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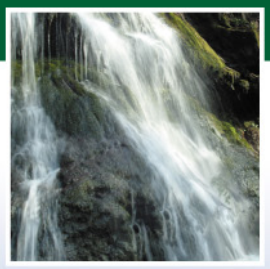

Chapter 17
Country Report – Spain

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17 Country Report - Spain

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17.1 Policy and Legislation

This section provides an overview of the policy and legislation relevant to the production of renewable electricity (RES-E), renewable heat (RES-H) and biofuels.

Learning objectives

This chapter should provide you with key national policy and legislation relevant to renewable energy. After studying this chapter you should be able to answer the following questions:

- Do national targets for renewable energy exist? Is there one global target or do sector-specific targets for electricity, heat and biofuels exist? Are the targets short- or long-term? Does something like a national strategy for renewable energy exist?
- What kind of support instruments are in place for the different sectors? Feed-in or premium tariffs, quota obligations, investment subsidies or tax reliefs?
- What is in brief the status of the renewable energy market?
- Which are the key institutions relevant to the renewable energy sector?

RES targets

In 1997 The Spanish Government set the target of meeting 12% of total energy consumption from renewable energy sources in 2010 in Spain. This goal was included into the Spanish Electricity Law (‘Ley 54/97’). The “Plan de Fomento de las Energías Renovables 2000-2010” (1999) was published to develop the measures to reach the goal of 12%.

The target for RES-E to be achieved by Spain in 2010 under the EU RES-E Directive is 29.4% of gross electricity consumption.

The revised ‘Plan de Energías Renovables’ (August 2005) sets new capacity targets for 2010 including wind (20,155 MW), photovoltaic (400 MW), solar thermal (4.9 million m^2), solar thermal electric (500 MW) and biomass (1,695 MW).

No biofuel targets have been set. In the Spanish report to the EU Commission under the EU Biofuel Directive it is stated that the reference value for the national targets for the marketing of biofuels and other renewable fuels in the transport sector is 0.40% by 31 December 2005. This is lower than the 2% target indicated in the Biofuel Directive.

Status renewable energy market

In 199, Spain introduced a strong programme to support RE, which has resulted in an enormous growth in new capacity, mainly wind power. Feed-in tariffs and premiums provide high transparency and certainty in the market and are therefore the main drivers for this growth.

Wind power has developed impressively. The biomass sector still needs an integral policy which recognises the added value of environmental and rural development. Small hydro needs to overcome the administrative barriers. From 2005 on the construction sector is required to install thermal or photovoltaic solar panels on all new and renovated buildings (solar obligation).

Main supporting policies

Renewable electricity

The Spanish Renewable Energy Act (Real Decreto 436-2004) obliges operators to buy the electricity generated from renewable sources. RE producers may choose between a fixed feed-in tariff and a premium price on top of the market price. In addition investment support is provided. Tariffs are specified for plants ≤ 50MW.

Tariffs and premium levels for each RES-E technology are calculated as a percentage of a standard figure, the “Tarifa Media de Referencia” (TMR) (medium electrical reference tariff), which is determined annually in the Real Decreto. For example:

- Photovoltaic <100 kWp is eligible to receive a fixed feed-in tariff of 575% of the TMR, which for 2006 is 7.6658 €ct/kWh; whereas electric-

ity from municipal solid waste combustion is entitled to a fixed feed-in tariff of 70% of the TMR.

Fixed and premium feed-in tariffs for 2006 are shown in Table 17.1 below. A draft law published 29 November 2006 foresees reduced support for new wind and hydro plants, but rising tariffs for biomass, biogas and solar thermal electricity. It also includes a cap and floor mechanism for the premium.

Technology	2006	
	fixed (€/MWh)	premium (€/MWh)
Photovoltaic < 100 kWp	440.4	x
Photovoltaic > 100 kWp	229.8	199.1
Solar thermal	229.8	199.1
Wind	68.9	38.3
Geothermal < 50 MW	68.9	38.3
Mini hydro < 25 MW	68.9	38.3
Hydro 25-50 MW	61.3	30.6
Biomass (biocrops, biogas)	68.9	38.3
Agriculture + forest residues	61.3	30.6
Municipal solid waste	53.6	23.0

Table 17.1 Fixed and premium feed-in tariffs for 2006

No time limit is set for the tariffs, but fixed tariffs are reduced after either 15, 20 or 25 years depending on technology.

Renewable heat

In March 2006 Spain introduced a new Technical Buildings Code (CTE, Codigo Tecnico de la Edificacion), which includes an obligation to cover 30-70% of the domestic hot water demand from solar thermal energy. This applies to all new buildings and renovations. The variation of the solar fraction between 30 and 70% depends on the assumed volume of hot water demand and the geographical location of the building. Large buildings in the tertiary sector (for instance office buildings > 4,000 m2) will also be obliged to install PV systems.

There are some exceptions for buildings that either satisfy their domestic hot water demand from other RES or CHP or for very shaded buildings.

Biofuels

A full tax exemption is applied until end of 2012 for biofuels. This may be adjusted to prevent overcompensation.

Other supporting policies

Subsidy schemes for energy technologies including renewable energy sources are periodically launched nationally by the Institute for the Diversification and Saving of Energy (IDAE), who also manages a third party finance scheme for renewables in collaboration with the Official Credit Institute (ICO). Eligibility of renewable energy sources varies according to the specific schemes. Regionally, the Autonomous Communities (Andalucia, Aragón, Catalonia, etc.) also promote and support schemes that vary in function according to their individual priorities and tend to involve capital cost subsidy. At the municipal level, in addition to the legislative initiatives described above, other support schemes exist. These tend to involve reductions or rebates of municipal taxes and charges in relation to construction. These various schemes are not mutually exclusive: projects may gain financial support from a variety of sources.

Key factors

- Transparent support schemes and secure feed-in tariffs deliver high investment certainty.
- Changes due to liberalisation of the sector cause uncertainty.
- Biomass feed-in tariffs were until now too low to develop new capacity.

New solar thermal obligation is a very strong policy with a large potential to stimulate the solar thermal market in the country.

Relevant national organizations/associations

APPA - Renewable Energy Producers Association
www.appa.es

EnerAgen - Association of Spanish Energy Agencies
www.energias-renovables.com

IDAE – Institute for the Diversification and Saving of Energy
www.idae.es

Ministry of Economic and Fiscal Affairs
www.mineco.es

Regional energy agencies

AEMPA - Agencia Energética Municipal de Pamplona
www.aempa.com

AGECAM – Agencia de Gestión de la Energía de Castilla – La Mancha
www.agecam.es

AGENEX - Agencia Extremeña de la Energía
www.agenex.org

ARGEM - Agencia de Gestión de Energía de la Región de Murcia:
www.argem.es

AVEN –Agència Valenciana de l'Energia
www.aven.es

CAEEM –
Centro de Ahorro y Eficiencia Energética de la Comunidad de Madrid
www.madrid.org

EREN – Ente Regional de la Energía (Castilla y Leon)
www.jcyl.es/jcyl-client/jcyl/cee/eren

EVE - Ente Vasco de la Energía (Bask Country)
www.eve.es

FAEN - Fundación Asturiana de la Energía
www.faen.es

ICAEN – Catalán Energy Agency
www.icaen.net

INEGA - Instituto Enerxético de Galicia
www.inega.es

SODEAN - Sociedad para el Desarrollo Energético de Andalucía
www.sodean.es

17.2 Overview of RE Technologies

Learning objectives

This chapter should help you to become more familiar with the specific national situation of the different renewable energy technologies. After studying this chapter you should be able to answer the following questions:

- Which are the relevant technologies in terms of current production and future potential?
- Which technologies have the potential to contribute significantly to an increase of renewable energy use? Which problems need to be overcome to realise this growth?
- What are the key characteristics of the different technologies?

17.2.1 Overview of installed capacity and potential

This section provides an overview of the installed capacity and the potential of all technologies used for the production of renewable electricity (RES-E), renewable heat (RES-H) and biofuels. Interpretation and details can be found in the technology-specific sections.

RES-E Technology	1997 [GWh]	2004 [GWh]	Av. Annual growth [%]
Biogas	139	825	29%
Solid Biomass	672	2,193	18%
Biowaste	273	587	12%
Geothermal electricity	0	0	-
Hydro large-scale	30,771	27,019	-2%
Hydro small-scale	4,007	5,198	4%
Photovoltaics	3	57	54%
Wind on-shore	742	15,056	54%
Total	**36,607**	**50,935**	**5%**

Table 17.2 Renewable electricity production in Spain in 1997 and 2004 in GWh

	Penetration 1997 (ktoe)	Penetration 2004 (ktoe)	Av. Annual growth [%]
Biomass heat	3262	3453	1%
Solar thermal heat	25	54	12%
Geothermal heat incl. heat pumps	7	8	4%

Table 17.3 Production of renewable heat in Spain in 1997 and 2004 in ktoe

	Penetration 1997 (ktoe)	Penetration 2005 (ktoe)	Av. Annual growth [%]
Liquid Biofuels	0	218	-

Table 17.4 Production of Biofuels in Spain in 1997 and 2005 in ktoe

Sources: Member State reports, EUR'Observer, Eurostat, national statistics, industry associations and other sources

Figure 17.1 below compares the achieved potential in 2003 to the feasible potential to 2020. For the feasible potential it is assumed that those RE support policies that have shown in the past to be the most effective ones, are applied throughout the EU. It takes into account boundary conditions in the markets, for example several kinds of barriers that can only slowly be overcome.

