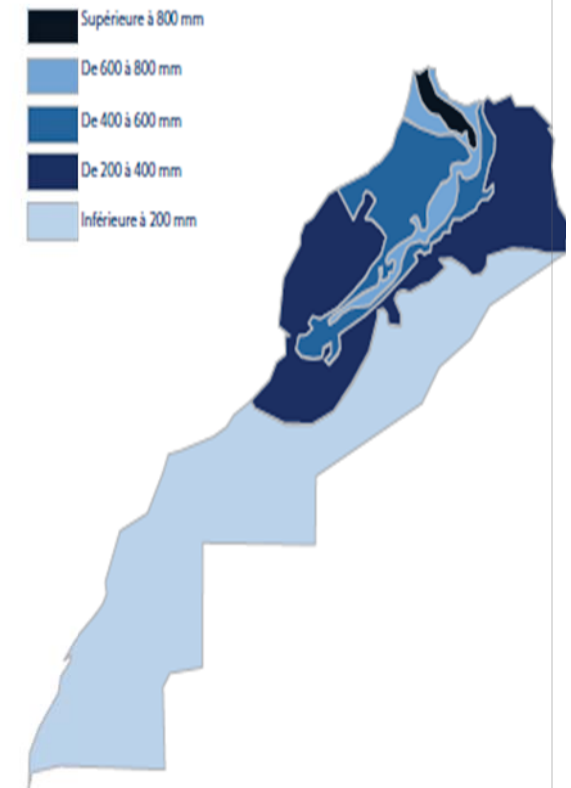
**Wind: 25 000 MW ON SHORE**  
8-12 m/s



**Solar**  
More than 5,5 Kwh/m<sup>2</sup>/j

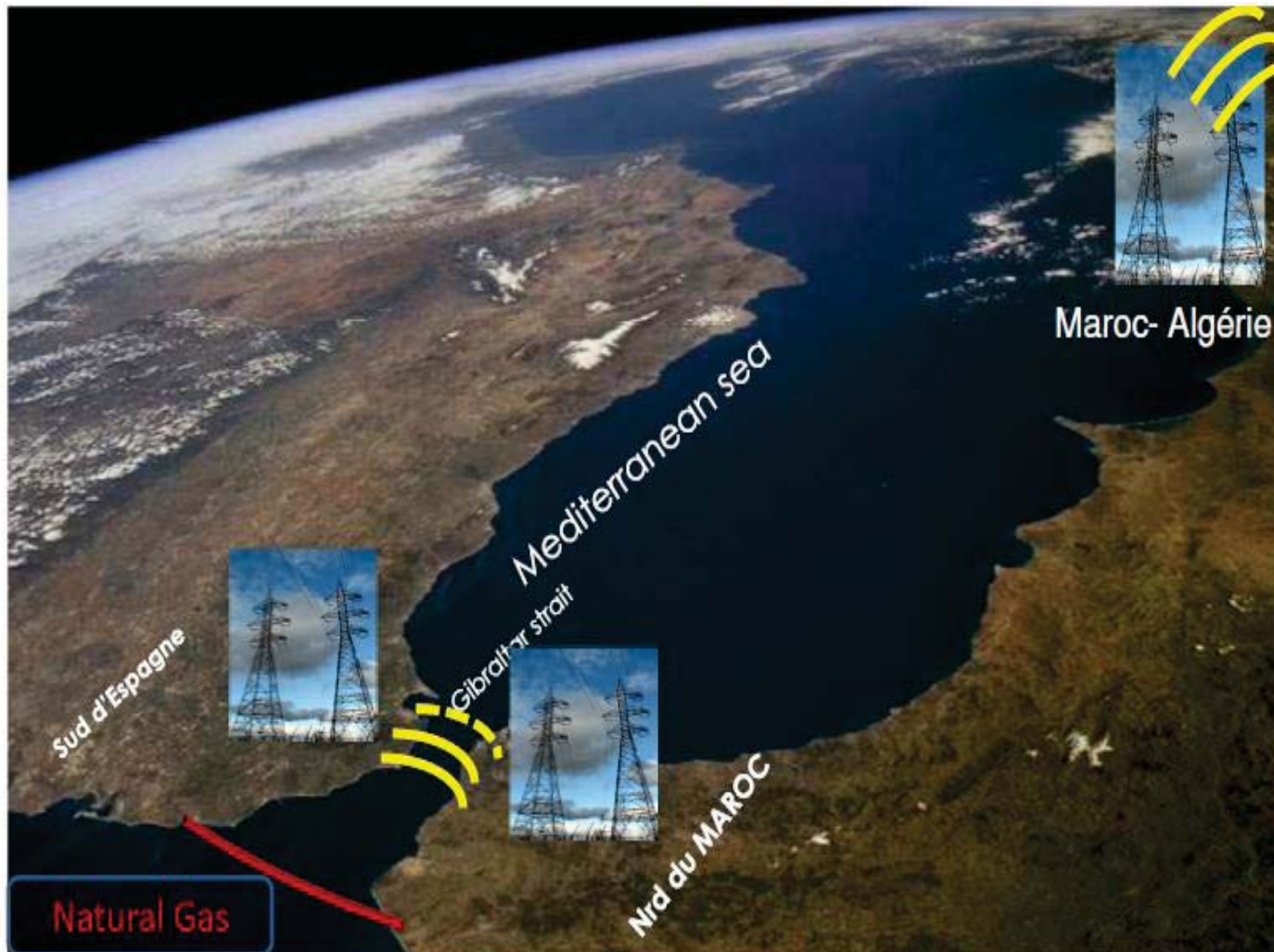


**Hydro**



## Strengths of Morocco

Morocco has become a regional crossroads for power exchange between north and south



### Morocco-Spain interconnection

Commissioning in 1997

An additional line in 2006

Exchange capacity: 1400 MW

Imported capacity 750 MW

ONE has been the 4<sup>th</sup> operator in the Spanish market since 1999

### Morocco-Algeria interconnection

Commissioning in 1988

400 kV in 2008

Exchange capacity 2400 MW

Exchange Backup

## *Strengths of Morocco*

- ❑ Structuring regulatory framework
  - Law 13-09 is designed to encourage independent production of RE
    - It allow access to the transmission network;
    - It also allow to export of surplus energy from RE, once the domestic market has been provided for;
