



**masden**

endless power for progress





**masen**

endless power for progress

“ [...] Based on Our long-term vision, which accounts for trends and developments in the global energy situation that will emerge over the course of the coming decades, We are making energy availability, security of supply and environmental protection Our top priorities. Therefore Our country must constantly prepare itself for, and adapt to the various changes that will come, so that we can ensure social and economic development whilst meeting our growing energy needs sustainably. [...] We are focused on the need to diversify our energy sources, to mobilize our renewable resources. ”

*Extract from a speech by His Majesty King Mohammed VI, may God bless him, to attendees at the first national energy conference, which began on 6 March 2009 in Rabat.*

“ [...] Since the world became aware, in Rio in 1992, of the urgent need to address climate change, the Kingdom of Morocco has firmly aligned its proactive policy on sustainable development and environmental protection with the international community's global effort, through a series of constitutional, legislative, institutional and regulatory reforms. [...] Therefore, the target to achieve 42 % of the country's energy mix from renewable sources by 2020 has recently been raised to 52 % by 2030. Morocco's ambitious, substantial "Intended, Nationally Determined Contribution" under the United Nations Framework Convention on Climate Change confirms the Kingdom's avant-garde approach. ”

*Extract from a speech by His Majesty King Mohammed VI, may God bless him, at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change on 30 November 2015 in Paris.*



# WHO ARE WE?

## IN WORDS

Morocco places particular importance on protecting the environment and ensuring our plans for socioeconomic development adhere to the vision of sustainable development.

As a committed player that stands shoulder-to-shoulder with the international community in the fight against climate change, the Kingdom has made the decision to pursue low-carbon growth and employ appropriate energy strategies.

In order to reconcile the country's growing energy needs with requirements to protect the environment, the national energy strategy aims to increase the share of renewable energy - hydro, wind and solar power, plus biomass and eventually other clean resources - in the country's total power generation capacity. The target set for 2030 is to achieve 52 % of the energy mix from renewable sources.

Created in 2010, Masen, the central player in this national strategy, is in charge, alongside the National Office of Electricity and Potable Water (ONEE), of implementing the Royal vision for renewable energy. Together, the resources deployed to make this vision a reality, the experience of developing projects in partnership with ONEE and the resulting expertise, put Morocco in a strong strategic position on the continental and world stage in the renewable energy sector.

## MASEN

“ It is both a great honour for Masen and an everyday challenge to be the central player for renewable energy in Morocco. With our unique model, we must be present at every stage of development of renewable projects, from site assessment to maintenance, design, funding, construction and operation of large-scale projects. Applied and pre-operational R&D backed by industrial projects and development of a competitive national renewable industry are also at the heart of our prerogatives.

” MUSTAPHA BAKKOURY / PRESIDENT

# MASEN AND RENEWABLE DEVELOPMENT

## IN FIGURES

### OUR NATIONAL TARGETS

42%

of the energy mix from renewable sources by 2020

52%

of the energy mix from renewable sources by 2030

3

priority resources: solar, wind and hydraulic

### MASEN'S CONTRIBUTION TO MEETING THIS TARGET

3000 MW

total minimum additional capacity by 2020

6000 MW

total minimum additional capacity by 2030

# OUR MISSIONS

1  
2  
3

Integrated development of REN\* installations at the highest international standards.

Contribution to the emergence of national expertise in the field of renewable energy.

Development of the local areas Masen operates in, following a sustainable model involving economic, human and environmental criteria.

Masen's missions are also designed to be applied on a continental and international scale.

\*Renewable energy

# MASEN'S EXPERTISE

With a unique model for intervention, Masen provides its integrated projects with a range of multidisciplinary skills and expertise.

Specific expertise are found in the development of REN installations, forming a complete and coherent chain.

