### **NOOR MIDELT I**



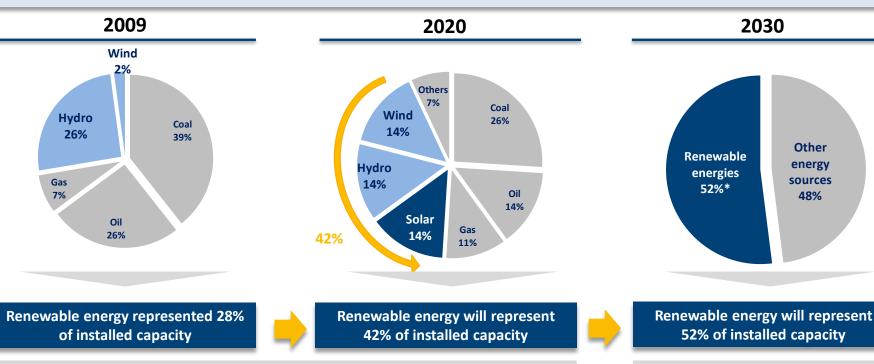


June 2019

#### RENEWABLE ENERGIES AT THE HEART OF MOROCCO'S ENERGY STRATEGY



Strong will of increasing renewable energy share within the national mix by 2020 and 2030, through a roadmap of deployment based on an optimal technological mix



Morocco launched the NOOR Plan (the Moroccan solar plan), to be implemented by Masen



Development of a minimum of 2 000 MW by 2020

Masen will implement a minimum of <u>6 000 MW</u> of renewable energy by 2030

Conventional energy Renewable energy

Projects developed/to be developed by masen

#### RENEWABLE ENERGIES AT THE HEART OF MOROCCO'S ENERGY STRATEGY



2009 2016

Law 57-09 initially establishing Masen

Law 38-16 amending and completing the Law 57-09

## Legal framework:

#### Object:

Development of solar integrated projects with a target of at least 2000 MW by 2020

#### **Legal Form:**

Limited liability company, created in March 2010

#### **Shareholding:**

State,  $ONEE^{(1)}$ , Hassan II  $Fund^{(2)}$  and  $SIE^{(3)}$  - equal shares

#### Object:

- Change of Masen's name from "Moroccan Agency for Solar Energy" to "Moroccan Agency for Sustainable Energy"
- Enlargement of Masen's scope from developing only solar energy plants to all types of renewable energy<sup>(4)</sup> in morocco and abroad

# Institutional framework:



- State-Masen Agreement (decree): Conditions, technical requirements and guarantee of the financial equilibrium of Masen's projects
- State-ONEE-Masen Agreement: Take or pay including terms and conditions for the purchase, supply, transport and commercialization of electricity produced

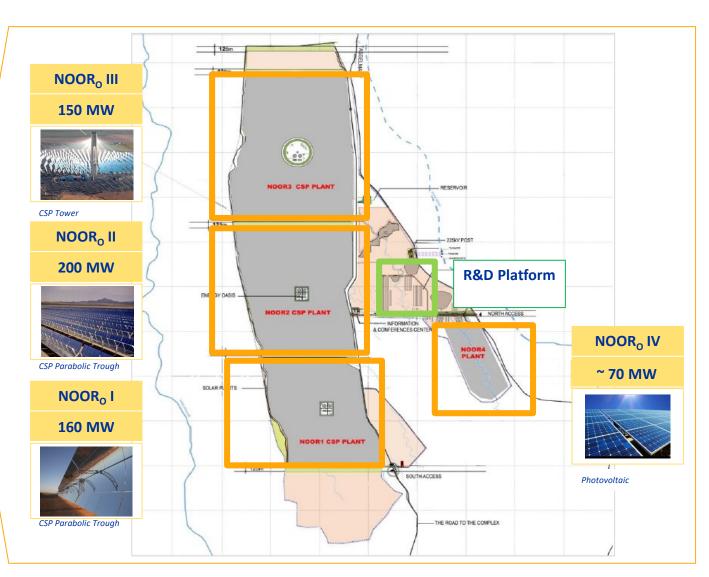
- (1) ONEE: Office National de l'Eléctricité et de l'Eau, the national utility
- (2) Hassan II Fund for Economic and Social Development
- (3) Société d'Investissements Energétiques
- (4) Except the assets dedicated to the stabilization of the grid

