



Green Power

# **MENAREC5**

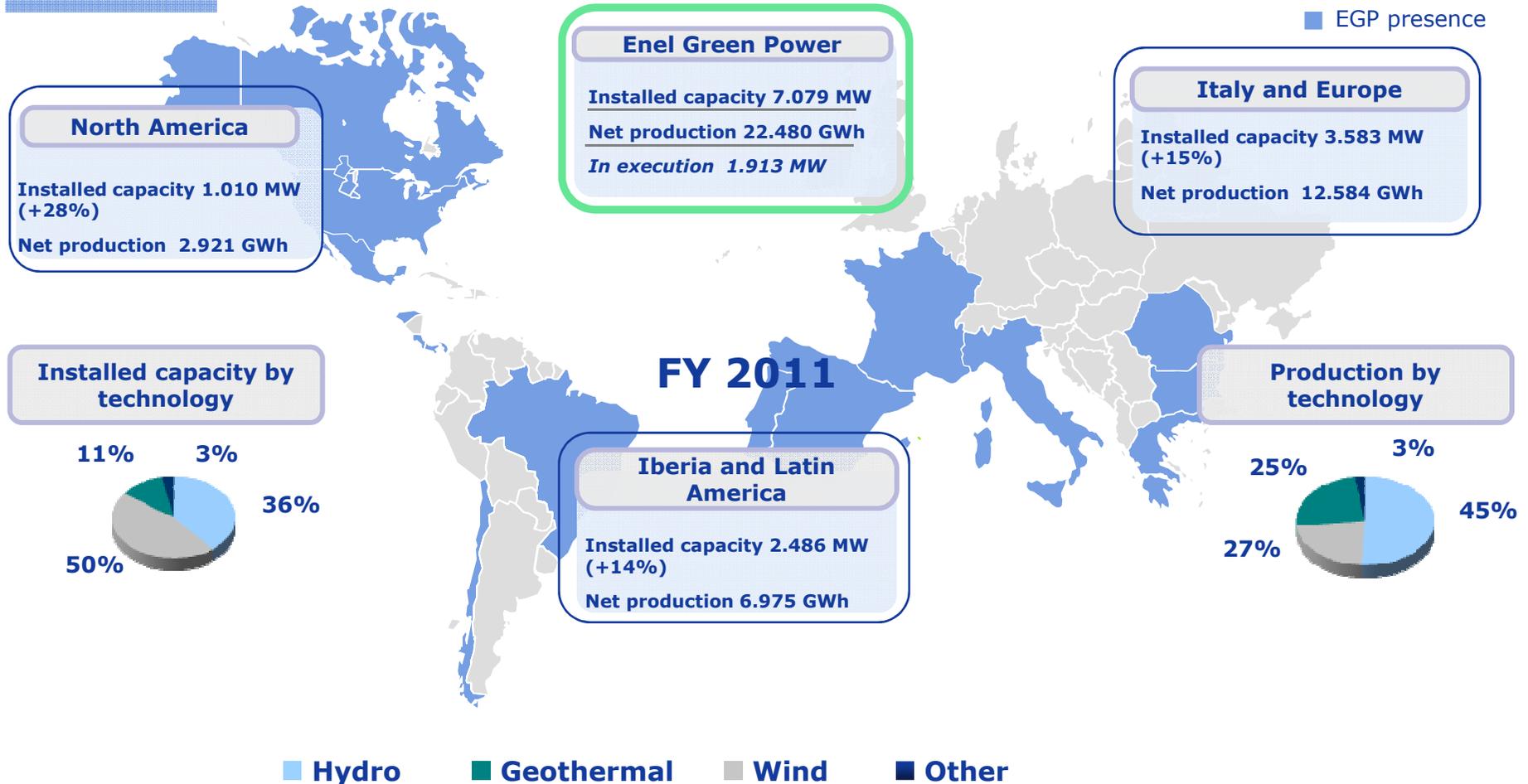
## **Prospect and Challenges for a Regional EU-MENA Grid and Market Integration**

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Head of Business Development New Countries, Enel Green Power*

