OVERVIEW OF MASEN
CLEAN ENERGY AND RENEWABLES LANDSCAPE IN MOROCCO

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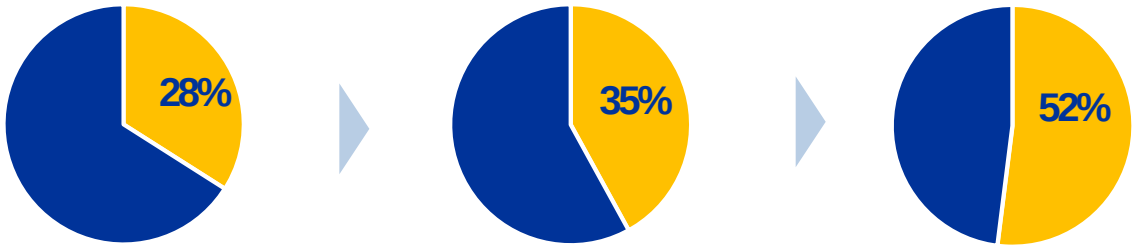
endless power for progress

AN AMBITIOUS ENERGY STRATEGY WITH CLEAR OBJECTIVES

AMBITIOUS OBJECTIVES SET TO ENSURE THE ENERGY SECURITY OF THE COUNTRY, DIVERSIFY THE SOURCES OF ENERGY AND PRESERVE THE ENVIRONMENT

SOLAR HYDRO WIND



ENGAGED ACTORS TO ACHIEVE NATIONAL ENERGY TARGETS

PRIVATE ACTORS

Law 13-09

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Law 57-09 / Law 37-16

Key partner to develop REN projects

المكتب الوطني للكهرباء و الماء الصالح للشرب
Office National de l'Electricité et de l'Eau Potable

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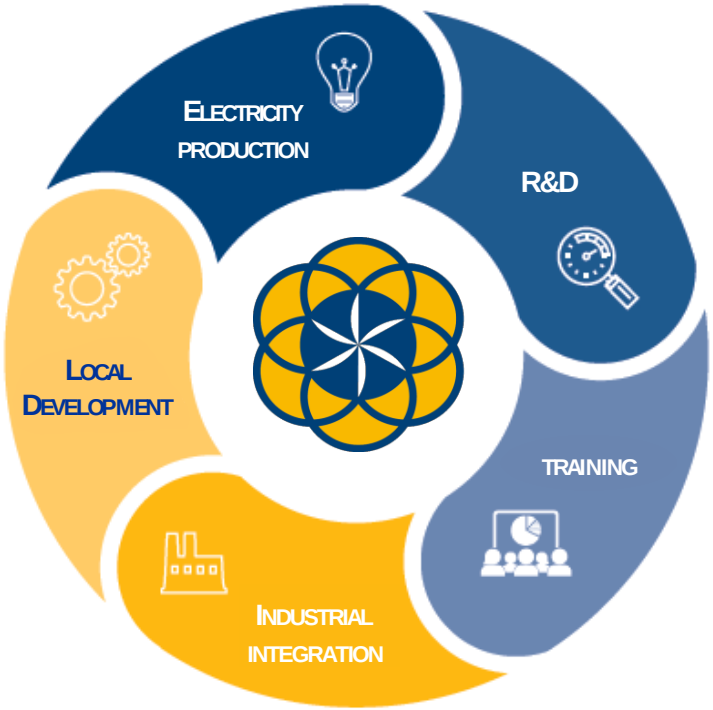
MASEN: CONTRIBUTION TO THE DEVELOPMENT OF AN INTEGRATED REN ECOSYSTEM

A UNIQUE MODEL RELYING ON AN INTEGRATED VISION OF REN PROJECTS DEVELOPMENT



SEVERAL ACTIONS FOR AN INTEGRATED DEVELOPMENT

Solar Cluster

- *80 members and 300 companies connected*
- *Several projects incubated and financed*