    - Obligation to purchase surplus of energy output from RE
  - Creation of the National Agency for Development of Renewable Energy and Energy Efficiency (ADEREE) by law 16-09
  - Creation of the Moroccan Agency of Solar Energy (MASEN) by law 57-09: set up to implement the solar plan;
  - Establishment of Electricity Regulatory Commission (Excepted in 2014).

# MOROCCAN ENERGY STRATEGY

## GOALS

1

**SECURITY OF SUPPLY**

2

**WIDESPREAD ACCESS TO  
ELECTRICITY**

3

**DEMAND SIDE MANAGEMENT**

4

**ENVIRONMENTAL PROTECTION  
ISSUES**

## STRATEGIC ORIENTATIONS

1

A mix diversified and optimized around a choice of reliable and competitive technologies;

2

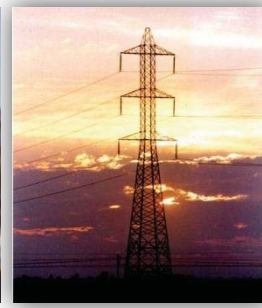
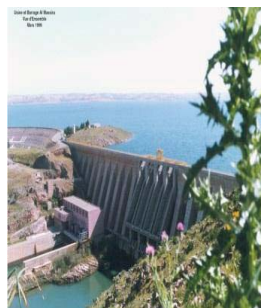
Taking advantage of national energy resources by increasing the share of Renewable Energies in the energy mix;

3

Energy efficiency as a national priority;