Marrakech, May 16<sup>th</sup> 2012

# A global leader

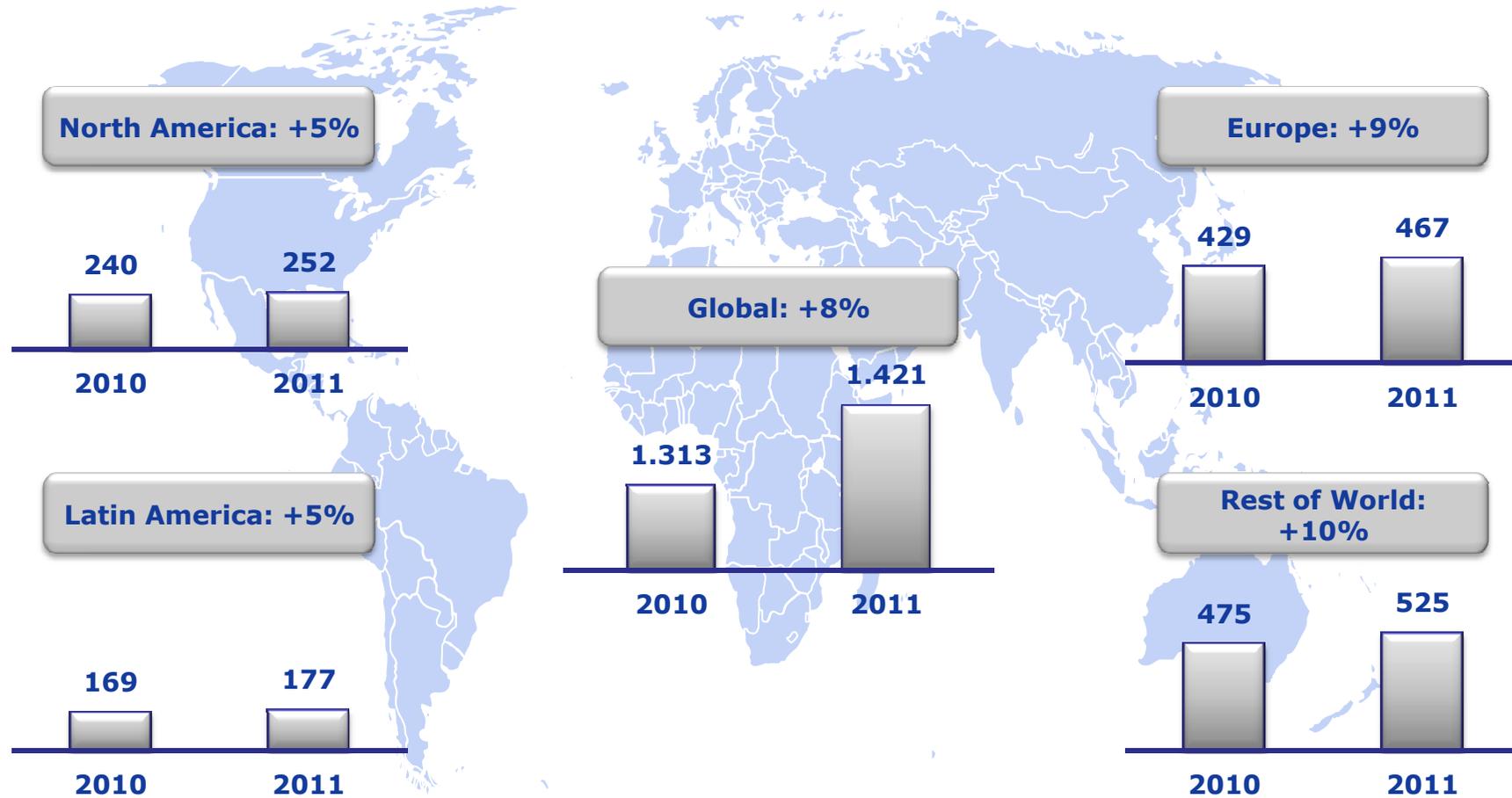
## EGP global footprint – 2011



**Unrivalled footprint in 16 countries across all main renewable technologies**

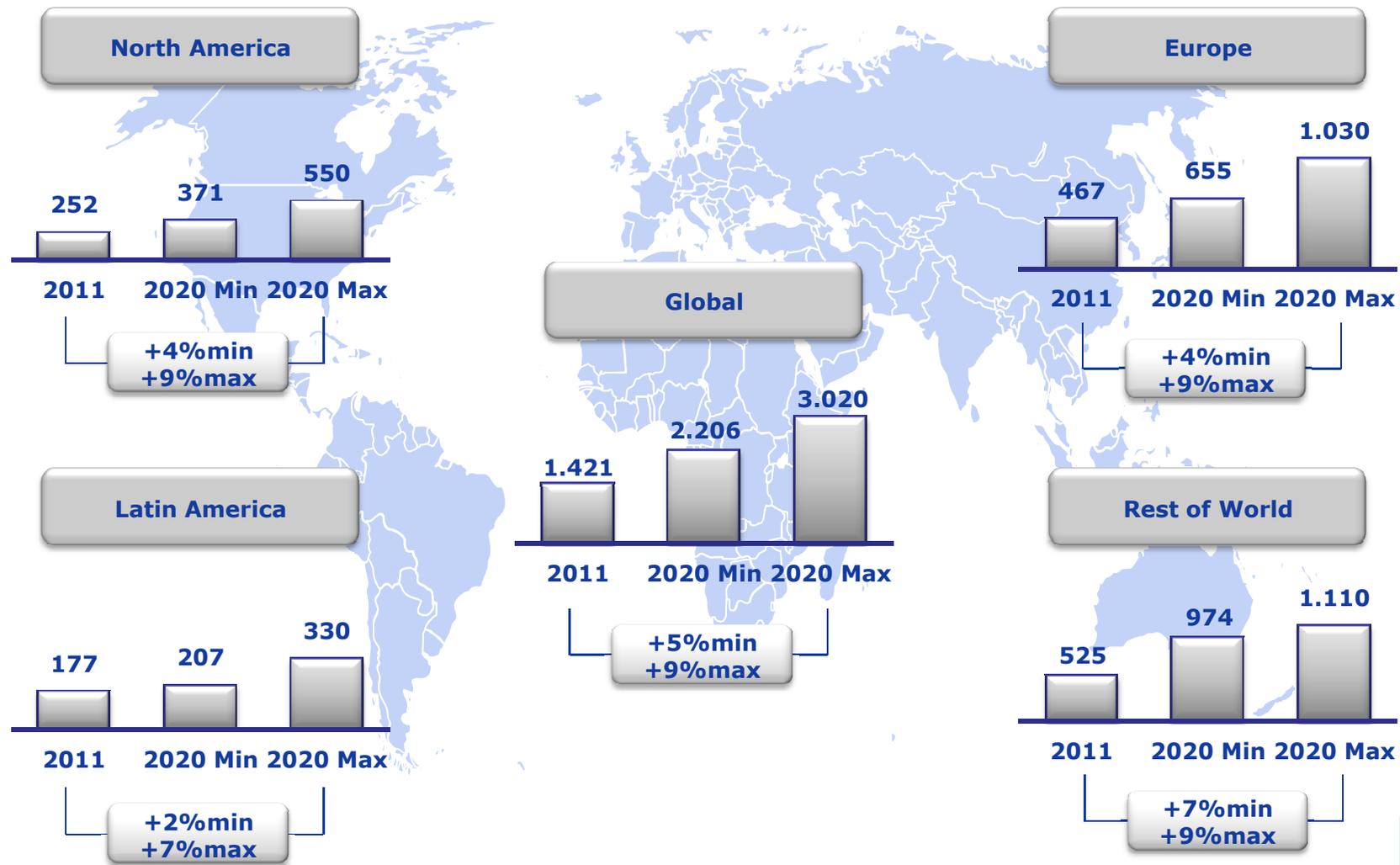


# Global growth in renewables: 2011 (GW)<sup>1</sup>



1. 2011 preliminary figures. Sources: EPIA, GWEC, EWEA, SEIA, EER (2011), WEO 2011, BNEF

# Global growth in renewables: future evolution (GW)<sup>1</sup>



1. 2011 preliminary figures. Sources: EPIA, GWEC, EWEA, SEIA, EER (2011), WEO 2011, BNEF