CLUSTER SOLAIRE

R&D

- *Several partnerships*
- *European projects of R&D collaboration*
- *1 demonstrator in operation, 1 demonstrator in construction and many others understudy*

cea HORIZON 2020 Sumitomo Masdar A MUBADALA COMPANY

Local development

- *5 sectors of intervention and 4 territories*
- *More than 150 actions led since 2010*
- *More than 77 000 beneficiaries*



…for the development of an integrated RENecosystem

MASEN: CONTRIBUTION TO THE DEVELOPMENT OF AN INTEGRATED REN ECOSYSTEM

Masen's skills and expertise

Evaluation of renewable energy resources

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

Carrying out advance studies needed to qualify a site

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

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

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

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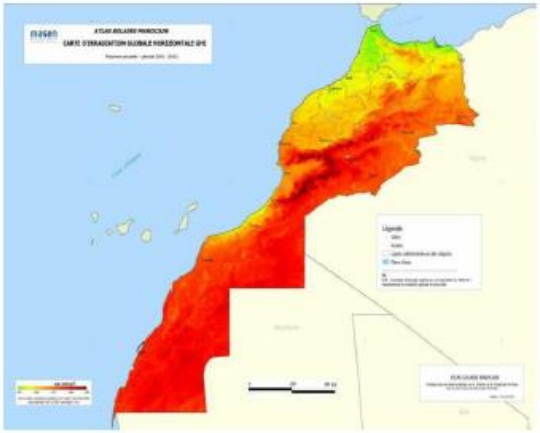
MASEN: RENEWABLE ENERGY RESOURCE ASSESSMENENT

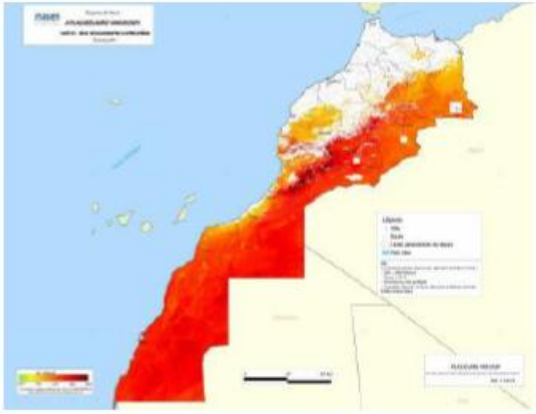
Illustration – assessing the solar potential



Development of solar atlas

Gathering of meteorological and climate related data

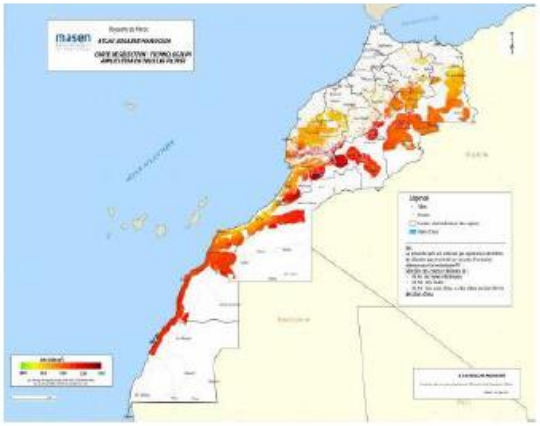
- Satellite irradiation data records *(overall territory coverage, period over 15 years)*
- Other geographic data *(altitude, slope, various networks, hydrographic map, etc.)*



Assessing the solar potential

Definition of exclusion criteria

- A relevant irradiation threshold
- Flat land / low slope
- Usage and land covering *(non-building land, forest, etc.)*
- Protected areas *(humid, biological and ecological interest site, archeological site, etc.)*



Selecting the most suitable sites

Definition of selection criteria and weighting matrix

- Acute irradiation *(> 2,000 KWh/m²/year)*
- Flat field *(< 4% to 5% slope)*
- Proximity to basic infrastructure *(roads < 25 Km, high voltage lines < 50 Km, water < 25 Km)*
- Availability of empty fields