4

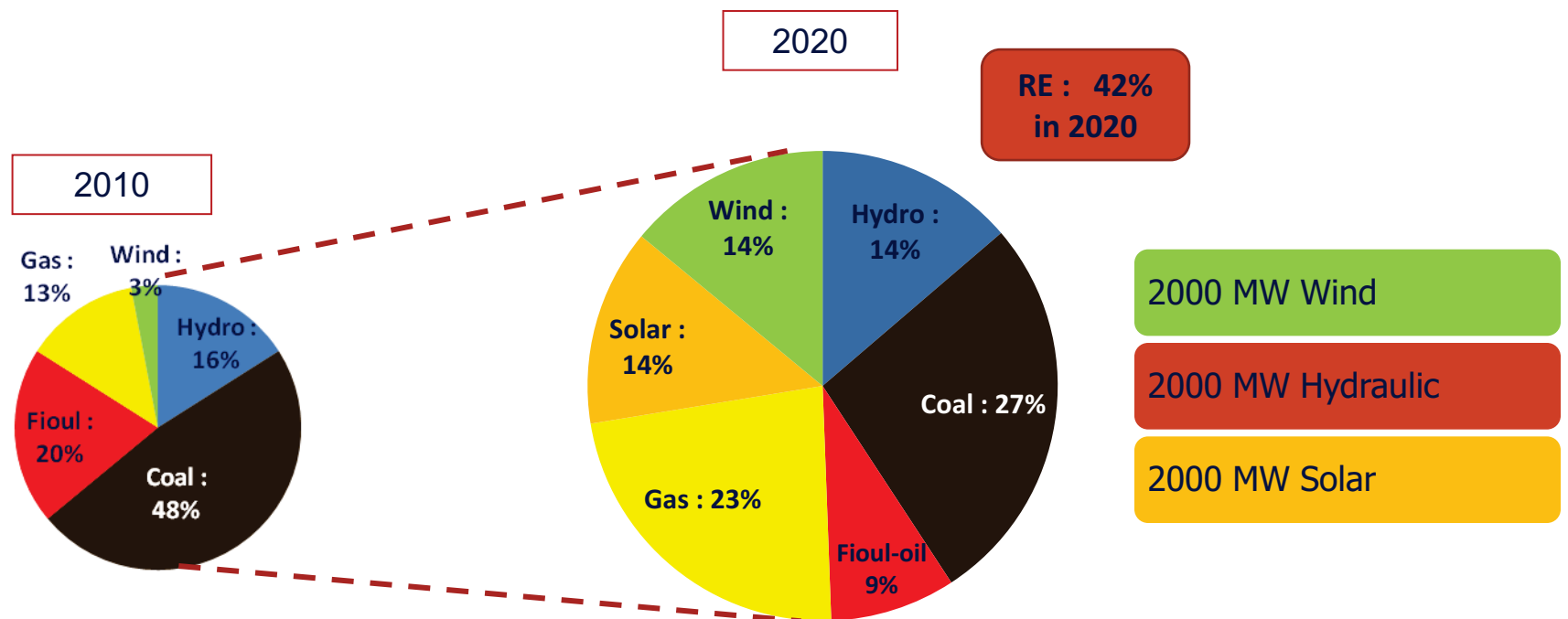
Regional integration.