# Renewable energy investments: a growing industry

## Expected worldwide growth

By technology								By geography						
Technology	Installed base	Installed base	Delta capacity		Expected Growth CAGR 2011-20		Investments	Area	Installed base	Installed base	2020 Min	2020 Max	Expected Growth CAGR '11-'20	
	2010 (GW)	2011 (GW)	'10-11 (GW)	%	Min	Max			2011 (€bn)	2010 (GW)	2011 (GW)	(GW)	(GW)	Min
Hydro	~1,005	~1,037	+32	2%	2%	2%	~65	North America	240	252 +5%	371	550	4%	9%
Wind	~197	~240	+43	22%	10%	14%	~57	Europe	429	467 +9%	655	1,030	4%	9%
Biomass	~60	~64	+4	7%	6%	25%	~15	Latin America	169	167 +5%	207	330	2%	7%
Solar	~40	~69	+28	69%	13%	25%	~105	Africa	27	28 +6%	53	110	7%	16%
Geothermal	~11	~12	+0.4	4%	6%	11%	~2	Asia	449	494 +11%	921	1,000	7%	8%
<b>TOTAL</b>	<b>~1,313</b>	<b>~1,421</b>	<b>+108</b>	<b>8.2%</b>	<b>5.0%</b>	<b>8.7%</b>	<b>~€244bn</b>	<b>TOTAL</b>	<b>~1,313</b>	<b>~1,421</b>	<b>~2,206</b>	<b>3,020</b>	<b>5.0%</b>	<b>8.7%</b>

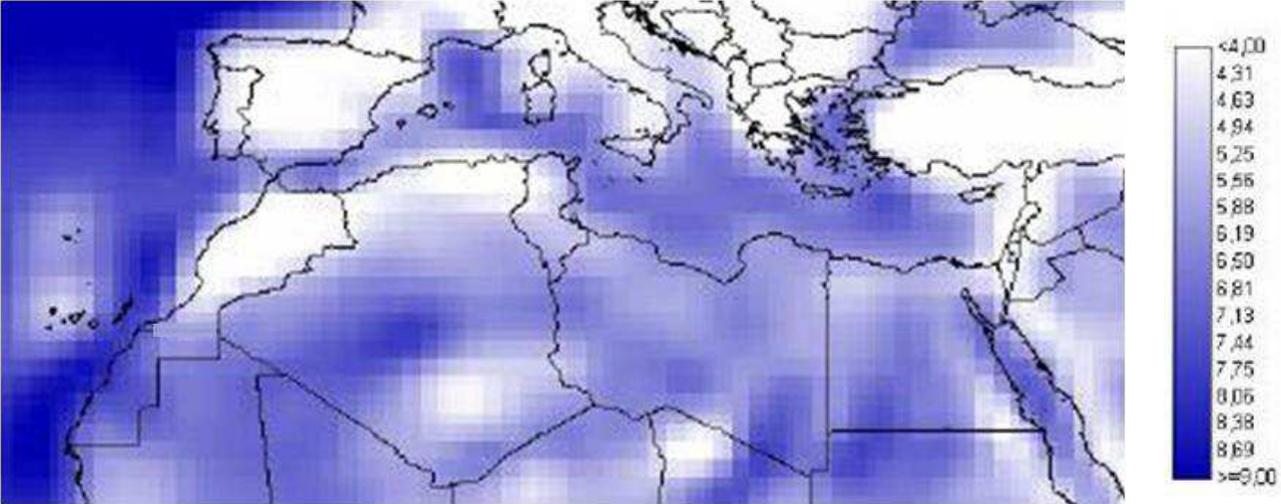
- All renewable technologies and regions confirm their strong potential
- Investments in distributed generation accounted for 25% of the total
- During 2011, total R&D investments amounted to €20bn (€10bn from corporate and €10bn from government)

Source: EPIA, GWEC, EER (2011); WEO 2011 New Policies scenario (2020 min); industry reports/McKinsey (2020 max); BNEF, EGP estimates  
 Note: All 2011 figures are preliminary estimates. Investments estimated based on BNEF figures and assuming an fx of 1.3 €/\$. Hydro investments estimated assuming 16GW of new installations and 2.0€/MW capex.

# Outstanding RES potential in MENA Region

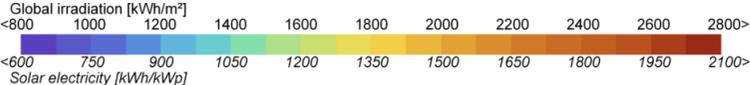
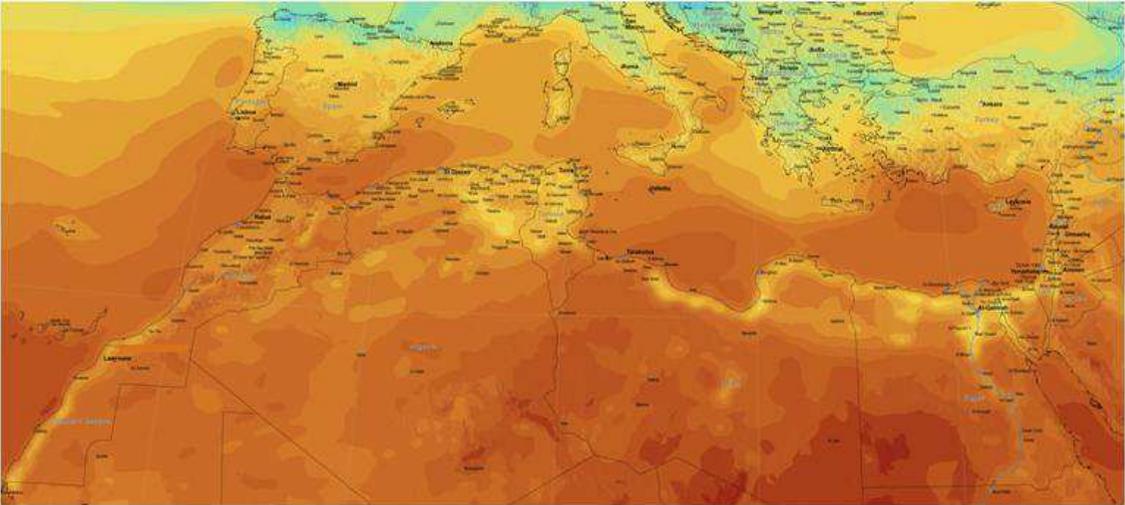
## Wind

Annual average wind speed at 80m above ground level in m/s.



## Solar

Yearly sum of global irradiation incident on optimally-inclined surface.