MASEN: QUALIFICATION STUDIES

Illustration – qualification studies

Various studies conducted upfront to select sites with the suitable characteristics for the development of solar projects

- Topography study
- Seismicity study
- Geotechnical study
- Water resources study
- Hydrological study
- Environmental impact study – plant
- Sun radiation study
- Dust study
- Other climate and meteorological studies
- Social impact study
- Waste management study
- Environmental impact study – common infrastructures

Studies highlighting sites specificities, particularly in terms of solar resource, allowing detailed design of the plants to be conducted

MASEN: MOBILIZATION OF CONCESSIONAL FINANCING

An innovative mobilization of concessional financing

KFW

Banque européenne d'investissement

AFD

THE WORLD BANK
IBRD • IDA

CTF CLEAN TECHNOLOGY FUND

First green bond Issuance of Morocco and Africa

البريد بنك
AL BARID BANK

Société Centrale de Réassurance
GROUPE CCG

الصندوق المغربي للتقاعد
Caisse Marocaine des Retraites

التجاري وفا بنك
Attijariwafa bank

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MASEN: BUILDING INFRASTRUCTURES

Illustration – common infrastructures developed

Common infrastructures development by Masen, to reduce development risks and offer the required comfort to selected developers

- Road infrastructures
- Water infrastructures
- Hydrological infrastructures
- Electric infrastructures
- Telecom infrastructures
- Security / safety infrastructures
- Other infrastructures (waste, lightning, etc.)

- Provide required **comfort and visibility** to the **selected developers**
- Ensure **global consistency** at the complex level
- Maximize **synergies** resulting from a simultaneous development of such common infrastructures
- **Manage in an optimal way timing, costs and inherent risks** in the development of common infrastructures

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MASEN: PROJECT MANAGEMENT

Illustration – power plan construction

Financial close

Final Commercial Operating Date (FCOD)

Engineering
- Design review
- Technical advisors contracting
- Independent engineer contracting
- Review of technological document under escrow

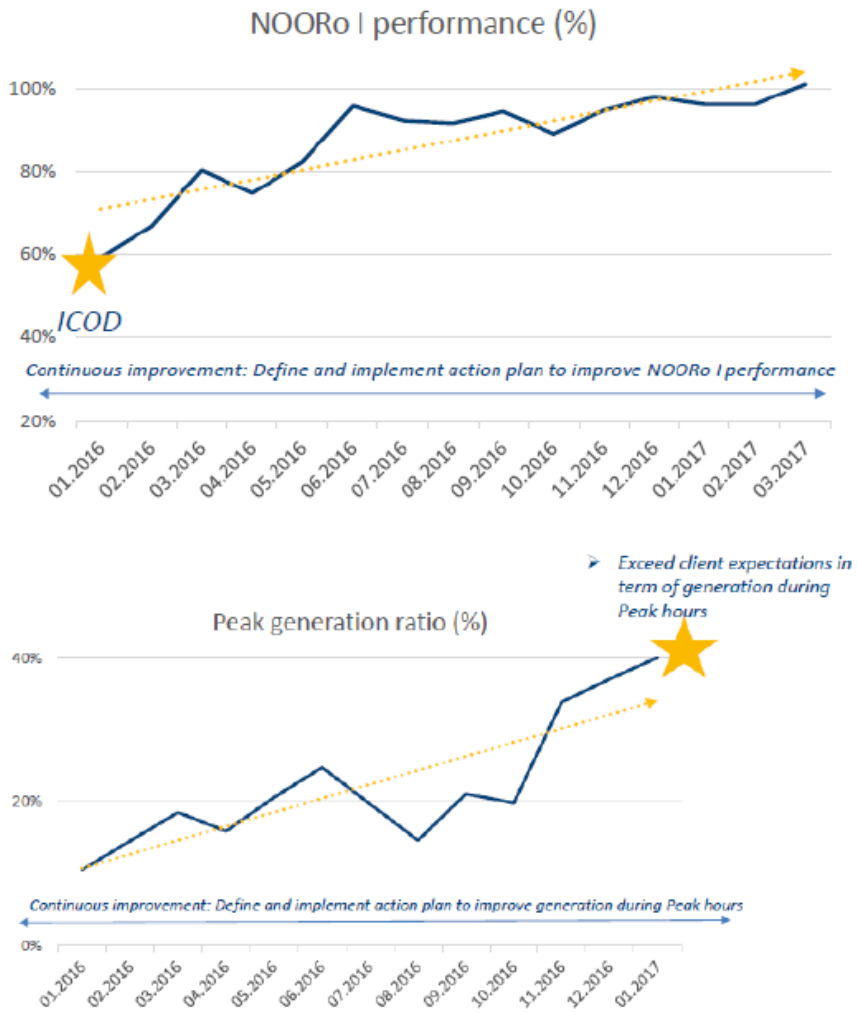
Construction
- Construction permits
- HSE
- Solar power plant construction
- Interface with infrastructures
- Industrial integration follow-up
- Employment follow-up