# ENERGY MIX

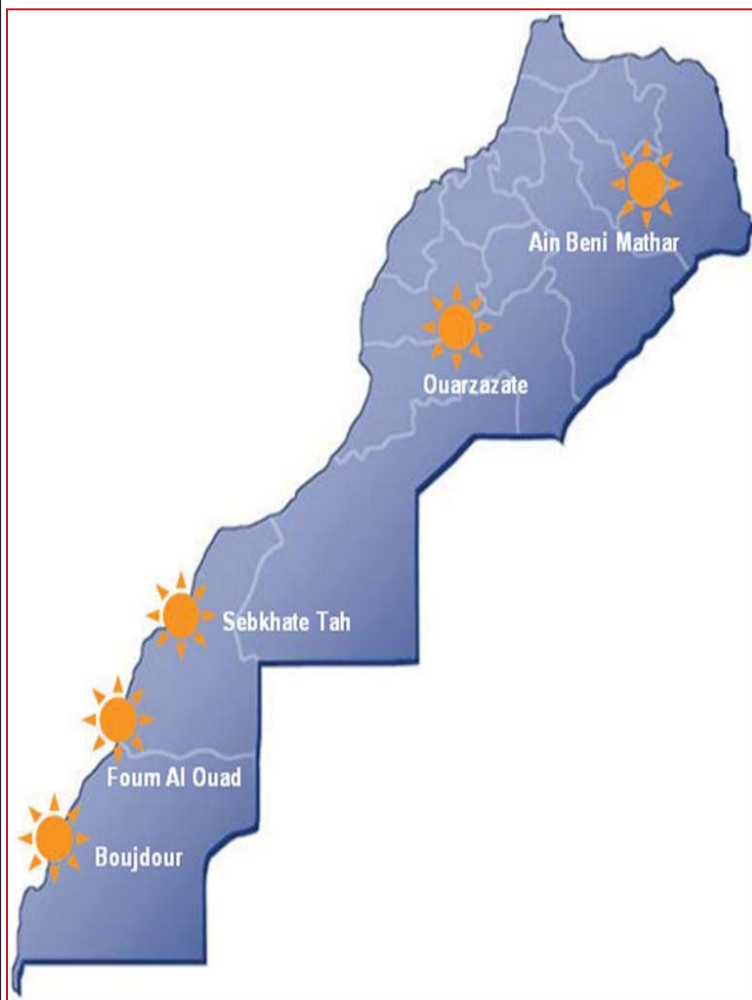
## 2020's target :

- 42 % of installed capacity in renewables;
- Natural gas to mitigate the RE intermittency.





# MOROCCAN SOLAR ENERGY GENERATION PROJECT



## Installed capacity/2020

- 2000 MW
- The Commercial Operation Date of the first solar plant (160 MW CSP): 2015

## Generation

- $\approx 4500$  Gwh per year

## Estimated investment cost

- 9 billions of US\$

## Fuel annual save

- 1 million of TOE per year

## CO<sub>2</sub> emission avoided

- 3,7 millions Tons per year

- MASEN as a lead in the implementation of the solar Project
- ONEE as off taker and Transmission System Operator (TSO)

# MOROCCAN SOLAR ENERGY GENERATION PROJECT

## ☐ Solar capacity under operation:

- Solar-gas Hybrid power plant in Aïn Beni Mathar
- Installed Capacity: 470 MW
- Solar part: 20 MW
- Technology: Cylinder-parabolic
- Date of start: 2010

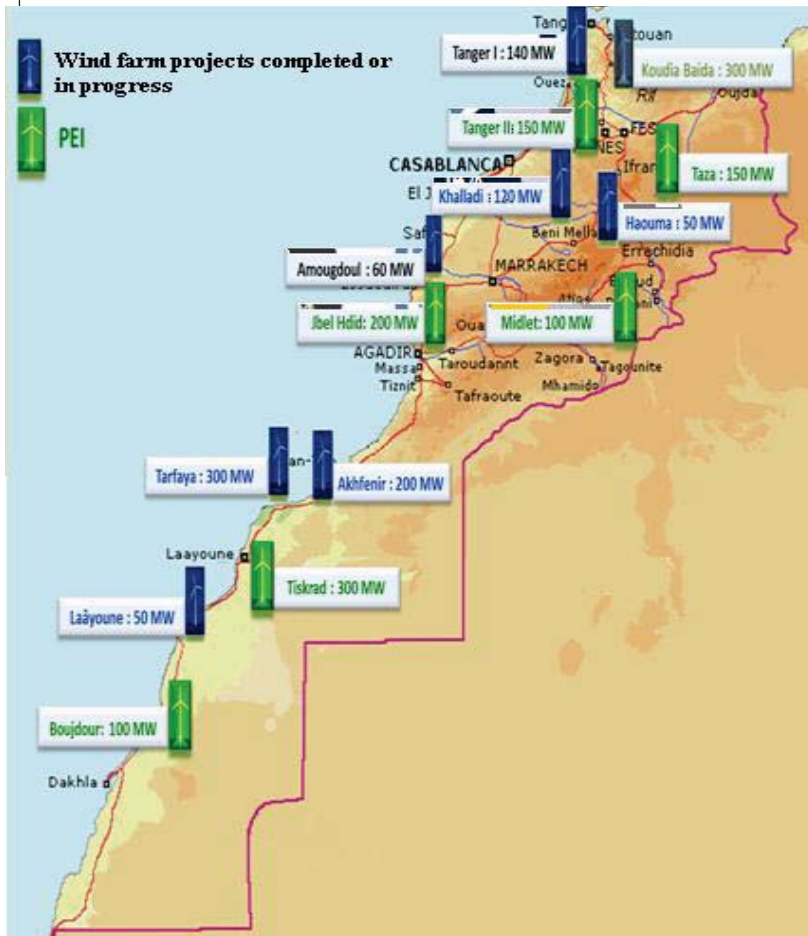
## ☐ Projects under construction:

- CSP power plant in Ouarzazate: Phase 1
- Power: 160 MW
- Technology: Cylinder-parabolic with thermal energy storage
- Start of construction: May 2013
- Commercial Operation Date: 2015

## ☐ Projects under development:

- CSP power plant in Ouarzazate: Phase 2&3
- Phase 2:
  - ✓ Power: 200 MW
  - ✓ Technology: parabolic with thermal energy storage
  - ✓ Tender expected by the end of 2013
  - ✓ Commercial Operation Date: 2017
- Phase 3:
  - ✓ Power: 100 MW
  - ✓ Technology: Tower with thermal energy storage
  - ✓ Tender expected by the end of 2013
  - ✓ Commercial Operation Date: 2017

# INTEGRATED WIND ENERGY GENERATION PROGRAM



## Installed capacity/2020

- 2000 MW
- Taza : The first Wind farm (150 MW) under operation in 2014

## Generation

- $\approx 6600$  Gwh per year

## Estimated investment cost

- 3.5 billions of US\$

## Fuel annual save

- 1,5 million of TOE per year

## CO<sub>2</sub> emission avoided

- 5,6 millions Tons per year

- ONEE as a lead in the implementation of the wind Program
- Private producers under the RE Law « 13-09 »
- Current Installed Capacity of Wind: 487 MW



# MOROCCAN SOLAR ENERGY GENERATION PROJECT

## ❑ Wind capacity under operation: 487 MW

- Abdelkhalek Torres: 50 MW (COD: 2000, PPA)
- Amougdoul : 60 MW (COD: 2007)
- Tanger : 140 MW (COD: 2010)
- Akhefennir I : 100 MW (COD: 2013 under the RE law)
- Haoumal: 50 MW (COD: 2013 under the RE law)
- Laâyoune: 50 MW (COD: 2013 under the RE law)
- Cement manufacturers: 37 MW (COD: 2005-2011)

