THE CHALLENGES OF THE OFFSHORE WIND ENERGY SECTOR

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1. OFFSHORE WIND ENERGY PERSPECTIVE IN SPAIN.
2. ONGOING LICENSING PROCEDURE – SPANISH REGULATORY FRAMEWORK.
3. OFFSHORE WIND FARM PROJECT CHALLENGES IN SPAIN.
4. SPANISH TECHNOLOGICAL EXPERIENCE.
5. CONCLUSIONS: OPORTUNITIES FOR THE OFFSHORE WIND SECTOR IN SPAIN.

1.

OFFSHORE WIND ENERGY PERSPECTIVE IN SPAIN.

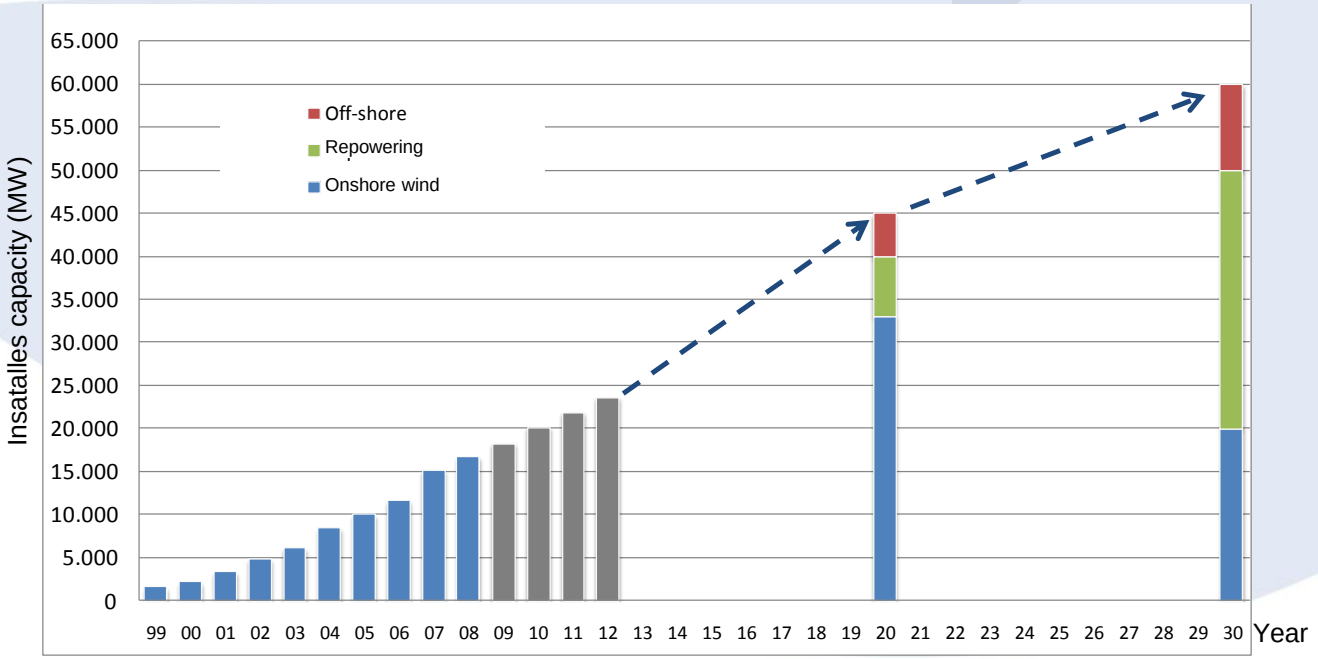
EVOLUTION OF THE FORECAST INSTALED CAPACITY – 2020 HORIZON

ZURBANO	Draft NREAP	NREAP (UE)	Proposal for state agreement: 500 MW	Renewable Energy Plan 2011/2020
5.000 MW	3.000 MW	3.000 MW		750 MW

AEE still bet for more ambitious objectives, based on:

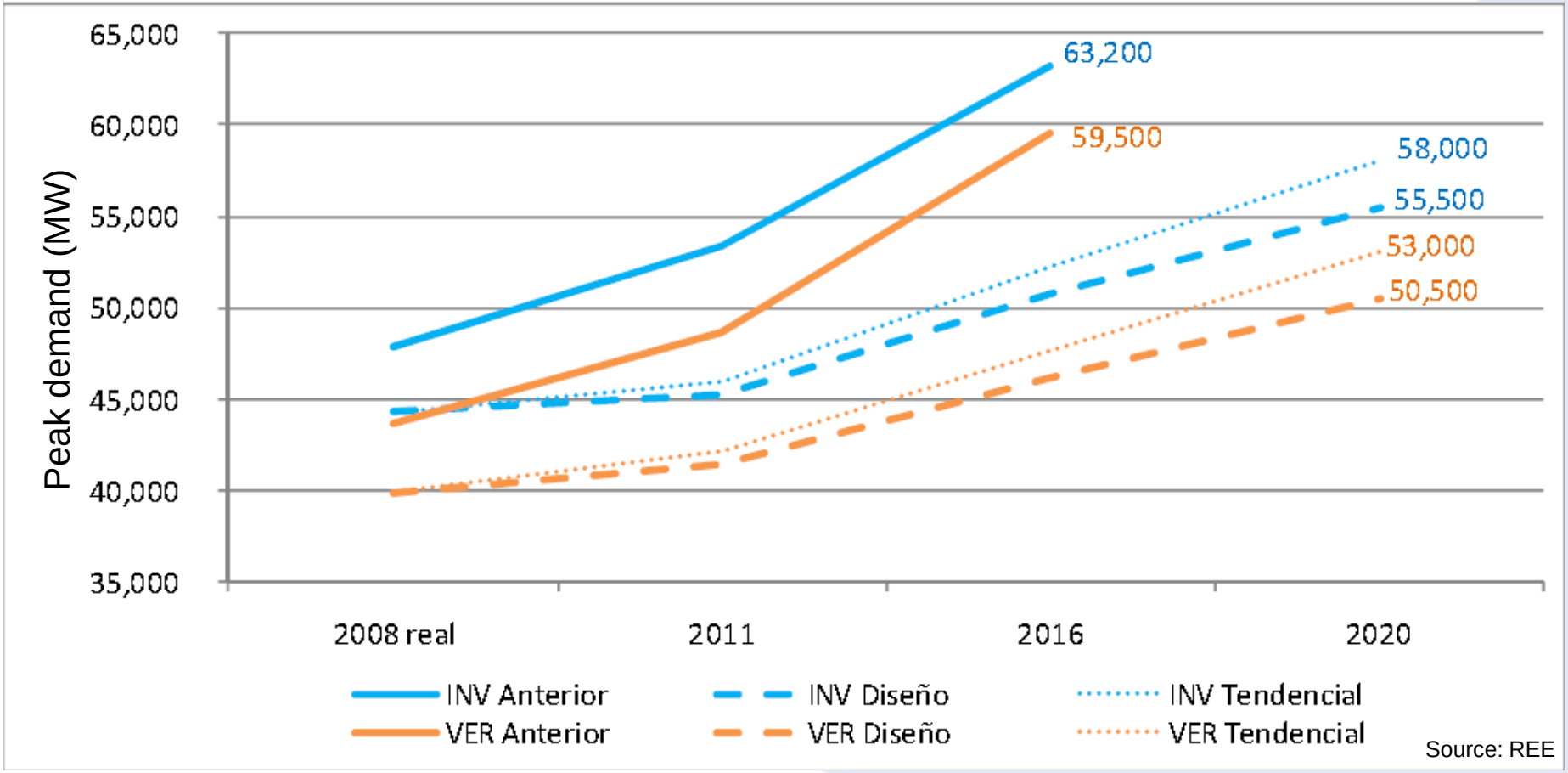
- **Necessity of a massive deployment of wind power as a clean and free power source.**

- **Reinforcement and support to a leading industry.**



AEE forecast: 2020 & 2030

INTEGRATION INTO THE POWER SYSTEM: EVOLUTION OF THE ELECTRIC DEMAND.