Logistics and procurement
- Inspection
- Test procedures analysis
- Factory acceptance tests
- Transport authorizations follow-up

Commissioning & start-up
- Commissioning procedures analysis
- Commissioning follow-up
- Equipment and plant certification with the independent engineer
- Performance tests
- HSE[1]

MASEN: OPERATIONS AND MAINTENANCE MANAGEMENT

Illustration – performance and peak generation ratio improvement in 2016 (Noor I)



The O&M team makes sure the plants are operated and maintained to meet performance, reliability and safety expectations over time

Among the tasks under its direct responsibility, the O&M team is vigilant in maintaining a high level of performance through :

- *Performance monitoring*
- *Data collection and check*
- *Production forecasting*
- *Daily declarations*
- *KPIs definition and follow-up*

ICOD : Initial Commercial Operating Date

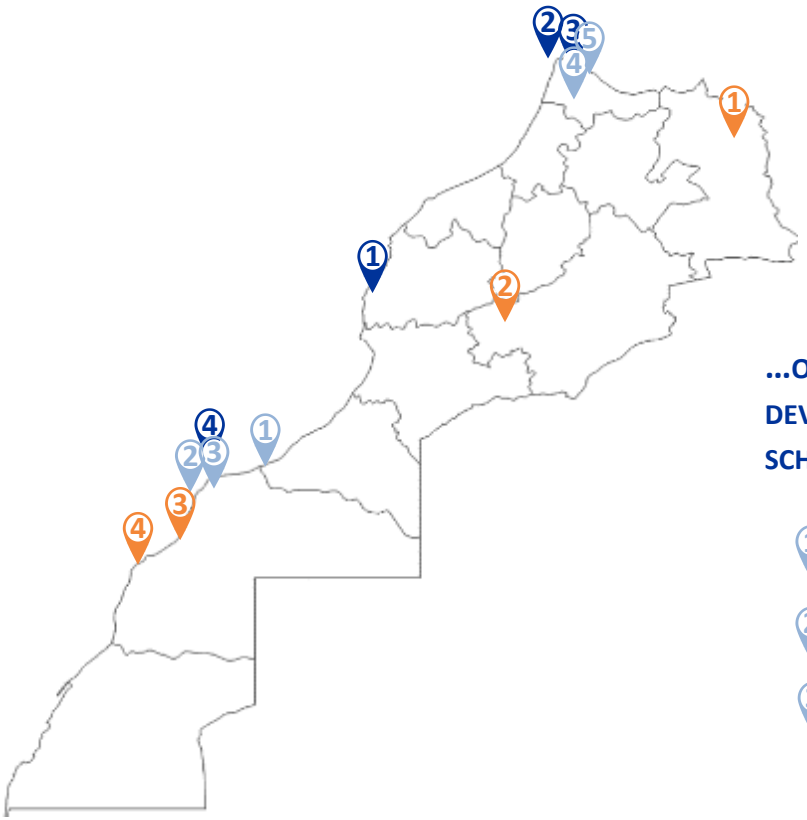
ALMOST 4 000 MW OF RENEWABLES IN OPERATION OVER A TOTAL INSTALLED CAPACITY SUPERIOR TO 10 000 MW