Identifying, designing, and programming electrical generation units based on renewable energy source



Evaluation of renewable energy resources

Carrying out advance studies needed to qualify a site



Design, production, operation and construction of those installations (or oversight of such activities)

Contributing to mobilizing the funds needed for the construction of REN installations



Building the infrastructure needed to connect the sites to the various national networks (roads, electrical, water and telecommunications)

## BE OPEN-MINDED

“ At Masen, we're always listening. Listening to a world that's teeming with innovation, listening to the Moroccan and African environments around us and their challenges, and also listening to each other. At Masen, we have open minds, and that's how we carry out our missions. ”

OBAID AMRANE / MASEN MANAGEMENT



# DEVELOPMENT IS AT THE HEART OF OUR APPROACH

Masen runs Morocco's renewable energy projects, transforming natural energy into power for progress.

As part of our integrated approach which is encoded in our DNA, Masen sets up coherent energy ecosystems that contribute to the country's socioeconomic growth.

## KEEP OUR PROMISES

“ At Masen, we do what we say. Every day, at every step of developing our REN installations, we give ourselves the human, organizational, technological and financial resources to keep our promises.

MASEN TEAM

# WHAT DO WE DO?

## IN WORDS

Masen generates electricity from renewable energy. Its projects harness these power sources to make the best use of solar, wind and hydraulic by choosing appropriate technology for the sites selected and needs identified.

As the key contributor, alongside ONEE, to achieving national targets, Masen pays special attention to the environmental impact of its projects, on the social, economic and environmental aspects.

# MASEN AND RENEWABLES IN ACTION

## IN FIGURES

Installed solar capacity by **2020**

**2000 MW\***

Installed wind capacity by **2020**

**2000 MW\***

Minimum installed hydraulic capacity by **2020**

**2000 MW\***

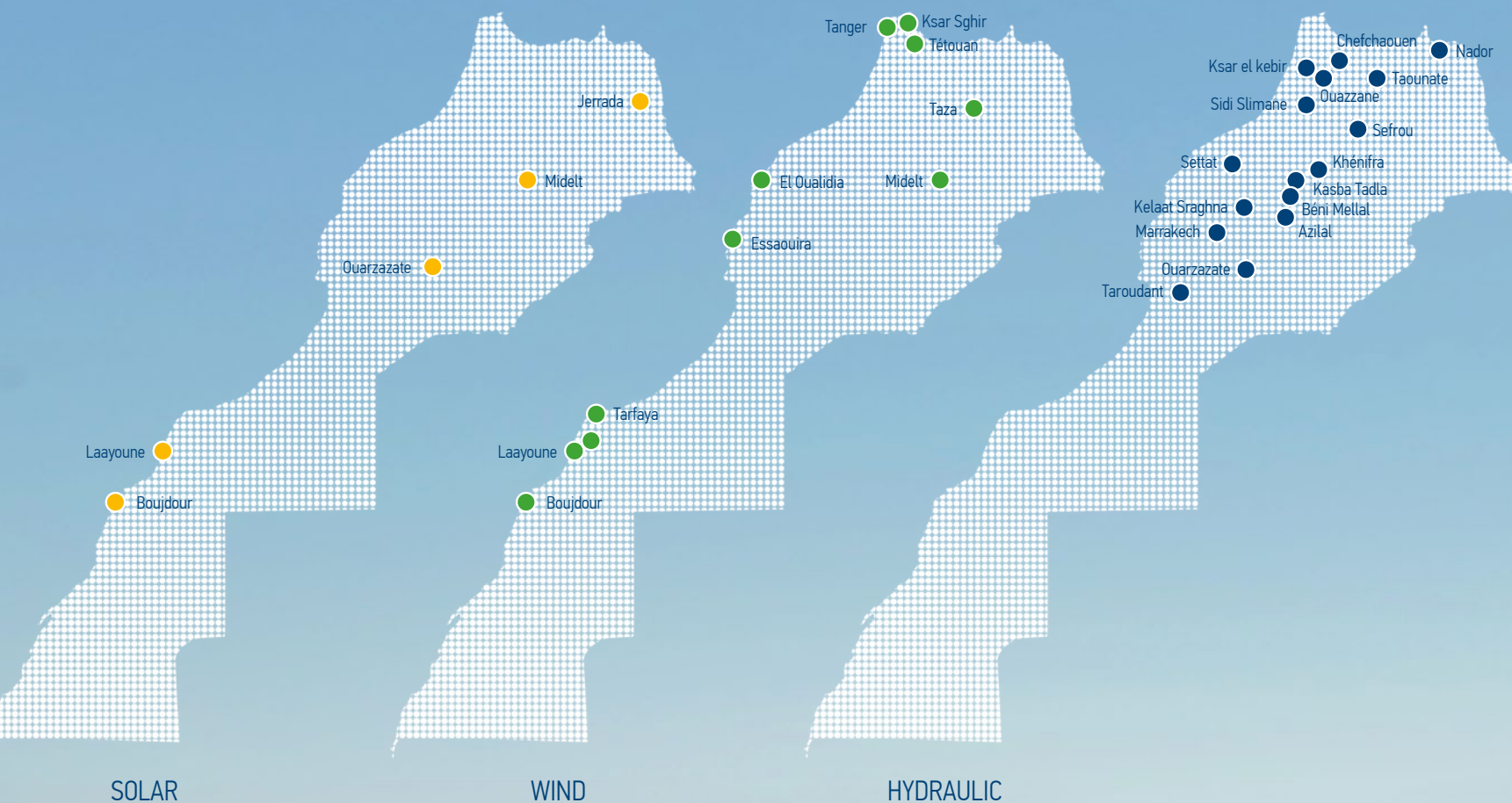
*\* National targets, including private projects.*