Electric demand lowering is responsible for a dicrease of the energy price in the pool market and limit the entry of more expensive production technologies.

INTEGRATION STUDY IN THE POWER SYSTEM: INSTALLED CAPACITY

Potencia instalada a final de año (MW)	2010	2012	2014	2016	2020	Δ 2020-2010
Hidráulica convencional y mixta	14.110	14.110	14.310	14.310	14.310	200
Bombeo puro	2.550	2.550	3.180	3.900	5.700	3.150
Nuclear	7.720	7.720	7.260	7.260	7.260	-460
Carbón	11.380	8.870	8.390	7.910	7.490	-3.890
Fuel/gas	1.220	200	200	200	200	-1020
Ciclos combinados	25.220	25.220	25.220	25.220	25.220	0
Eólica	20.600	23.190	25.930	28.690	34.320	13.720
Eólica marina	0	0	20	50	750	750
Solar FV	3.610	4.370	4.800	5.330	6.760	3.150
Solar termoeléctrica	630	2.030	2.720	3.300	4.800	4.170
Otro Régimen Especial Renovable[1]	2.700	3.040	3.230	3.530	4.610	1.910
Cogeneración	6.960	7.860	8.970	9.450	10.390	3.430
Otro Régimen Especial no renovable	80	80	80	100	160	80
TOTAL POTENCIA BRUTA INSTALADA	**96.780**	**99.240**	**104.310**	**109.250**	**121.970**	**25.190**
TOTAL POT. NETA Disponible INV	54.130	54.420	55.400	56.140	59.320	5.190
PUNTA Invierno "Escenario de Diseño"	43.600	46.100	48.300	50.700	55.500	11.900
ÍNDICE de COBERTURA	**1,24**	**1,18**	**1,15**	**1,11**	**1,07**	
Pot. Firme Adicional para IC=1,1	0	0	0	0	**1.800**	
PUNTA Invierno "Escenario Tendencial"	43.600	47.300	49.700	52.200	58.000	14.400
ÍNDICE de COBERTURA	**1,24**	**1,15**	**1,11**	**1,08**	**1,02**	
Pot. Firme Adicional para IC=1,1	**0**	**0**	**0**	**1.300**	**4.500**	

Source: REE

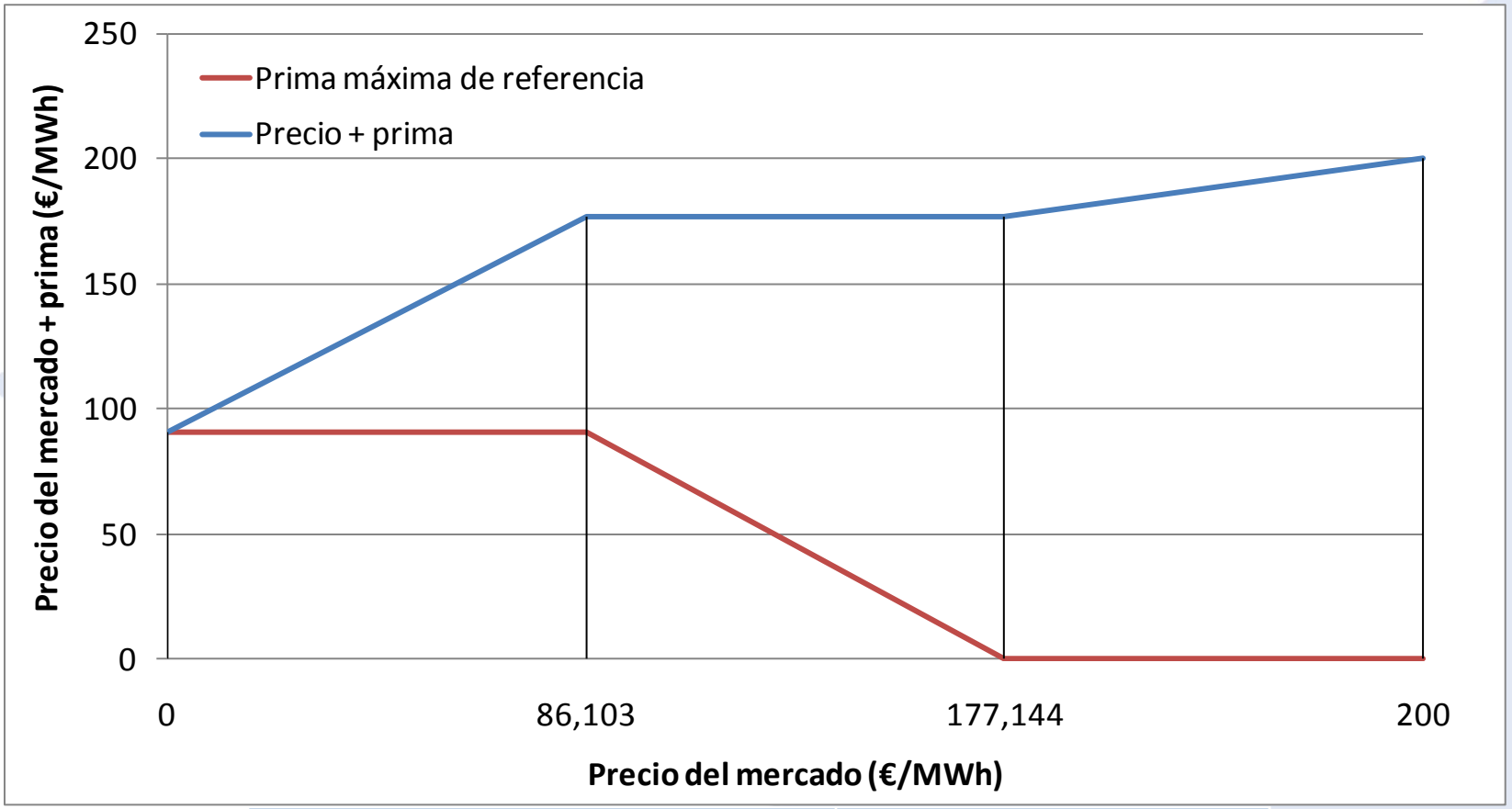
INTEGRATION STUDY IN THE POWER SYSTEM: GENERATING CAPACITY EVOLUTION

Balance Energía peninsular (GWh)	2010	2012	2014	2016	2020	Δ 2020-2010
Hidráulica convencional y mixta	35.630	26.990	26.280	26.070	26.000	-9.630
Bombeo puro	3.110	5.130	6.580	8.020	8.020	4.910
Nuclear	61.790	59.000	55.600	55.600	55.600	-6.190
Carbón	21.350	30.000	29.800	29.300	28.080	6.730
Fuel/gas	3.190	2.190	1.860	1.200	1.200	-1.990
Ciclos combinados	64.640	64.660	71.070	73.570	71.310	6.670
Eólica	43.300	45.650	51.710	57.570	70.280	26.980
Eólica marina	0	0	40	110	1.850	1.850
Solar FV	6.010	7.310	8.190	9.110	11.770	5.760
Solar térmica	690	4.710	7.400	9.280	14.380	13.690
Otro Régimen Especial Renovable	10.600	11.670	12.600	14.090	19.580	8.980
Cogeneración	33.560	41.090	46.430	50.580	54.620	21.060
Otro Régimen Especial no renovable	450	580	580	750	1.220	770
Generación bruta	**284.310**	**298.990**	**318.120**	**335.250**	**363.910**	**79.600**
Consumos en generación	9.080	8.320	8.230	8.170	8.290	-790
Producción neta	275.230	290.670	309.890	327.080	355.620	80.390
Consumos en bombeo	4.440	7.330	9.400	11.460	11.460	7.020
Intercambios internacionales(1)	-8.340	-9.730	-11.470	-13.360	-13.500	-5.160
Demanda b.c.(2)	**262.460**	**273.610**	**289.020**	**302.260**	**330.660**	**68.200**