Source: DLR, EC-JRC

# Mediterranean cross-border links

- Closest (and existing) connection from MENA to EU, but only for limited size, due to limited capacity between Spain and France;
- Good in short term and for pilot projects

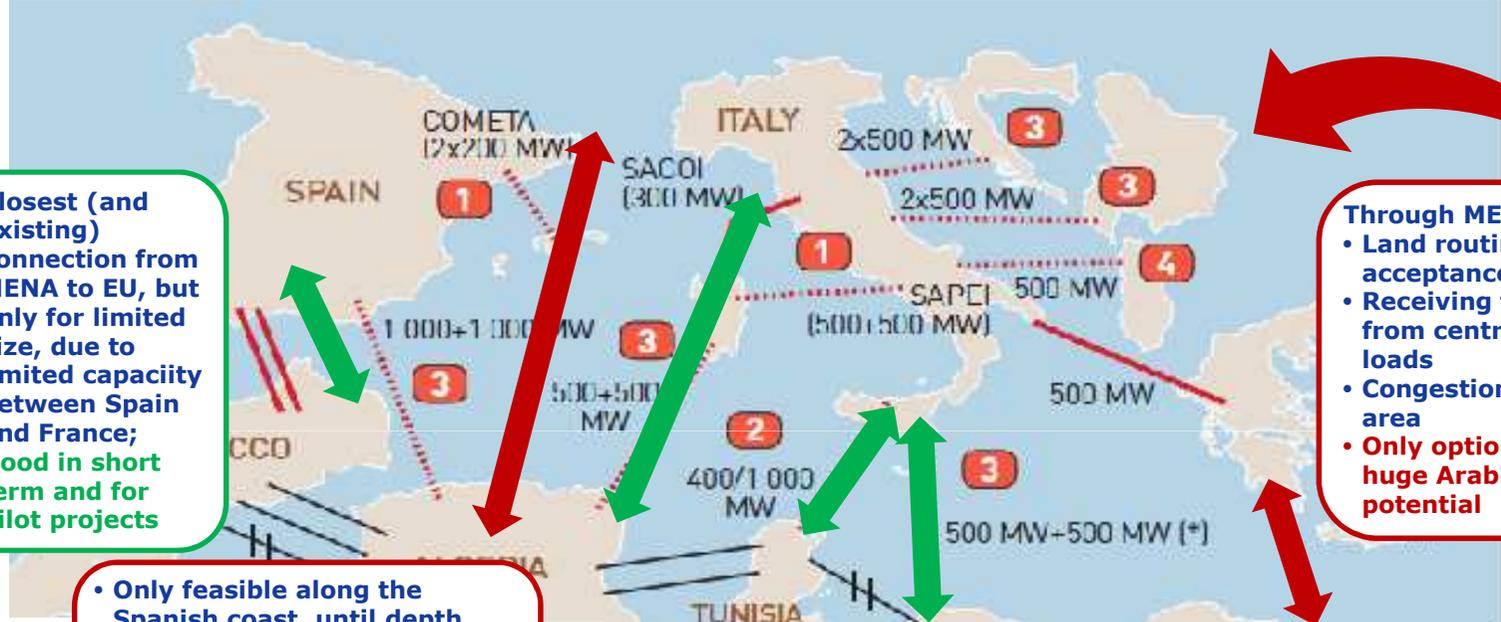
- Only feasible along the Spanish coast, until depth limits are overcome;
- Major challenge due to long distance;
- Proximity to central EU load centers;
- **Very long term perspective**

- Technically and economically feasible
- Leverage on existing northern border links, whose flow can be reversed
- need to by-pass Southern Italy congestions
- several new interconnections under way
- **good option in medium term**

- Through ME and Turkey
- Land routing with social acceptance issues
- Receiving terminals far from central European loads
- Congestions in Balkan area
- **Only option to exploit the huge Arabic peninsula potential**

- Depth problems
- Receiving terminals far from central European loads
- **Congestions in Balkan area**

- 1 Project under construction
- 2 "Quick start" project
- 3 Feasibility study completed
- 4 Feasibility study to be completed
- In operation
- ..... Under construction or potential



Source: Terna, OME

# Main challenges for EU-MENA RES integration

## Institutional and regulatory framework

### Some aspects to focus on:

- ✓ Cooperation mechanisms between States
- ✓ Harmonization of incentives and ease the permitting process and all required bureaucratic procedures
- ✓ Technical assistance on market and transmission issues
- ✓ Suitable and stable Regulatory framework
- ✓ Suitable tariffs/subsidies policy in order to:
  - Cover investment and operation plants costs
  - Cover infrastructural systems costs: grid connection and system costs, power transportation locally and/or towards EU
  - Avoid competing subsidies to conventional power production
- ✓ Concrete possibility to implement **Art. 9 of Directive 2009/28/CE**
- ✓ Select the **proper technology mix according to local conditions**

## Interconnections

### Development of interconnections:

- ✓ among European Countries
- ✓ between MENA Region and EU

## System flexibility

### Enhancement of:

- ✓ Flexibility of the power generation mix (through an increased use of electricity from natural gas)
- ✓ Electricity storage
- ✓ Smart grids technologies and infrastructures at the distribution level
- ✓ Mobility (i.e. electric vehicles)
- ✓ Demand Side Management

# RES targets in selected MENA Countries



Note: RES = Renewable Energy Sources.