## TAKING ACTION

“ Every project is a separate experience we draw on to improve our work year after year. At Masen, we make progress through taking action. ”

MASEN TEAM

# TODAY... A RENEWABLE MOROCCO



## MAKING ENERGY AND TECHNOLOGY WORK TOGETHER

As the sole player managing renewable technology in Morocco, Masen is able to identify the best, most innovative technological configurations to generate the most useful electricity for the national electrical grid.

It is the diversification of renewable energy sources in the national mix that allows for a flexible electricity generation that can be adapted to the consumer demand whilst optimizing the cost per Kwh.

Masen makes the most of these sources and chooses the most adapted technological configuration to the needs identified. The major forms of technology either developed or at the planning stage in Morocco are :

- solar thermal (concentrated and photovoltaic) ;
- onshore wind ;
- hydroelectric dams and pumped storage hydroelectric.

Other forms of technology could be operated in the foreseeable future.

## WHAT ABOUT TOMORROW?

By gaining expertise in renewable energy development and optimizing the price of electricity, Masen, together with ONEE, is strengthening Morocco's advantageous position in the renewables sector at regional, continental and international level.

While the energy situation in Africa is defined by a major electricity shortfall and growing demand, Europe is facing stable but high energy demand, coupled with obligations to ensure a higher proportion of its energy mix comes from renewable sources.

By capitalizing on the national expertise Masen has developed, Morocco can already help address Africa's energy challenge. Its strategic geographical position, strengthened by the interconnected electricity transmission infrastructure in place and under construction, make the Kingdom a real hub for trade with Africa and also between Africa and Europe.





# HOW DO WE DO IT?

## IN WORDS

Masen operates renewable energy sites that transform natural energy into power for progress. The integrated model Masen has devised aims to establish self-sustaining and financially viable ecosystems.

In addition to producing electricity and raising the funds required to do so, Masen seeks to develop a competitive economic network that employs existing skills efficiently and helps create new ones. At the same time, Masen supports and fosters the development of applied and pre-operational R&D backed by industrial projects, and the promotion of technological innovation. This support for innovation, which is at the core of Masen's integrated approach, is illustrated by the creation of a 200 hectares platform on-site at the Noor Ouarzazate solar complex.

The local development strategy Masen has developed – a true reflection of its integrated approach – helps the region that hosts its projects to achieve territorial equity and sustainable growth.

Finally, the constant concern for protecting the environment and reducing greenhouse gas emissions underpins Masen's entire approach.