(1) Valor positivo: saldo importador; Valor negativo: saldo exportador
(2) Incluye autoconsumos de cogeneración

Source: REE

OFFSHORE WIND ENERGY RETRIBUTION (RD 661/2007) COULD ALLOW THE FORECASTED OBJECTIVES



	Year 2011
Max. premium	91,041 €/MWh
CAP	177,144 €/MWh

2.

ONGOING LICENSING PROCEDURE – SPANISH REGULATORY FRAMEWORK.

RD 1028/2007 – Strategic Environmental Study of the Spanish Coastline

Administrative procedure for licensing of power generation installations in territorial waters.

RD 1028/2007

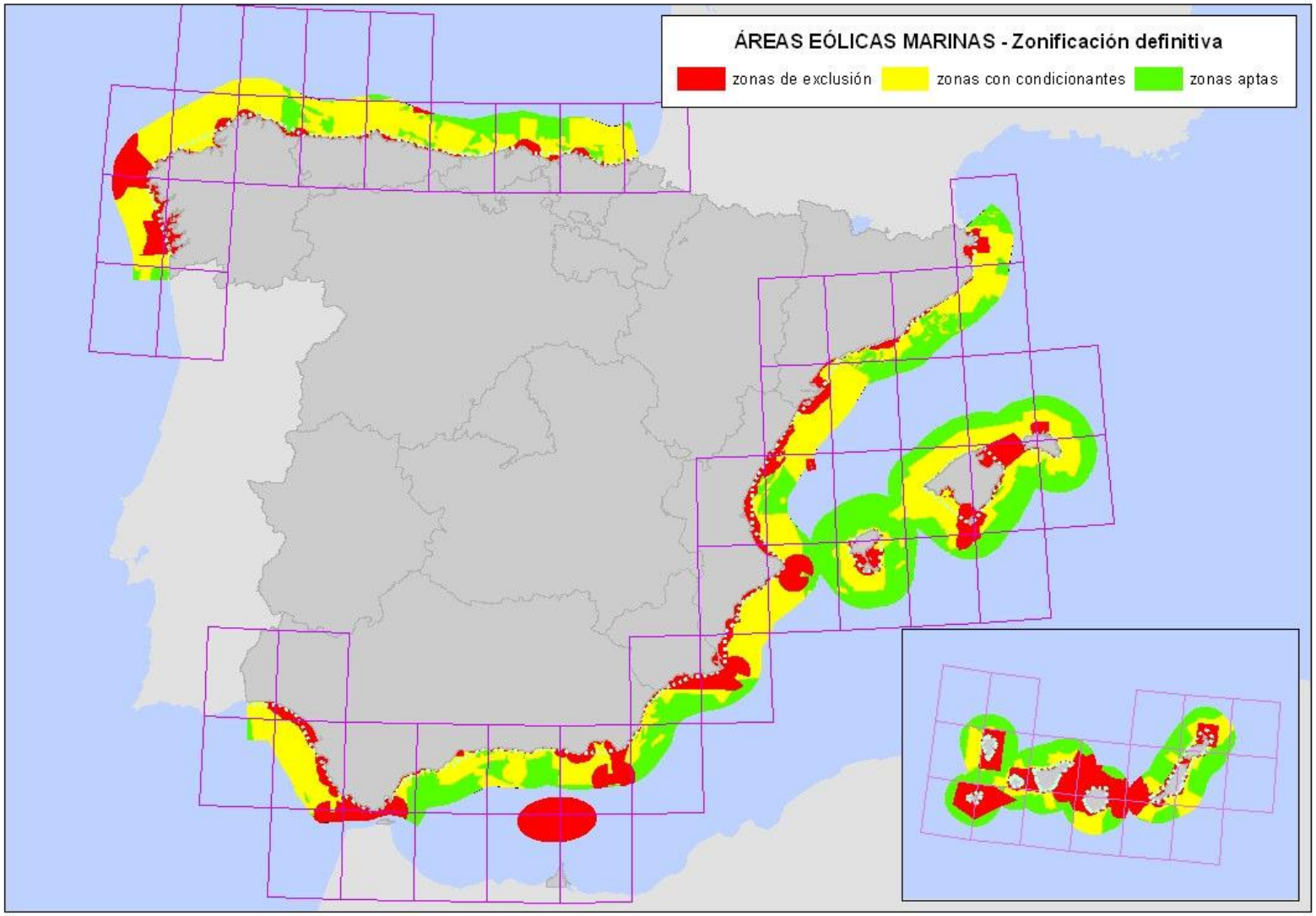
Strategic Environmental Study of the Spanish Coastline

Publication: April 2009:

Objective: Anticipation of possible negative effects of offshore wind farms, whose correction could de more complex and more costly in future step of the licensing procedure.

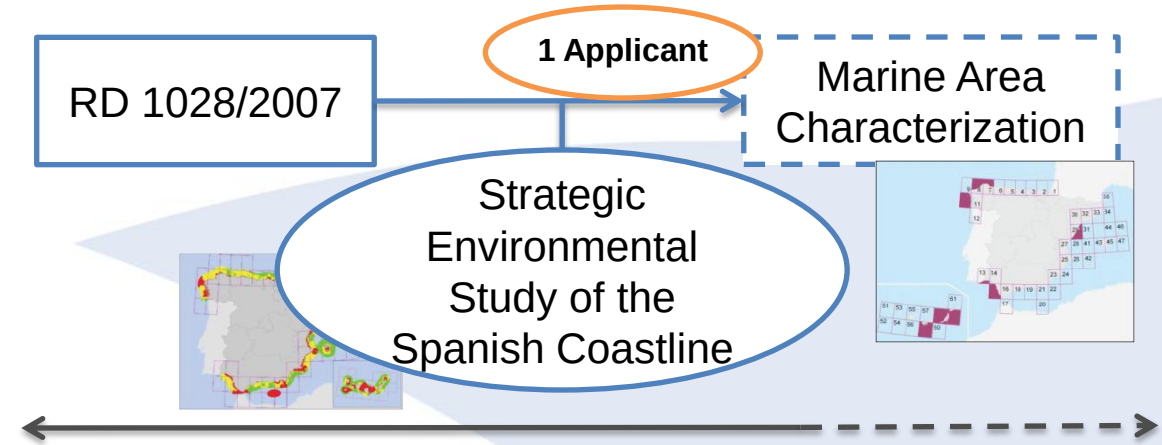
- **Available areas**
- **Limitation areas**
- **Excluded areas**

RD 1028/2007 – Strategic Environmental Study of the Spanish Coastline



RD 1028/2007 – Marine Area Characterization

Administrative procedure for licensing of power generation installations in territorial waters.