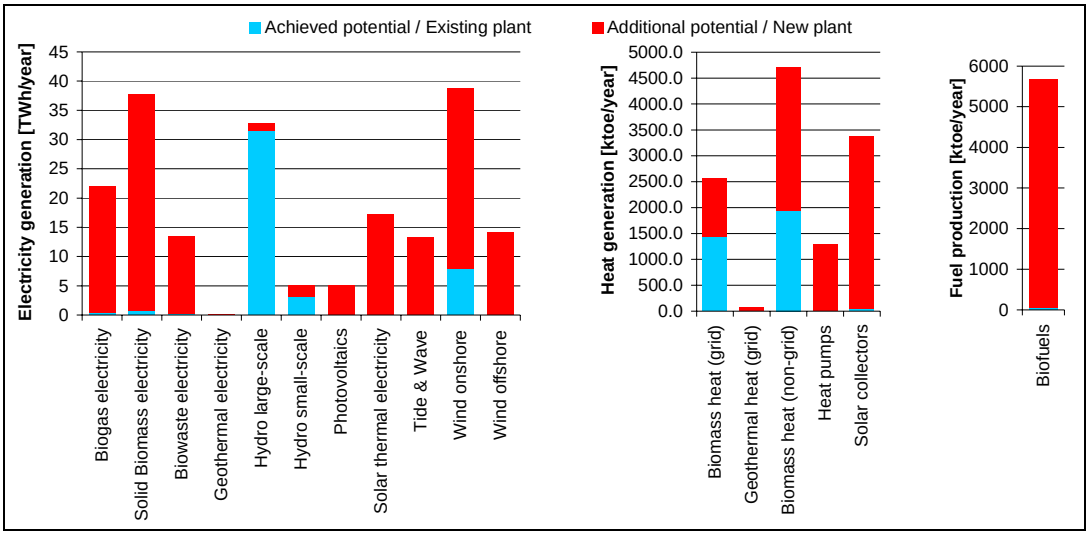


Figure 17.1 Achieved potential in 2003 compared to additional potential up to 2020 (FORRES)

17.2.2 Solar heat

Background

Despite the high potential for solar energy in Spain, the installed solar thermal capacity per capita is below the EU average. However, the national solar obligation, effective from September 2006 onwards, is expected to significantly increase the penetration of solar thermal energy in Spain.

National potential

The national potential for solar heat in Spain to 2020 is estimated to be about 3,300 ktoe. Figure 17.2 shows the annual solar radiation on a horizontal surface in Spain.

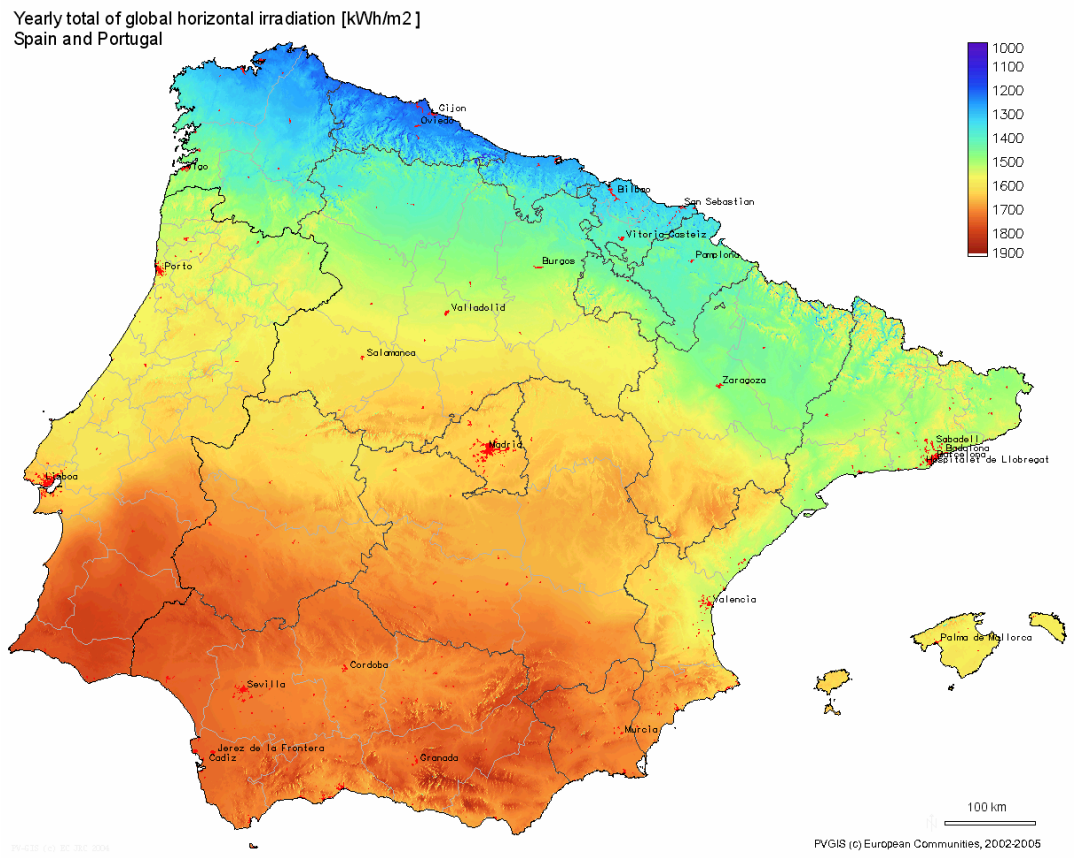


Figure 17.2 Yearly sum of global irradiation in Spain (PVGIS)

National installed capacity

In 2004, about 54 ktoe of solar heat were produced in Spain, which is less than 2% of the national potential until 2020. Figure 17.3 below shows the historic development of the Spanish market for solar heat in terms of installed capacity. The agreed conversion factor for solar thermal between collector surface and capacity is 0.7 kWth/m2 (ESTIF).

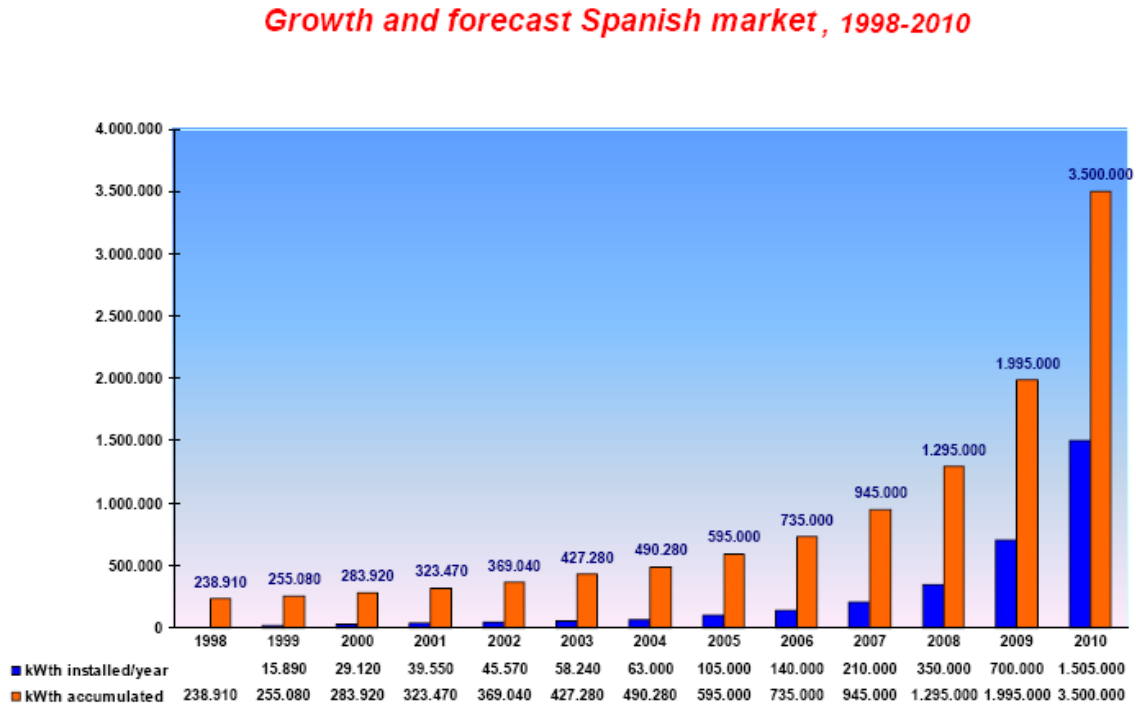


Figure 17.3 Growth and forecast Spanish market (ASIT)

Characteristic features of the technology in the particular country

Focus is on the support of the generation of solar thermal energy in buildings (by means of the national solar obligation for new buildings and renovations).

Relevant policy and legislation at the national level specific to the technology

Spain is the first European country to adopt a national obligation for buildings to take measures to guarantee a minimum use of solar energy (solar thermal or PV) in new buildings or in buildings being remodelled. The Technical Buildings Code (CTE, Codigo Tecnico de la Edificacion - Royal Decree 314/2006) includes an obligation to cover 30-70% of the domestic hot water demand from solar thermal energy. This solar obligation applies to all new buildings and renovations. Large buildings in the tertiary sector (for instance office buildings > 4,000 m2) will also be obliged to install PV systems. There are some exceptions for buildings that use other RES or CHP or for very shaded buildings.

An investment subsidy of 36.4% of total financial investment is available for RES-H (Plan de Formento de las Energias Renovables (1999-2010)).
Installed collector surface until 2004, expected additional capacity until 2010, and 2010 targets can be seen per autonomous region from Table 17.5 below.

Autonomous region	Installed collector surface until 2004 (m^2)	Increase 2005- 2010 (m^2)	2010 target (m^2)
ANDALUCÍA	213.239	910.398	1.123.637
ARAGÓN	6.686	85.892	92.578
ASTURIAS	9.022	41.810	50.832
BALEARES	78.362	358.474	436.836
CANARIAS	95.731	382.954	478.685
CANTABRIA	1.501	20.856	22.357
CASTILLA Y LEÓN	34.646	257.227	291.873
CASTILLA - LA MANCHA	7.845	294.666	302.511
CATALUÑA	82.358	489.523	571.881
EXTREMADURA	3.310	168.181	171.491
GALICIA	8.911	52.900	61.811
MADRID	56.204	380.123	436.327
MURCIA	19.321	143.903	163.224
NAVARRA	12.473	77.405	89.878
LA RIOJA	204	20.856	21.060
COMUNIDAD VALENCIANA	58.199	389.260	447.459
PAÍS VASCO	4.849	125.572	130.421
TOTAL (m^2)	700.433	4.200.000	4.900.433

FUENTE: IDAE. No regionalizados: 7.572 m2

Figura 13. Objetivos solar térmica para el año 2010. Datos propios

Table 17.5 Installed collector surface until 2004, expected additional capacity until 2010 and 2010 target (all in m2) per autonomous region (IDAE)

17.2.3 Solar thermal electricity

Background

Solar thermal electricity is still in the initial phase of development. No commercial installations are in operation in Europe at the moment. The first three projects in Spain are currently under development.