Solar Projects – 700 MW

- Ain Beni Mathar – 20 MW
- NOOR Ouarzazate I – 160 MW
- NOOR Ouarzazate II – 200 MW
- NOOR Ouarzazate III – 150 MW
- NOOR Ouarzazate IV – 70 MW
- NOOR Laayoune – 80 MW
- NOOR Boujdour – 20 MW

Hydro projects – 1 770 MW

More than 29 hydro-electric dams across the country and 1 STEP



Wind projects – 1430 MW

1. Amougdoul – 60 MW
2. Tanger I – 140 MW
3. Torres / Koudia Al Baida – 50 MW
4. Tarfaya – 300 MW

...of which around 620 MW developped under the Law 13-09 scheme

1. Akhfenir 1 & 2 200 MW
2. Foum Al Oued 50 MW
3. Cimar 5 MW
4. Haouma 50 MW
5. Lafarge 32 MW

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NOOR OUARZAZATE: THE FIRST MULTI TECHNOLOGIES COMPLEX

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A SOLAR COMPLEX OF 580 MW COMBINING 3 DIFFERENT SOLAR TECHNOLOGIES

NOORo I

IN OPERATION

- *Technology*: **CSP trough**
- *Capacity*: **160 MW**
- *Storage*: **3 hours**
- *CO2 emissions avoided*: **~280 000 tCO2 / year**
- *Industrial integration*: **30%***

NOORo II

IN OPERATION

- *Technology*: **CSP trough**
- *Capacity*: **200 MW**
- *Storage*: **> 7 hours**
- *CO2 emissions avoided*: **~380 000 tCO2 / year**
- *Industrial integration*: **35%**

NOORo III

IN OPERATION

- *Technology*: **CSP Tower**
- *Capacity*: **150 MW**
- *Storage*: **> 7 hours**
- *CO2 emissions avoided*: **~250 000 tCO2 / year**
- *Industrial integration*: **35%**

NOORo IV

IN OPERATION

- *Technology*: **PV with tracking system**
- *Capacity*: **70 MW**
- *CO2 emissions avoided*: **~87 000 tCO2 / year**

** Real industrial integration reached: 34%*

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FUTURE REN PROJECTS : OTHER PROJECTS PLANNED

2018

Solar projects

700 MW of solar projects in operation

Wind projects

1 430 MW of wind projects in operation

Hydro projects

1 770 MW of Hydro projects in operation
More than **29** dams in operation and **1** STEP

2030

Noor Midelt I
800 MW

Noor Midelt II
400 à 800 MW

NOOR Tafilalet
800 MW

NOOR PV II
800 MW

NOOR Atlas
200 MW

Programme Eolien Intégré (Jbel Hdid 200 MW; Tiskrad 100 MW, Tanger II 70 MW; Midelt 180 MW, BOUJDOUR 300 MW)
850 MW

Projet Eolien Intégré – Taza Iet II
150 MW

Koudia Al Baida Repowering
120 MW

Aftissat II
200 MW

Detailed programing ongoing to take into account the possible synergies between REN technologies