Max. timeframe: 6 month / real timeframe: not complete (4 years)

Work in progress:

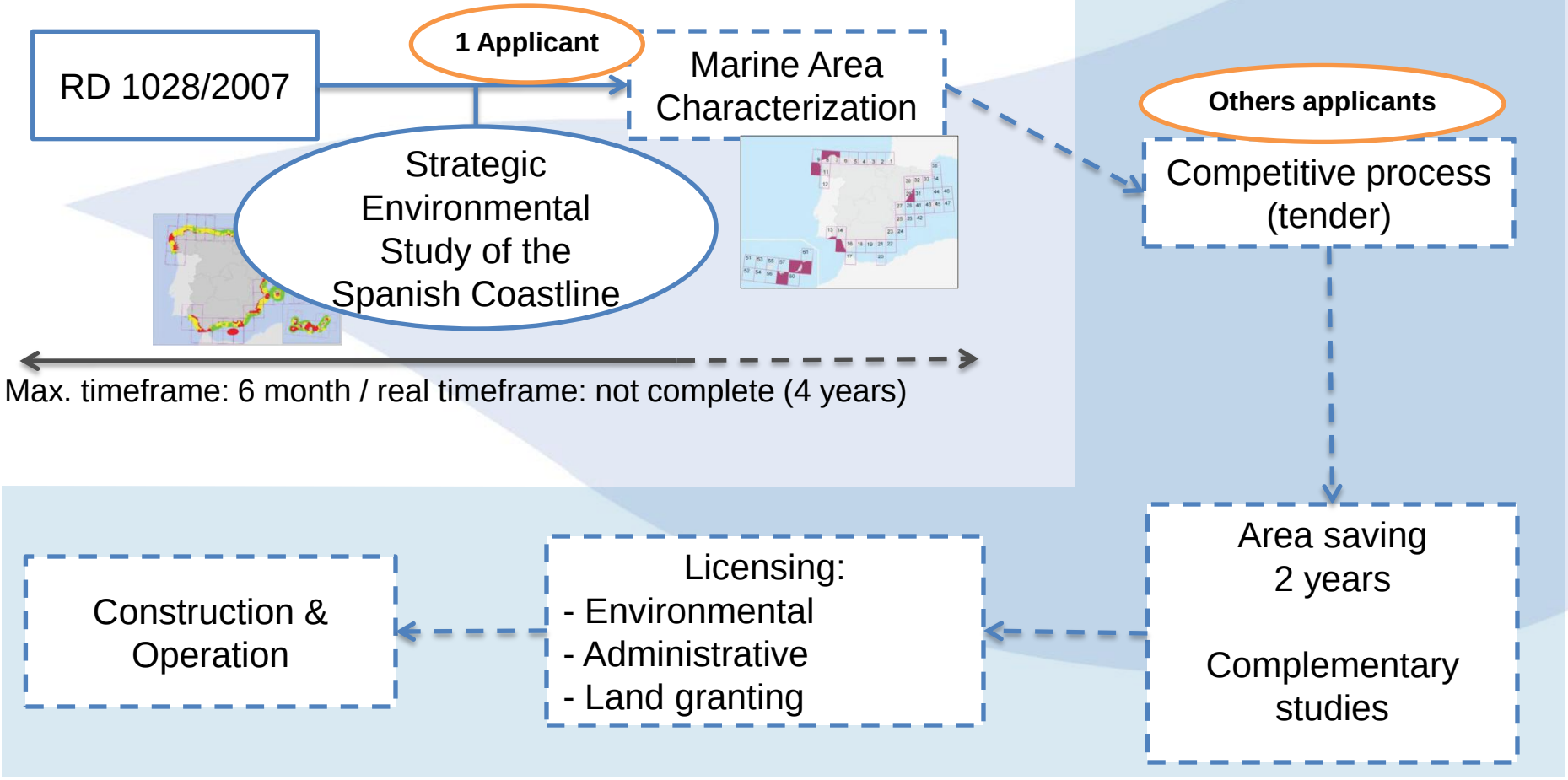
-Collection of **reports from Entities/Administrations (non binding)**

-**Effects on fisheries**, flora, fauna, birds, maritime and air traffic, tourism, archaeological resource, landscape, geomorphology y biological communities of marine bed, beach, coastline dynamics, environmental protected areas, mining resource, defense and security, submarine cables and pipeline.

-**Report from the TSO**. Max. installed capacity and power evacuation (binding).

RD 1028/2007 – Pending tasks

Administrative procedure for licensing of power generation installations in territorial waters.



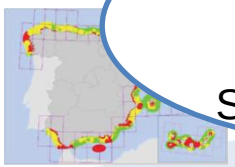
RD 1028/2007 – Bottlenecks in the licensing process

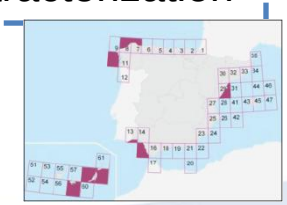
RD 1028/2007

1 Applicant

Marine Area Characterization

Strategic Environmental Study of the Spanish Coastline





Max. timeframe: 6 month / real timeframe: not complete (4 years)

Others applicants

Competitive process (tender)

Area saving 2 years

Complementary studies

Licensing:
- Environmental
- Administrative
- Land granting

Construction y Operation

Social acceptance

Local administration positioning.

Power output evacuation

3.

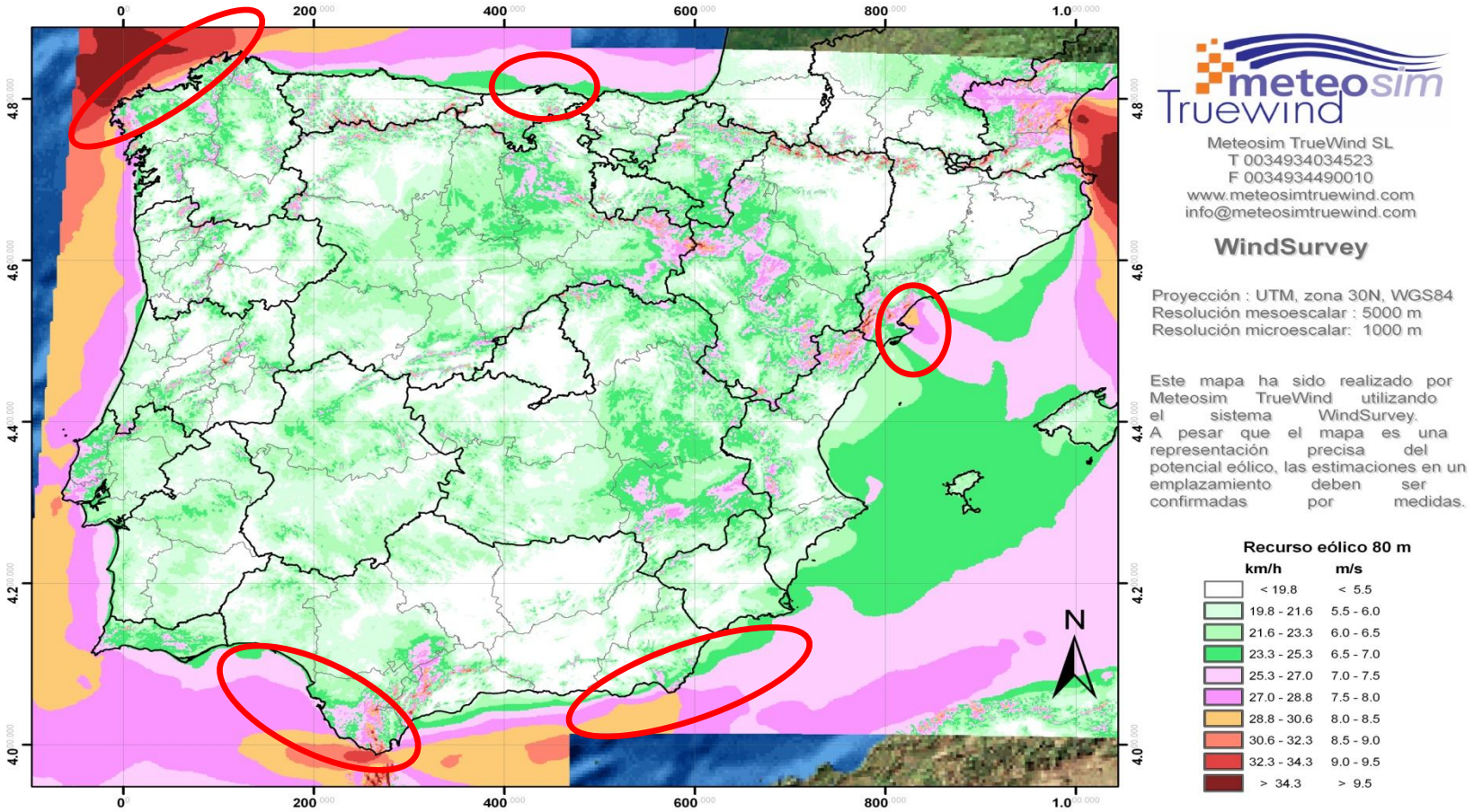
OFFSHORE WIND FARM PROJECT CHALLENGES IN SPAIN.