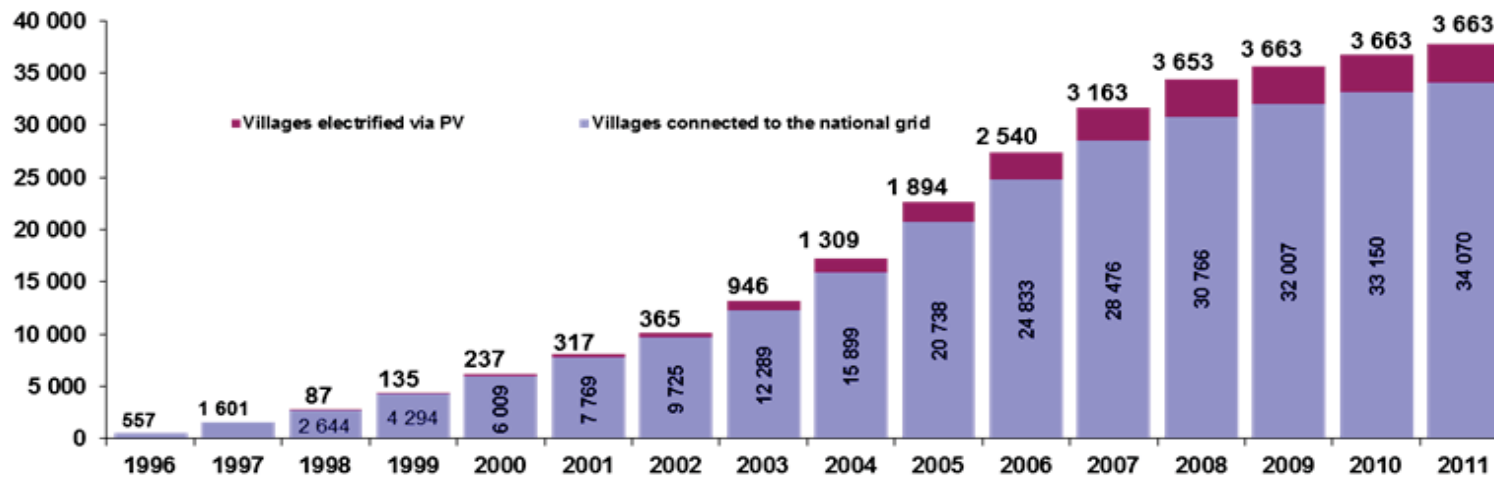
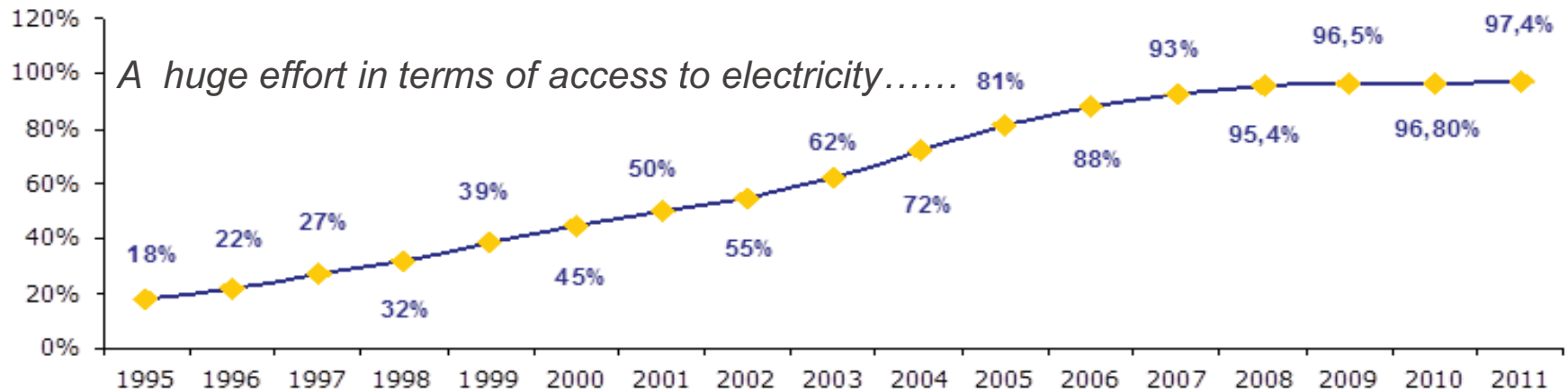
## ❑ Projects under construction: 300 MW

- Tarfaya : 300 MW (COD: 2014, PPA)

## ❑ Projects under development: 1320 MW

- Taza : 150 MW (COD: 2015, PPA, Financial Closing in progress)
- Koudia Al Baïda: 100 MW (COD: 2015, PPA)
- Integrated Wind Program: 850 MW (COD: 2017-2020, PPA, Tender expected for the end of 2013)
- Akhefennir II : 100 MW (COD: 2017 under the RE law)
- Jbel Khalladi : 120 MW (COD: 2017 under the RE law)

## RURAL ELECTRIFICATION PROGRAM



- 12 million citizens have benefited from this program;
- Investing more than 20 billion of MAD ;
- Creating of 100,000 jobs