+ 6000 MW ***by 2030***

NB: private projects developed under the Law 13-09 included

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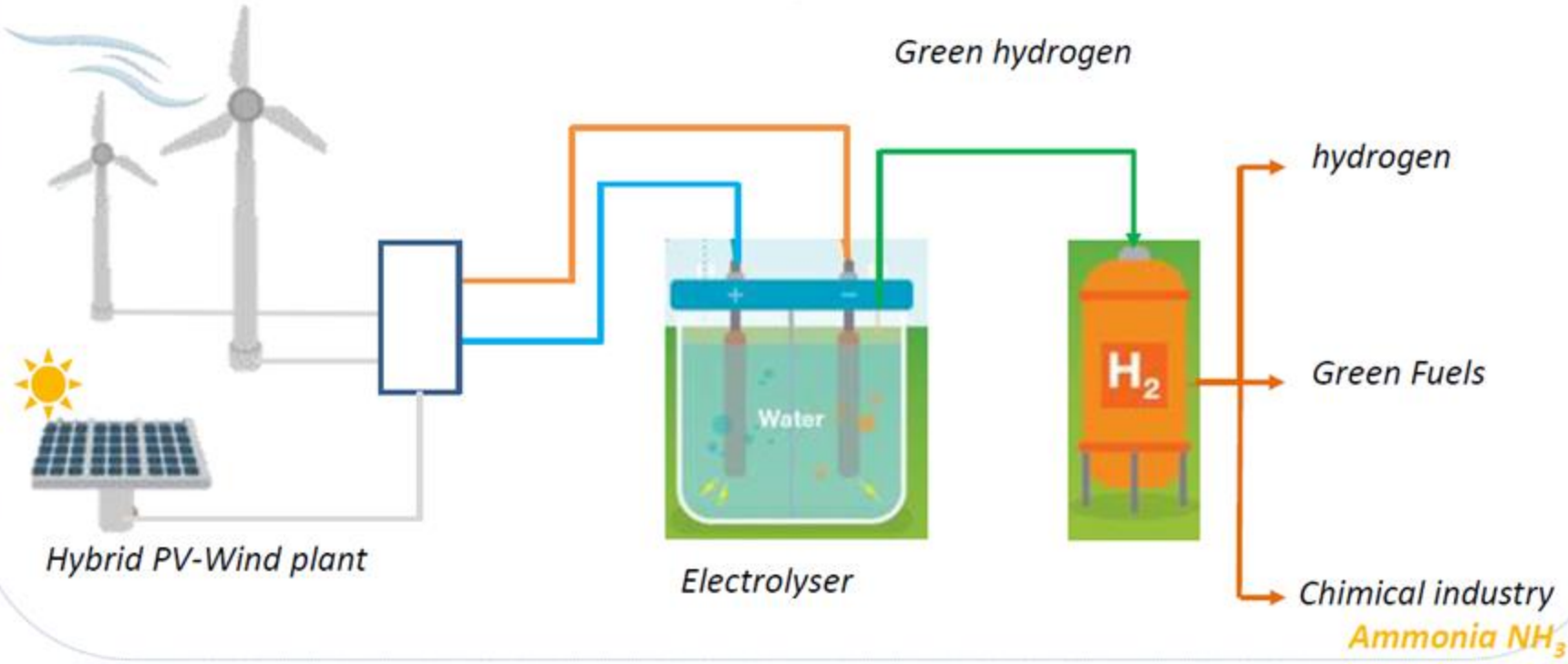
AMBITION TO DEVELOP THE PRODUCTION OF GREEN MOLECULES IN MOROCCO WITH A FIRST H2 REFERENCE

Project definition

To benefit from the economy of scale relating to the production of electricity ➔ Competitive electricity costs