National potential

The national potential for solar thermal electricity production is estimated to be about 17 TWh/year to 2020. For a map showing the solar radiation in different regions in Spain see section 2.2.

National installed capacity

No commercial installations are in operation so far. Until now only prototypes exist in Spain.

Characteristic features of the technology in the particular country

Solar thermal electricity is still in the initial phase of development. The first three projects (Andasol I, Andasol II and PS 10) in Spain are currently under development with a total capacity of 110 MW.

The leading research institute in the field of solar thermal electricity in Europe is the Plataforma Solar de Almería in southern Spain.

Royal Decree 436/2004 defines for the first time tariffs (feed-in and premium) for electricity generated by solar thermal installations.

Barriers to adoption

Feed-in tariff/premium has only been defined for the first 200 MW being installed. This limit imposes a serious barrier once the first projects have been realised. There might be a lack of providers of necessary components.

Relevant policy and legislation at the national level specific to the technology

2010 targets for solar thermal electricity per autonomous region are provided in Table 17.6 below.

COMUNIDAD AUTÓNOMA	POTENCIA (MW)
ANDALUCÍA	300
ARAGÓN	
ASTURIAS	
BALEARES	
CANARIAS	
CANTABRIA	
CASTILLA Y LEÓN	50
CASTILLA - LA MANCHA	50
CATALUÑA	
EXTREMADURA	50
GALICIA	
MADRID	
MURCIA	50
LA RIOJA	
COMUNIDAD VALENCIANA	
PAÍS VASCO	
TOTAL	500 MW

Autonomous region	2010 target in MW

Table 17.6 2010 targets for solar thermal electricity per autonomous region (IDEA)

Government supports

Solar thermal electricity is eligible to the feed-in tariff/premium. Currently the tariff is about 230 Euro/MWh for the feed-in tariff and 199 Euro/MWh for the premium.

Case studies

Descriptions of applied technologies can be found on the website of the research centre Plataforma Solar de Almería: www.psa.es

17.2.4 Photovoltaic

Background

Spain is one of the global leaders in PV. In absolute terms, the Spanish PV market is the second largest in Europe, after Germany: installed capacity in Spain was 58 MWp by the end of 2005. Installed capacity per capita was 1.4

Wp/inhabitant. Also Spanish industry is one of the leading PV industries in the world, accounting for about 30% of the European PV market. The Plan de Energías Renovables 2005-2010 formulates an objective of 400 MWp installed capacity by 2010.

National potential

The national potential for photovoltaic electricity production is estimated to be about 5 TWh/year until 2020. For a map showing the solar radiation in different regions in Spain see section 2.2.

National installed capacity

Electricity production from photovoltaic strongly increased during the last years to 57 GWh in 2004, but is still on a low level compared to the potential. The development of installed PV capacity up to 2004 can be seen from the figure below.

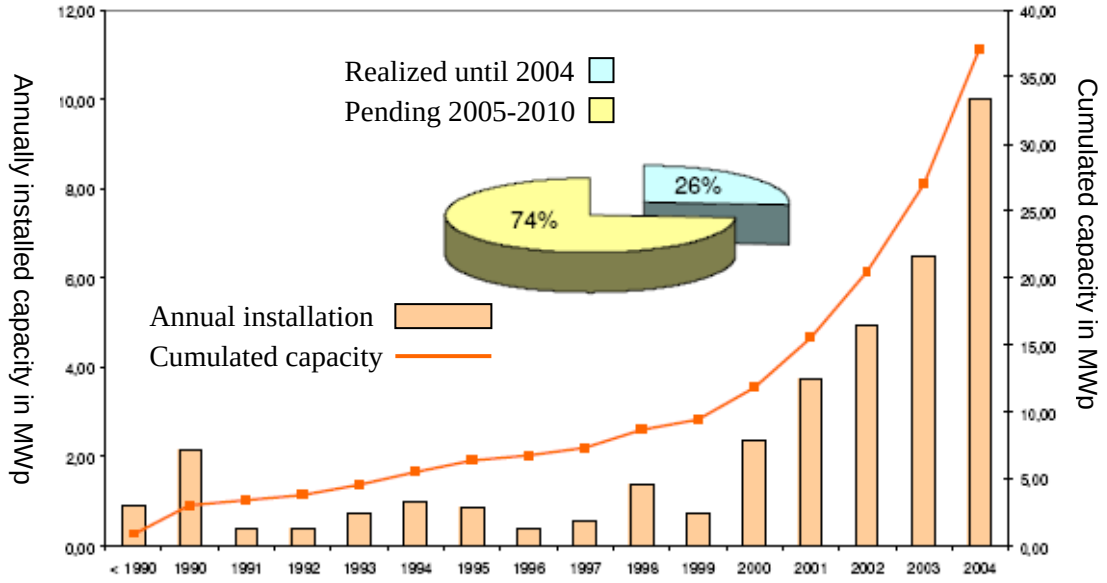


Figure 17.4 Annually installed PV capacity and cumulated capacity (IDAE)

Characteristic features of the technology in the particular country

Traditionally stand-alone PV systems are an important application in Spain, more than in most European countries. However, in recent years grid-connected PV systems are growing more rapidly. Currently about two thirds of installed PV capacity is grid-connected.

Relevant policy and legislation at the national level specific to the technology

The installed PV capacity in 2004 and the objective for 2010 per autonomous region can be seen from Table 17.7 below.

Autonomous region	Installed capacity until 2004 (MWp)	Increase 2005 - 2010 (MWp)	2010 target (MWp)
ANDALUCÍA	7,86	43,38	51,24
ARAGÓN	0,67	16,08	16,75
ASTURIAS	0,34	8,93	9,27
BALEARES	1,33	16,41	17,74
CANARIAS	1,20	16,04	17,24
CANTABRIA	0,07	9,14	9,21
CASTILLA Y LEÓN	2,73	25,60	28,33
CASTILLA - LA MANCHA	1,78	11,64	13,42
CATALUÑA	4,11	52,48	56,59
EXTREMADURA	0,54	12,85	13,39
GALICIA	0,51	23,49	24,00
MADRID	2,38	29,33	31,71
MURCIA	1,03	19,03	20,06
NAVARRA	5,44	14,20	19,64
LA RIOJA	0,15	9,08	9,23
COMUNIDAD VALENCIANA	2,83	31,25	34,08
PAÍS VASCO	2,40	23,70	26,10
NO REGIONALIZABLE	0,77	-	0,77
TOTAL (MW)	**37**	**363**	**400**

Table 17.7 Cumulated PV capacity in 2004, expected additional capacity until 2010 and objective for 2010 (all in MWp) per autonomous region
(IDAE)

Government supports

Photovoltaic electricity is eligible to the feed-in tariff/premium. Currently the tariff for installations above 100 kWp installed capacity is about 230 Euro/MWh for the feed-in tariff and 199 Euro/MWh for the premium. For installations below 100 kWp installed capacity only the feed-in tariff applies; the tariff is currently about 440 Euro/MWh.

Financial viability

Financial viability of several RES-E technologies in all EU countries has recently been analysed in an EU funded research project. When comparing costs and support levels among the countries, one has to make sure to deal with comparable quantities. In particular, the support level in each country needs to be normalised according to the duration of support in each country, e.g. the duration of green certificates in Italy is only 12 years compared to 20 years for guaranteed feed-in tariffs in Germany. The support level under each instrument has therefore been normalised to a common duration of 15 years. The conversion between the country-specific duration and the harmonised support duration of 15 years is performed assuming a 6.6% interest rate.

Figure 17.5 below shows price ranges (average to maximum support) for direct support of photovoltaic electricity in EU-15 Member States (average tariffs are indicative), compared to the long-term marginal generation costs (minimum to average costs).

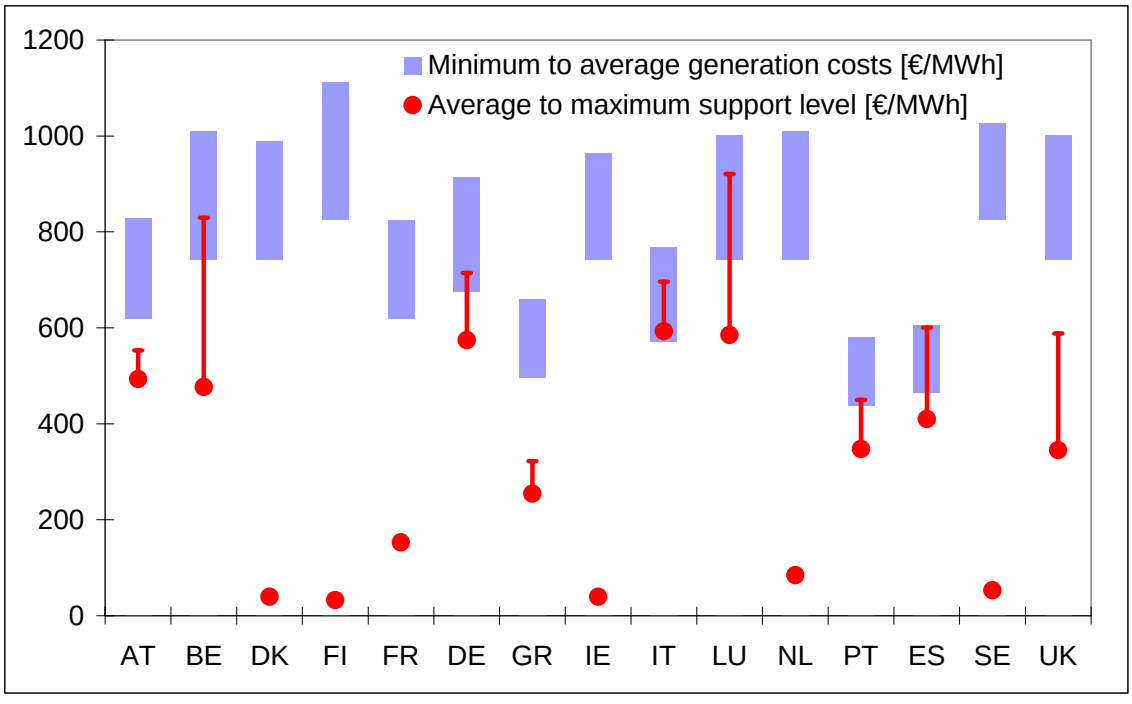


Figure 17.5 Price ranges for photovoltaic in EU-15 Member States compared to support levels

(European Commission 2005)

The figure shows that efficient projects might be financially viable.