## Existing on going energy initiatives in MED area

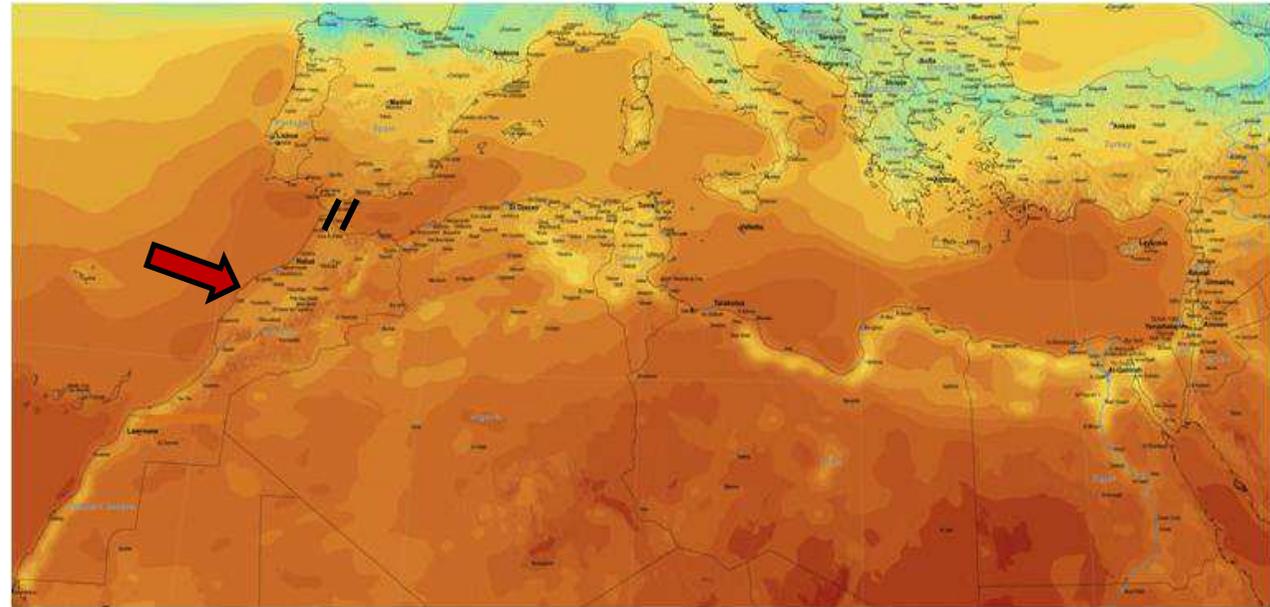
	Initiative	Type	Area of Activities	Technology focus	Year of foundation	N. of members
	<b>RES4MED</b>	Industrial & Institutional	Cooperation with ongoing MED initiatives	All renewable energies	2012	12
	<b>OME</b>	Industrial	Analysis of energy Issues	All energy, RE and efficiency	1991	33
	<b>MedReg</b>	Institutional	Regulatory framework, supporting scheme	Electricity and Gas	2007	24
	<b>Mediterranean Solar Plan</b>	Institutional	Policy, regulatory framework, supporting scheme	Renewable deployment of 20 GW at 2020	2008	43
	<b>Desertec Industrial Initiative</b>	Industrial consortium	Markets, transmission regulation	Transmission and interconnection grids	2009	56
	<b>MedGrid</b>	Industrial consortium	Regulation for grid access for RES producers	Grid network	2010	20
	<b>PWMSP</b>	Institutional	Paving the way to Med Solar Plan	All renewable energies	2010	5
	<b>MedTSO</b>	Industrial	Transmission system in the MED	TSO	2012	16

Source: RES4MED

# Focus on Morocco

## Countries of the Mediterranean Basin

- **Morocco** presents the **best balance in the MENA region** between **yearly irradiation, grid development** for local consumption and **existing interconnection capacity with European countries**
- This allows for **immediate development of distributed photovoltaic generation capacity at profitable economic conditions**



\* Yearly sum of global irradiation incident on optimally-inclined surface  
Source: EC-JRC



# PV is reaching a grid parity at certain conditions

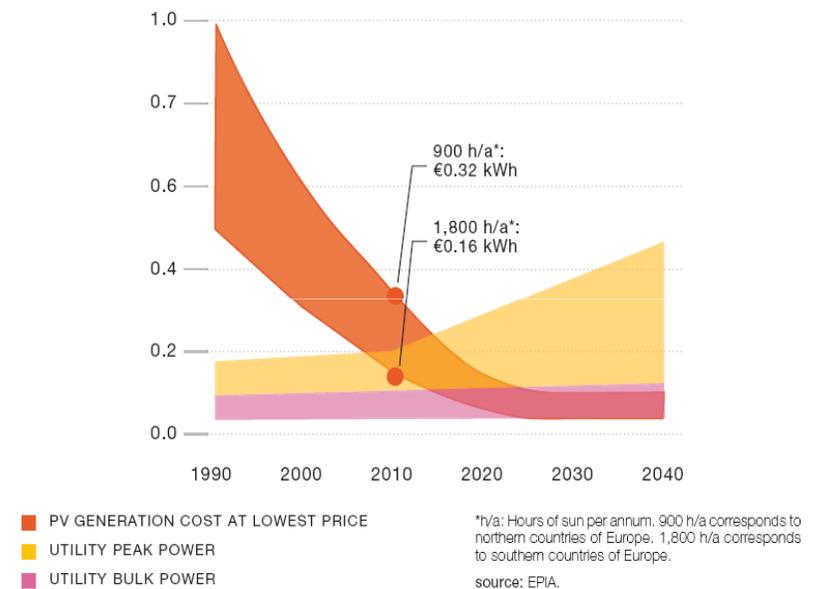
## LCOE for market segments and operating hours

Large Plant (2.5 MW)	LCOE (€/MWh)	1000 EOH	1250 EOH	1500 EOH
	Capex : 1.6 €/W	220	180	<b>150</b>
	Capex : 1.0 €/W	150	120	<b>100</b>

Medium Rooftop (100 kW)	LCOE (€/MWh)	1000 EOH	1250 EOH	1500 EOH
	Capex : 1.8 €/W	185	150	<b>125</b>
	Capex : 1.2 €/W	130	105	<b>90</b>

Residential Rooftop (3 kW)	LCOE (€/MWh)	1000 EOH	1250 EOH	1500 EOH
	Capex : 2.0 €/W	215	175	<b>145</b>
	Capex : 1.4 €/W	160	130	<b>110</b>

DEVELOPMENT OF UTILITY PRICES AND PV GENERATION COSTS €/kWh



Source: EPIA, EGP estimates

Note: For the LCOE calculation the following assumptions were used: 7% WACC, 35% tax rate for large plant, 30k€/MW annual opex for residential and large plant and 20k€/MW for medium rooftop installations, 25 years of life, no terminal value and 0.05% annual decay of productivity.