Factors that influence the offshore wind farm siting:

WIND RESOURCE

Factors that influence the offshore wind farm sitting:

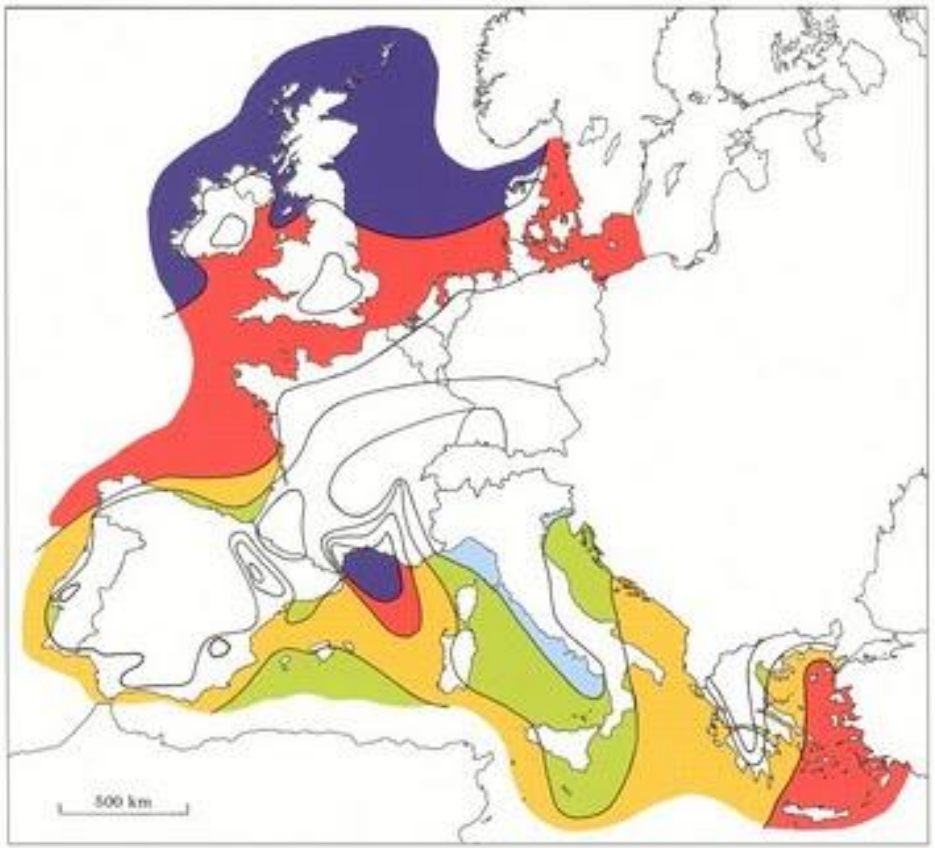
WIND RESOURCE



5 AREAS WITH GOOD WIND CONDITIONS.

Factors that influence the offshore wind farm sitting:

WIND RESOURCE



Wind resources over open sea (more than 10 km offshore) for five standard heights

	10 m		25 m		50 m		100 m		200 m	
	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}
	> 8.0	> 600	> 8.5	> 700	> 9.0	> 800	> 10.0	> 1100	> 11.0	> 1500
	7.0-8.0	350-600	7.5-8.5	450-700	8.0-9.0	600-800	8.5-10.0	650-1100	9.5-11.0	900-1500
	6.0-7.0	250-300	6.5-7.5	300-450	7.0-8.0	400-600	7.5- 8.5	450- 650	8.0- 9.5	600- 900
	4.5-6.0	100-250	5.0-6.5	150-300	5.5-7.0	200-400	6.0- 7.5	250- 450	6.5- 8.0	300- 600
	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 6.0	< 250	< 6.5	< 300

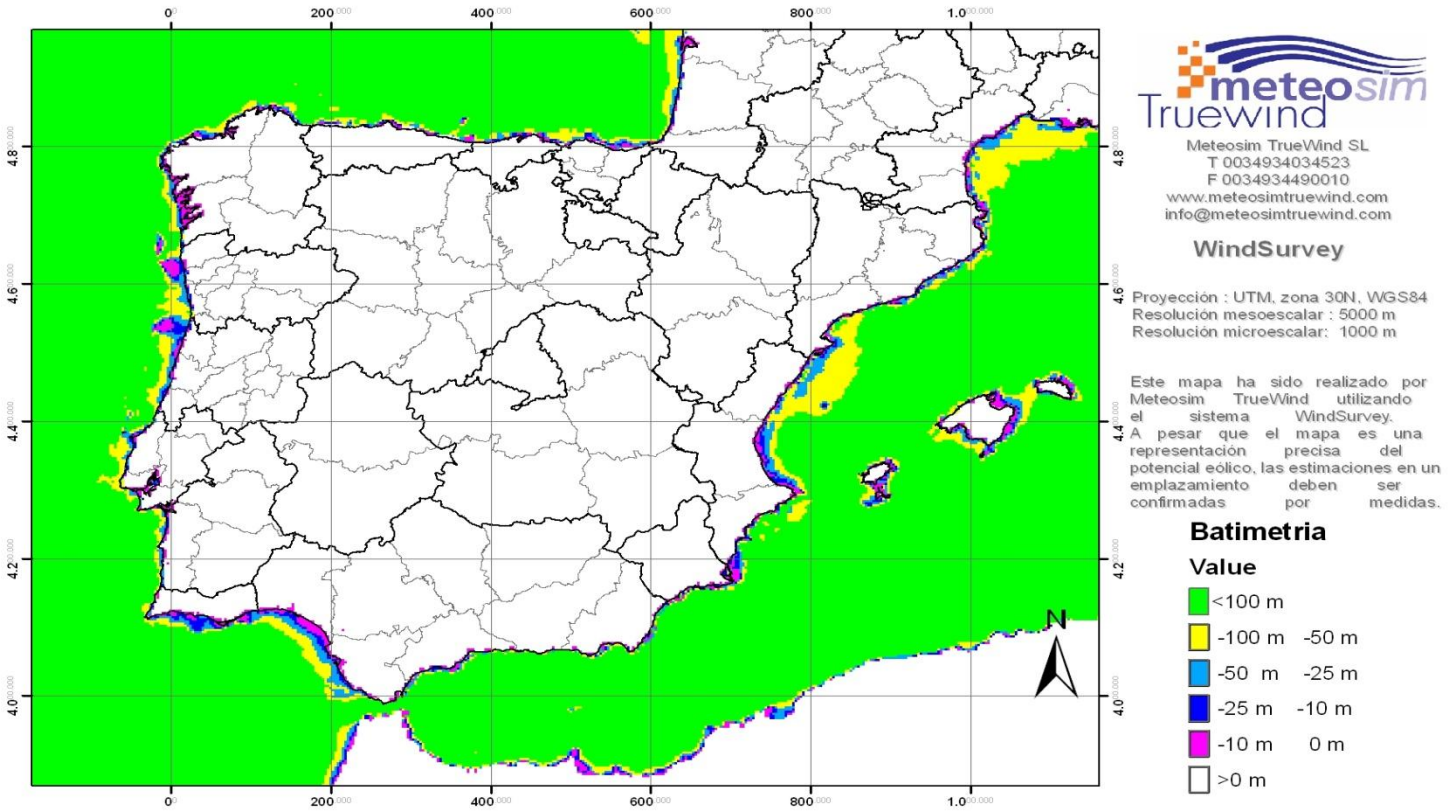
Best wind conditions are mainly located in the north of Europe
- **Atlantic ocean**
- **Irish sea**
- **North sea**
- **Baltic sea**