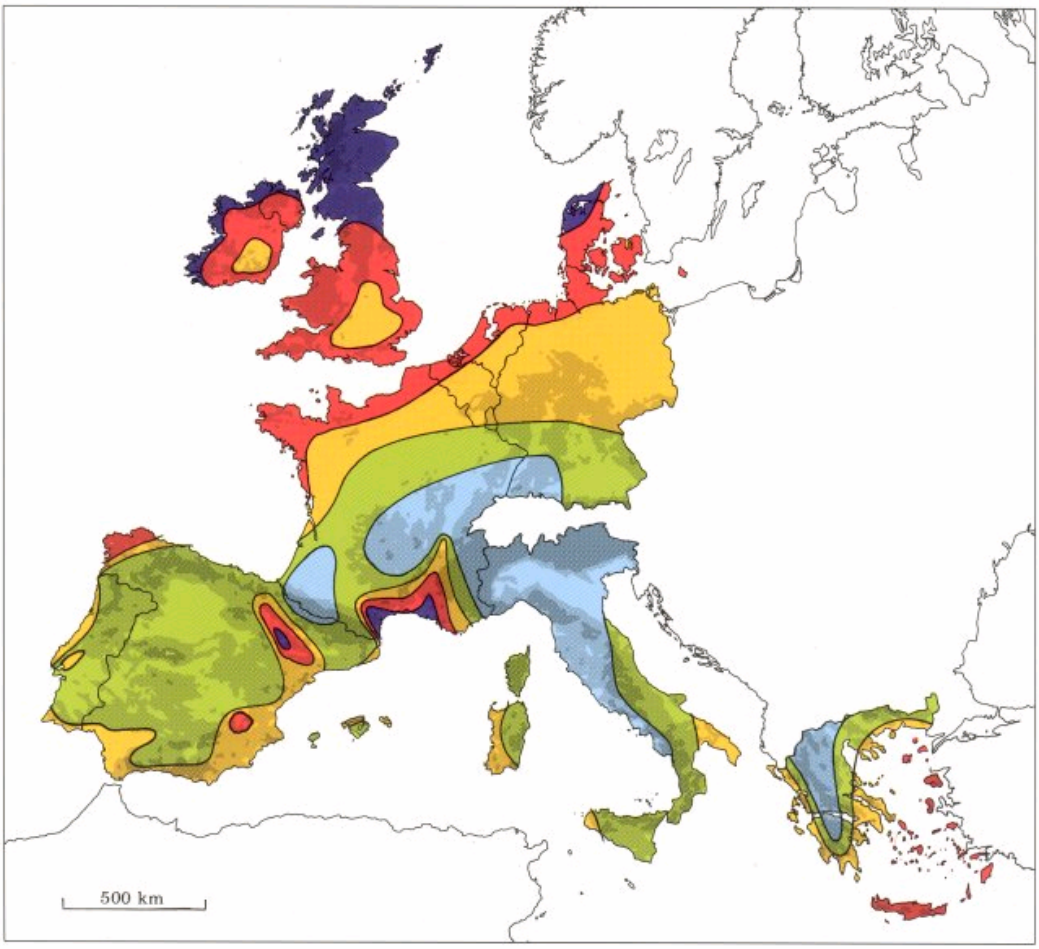
17.2.5 Wind

Background

Over the past few years wind energy has developed at an extraordinary pace in Spain, turning Spain into a global leader of wind energy. Only Germany has been able to show a higher growth of wind energy. Installed wind power capacity in Spain at the end of 2005 was 10,027 MW. This extraordinary growth has been possible due to favourable wind conditions combined with attractive support policies, both at the national and regional level.

National potential

The onshore potential is estimated to be about 38 TWh/year until 2020. The offshore potential is 18 TWh/year. Figure 17.6 below shows the wind conditions in Spain compared to other parts of Western Europe.



Wind resources[1] at 50 metres above ground level for five different topographic conditions

	Sheltered terrain[2]		Open plain[3]		At a sea coast[4]		Open sea[5]		Hills and ridges[6]	
	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10.0-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0- 8.5	400- 700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

Figure 17.6 Wind potential in Western Europe
(European Wind Atlas)

National installed capacity

Growth of wind power production in Spain has been remarkable during the last years with Spain being worldwide among the countries with the highest annual additional installed capacity. The development of additional and cumulated installed capacity can be seen from Figure 17.7 below. In 2004 about 15 GWh of electricity from wind power were produced.

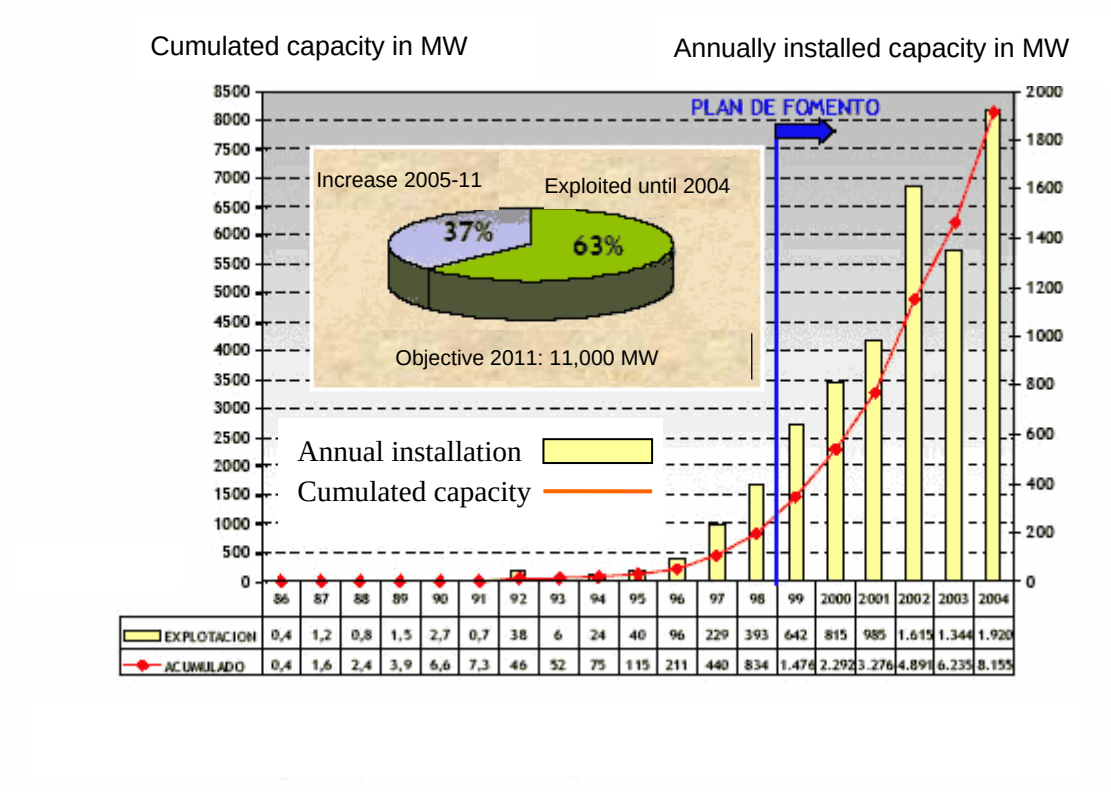


Figure 17.7 Annually installed wind capacity and cumulated capacity (IDAE)

Characteristic features of the technology in the particular country

Spain has both favorable wind resources and vast, scarcely populated areas for wind farm development. In combination with good and stable support policies this led to a strong growth and the development of an indigenous industry.

Barriers to adoption

It is expected that current high growth rates of wind energy will be continued in the coming years. The main barriers which will have to be addressed in the near future are related to the electricity grid: the main challenges will be how to cope with a higher share of electricity from wind in the electricity grid, and the development of new grid infrastructure needed to allow for the erection of wind parks in remote areas.

Lack of regulations/zonal planning for offshore uses, makes the erection of offshore wind difficult. So far there is no offshore wind farm in operation. In

addition, the tariff for electricity from offshore wind parks is identical to the tariff for onshore wind, although investment costs are considerably higher. Plans for offshore wind meet fierce opposition from environmental associations.

Relevant policy and legislation at the national level specific to the technology

The 2004 penetration and 2010 target per autonomous region can be seen from Table 17.8 below.

Wind capacity			
Autonomous region	**Capacity in 2004 (MW)**	**Increase 2005-10 (MW)**	**Target 2010 (MW)**
ANDALUCÍA	350	1.850	2.200
ARAGÓN	1.154	1.246	2.400
ASTURIAS	145	305	450
BALEARES	3	47	50
CANARIAS	139	491	630
CANTABRIA	-	300	300
CASTILLA Y LEÓN	1.543	1.157	2.700
CASTILLA - LA MANCHA	1.534	1.066	2.600
CATALUÑA	94	906	1.000
EXTREMADURA	-	225	225
GALICIA	1.830	1.570	3.400
MADRID	-	50	50
MURCIA	49	351	400
NAVARRA	854	546	1.400
LA RIOJA	356	144	500
COMUNIDAD VALENCIANA	21	1.579	1.600
PAÍS VASCO	85	165	250
Total in 2010	**8.155 MW**	**12.000 MW**	**20.155 MW**

Table 17.8 Cumulated installed wind capacity in 2004, projected additional capacity until 2010 and 2010 target (all in MW) per autonomous region
(IDAE)

Government supports

Electricity production from wind power is eligible to the feed-in tariff/premium. Currently the tariff is about 69 Euro/MWh for the feed-in tariff and 38 Euro/MWh for the premium.

Financial viability

Figure 17.8 below shows price ranges (average to maximum support) for direct support of wind onshore in EU-15 Member States (average tariffs are indicative), compared to the long-term marginal generation costs (minimum to average costs). Support schemes are normalised to 15 years. See section on financial viability of photovoltaic projects for an explanation of this figure.