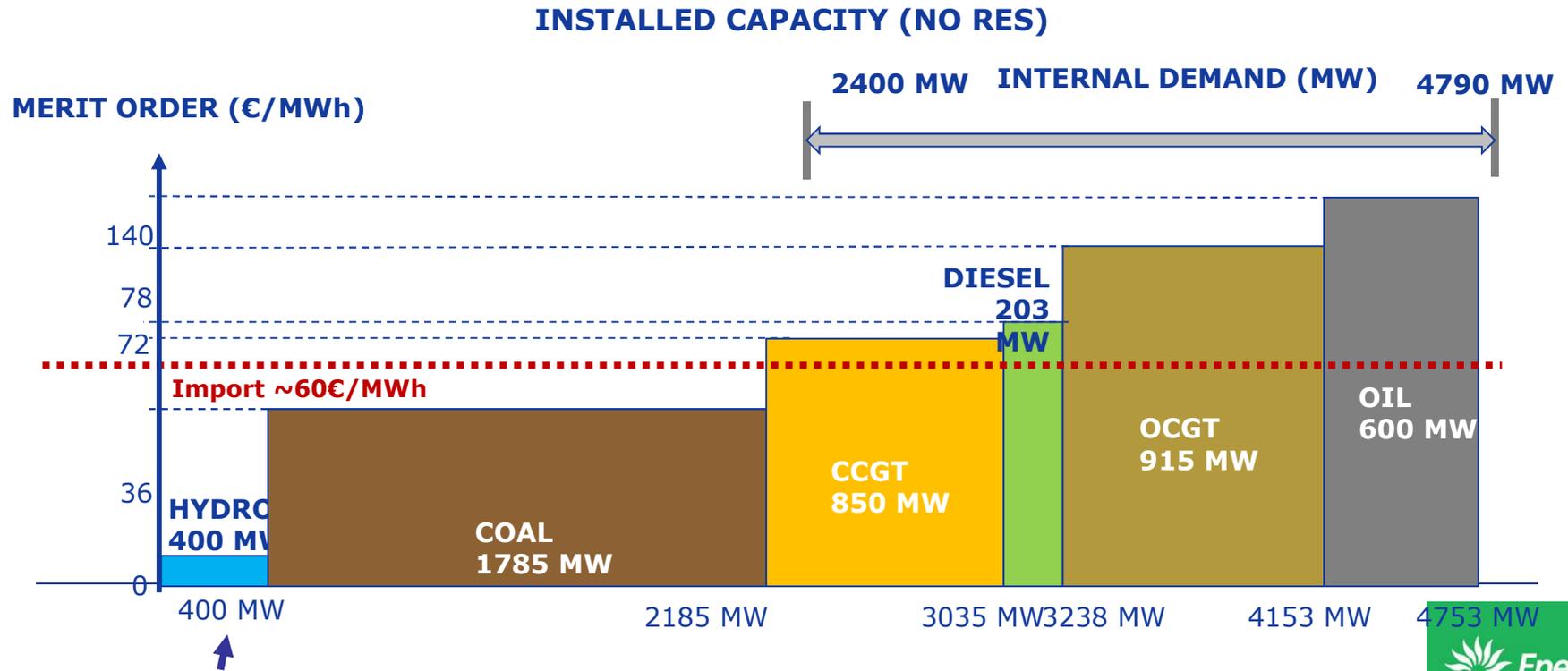
For residential installations a WACC decreased for 1% leads to a LCOE decrease of ~10€/MWh



# Morocco Electricity Market

## Merit Order

A significant demand growth together with a high marginal cost of production (old fuel oil), and in many occasions with negative reserve margin, creates the urgent need to increase the generation capacity. Simultaneously Morocco is seeking to increase its energy independence from the Algerian gas and the electricity imports from Spain



Conservative assumption: hydro installed capacity equal to 1300 MW  
 but with EOH = 2650 (30%) + installed pumping 464 MW with EOH = 350 (4%)

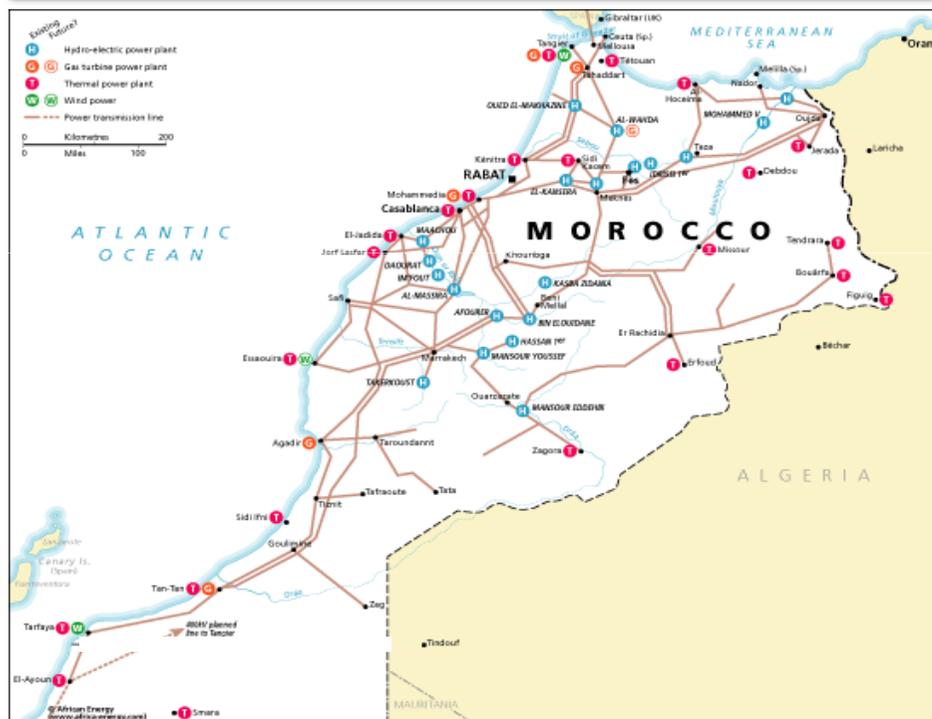


# Morocco Electricity Market

## Electricity Market Infrastructure

The Moroccan Grid is already suitable to manage the not programmable renewable resources as defined in the National Plan for Renewable

### Morocco Grid Map & Interconnection



Morocco is interconnected with\*:

- Algeria (400 MW)
- Spain (900 MW import 600 MW export underwater)

Source: GENI - Global Energy Network Institute, Enerdata

\* Morocco is interconnected with Spain since 1998, in May 2006 the second part of the electricity interconnection was commissioned (further 700 MW). The interconnection with Algeria should be increased as well from 400 MW to 1700 MW

In minimum load conditions, the **maximum wind generation** that is possible to inject in the Moroccan system is sufficient to cover the Moroccan Grid Plan and the external investment. In fact the power production can be up to nearly 2000 MW

Without pumping system		With pumping system	
Wind generation	PV solargeneration	Wind generation	PV solargeneration
1840	819	1840	1260