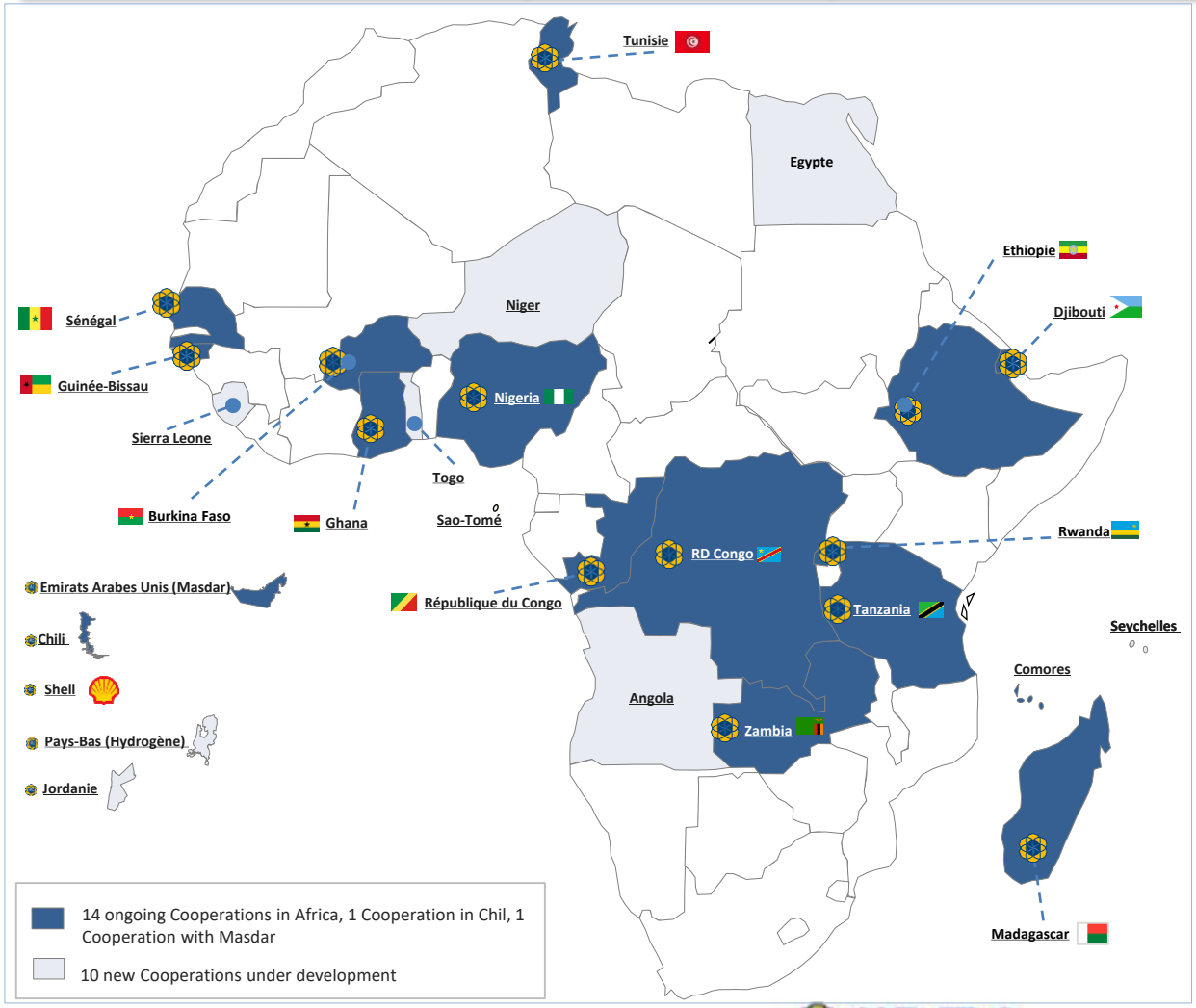
+

To produce a quantity of hydrogen that can be consumed locally



ACTIONS INITIATED BY MASEN IN SEVERAL SUBSAHARIAN COUNTRIES

14 ongoing Cooperations in Africa, 1 Cooperation in Chile, 1 Cooperation with Masdar and 10 new Cooperations under development



Areas of Cooperation

- Know-how exchange
- Capacity reinforcement
- Technical assistance
- Co-Development

COALITION FOR SUSTAINABLE ENERGY ACCESS

CLIMATE ACTION SUMMIT 2019 A RACE WE CAN WIN

Morocco and Ethiopia, have taken the lead on the "Leaving no one behind" theme

Announcement on the Coalition during the General Assembly of the UN – 23rd of September 2019