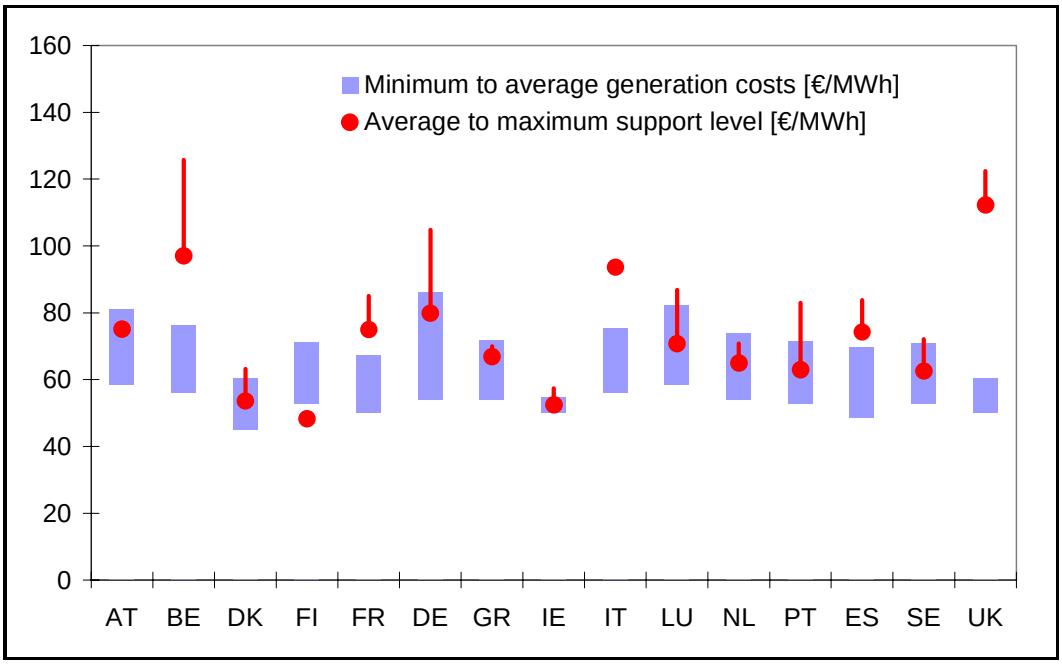


Figure 17.8 Price ranges for wind power in EU-15 Member States compared to support levels

(European Commission 2005)

The figure shows that wind energy production in Spain is financially very viable.

Investment costs, including costs for grid connection, have decreased from over 1600 $Euro_{2004}$/kW in 1986 to 920 $Euro_{2004}$/kW in 2004. During the last years the investment costs are slightly increasing, due to the application of wind generators of a higher capacity which still have slightly higher costs. The historic evolution of investment costs in Spain can be seen from Figure 17.9 below (in 2004 Euro).

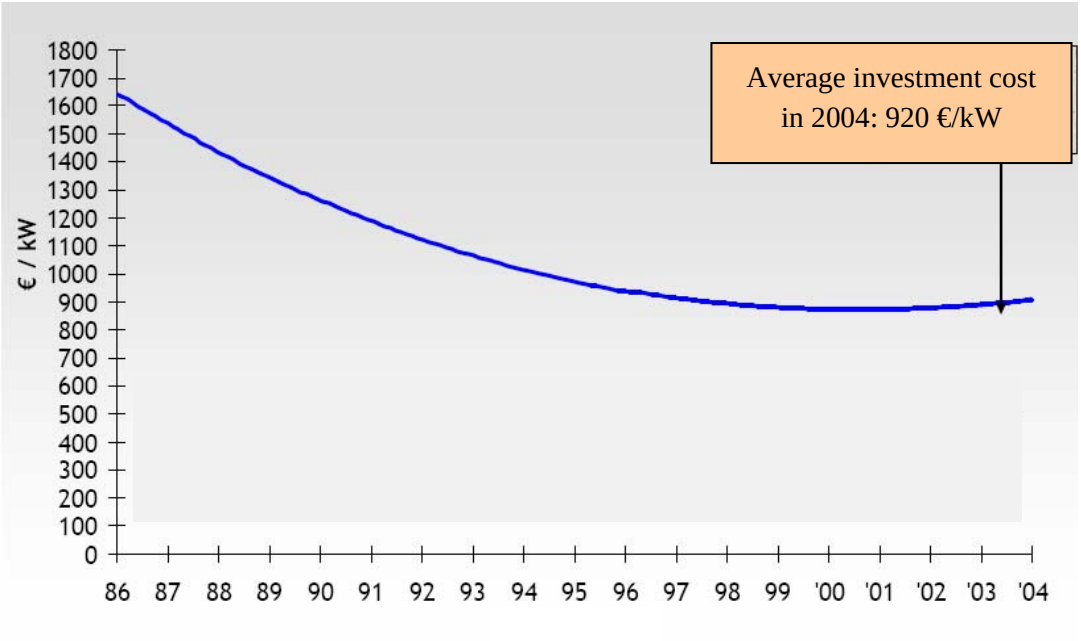


Figure 17.9 Development of investment cost for wind power over time (IDAE)

17.2.6 Hydro

Background

Hydropower technology is a mature technology, being the fruit of decades of research, development and realisation. About 150 Spanish companies are active in hydropower, ranging from equipment manufacturing, installation and maintenance.

Currently installed hydropower capacity in Spain is growing slowly due to environmental and administrative barriers.

National potential

The national potential for hydro power to 2020 is about 43 TWh/year. The potential is almost completely exploited.

National installed capacity

In 2004 about 39 TWh of electricity was generated from hydro power. Large hydro represents the largest proportion of RES-E in Spain, accounting for 53% of RES-E in 2004. Large hydro is however not growing currently in Spain, although small hydro shows an average annual growth rate in the pe-

riod 1997 to 2004 of 4%. Small hydro accounted for just over 10% of RES-E in Spain in 2004.

Characteristic features of the technology in the particular country

Spain uses a different definition for large and small-scale hydro power capacity than commonly used in the EU. In Spain a hydro power capacity up to 50 MW is considered to be small-scale hydro power capacity, whereas usually this is up to 10 MW in the EU. A capacity below 10 MW is considered to be mini-hydro in Spain.

Barriers to adoption

Strong environmental and administrative barriers exist for hydropower developments.

Relevant policy and legislation at the national level specific to the technology

The objective for 2010 is 450 MW new mini-hydro capacity (<10 MW) and 360 MW new small-hydro capacity (capacity between 10 MW and 50 MW).

Installed capacity (2004) and targeted capacity (2010) of mini-hydro (<10 MW) per autonomous region can be seen from Table 17.9 below.

Mini Hydropower (< 10 MW)			
Autonomous region Comunidad Autónoma	Capacity in 2004 (MW) (MW)	Increase 2005-10 (MW)	2010 Target (MW)
ANDALUCÍA	198	30	228
ARAGÓN	194	40	234
ASTURIAS	90	10	100
BALEARES	0	0	0
CANARIAS	1	1	2
CANTABRIA	54	5	59
CASTILLAY LÉON	264	90	354
CASTILLA-LA MANCHA	105	40	145
CATALUÑA	232	50	282
EXTREMADURA	25	7	32
GALICIA	215	102	317
MADRID	46	3	49
MURCIA	18	4	22
NAVARRA	161	34	195
LA RIOJA	46	10	56
COMUNIDAD VALENCIANA	45	13	58
PAIS VASCO	55	11	66
TOTAL:	1.749	450	2.199

Table 17.9 Cumulated installed capacity of mini-hydro (<10 MW), projected growth until 2010 and 2010 target (all in MW) per autonomous region

(IDAE)

Mini Hydropower (10-50 MW)			
Autonomous region Comunidad Autónoma	Capacity in 2004 (MW) (MW)	Increase 2005-10 (MW) (MW)	2010 Target (MW) (MW)
ANDALUCÍA	285	47	332
ARAGÓN	476	33	509
ASTURIAS	153	0	153
BALEARES	0	0	0
CANARIAS	0	0	0
CANTABRIA	43	0	43
CASTILLAY LÉON	378	65	443
CASTILLA-LA MANCHA	154	30	184
CATALUÑA	679	25	704
EXTREMADURA	112	0	112
GALICIA	432	86	518
MADRID	53	0	53
MURCIA	14	0	14
NAVARRA	20	28	48
LA RIOJA	0	0	0
COMUNIDAD VALENCIANA	69	46	115
PAIS VASCO	29	0	29
TOTAL:	2.897	360	3.257

Table 17.10 Cumulated installed capacity of mini-hydro (10-50 MW), projected growth until 2010 and 2010 target (all in MW) per autonomous region
(IDAE)

Government supports

Small hydro power is eligible for the feed-in tariff/premium. The feed-in tariff for installations below 25 MW installed capacity is 68.9 Euro/MWh while the feed-in premium is 38.3 Euro/MWh. For installations below 25 and 50 MW installed capacity these figures are 61.3 and 30.6 Euro/MWh respectively.

Financial viability

Figure 17.10 below shows price ranges (average to maximum support) for direct support of small-scale hydro in EU-15 Member States (average tariffs are indicative). compared to the long-term marginal generation costs (minimum to

average costs). See section on financial viability of photovoltaic projects for an explanation of this figure.