# MASEN AND INTEGRATED ENERGY

## IN FIGURES

**200 ha** of applied and pre-operational R&D backed by industrial projects platform

**35%** of industrial integration for the development of Noor Ouarzazate II and III

**34 000** direct and indirect beneficiaries of Masen's local development programme (2010–2016)

## 5 DRIVERS FOR AN INTEGRATED APPROACH

Electricity generation 

Training 

R&D\* 

Industrial Integration 

Local Development 

*\*Applied and pre-operational R&D backed by industrial projects*

# A LOCAL, NATIONAL AND ENVIRONMENTAL INTEGRATION

## 1 DEVELOP LOCALLY AND SUSTAINABLY

Masen seeks to maximize the synergy and the benefits of its energy projects by helping fight poverty, improving living conditions for people near its energy production sites, promoting shared, sustainable economic development, and protect the environment.

Masen adapts its actions to the socioeconomic profile of the regions it operates in, and takes action in many sectors, especially basic infrastructure, education, health and agriculture.

### FOCUS ON THE LOCAL DEVELOPMENT STRATEGY

Masen's strategy for local development is based on three approaches to intervention:



## 2 ESTABLISH A VIRTUOUS CIRCLE IN THE SECTOR

In economic terms, taking into account socioeconomic aspects of the renewable energy industry enables job creation by increasing the need for resources and introducing new professions, and helps with wealth creation.

Masen aims to establish a virtuous circle in this sector at local and national level.

## 3 TAKE ACCOUNT OF THE ENVIRONMENTAL IMPACT

Masen takes special care to identify the potential impact that the projects have on the environment throughout their development. Masen implements mitigation measures to avoid, reduce or compensate for the effects identified and ensure the projects are optimally integrated into the areas where they operate.

### FOCUS ON REDUCING CO2

By switching to renewable energy, Morocco will avoid at least 9.3 million tonnes of CO2 emissions by 2020, or 2.5 million tonnes of oil equivalent (TOE). 3.7 million tonnes of these CO2 savings will come from solar projects and 5.6 million tonnes will come from wind projects.



## SYNERGY AS A DRIVER OF DEVELOPMENT

Masen's unique model creates synergy in two areas.

### SYNERGY BETWEEN PEOPLE AND RESOURCES

To develop and manage projects, Masen combines human resources, skills, choices of technology, equipment and infrastructure.

### CATALYZE ENERGIES

“ Uniting people, institutions and resources, and using energy as a catalyst, from local to international level, will enable us to achieve our development objectives ”

MASEN TEAM

### SYNERGY BETWEEN DIFFERENT STAKEHOLDERS IN RENEWABLES PROJECTS

Now a single institutional operator in the renewable energy field, Masen, alongside ONEE, acts as facilitator to institutions, investors, developers, to the scientific and local communities in order to achieve its development objectives.