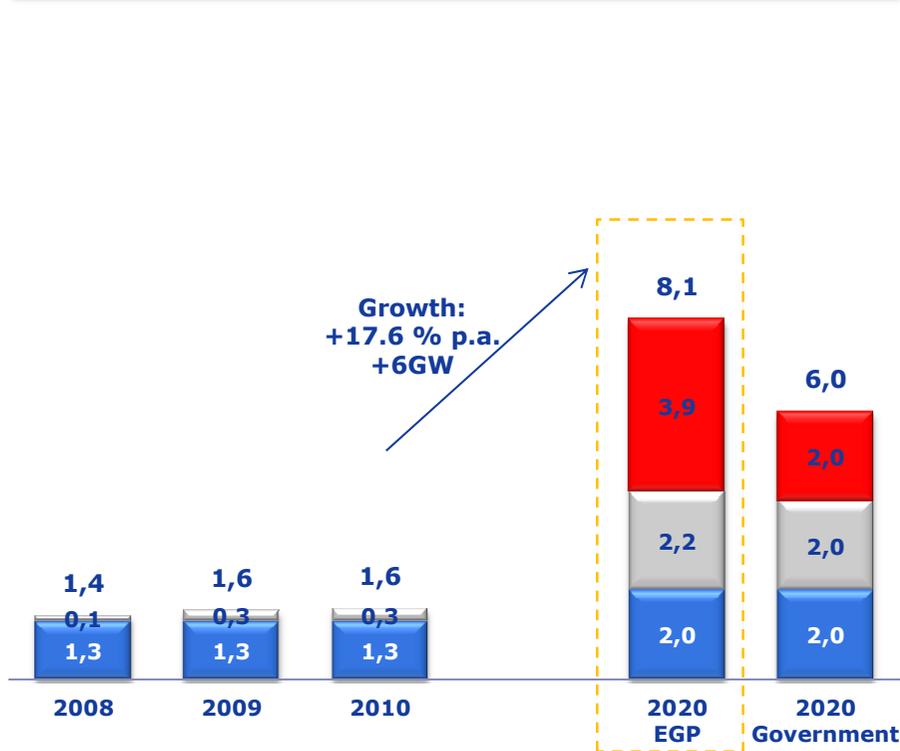


# Morocco Electricity Market

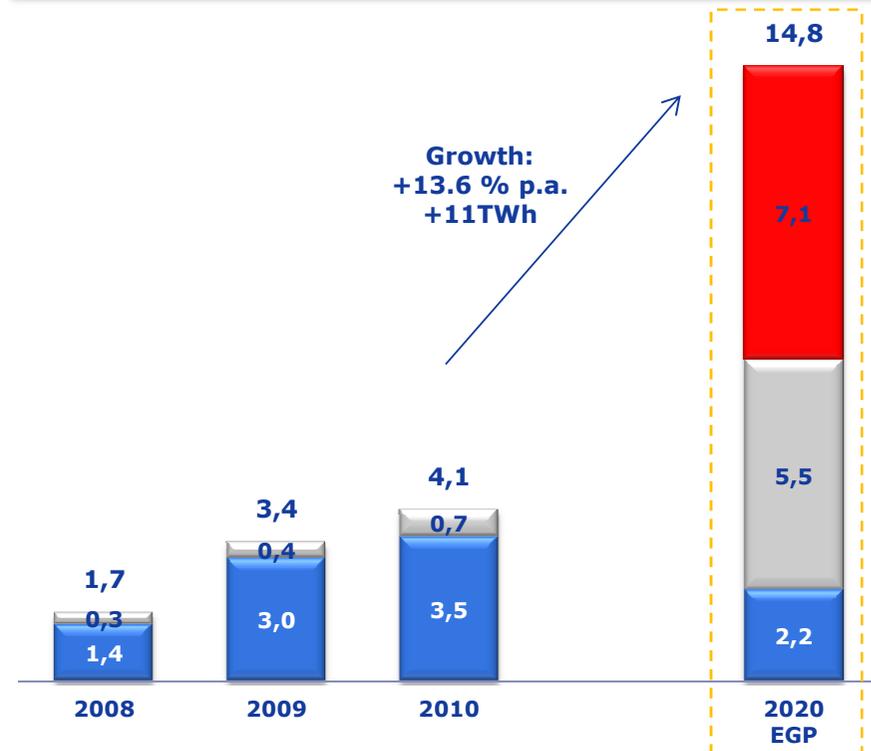
## Renewables - Market Overview



Renewables - Installed Capacity 2008-2020 (GW)



Renewables - Production 2008-2020 (TWh)



As for the Government Target:

- **MASEN Solar Plan** foresees 2 GW of solar capacity in 2020
- In addition to the 1 GW of wind capacity in operation and under development, ONE is planning further 1 GW under its integrated wind program.

Source: Enerdata, OME, EPIA, CSP Today, MEED, MASEN, ONE, EGP estimates

Note: For the calculation of the 2020 production, the following load factors are assumed: Hydro 1.100 EOH, Wind 2.500 EOH, PV 1.500 EOH, CSP 3.400 EOH. Hydro figures exclude Pump (0.5 GW installed and 0.2 GWh production in 2010)