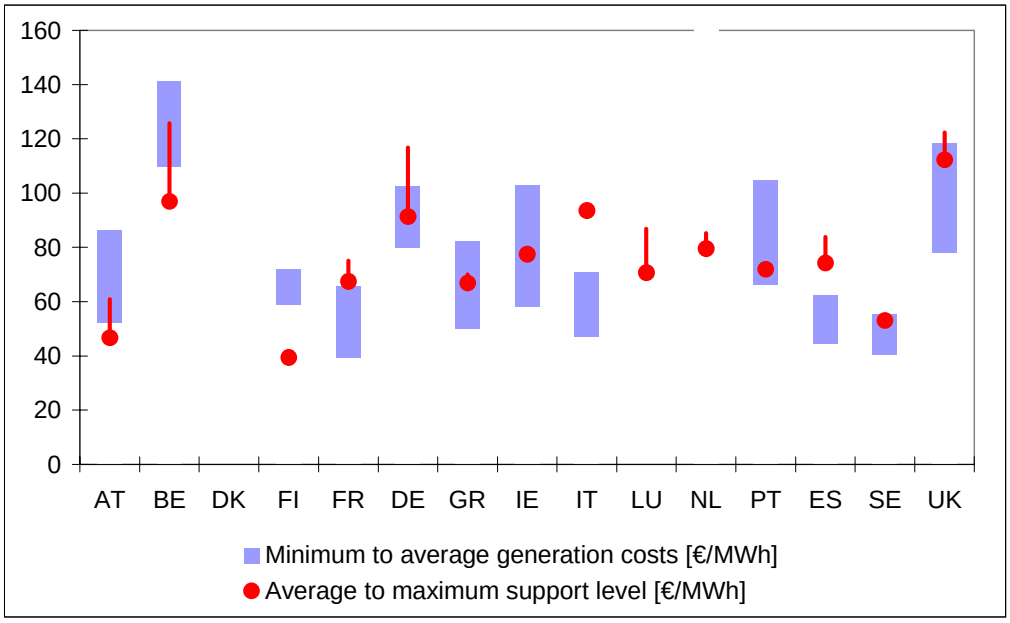


Figure 17.10 Price ranges for electricity from small hydro in EU-15 Member States compared to support levels
(European Commission 2005)

17.2.7 Anaerobic Digestion

Background

The penetration of anaerobic digestion in Spain is very limited. The main reasons are lack of financial incentives and lack of experience with regard to anaerobic digestion.

Recently the production of biogas in Spain is increasing, but this is mainly due to the development of landfill gas and sewage gas instead of biogas plants.

National potential

The national potential for electricity production from all kinds of biogas projects is estimated to be 22 TWh/year to 2020.

National installed capacity

In 2004 about 800 GWh of electricity was produced from biogas. The installed capacity was about 141 MWe excluding landfill gas. Table 17.11 below shows the number of biogas plants arranged by installed capacity.

BIOGAS (mainly landfill and waste)	Number of plants
< 1 MW	40
1 - <5 MW	50
5 - <10 MW	10
10 - <20 MW	5
Total	**105**

Table 17.11 Existing biogas plants by installed capacity

Table 17.12 shows the sectors where anaerobic digestion could play a role. It is evident that anaerobic digestion has hardly been developed in Spain up to now.

Sector	Number of projects	Penetration 2004 in primary energy - toe	Target 2010 in primary energy - toe
Cattle farming	2	3,875	8,000
Industrial waste	1	1,798	40,000

Table 17.12 Anaerobic digestion projects in operation (2004) (IDAE)

Characteristic features of the technology in the particular country

Most biogas projects are landfill gas utilisation or waste water treatment. Very little experiences exists on biogas from stock farming in Spain. Some existing biogas plants are related to agricultural residues from greenhouses.

Barriers to adoption

Anaerobic digestion of manure as the alternative route of drying manure with natural gas and then combusting it for electricity production has a higher economic yield, anaerobic digestion of manure is currently not an interesting option for investors. Another important barrier for anaerobic digestion are high investment costs (typically 1500 euro/kW) combined with (too) low tariffs to develop the market for anaerobic digestion.

Relevant policy and legislation at the national level specific to the technology

The national objective for installed electricity production capacity from biogas is 235 MW by 2010.

Government supports

Electricity production from biogas is eligible for the feed-in tariff/premium. Currently the feed-in tariff is 69 Euro/MWh while the premium is 38 Euro/MWh.

Financial viability

Figure 17.11 below shows price ranges (average to maximum support) for direct support of agricultural biogas in EU-15 member states (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). See section on financial viability of photovoltaic projects for an explanation of this figure.

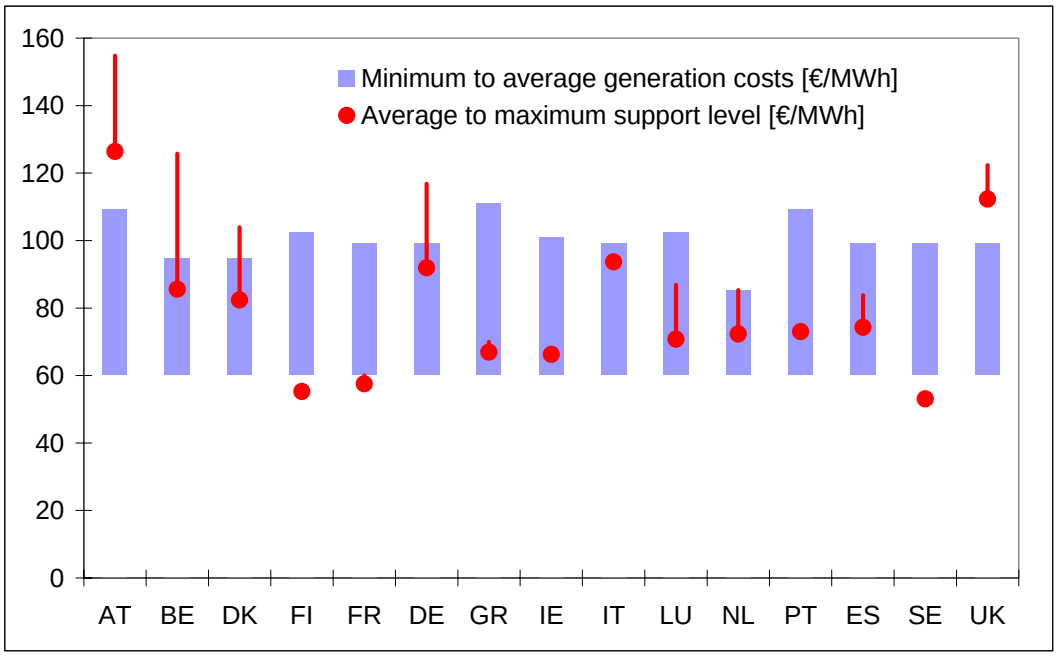


Figure 17.11 Price ranges for electricity from biogas in EU-15 Member States compared to support levels

(European Commission 2005)

The figure shows that the most efficient biogas projects are financially viable.

17.2.8 Wood Fuel

Background

Biomass has gained importance in the last five years, increasing rapidly since 2001. Woody biomass is the largest resource contributing to this development but also more exotic biomass plays a role (like for example a 25 MWe-straw fired power plant in Sanguesa or a 11MWe-olive cake fired power plant in Jaen or others using cotton residues).

Plants for combustion of biomass are mainly for electricity production. Power plants using agricultural industry residues are one of the existing and developed technologies in Spain, although more support from the public sector is also needed The PER (Plan de Energías Renovables) sees the co-combustion technology as one of the main opportunities for Spain.

National potential

The potential for heat production from solid biomass to 2020 is more than 7,000 ktoe. The potential for electricity production is almost 40 TWh/year. Table 17.12 below shows the potential of solid biomass arranged by biomass source.

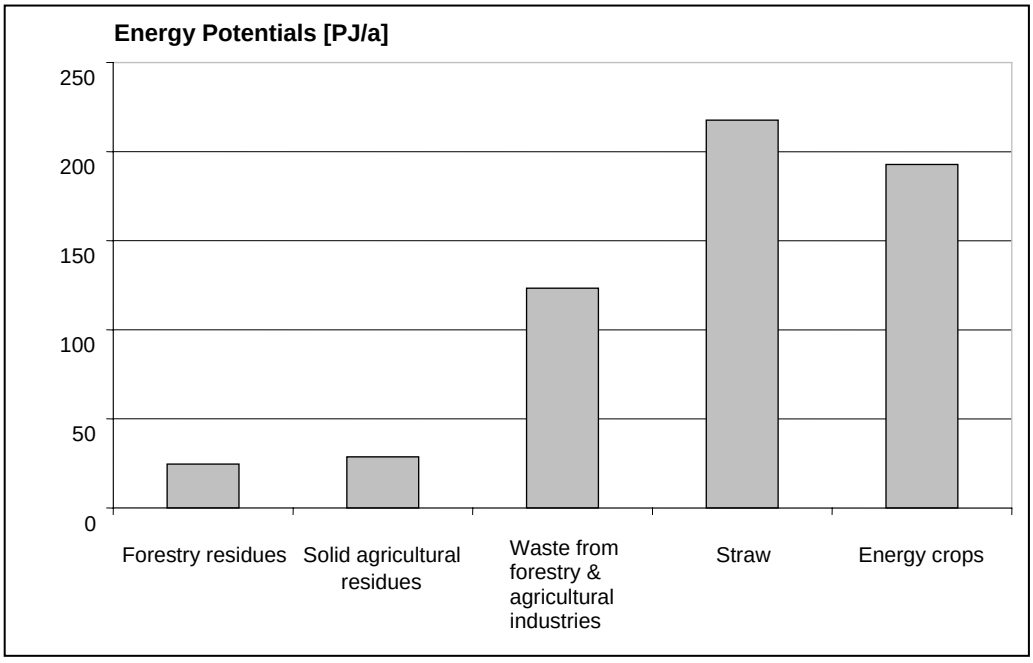


Figure 17.12 Potential of solid biomass by biomass source

The regional distribution of resources is

- forestry residues: north west region (Castilla-Leon & Galicia)
- agricultural residues (e.g. straw, cotton or wine growing residues; agro-industrial residues: e.g. from wine or olive oil production): central & south-east region (Castilla-La Mancha & Catalonia & Com. Valencia)
- residues from forestry & agricultural industries south (Andalusia)
- straw: centre and south (Castilla-La Mancha & Castilla-Leon)
- energy crops: South & centre (Andalusia & Aragon & Castilla-La Mancha & Castilla-Leon)

Forestry residues per autonomous region can be seen from Table 17.13 below.