# OUR ACHIEVEMENTS

Masen's Solar projects

Masen, a resolute local development strategy

Noor Ouarzazate I Solar plant

Noor Ouarzazate II Solar plant

Noor Ouarzazate III Solar plant

Noor Ouarzazate IV Solar plant

Noor Laayoune Solar plant

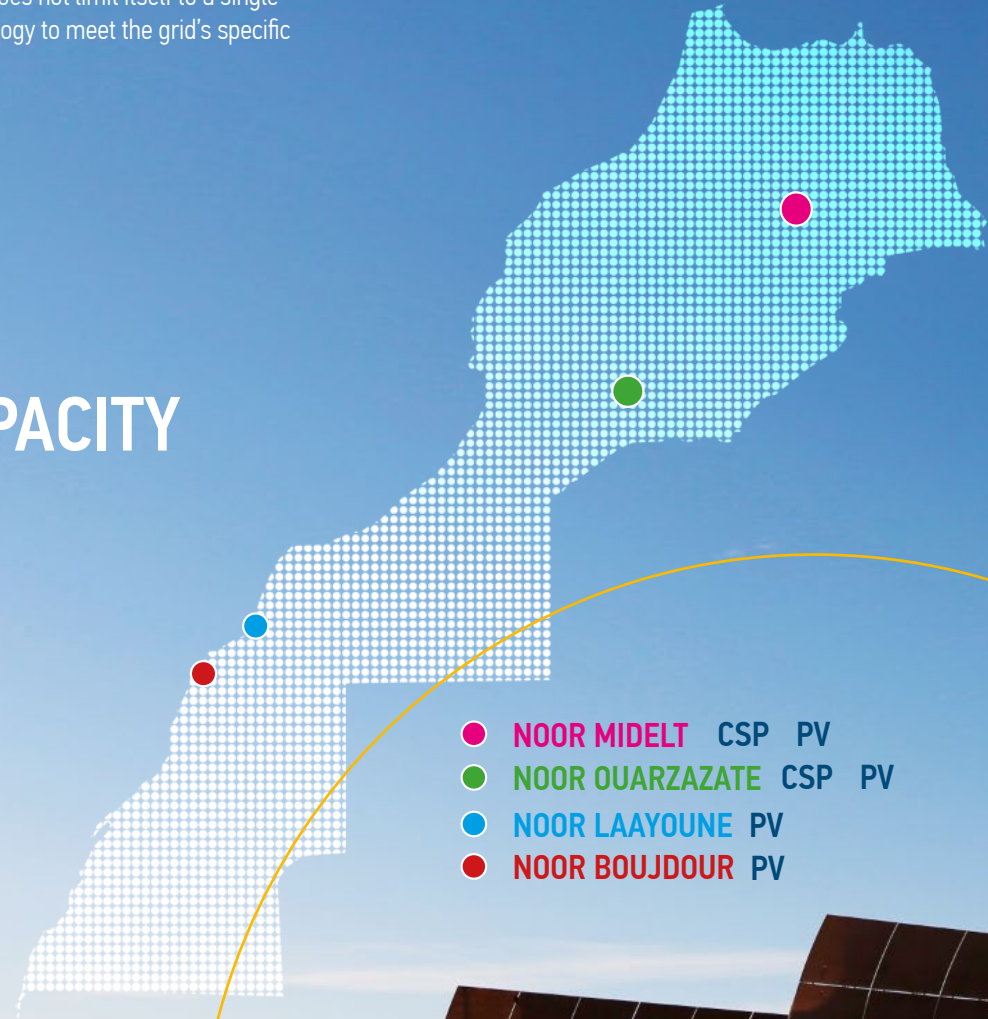
Noor Boujdour Solar plant

# MASEN'S SOLAR PROJECTS

## MULTIPLE SITES. MULTIPLE TECHNOLOGIES.

Masen is agnostic regarding technology – meaning it does not limit itself to a single kind. The group is developing different forms of technology to meet the grid's specific needs at the most competitive price.

**4** SITES WITH A  
MINIMUM CAPACITY  
OF 2,000 MW  
BY 2020



- **NOOR MIDELT** CSP PV
- **NOOR OUARZAZATE** CSP PV
- **NOOR LAAYOUNE** PV
- **NOOR BOUJDOUR** PV

## CSP AND PV AT MASEN

**CSP (Concentrated Solar Power)** technology captures the sun's rays using flat and curved mirrors and then concentrates them on a receiver that contains heat transfer fluid. This technology provides a good storage capacity, which is useful for meeting the specific needs of the Moroccan grid.

**PV (photovoltaic)** technology generates electricity directly from solar rays captured by semi-conductor cells. The maturity of this technology in a rapidly growing market makes it a very competitive solution for Morocco.

### NOOR OUARZAZATE I



**COMMISSIONED**

CSP with parabolic troughs

160 MW  
3 hours of storage

### NOOR OUARZAZATE II



**UNDER CONSTRUCTION**

CSP with parabolic troughs

200 MW  
> 7 hours of storage

### NOOR OUARZAZATE III



**UNDER CONSTRUCTION**

CSP with power tower

150 MW  
> 7 hours of storage

### NOOR PV I



**UNDER CONSTRUCTION**

Photovoltaic (PV)

Noor Ouarzazate IV : 72 MW  
Noor Laayoune : 85 MW  
Noor Boujdour : 20 MW

### NOOR MIDELT



**IN DEVELOPMENT**

Hybrid (CSP and PV)

Between 150 and 190 MW for each plant

# MASEN, A RESOLUTE LOCAL DEVELOPMENT STRATEGY

Masen's integrated approach combines economic, social and environmental aspects to positively impact project areas and local populations. To transform natural forces into forces of development, Masen acts together with local authorities, following a strategy that is tailored to the priorities of the local populations.