In the Mediterranean sea, gulf of Lyon is the best site.

The development of offshore wind power in Spain with a lower resource has to guarantee the economic viability of the projects.

Factors that influence the offshore wind farm sitting:

WATER DEPTH

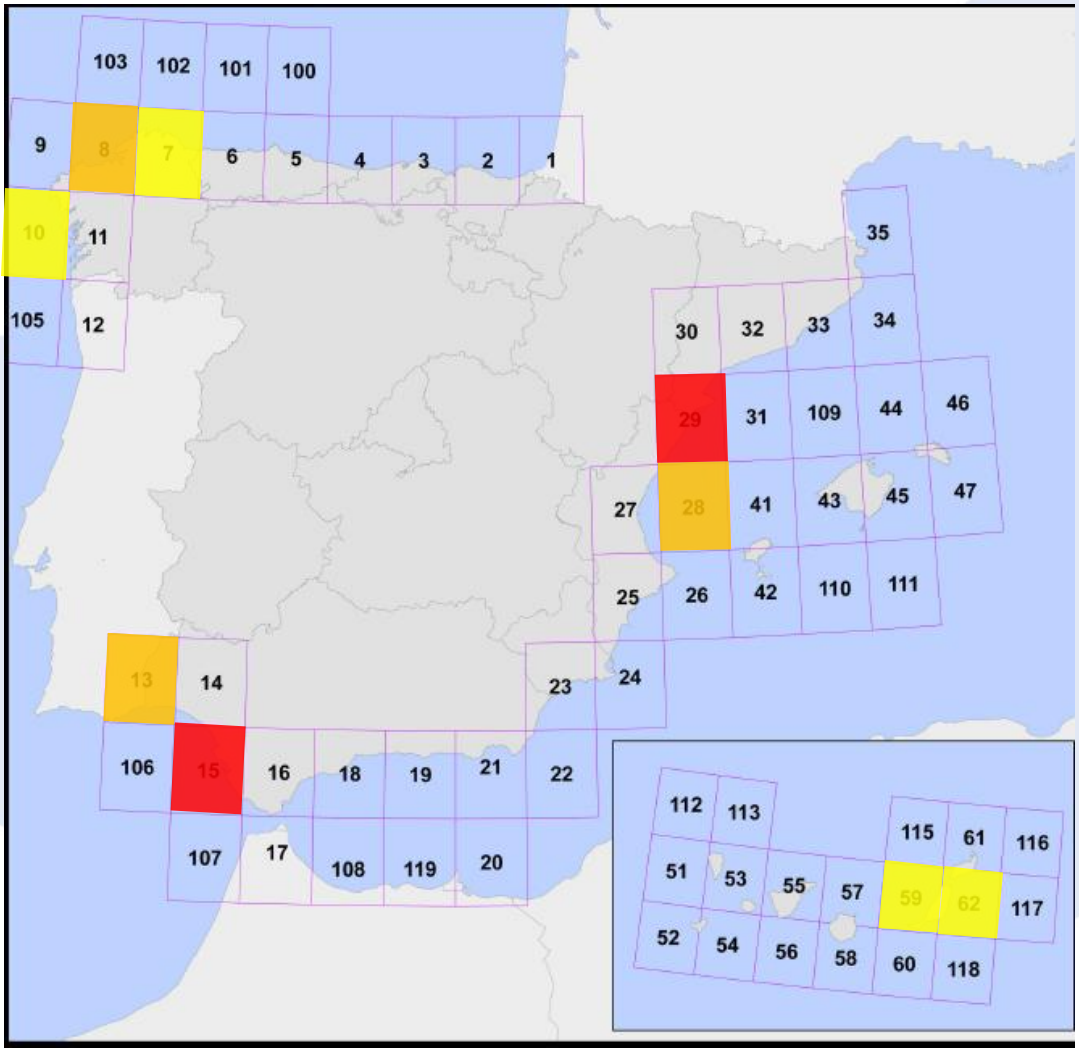


- The continental platform is very narrow in Spain instead of North and Baltic seas where water depth are max. 60 m in wide areas.
- Current foundation technology do not allow installation of offshore wind farms in very deep waters (> 100 m).

OFFSHORE WIND FARMS PROJECTS IN SPAIN

Around 40 projects for around 14 GW.

28 projects are already in the licensing phase, representing 9.540 MW.