Autonomous region	Forestry residues (toe)	Share in national potential
Andalucía	124.380	9,1%
Aragón	98.058	7,1%
Asturias	34.238	2,5%
Baleares	0	0,0%
Canarias	0	0,0%
Cantabria	25.823	1,9%
Castilla-La Mancha	113.156	8,2%
Castilla-León	367.668	26,8%
Cataluña	92.340	6,7%
Com. Valenciana	54.851	4,0%
Extremadura	134.338	9,8%
Galicia	220.461	16,1%
La Rioja	12.454	0,9%
Madrid	12.991	0,9%
Navarra	19.302	1,4%
País Vasco	34.239	2,5%
Región de Murcia	29.129	2,1%
TOTAL	1.373.428	

Table 17.13 Forestry residues (middle column) per autonomous region (left column) and share in national potential (right column)
(IDAE)

The two autonomous regions, Castilla-León and Galicia, have more than 40% of Spain's available potential of forestry residues.

National installed capacity

In 2004 about 2,200 GWh of electricity was produced from solid biomass with an annual growth rate of 18% on average in the last years. Heat production from solid biomass remained on the same level with a production of about 3,400 ktoe in 2004.

The installed electricity production capacity from solid biomass in 2004 was 344 MW, excluding co-firing. The 2005 numbers show already ~800 MW installed capacity for solid biomass.

Table 17.14 below shows the number of biomass plants arranged by installed capacity.

BIOMASS (combustion)	Number of plants
< 1 MW	5
1 - <5 MW	25
5 - <10 MW	20
10 - <20 MW	20
20 - 40 MW	10
Total	**80**

Table 17.14 Existing biomass plants by installed capacity

Characteristic features of the technology in the particular country

There is no established market for biomass, thus prices and quantities have to be negotiated directly with potential suppliers. Possible sources of Biomass are local farmers, olive processing industries, etc. PER reports good availability and quality of:

- Forest residues
- Firewood
- Agricultural residues (grass)

Most of the operators of combustion plants are the industries producing the biomass or companies founded for energy-supply of these industry connected directly to these industrial companies. Examples for independent operators are:

- ENDESA - running two 16MWe Power plant based on olive processing resources

- Acciona Energía - operating Sangüesa Straw Power plant of 25MW, Tasola (4MW) and Pinasa (4MW)
- TAFISA TRADEMA - cogeneration plant using the wood residues of their industry

Projects are developed by all larger energy companies such as HC Energía, UNION FENOSA, IBERDROLA, ENDESA, but also by engineering and construction companies like ABENGOA BIOENERGIA, SUFI, GHESA, IDOM, SINAE (now Hidrocantabrico) and IBERESE.

Barriers to adoption

The profitability of the biomass power plants are not reaching the levels expected. Different regulations and supporting plans exist, depending on the Comunidad Autónoma. The lack of an established biomass market results in variability of prices and resource availability.

An important barrier related to forestry residues is the difficulty to guarantee availability of fuel in sufficient quantity, of sufficient quality at a reasonable price. Supply of forestry residues is typically non-continuous.

Relevant policy and legislation at the national level specific to the technology

The revised “Plan de Energías Renovables” (PER) sets the target for electricity from solid biomass to 2 GW for 2010 (including ~720 MWe from co-firing). Plants above 50 MW installed capacity are obliged to negotiate their production and surplus in the free market.

Government supports

Electricity production from solid biomass is eligible for the feed-in tariff/premium. Currently the feed-in tariff is 69 Euro/MWh while the premium is 38 Euro/MWh.

ICO-IDAE provides low-interest loans for projects of renewable energies. Up to 80% of the reference costs could be financed (1.700 €/kW for biomass power plants and 1.800 €/kW for CHP)

Financial viability

Figure 17.13 below shows price ranges (average to maximum support) for supported biomass electricity production from forestry residues in EU-15 member states (average tariffs are indicative), compared to the long-term marginal generation costs (minimum to average costs). See section on financial viability of wind projects for an explanation of this figure.

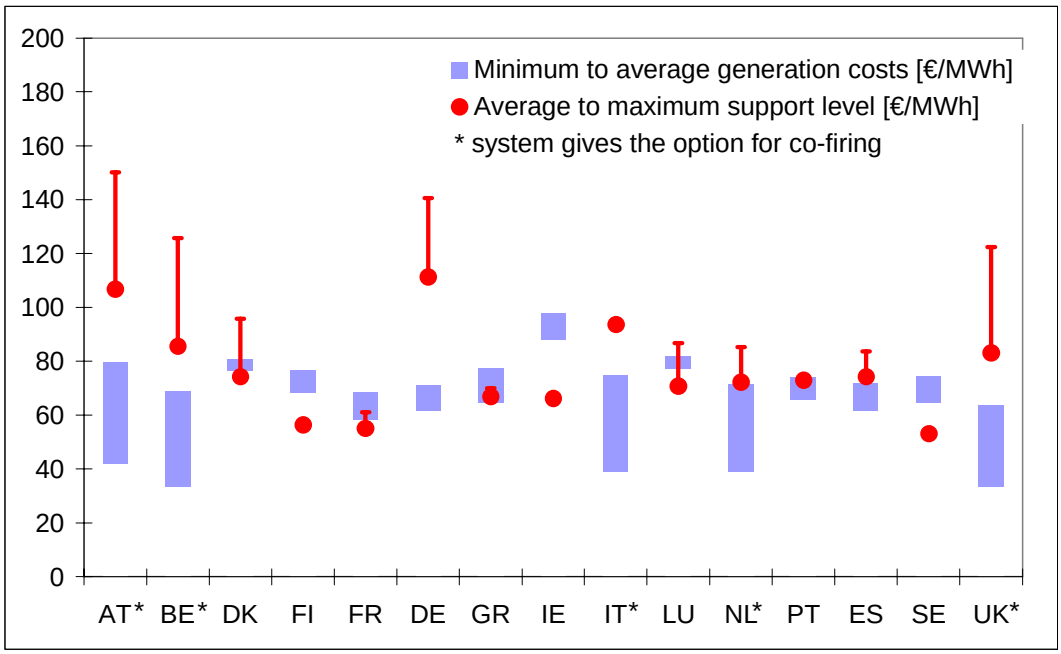


Figure 17.13 Price ranges for electricity from forestry residues in EU-15 Member States compared to support levels

(European Commission)

The figure shows that under the support system MEP – which is currently discontinued – it was possible to realise financially viable biomass projects.

Relevant organizations for the biomass sector

ASERMA - Association for wood recovery

www.aserma.org

AVEBIOM – Association for the energetic valorisation of the biomass www.avebiom.org

CONFEMADERA - Spanish Association for Wood Entrepreneurs www.confemadera.es

17.2.9 Liquid Biofuels

Background

Compared to other European countries the production of liquid biofuels has increased significantly in Spain over the last five years. In 2000, there was no production facility in operation but by 2005 Spain has become the most important producer of bioethanol in Europe, accounting for more than 30% of total production in the EU in 2005.

National potential

The national potential for biofuel production to 2020 is estimated to be about 5,700 ktoe/year.

National installed capacity

Biofuel production is currently at a relatively high level in Spain and has shown very high growth in recent years. Bioethanol production in Spain is the highest in the EU25. In 2005 total bioethanol for transport production in Spain was 240 ktoe. Bioethanol accounts for approximately three quarters of biofuel production in Spain, with biodiesel accounting for the remaining portion. Biodiesel production capacity in Spain is currently the fifth highest in the EU25, after the UK. In 2006 biodiesel production capacity is estimated to be 224 kt per year, up from 100 kt per year in 2005.

An overview of biofuel production facilities operating in Spain in 2004 is provided in the following Table 17.15.

Plant name	Autonomous community	Fuel type	Production capacity (t/a)	Commis-sioning
Ecocarburantes Españoles	Murcia (Cartagena)	Bioetanol	80.000	2000
Stocks del Vallés	Cataluña (Montmeló)	Biodiesel	6.000	2002
Bioetanol Galicia	Galicia (Curtis)	Bioetanol	100.000	2002
Bionet Europa	Cataluña (Reus)	Biodiesel	6.000	2003
Bionor Transformación	País Vasco (Berantevilla)	Biodiesel	20.000	2003
Biodiesel de Castilla-La Mancha	Castilla-La Mancha (Santa Olalla)	Biodiesel	40.000	2004
Bionorte	Asturias (S. Martín del Rey Aurelio)	Biodiesel	4.000	2004
Biodiesel-IDAE	Madrid (Alcalá de Henares)	Biodiesel	5.000	2004

Table 17.15 (from left to right) Name of facility, Autonomous community, type of biofuel produced, annual capacity (t/year), year of commissioning

Barriers to adoption

No guarantees regarding the financial support framework: currently a full tax exemption applies for the volume of biofuel used. However, as this tax exemption may be adjusted to prevent overcompensation, investors have no guarantee regarding the level of the tax exemption. The tax exemption has been defined to 31 December 2012. At the moment investors do not know what the financial framework will be after this date.

An infrastructural barrier is the absence of a distribution network for biofuels. A specific barrier for biodiesel is the high market price for oils due to demand for oils from food industry.

Government supports

A full tax exemption is applied until the end of 2012 for biofuels. This may be adjusted to prevent overcompensation to project developers in the market place.

17.3 Planning and Consultation

This chapter provides an overview of the administrative procedures for renewable energy projects. An overview of the relevant legislation and authorities is given, while procedures from a project developer's point of view are explained for wind projects.

Learning objectives

After studying this chapter you should be able to answer the following questions:

- What are the main steps in obtaining the necessary permits for realising a renewable energy project?
- Which institutions are/should be involved?
- How is the public involved in planning procedures? How can project developers contribute to policy relevant to renewable energy projects?

The governments in Spain can be divided in three layers, namely:

1. National Authority;
2. Regional Authority (Autonomous Communities);
3. Local Authority (Municipality).

National Authority

Ministries involved in renewable energy are:

- Ministry of Industry - sets up the RE target and takes care of subsidies and fiscal measures;
- Ministry of the Environment - responsible for environmental issues such as the Kyoto agreement;

In the Renewable Energy Plan 2005-2010 ('Plan de Energías Renovables en España 2005-2010') the national government set goals for every renewable energy source and technology in order to comply with the law (12% of primary energy consumption from renewables by 2010).

There is a national economic framework for renewable energy: the feed-in tariffs and the premium prices. The government fixes on an annual basis the prices for each renewable energy technology.