## *Characteristics of the PERG*

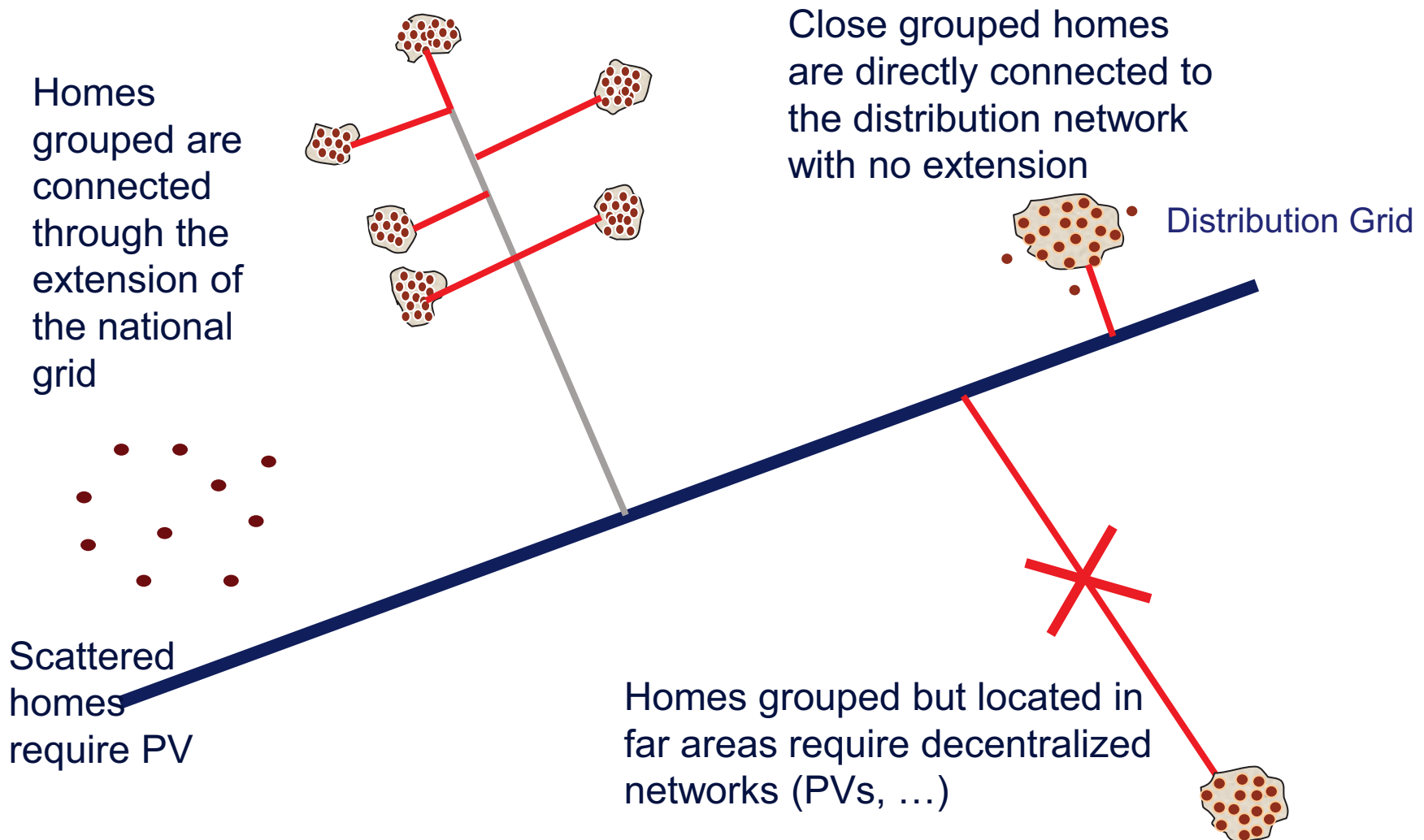
- ❑ PERG has the particularity of being a participative program associated to funding by ONE, of the beneficiary households and communes.
- ❑ The general scheme of this distribution, with regard to electrification by the network, is the as follows:
  - Local authorities partake at 2 085 DH per beneficiary household, an amount paid in cash or 500 DH per beneficiary household per year over a period of 5 years.
  - The beneficiary household partakes in financing by 2 500 DH per household, payable in cash upon subscription or by 40 DH per household and per month for a period of 7 years.
  - ONE finances the remainder, i.e. 55% of the global amount of the investment.
- ❑ Other partners can also participate in the funding of PERG. For example that is the case of village associations, development agencies and private companies.