#### RENEWABLE ENERGIES AT THE HEART OF MOROCCO'S ENERGY STRATEGY





NOOR OUARZAZATE
COMPLEX,
A GRADUAL
DEPLOYMENT OF
580 MW



#### WIND AND SOLAR ENERGY AS BASELOAD SOLUTION



#### Solar and wind plants are in direct competition with conventional baseload power plants

#### Scénario ENF **Current Grid Managment:** 6,000.00 5.000.00 Renewable intremittent generation is being enforced in conventional system without any grid strategy 3,000.00 2,000.00 We will have to curtail renewables or baseload power plants having a huge impact on cost MST-CE-JORF1 MST-CE-JORF4 MST-CE-JORF6 MST-CC-JERA4 MST-CE-MOHA1 MST-CE-MOHA2 MCC-GE-ABM MCC-GE-TAHAD MST-CF-JERA5 GenHydro -GenPump --- Demande

A new energy mix shall be developped based on:

**Synergies between renewables** 

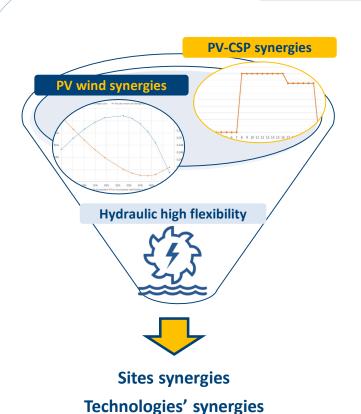


**Storage technologies** 

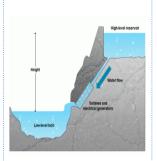
#### RENEWABLE MIX TO MAXIMISE RENEWABLE INTO GRID



#### **Mix ENR**

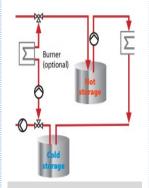


## Hydro pumped storage



- Mature energy storage
- Hours
- Lowest cost
- Linked to potentiel site

#### **Thermal storage**



- Limited maturity energy storage
- Long time (many hours)
- Used onsite

#### **Batteries**



- Limited maturity in utility scale
- Capacity storage
- Installation everywhere
- High cost/ decreasing fast

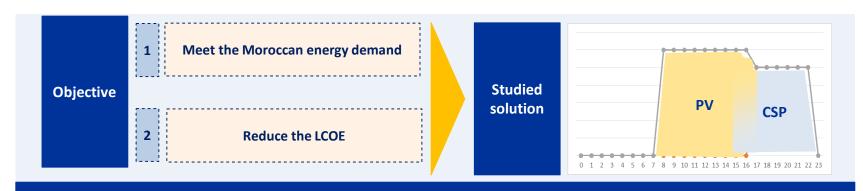




#### NOOR MIDELT I: A NEW STAGE OF THE NEW MIX TO BE DEVELOPED



#### NOOR Midelt: a CSP-PV hybrid power plant a project developed in accordance with this vision



#### Main characteristics of the studied Solution

### Operating Mode

Hybrid solution combining PV and CSP:

- PV operated during day
- CSP operated mainly during evening
- Minimum 5 hours storage capacity
- 25 % energy to be generated during peak hours

**Capacity** 

- The PV<sub>AC</sub> capacity represents 1.20\*CSP gross capacity.
- The PV<sub>DC</sub> capacity represents 1.4\*PV<sub>AC</sub> capacity.

Peak hours tariff of 68 Cents of MAD/kWh (about 6,2cEuro/kWh)

Average tariff of 60,4 Cents of MAD /kWh (about 5,5 cEuro/kWh)

⇒ The solution could compete with coal

#### **Next steps**



#### To check if the proposed approach respond to demand, the next steps will be:

1. Define the optimal Wind/PV mix to be developed by 2030 to maximise useful energy for grid at lower cost

- 2. To lauch Noor Midelt II to confirm the results of Noor Midelt I while opening to other storage technologies such as batteries
- 3. To lauch a baseload renewable power plant with storage ensuring 90 % capacity factor (Capacity Factor of Coal or Nuclear power plants) replacing a coal power plant



**QUESTIONS**