# Looking at New Opportunities

## EGP New Countries activities in the Mediterranean Area

### Key

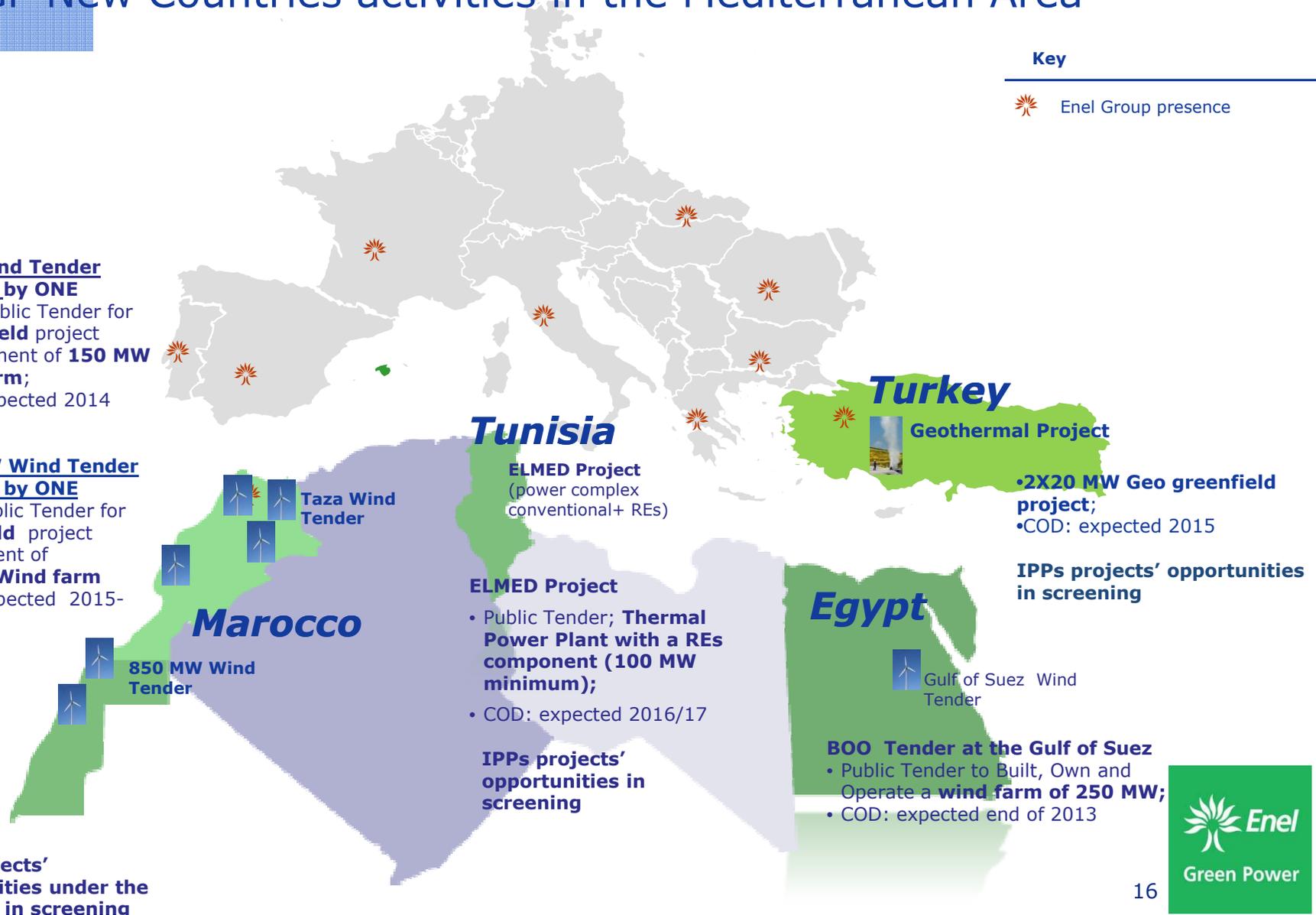
 Enel Group presence

#### > Taza wind Tender launched by ONE

- BOOT Public Tender for **green field** project development of **150 MW wind farm**;
- COD: expected 2014

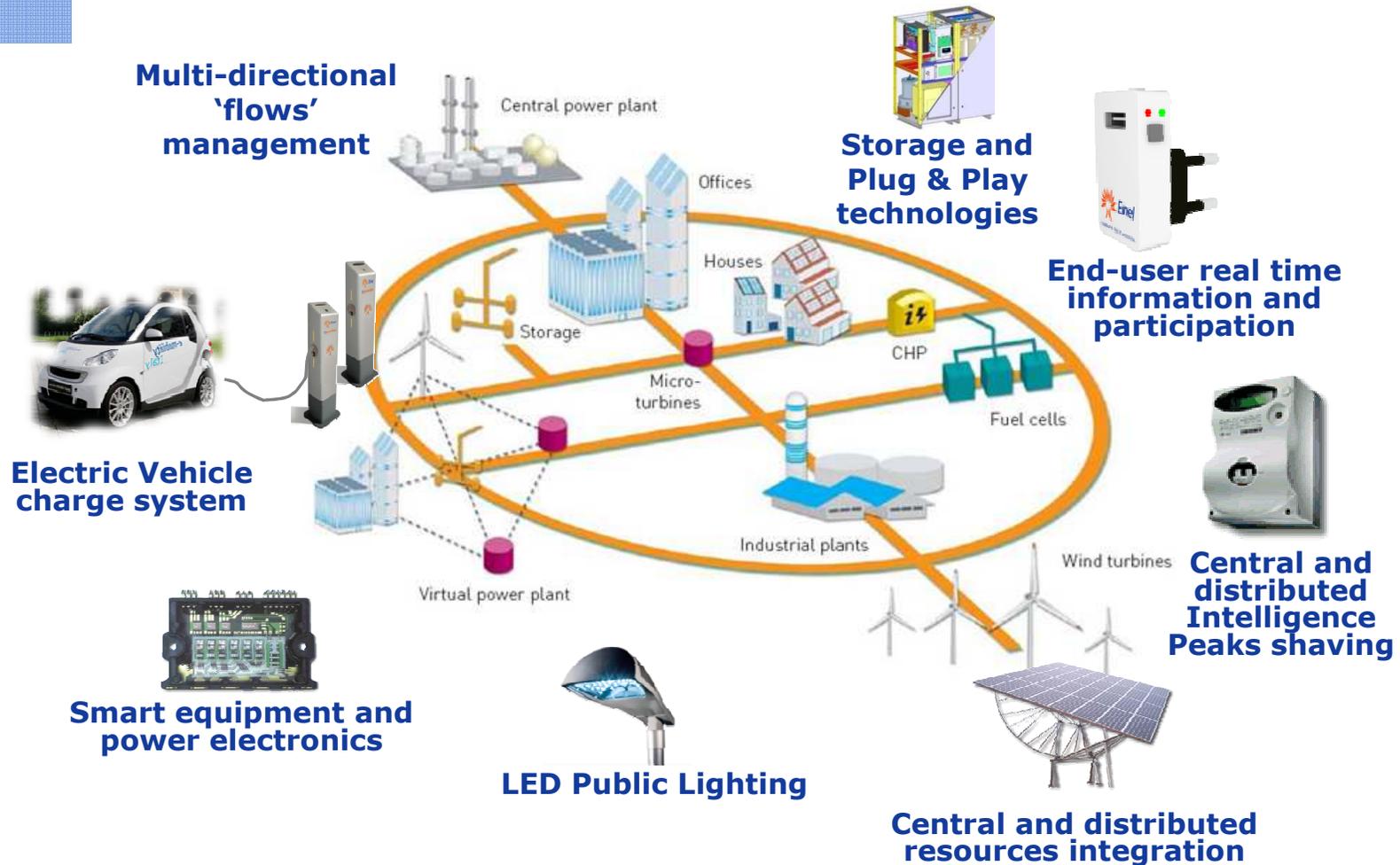
#### > 850 MW Wind Tender launched by ONE

- BOOT Public Tender for **green field** project development of **850 MW Wind farm**
- COD: expected 2015-2019



# Enel Smart Grids

Vision: Building a smart Energy future



Network interacts intelligently with all connected parties in order to efficiently deliver sustainable, economic and secure electricity supply

# THANK YOU!

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