# **Realization planning of the PERG:**

## **Location of the villages/MV Network**

<b>Geographical location</b>	<b>Electrification option</b>
<b>Grouped village located near the MV network</b>	<b>Grid connection</b>
<b>Dispersed village regardless of the location / MV network</b>	<b>Stand alone PV Kits</b>
<b>Isolated grouped village, but far from the MV network</b>	<b>Decentralised Grid</b>
<b>Distant villages with grouped habitat</b>	<b>Grid connection</b>

# ELECTRIFICATION MODE



# THE PROGRAM'S SCHEDULE

- Rural electrification via the power grid should cover 38,200 homes by 2014 according to the following schedule:
  - 1996-2002 : Step 1 and Step2 (Cost/Home  $\leq$  10 00 DH) RER\* : 55%
  - 2002-2004 : Step 3 (Cost/Home  $\leq$  14 000 DH) RER : 72%
  - 2004-2006 : Step4-1st part (Cost/Home  $\leq$  20 000 DH) RER : 87%
  - 2006-2014 : Step4-2nd part (Cost/Home  $\leq$  27 000 DH) RER : 99%
- Rural electrification via PV has enabled us to electrify 3,663 homes so far.

\*: RER stands for Rural Electrification Rate

# DECENTRALISED RURAL ELECTRIFICATION

- The decentralized Electrification concerns villages with dispersed habitats which connection cost is high.
- Used Techniques:
  - Photovoltaic systems (stand alone PV systems);
  - Micro hydro-electric power stations;
  - Diesel engine.
- 150.000 households in 6000 villages are eligible to be Electrified by PV systems, practically 7% of rural households.

# FEE FOR SERVICE APPROACH (FFS)

The current achievements for photovoltaic option are mainly based on a Fee For Service approach:

- Objectives of FFS approach :
  - Accelerate the achievements;
  - Ensure a sustainable service, adapted and with lower cost;
  - Involvement of the private sector.
- Services provider ensures :
  - Identification and sensitization of the potential customers;
  - Supply and installation of all equipment;
  - After sale service and renewal of the material under guarantee during 10 years;
  - Advances and monthly payments collect during 10 years;
  - Intervention in less than 48 hours in case of breakdown;
  - Recycling of the batteries.
- ONE is the owner of equipment during 10 years
- Environmental aspect: Collection and recycling of batteries are the responsibility of the service provider.



# FEE FOR SERVICE CONTRACT

**ONE** → Grants subsidies + Monitors

**Customer** → Cash advance + monthly payments/ 10 years

- ❑ From a technical standpoint, two systems are proposed to the customer:
  - 75 Wc for lighting and audiovisual applications;
  - 200 Wc for lighting, audiovisual applications and refrigeration.
- ❑ The financial package for Fee For Service includes participation by ONE according to the system installed (75 or 200 Wc), payable to the service provider after completion and commissioning of the installation.
- ❑ The beneficiary household participates by payment to the services provider of an advance upon taking out of a subscription and monthly payments over a period of 10 years.

## TRANSACTIONS UNDER “FEE FOR SERVICE”

	Sizes available	Customer's part (US\$)	ONE's subsidy (US\$)
<b><u>Transaction – 1 –</u></b> ✓16,000 units; ✓Start up in 2002;	- 50 Wc, - 75 Wc, - 100 Wc.	- 82+ 7,5/month - 212 + 11/month - 365+15/month	635
<b><u>Transaction – 2 –</u></b> ✓12,000 units; ✓Start up in 2003;	- 50 Wc, - 75 Wc, - 200 Wc.	- 82+ 7,5/month - 212 + 11/month - 590 +27/month	425 to 1725 depending upon the system
<b><u>Transaction – 3 –</u></b> ✓37,000 units; ✓Start up in 2004;	-75 Wc, - 200 Wc.	- 106+ 7,5/month - 470+ 18/month	645 1290
<b><u>Transaction – 4 –</u></b> ✓40,000 units; ✓Start up in 2005; ✓.	-75 Wc, - 200 Wc.	- 106+ 7,5/month - 470+ 18/month	645 1290

51,559 homes have been provided with PV under “Fee For Service” contracts



# Thank you for your attention