SUSTAINABLE DEVELOPMENT GOAL 7

Ensure access to affordable, reliable, sustainable and modern energy for all

THE COALITION OF SUSTAINABLE ENERGY ACCESS PROJECT AIMS AT RESPONDING TO THE VITAL NEEDS OF THE GLOBAL POPULATION

PARTICULARLY THOSE LOCATED IN REMOTE AREAS OF DEVELOPING COUNTRIES, ESPECIALLY IN LESS DEVELOPED COUNTRIES (LDCS)

- ELECTRICITY ACCESS
- CLEAN COOKING
- CLEAN WATER SUPPLY
- IRRIGATION
- COOLING AND HEATING

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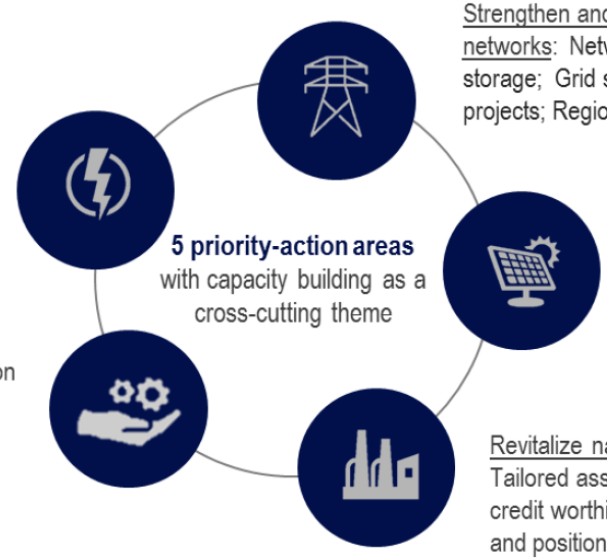
DESERT TO POWER INITIATIVE

OWNER

CHAIR



Accelerate solar generation at utility-scale: IPP Procurement Programs, Regional solar parks

Strengthen and extend transmission networks: Network absorption and storage; Grid strengthening & extension projects; Regional interconnections

Accelerate off-grid electrification: Deployment of mini grids programs and solar home systems

Improve business environment: Optimization and harmonization of regulatory frameworks; Harmonization of quality standards; Fiscal incentives

Revitalize national power utilities: Tailored assistance to achieve credit worthiness of power utilities and position them as viable off-takers

PHASE I

Identification of solar investment programs

PHASE II

Project development

PHASE III

Project funding

Mobilizing public and private funds for the installation of up to 10 GW of capacity by 2025 in the concerned countries

ISLAMIC DEVELOPMENT BANK COOPERATION ACTIVITIES

CONTEXT:

- **Partnership agreement between Masen and the Islamic Bank of Development (IsDB) during the General Assembly of the IsDB (6th of April, Marrakech)**
- **The partnership relates to the co-development of projects in African countries that are eligible by the IsDB in the framework of the Reverse Linkage Programme (South-South cooperation and knowledge transfer)**

COOPERATION LINE :

- **The IsDB will provide grants to cover the external costs for the Due Diligence, and for the preliminary structure of the project by Masen**
- **It will also provide concessional financing to the country covering all the development costs and procurement, including technical assistance by Masen**
- **Once financial close reached, Masen can take up to 25% of the shares in the project company**

AN EXCHANGE OPPORTUNITY WITH EUROPE THROUGH THE IMPLEMENTATION OF A RENEWABLE EXCHANGE ROADMAP

GREEN ELECTRICITY EXCHANGE ROADMAP BETWEEN MOROCCO AND EUROPE

COUNTRIES: FIVE SIGNATORY COUNTRIES:

STEERING COMMITTEE STEERING COMMITTEE SECRETARIAT BY MASEN

PHASE I	PHASE II	PHASE III
Project scope and synthesis of previous studies	Studies implementation and identification of target markets for the exchange of electricity between the five countries	Roadmap elaboration and preparation of the implementation

PARTNERS INVOLVED IN THE PROJECT

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

Commission européenne

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Electricity transmission System Operators TSOs


endless power for progress