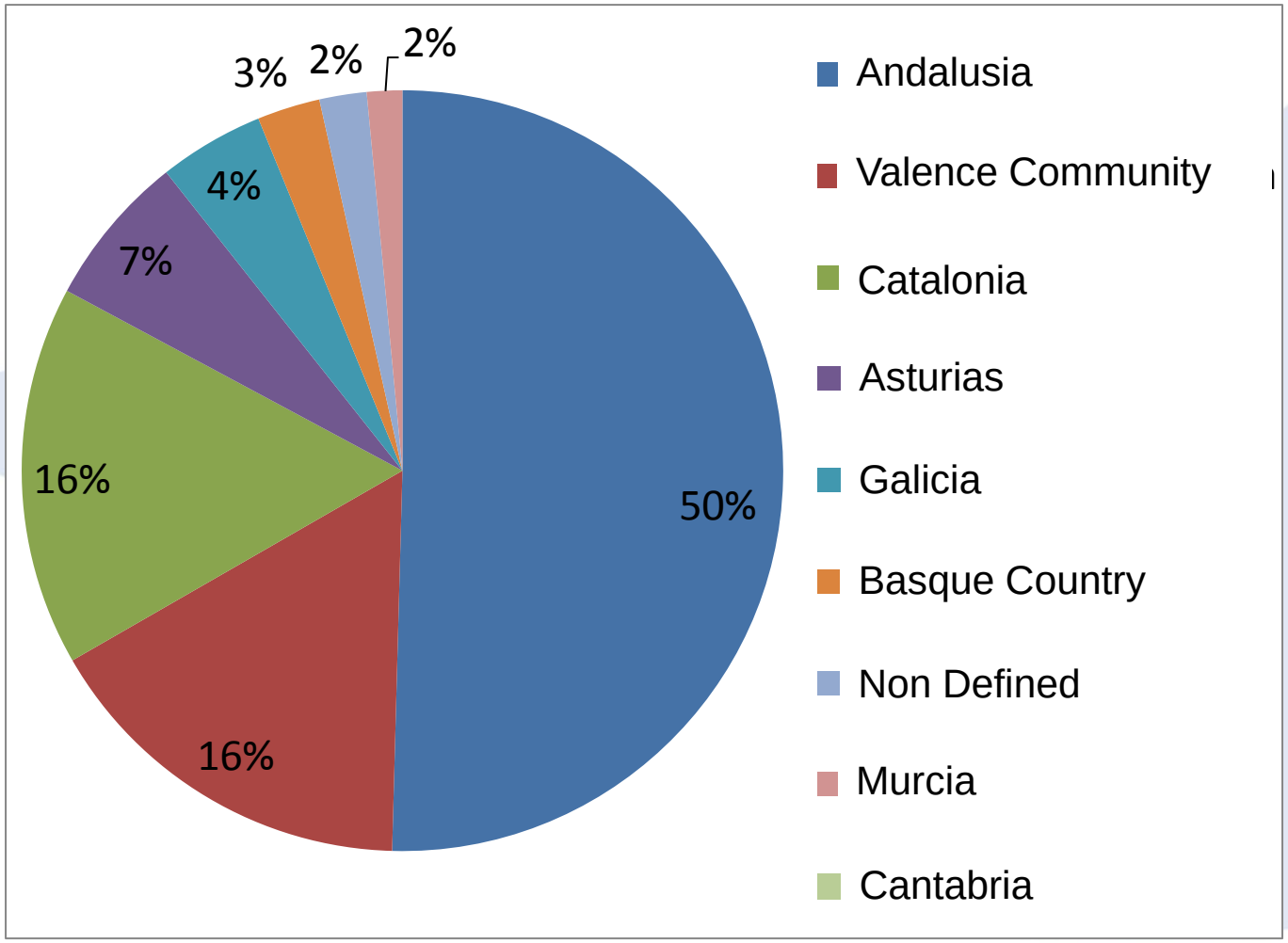


More than 7 projects

2 to 7 projects

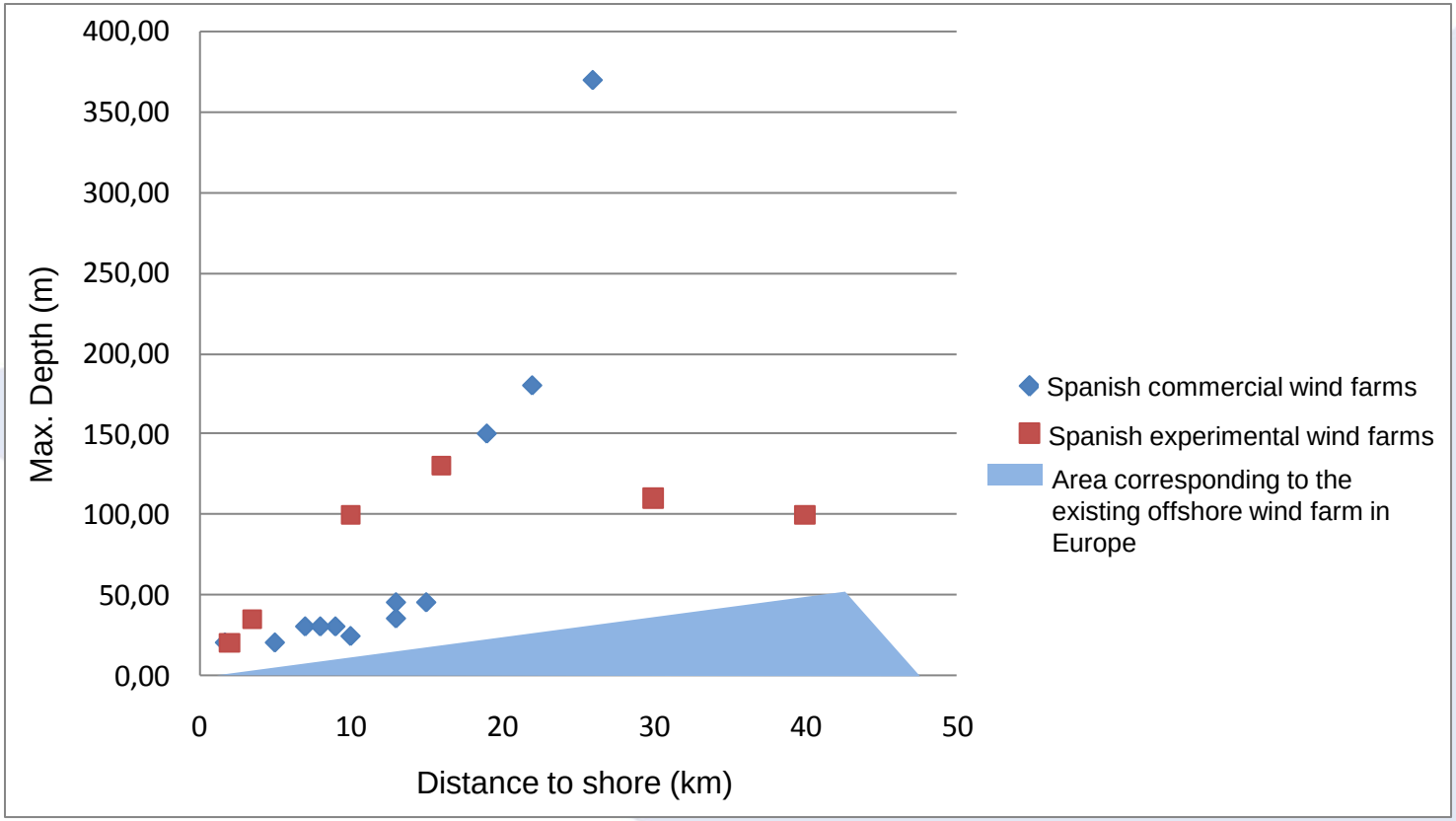
Under 2 projects

ONGOING CAPACITY BY REGIONS.



Source: AEE & C4Offshore

THE TECHNOLOGICAL CHALENGE: DISTANCE TO SHORE AND WATER DEPTH.



Instead of the offshore wind farm of northern Europe, ongoing Spanish projects are located in very specific geographical conditions, especially regarding depth, with consequences on installation costs and used technologies.

4.

SPANISH TECHNOLOGICAL EXPERIENCE.