Relevant national legislation applicable to planning and consultation for renewable energy projects are:

- Law 54/1997, of 27 November 1997, on the Electric Sector defines the Special Regime for electricity generation and recognises the right to feed into the grid all the electricity produced by wind energy generation systems.
- Royal Decree 2818/1998, of 23 December 1998, establishing the regulation of Special Regime of Wind Electricity
- Royal Decree 436/2004, of 12 March 2004, establishing the methodology for actualising the legal and economic framework for special regime
- Law 6/2001, of 8 May 2001, on Environmental Impact Assessment
- Law 3/1998, of 27 February 1998, on the Integral Intervention of Environmental Administration.

Regional Authority (Autonomous Communities)

It is important to notice that the regions (autonomous communities) have the power to regulate all the procedures concerning renewables. So almost any region has different requirements, which complicates the system quite a lot. On the following pages the procedures as applicable to wind projects in the region of Catalonia are described. The procedures for other renewable energy technologies are similar.

The Regional Authorities have to elaborate the national policies in regional plans. The Regional Government decides, based on spatial criteria, on which locations renewable energy development is possible. On the other hand, the Regional Authority can protect areas from renewable energy development. Furthermore the Regional Authorities have the jurisdiction to put conditions on the development of renewable energy.

An example of preconditions for wind energy development in a region plan is shown in Figure 17.14 below. It concerns a regional plan of Catalonia.

Figure 17.14 Preconditions for wind energy development in a regional plan (Example of Catalonia)

Summarising, the regional wind policy in the region plan is:
- *The Autonomous Community organises its space in three wind categories:*
  - *Red areas: no possibility to build any wind development because of environmental restrictions.*
  - *Yellow areas: possibility to build wind projects but with an environmental impact assessment.*
  - *Blank areas: no restrictions to build wind projects.*

An example for relevant regional legislation in the region of Catalonia:

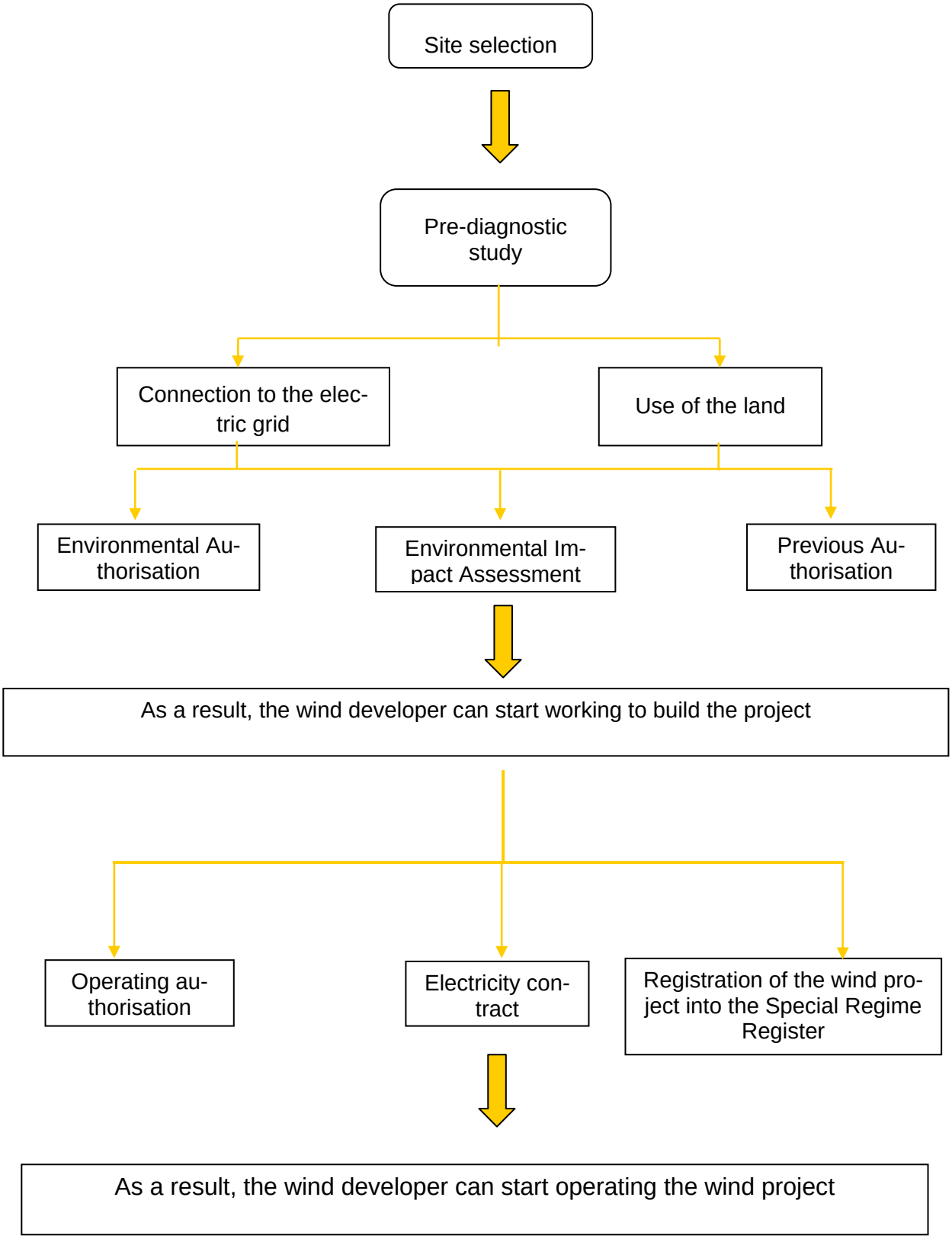
- Decree 143/2003, of June 10th modifying the decree 136/1999 of May 18th, by which it approves the General Rules for the development of the Law 3/1998 of February 27th
- Decree 174/2002, of June 11th, regulating the wind energy implantation in Catalonia

Local Authority (Municipality)

Local Authorities are allowed to provide specific permits to build renewable energy projects. The Local Authority is also the authorised institute to check the initiatives – from the private investors – on the local policy. Initiators always have to deal with the Local Government at first. After all, the building- and environmental permits have to be applied through the Local Authority.

Bottlenecks in wind energy development on local level are the limited capacity of knowledge (in wind energy) and a shortage of personnel. Furthermore, Local Authorities are confronted with pressure from both the initiators and the Regional and National Governments. Sometime opposite interests are involved.

Procedures from the project developer's point of view (example of a wind project)


Site selection
Pre-diagnostic study
Connection to the electric grid
Use of the land
Environmental Authorisation
Environmental Impact Assessment
Previous Authorisation
As a result, the wind developer can start working to build the project
Operating authorisation
Electricity contract
Registration of the wind project into the Special Regime Register
As a result, the wind developer can start operating the wind project

Site selection: In order to identify a windy place there are several tools available:

- Theoretical Maps of wind potential (WASP, Catalonia Wind Atlas)
- In-situ wind measurements

The result is a selection of a future wind project

Pre-diagnostic-study: In order to know if the location selected has any constraint, it is necessary to do a short study to confirm the absence of environmental, judicial and technical constraints:

- Catalonia Map of Environmental Wind Farm Implantation
- Catalonia Data Base of Environmental Wind Vulnerability

The result is the confirmation of the ability to locate the wind project in a concrete location.

Connection to the grid: In order to reach an agreement about the point and the technical conditions to connect the wind project to the grid:

- the wind developer asks for a proposed point of connection
- the electric utility has to answer within a month (accepting the proposal or offering alternatives)
- if there is no mutual agreement, the developer has the right to appeal to the Department of Industry, which has to make a resolution in less than 3 months.

The result is to have access to the grid.

Land use: A visit to the landowners and to the municipality is necessary in order to reach an agreement to use the land for a wind project:

- To rent the use of land.
- To pay a percentage of incomes generated by selling wind electricity to the grid.

The result is to have access to the use of land for locating the wind project.

Environmental Authorisation: Based on the Annex 2.1 of the Law 3/1998, of February 27th, on the Integral Intervention of Environmental Administration, all

wind projects must apply for Environmental License. The project must be submitted to the Municipality affected and to the Unified Management Office of the Department of Industry. The municipality has to send to the Environmental Department all the documentation related to the Environmental License. The General Direction of Energy will submit the project to a Public Inquiry. After the public Inquiry the Environmental Department will submit the project to the Environmental Task Force (a joint commission with Department of Environment and of Industry). This Task Force will provide the Environmental License and, if it the case, the EIA.

Environmental Impact Assessment (EIA): According to the Article 13 of the Decree 174/2002, of June 11th, regulating the wind energy implementation in Catalonia, a wind project must be submitted to EIA: if it is located at less than 2 km distance from an existing wind farm, or if it is located at the ridge of a mountain with a continuous line longer than 3 km, or if it is located at less than 500 m distance from a village. The procedure for EIA is based on the Law 6/2001, of May 8th, on the Environmental Impact Assessment.

Previous authorisation: Based on the Article 28 of the Law 54/1997, of November 27th, on the Electric Sector. The Catalan Department of Industry provides the previous administrative authorisation, only after the Environmental Task Force has emitted a positive resolution. This authorisation is necessary before starting the works.

Operating authorisation: The developer has to submit a permit to the Department of Industry in order to get authorisation to start operation.

Electricity contract: The developer has to negotiate a contract with the electricity company.

Registration of the wind project into the Special Regime Register: The General Direction of Energy will register the wind project according to the Decree 308/1998, of September 2nd. The date of this registration is the date to

apply the benefits of Decree 2818/1998 (premium prices for wind generated electricity).

Opportunities to influence planning policy

At present the competences for planning policy, land use management policy, etc. are shared between central government and regional governments. Many regions have developed regulations about land use for RE projects, forced by the fact that developing RE is a competence of regional governments. But there are no clear rules on how stakeholders can influence policies. The reason is that Spain has a “centralistic policy culture” like France. So the governments at all levels do not have developed clear public participation policies.

Before authorising a RE project (normally only big projects), the governments have to publish it at the Official Gazette and people can submit written comments about the project. The government has to resolve the arguments, answering to parties that have alleged.

17.4 References

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ESTIF: European Solar Thermal Industry Federation

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PVGIS: PVGIS, Joint Research Centre, Institute for Environment and Sustainability, European Communities 2001-2006.