## 3 GUIDELINES

- Ensure integration
- Boost local areas
- Act sustainably

## 3 STRATEGIC ORIENTATIONS



## 5 AREAS OF INTERVENTION

- **Agriculture**  
Support program for farmers
- **Social, cultural and sporting events**  
The Morocco Solar Festival
- **Healthcare**  
Annual medical caravan to benefit the population in the commune of Ghessat
- **Education**  
Two school minibuses provided by Masen
- **Basic equipments and infrastructure**  
Construction of an 18.5 km road that connects the complex to the surrounding douars.

## FIRST RESULTS

### Encouraging achievements in Ouarzazate for the 2010-2016 period

Targeted projects are carried out for the benefit of local populations to support the integration of REN installations in their socio-economic and territorial environment.

Encouraged by the actions it has achieved in Ouarzazate, Masen aims to generalize its strategic approach to the zones of implementation of the future Moroccan energy complexes.

**70** initiatives and projects completed.  
Overall budget of **68,000,000 MAD**.  
More than **34,000** direct and indirect beneficiaries.



# NOOR OUARZAZATE I SOLAR PLANT

## NOOR OUARZAZATE I SOLAR PLANT

PLAN OF THE NOOR OUARZAZATE COMPLEX

SURFACE AREA OF  
NOOR OUARZAZATE I

**480HA**

**NOOR OUARZAZATE I IS THE 1ST  
OPERATIONAL PLANT IN THE NOOR  
PROJECT**

### PLANT DATA SHEET

Technology used: CSP with parabolic troughs  
Installed power: 160 MW  
Electricity purchase tariff: 1.62 MAD/KWh  
Storage period: 3 hours  
CO2 emissions avoided/year: 280,000 t  
Industrial integration rate: 30%  
Developer and EPC :



Investment amount: approx. 7,000 millions MAD  
Financial institutions:



Date of inauguration: 6 February 2016



# NOOR OUARZAZATE II SOLAR PLANT

NOOR OUARZAZATE II SOLAR PLANT

SURFACE AREA OF  
NOOR OUARZAZATE II

610HA

## PLANT DATA SHEET

Technology used: CSP with parabolic troughs and dry cooling  
Installed power: 200 MW  
Electricity purchase tariff: 1.36 MAD/KWh  
Storage period: 7-8 hours  
CO2 emissions avoided/year: 300,000 t  
Industrial integration rate: 35%  
Developer and EPC:



Investment amount: 9,218 millions MAD  
Financial institutions:



Delivery date: first trimester, 2018

PLAN OF THE NOOR OUARZAZATE COMPLEX





# NOOR OUARZAZATE III SOLAR PLANT

SURFACE AREA OF  
NOOR OUARZAZATE III

582HA

## PLANT DATA SHEET

Technology used: CSP with power Tower and dry cooling  
Installed power: 150 MW  
Electricity purchase tariff: 1.42 MAD/KWh  
Storage period: 7-8 hours  
CO2 emissions avoided/year: 222,000 t  
Industrial integration rate: 35%  
Developer and EPC:



Investment amount: 7,180 millions MAD  
Financial institutions:



Delivery date: first trimester, 2018

## NOOR OUARZAZATE III SOLAR PLANT

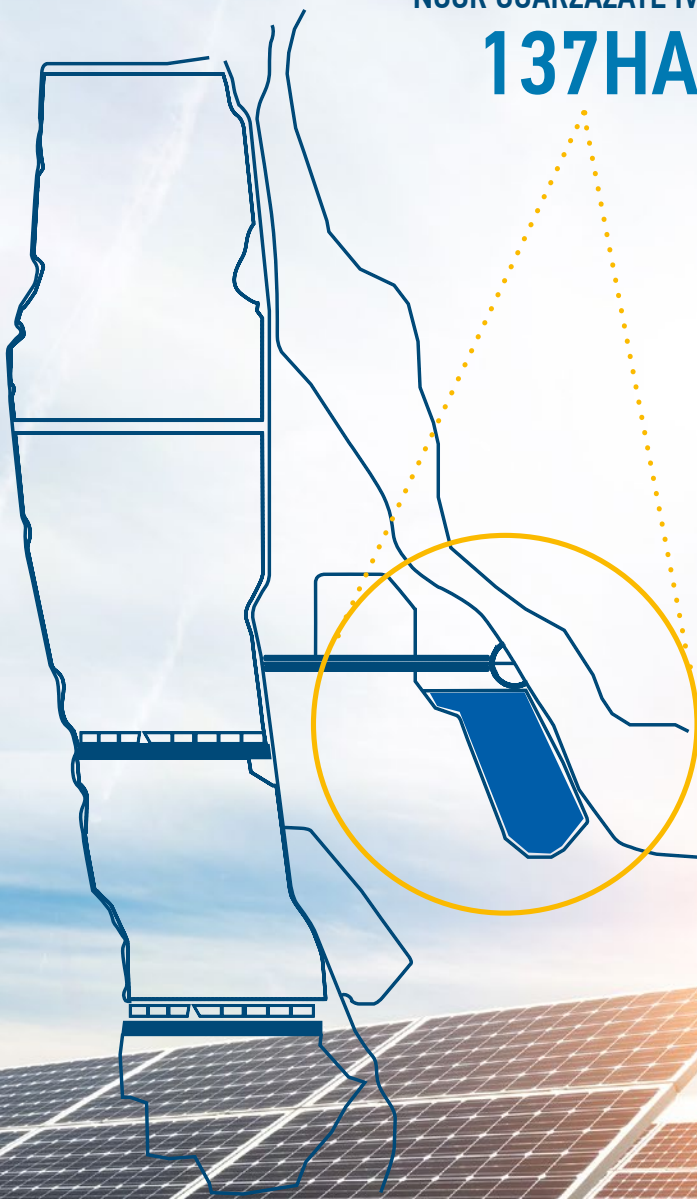
PLAN OF THE NOOR OUARZAZATE COMPLEX



# NOOR OUARZAZATE IV SOLAR PLANT

SURFACE AREA OF  
NOOR OUARZAZATE IV

**137HA**



## PLANT DATA SHEET

Technology used: photovoltaic polycrystalline with a tracking system

Installed power: 72 MW

Electricity purchase tariff: 0.44 MAD/kWh

CO2 emissions avoided/year: 86,539 t

Project's consortium :



Investment amount: +750 millions MAD

Funding:

Up to 659 millions MAD by the KFW  
Bankengruppe



Delivery date: second trimester, 2018

Warranty period: 2 years

Duration of operation by the Developer: 20 years starting from  
the beginning of the project operation



# NOOR LAAYOUNE SOLAR PLANT

SURFACE AREA OF  
NOOR LAAYOUNE  
**240HA**



## PLANT DATA SHEET

Technology used: photovoltaic polycrystalline with a tracking system

Installed power: 85 MW

Electricity purchase tariff: 0.44 MAD/kWh

CO2 emissions avoided/year: 104,276 t

Project's consortium:



Investment amount: +950 millions MAD

Funding:

Issuance of Green Bonds for Noor PV I, with a total amount of 1,150 millions MAD

Institutional investors\*:



\*Attijariwafa Bank also intervened as an Advisory and Investment Bank

Delivery date: second trimester, 2018



# NOOR BOUJDOUR SOLAR PLANT

SURFACE AREA OF  
NOOR BOUJDOUR  
**60HA**



## PLANT DATA SHEET

Technology used: photovoltaic polycrystalline with a tracking system

Installed power: 20 MW

Electricity purchase tariff: 0.64 MAD/kWh

CO2 emissions avoided/year: 23,855 t

Project's consortium:



Investment amount: +300 millions MAD

Funding:

Issuance of Green Bonds for Noor PV I, with a total amount of 1,150 millions MAD

Institutional investors\*:

\*Attijariwafa Bank also intervened as an Advisory and Investment Bank

Delivery date: second trimester, 2018





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