R&D INITIATIVES: LIDER IN COLABORATION PROJECTS (EU & NATIONAL PROJECTS)

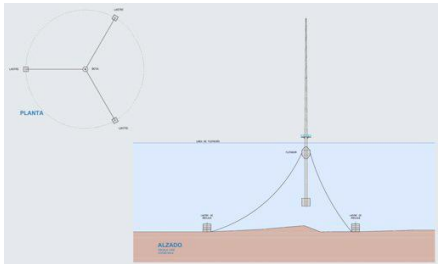
Projects R&D	Program	Objectives	Cost	Grants
Marina Platform (Acciona Energía, Tecnalia, DONG, Statoil, Technip…)	FP7 (EU)	Creation of an integral tool for designing offshore energy production facilities.	12.7 M€	8.7 M€
EOLIA (Acciona Energía, ABB, Ormazabal, Ingeteam…)	CENIT (SP)	Development and testing of deep offshore floating structures.	39 M€	19.5 M€
EMERGE (Iberdrola Renovables)	PSE (SP)	Development of deep offshore structures dedicated to wind power	-	-
OCEAN LIDER (Iberinco, Acciona Energía, Areva, Iberdrola Renovables, Ingeteam, Idesa, Norvento…)	CENIT (SP)	Integral technical solutions for marine renewable energies.	30 M€	15 M€
RELIAWIND (Gamesa, Alstom, LM, ABB, SKF, Hansen…)	FP7	Design, O&M optimization for offshore wind farms.	7.83 M€	5.18 M€
AZIMUT (Gamesa, Alstom, Acciona WindPower y Energía, Iberdrola Renovables, Tecnicas Reunidas, Ingeteam…)	CENIT (SP)	15 MW Offshore WTG Development	25 M€	-

R&D RESULTS

- Offshore wind-turbines prototypes:
  - Gamesa G11X – 5 MW: 2012
  - Gamesa G14X – 6/7 MW: 2014
  - Alstom Wind (Ecotecnia) - 6 MW: 2012

Source: Alstom Wind

- And gaining experience in several others areas:
  - O&M in offshore wind farms.
  - Floating foundations.
  - Mixed platforms: wind power and marine renewable energies.
  - Resource assessment through floating met towers (Idermar).



SHORT TERM NEED: EXPERIMENTAL AND TESTING FACILITIES

Project	HiPRWind	Test center of UBIARCO	SeAsturlab Fase 1	SeAsturlab Fase 2	Zefir Phase 1	Zefir Phase 2	P.E. Mar de Canarias
Entry in operation	2013/2014	Estimated 2013.	2013		Q4 – 2012	Q4 – 2014	
Project leader	Fraunhofer IWES & Acciona Energía for Spain	IDERMAR (SODERCAN & IH Cantabria).	Universidad de Oviedo	Universidad de Oviedo	IREC	IREC	ESDRAS
Region	ND	Cantabria	Asturias	ND	Catalonia	Catalonia	Canary
Capacity	1,5	15	10		20	50	10
Number of positions	1	3	3		4	8	2
Distance to shore		16	2		5		
Max. depth	100	130	20	100	35	110	

5.

CONCLUSIONS: OPORTUNITIES FOR THE OFFSHORE WIND SECTOR IN SPAIN.

TODAY, THE OFFSHORE BUSINESS IS LOCATED IN NORTHERN EUROPE

The high expected demand for WTG and components due to UK, Germany, Netherland dynamism represent a oportunity for the Spanish supply chain.

- **WTG manufacturers**: local implantation strategy.
- **Component manufacturer**: local implantation or through export.
- **WF developers:** construction & O&M

Source: Ormazabal

Medium Votage Switchgears

Source: GOIAN

Lifts for Wind Turbines

Cables

Source: Matz Ereka

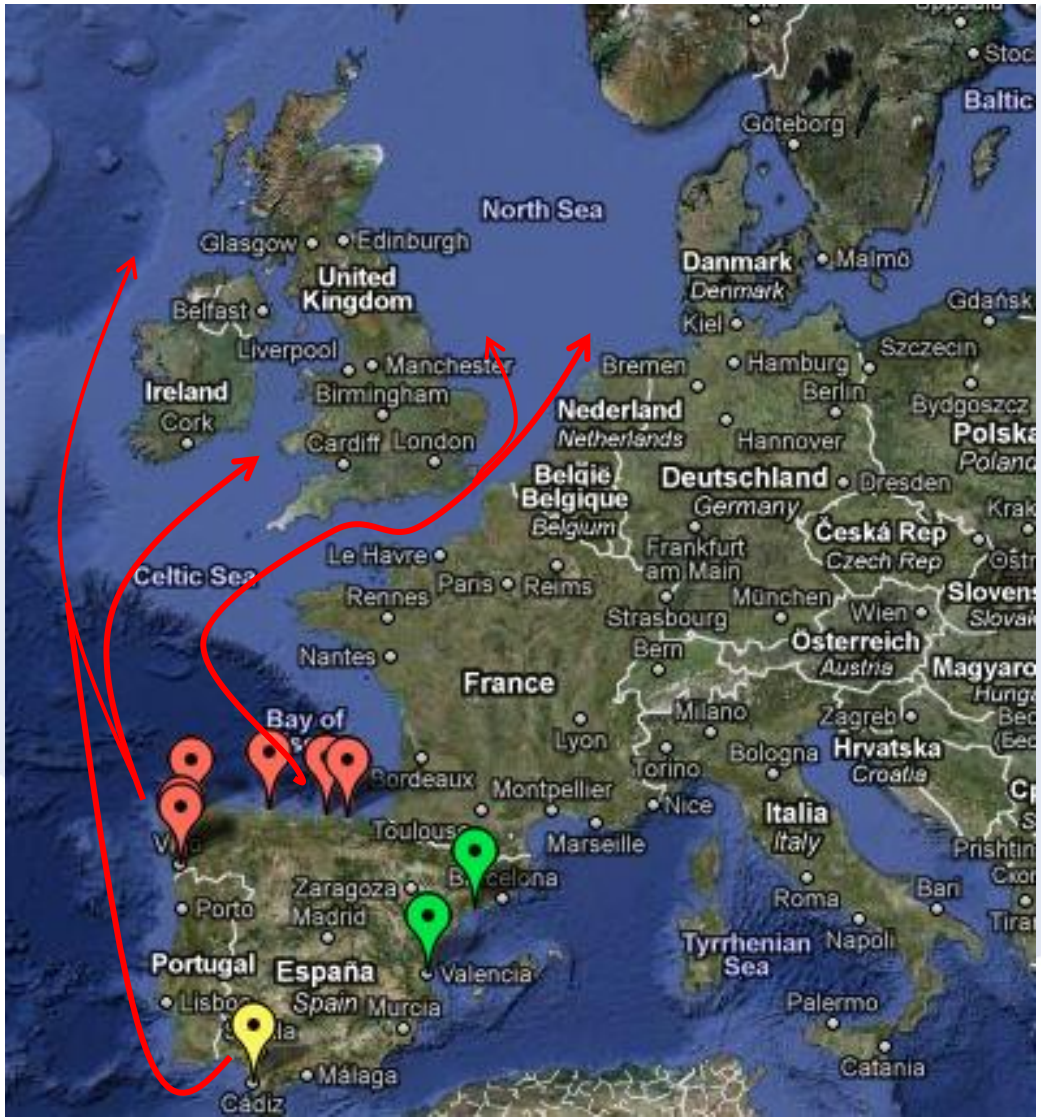
Bolts

TODAY, THE OFFSHORE BUSINESS IS LOCATED IN NORTHERN EUROPE.

The Spanish coastline has very good harbour infrastructures that ensure high export possibilities:

North:
- Vigo
- A Coruña
- Gijón
- Santander
- Bilbao

South:
- Cádiz
- Puerto Real
- Algeciras



MEDIUM TERM: SOLUTIONS ADAPTED TO THE SPANISH CONTEXT.

- Administrative consolidation: reaction of MITyC to launch project development and give support to the industry.
- Importance of R&D:
- Strategic importance of experimental wind farms to test structures and WTG.
- Offshore wind industry integration in the maritime sector: harbour adaptation, work together with the naval sector.

CONCLUSIONES:

- High demand from northern Europe is an opportunity for the Spanish industry which counts with good export possibilities.
- Offshore wind development in Spain need a first administrative consolidation process.
- R&D plays an important role and allows the worldwide positioning of the Spanish companies.
- To face entrance of new competitors, last impulse to demonstration project is needed.
- Key elements have to be planned:
  - Harbour infrastructures.
  - Raw material supply.

Thank you for your attention

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