

Wind power development in Spain – a success story between innovative promotion and market demand

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Outline:

- **geographical wind conditions & starting position in the energy market**
- **division of the different phases of wind development in Spain between 1979 – 2006 (main criteria of distinction: annually installed capacity & major changes in the promotion system)**
- **chronological analysis of the different wind development periods according to the main driving forces, regulative impulses & the technological development**
- **summary of the main findings of wind power development in Spain**
- **main differences to the wind power development in Germany, Denmark and the UK**

Geographical wind conditions:

- third best wind conditions in the EU after Ireland and France (80% of territory with wind speeds > 7 m/s)
- technical available potential in 2050: 915 GW onshore + 165 GW offshore
- possible electricity generation: 2,215 TWh onshore (> 8 x of gross electricity demand of Spain in 2050) & 334 TWh offshore (1,2 x of gross electricity demand of Spain in 2050) → data from Greenpeace 2005 (already excluding protected areas = 28% of the Spanish territory)

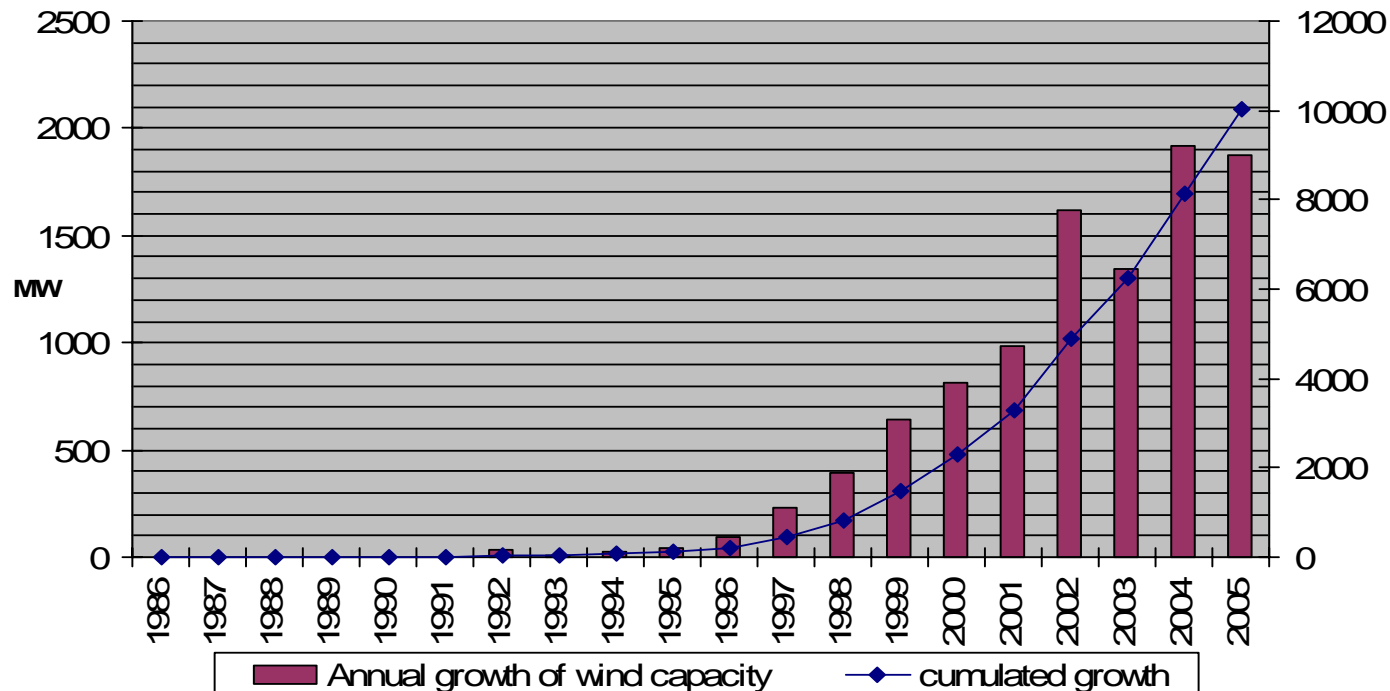
starting position in the energy market 1:

- Growth of primary energy consumption of EU-25 between 1995-2005: 9.5% (0.86% annually)
- Growth of primary energy consumption of Spain between 1995-2005: 46.7% (4.24% annually)

- Growth of final electricity consumption of EU-15 between 1990-2004: 44% (2.93% annually)
- Growth of final electricity consumption of Spain between 1990-2004: 80.7% (5.38% annually)

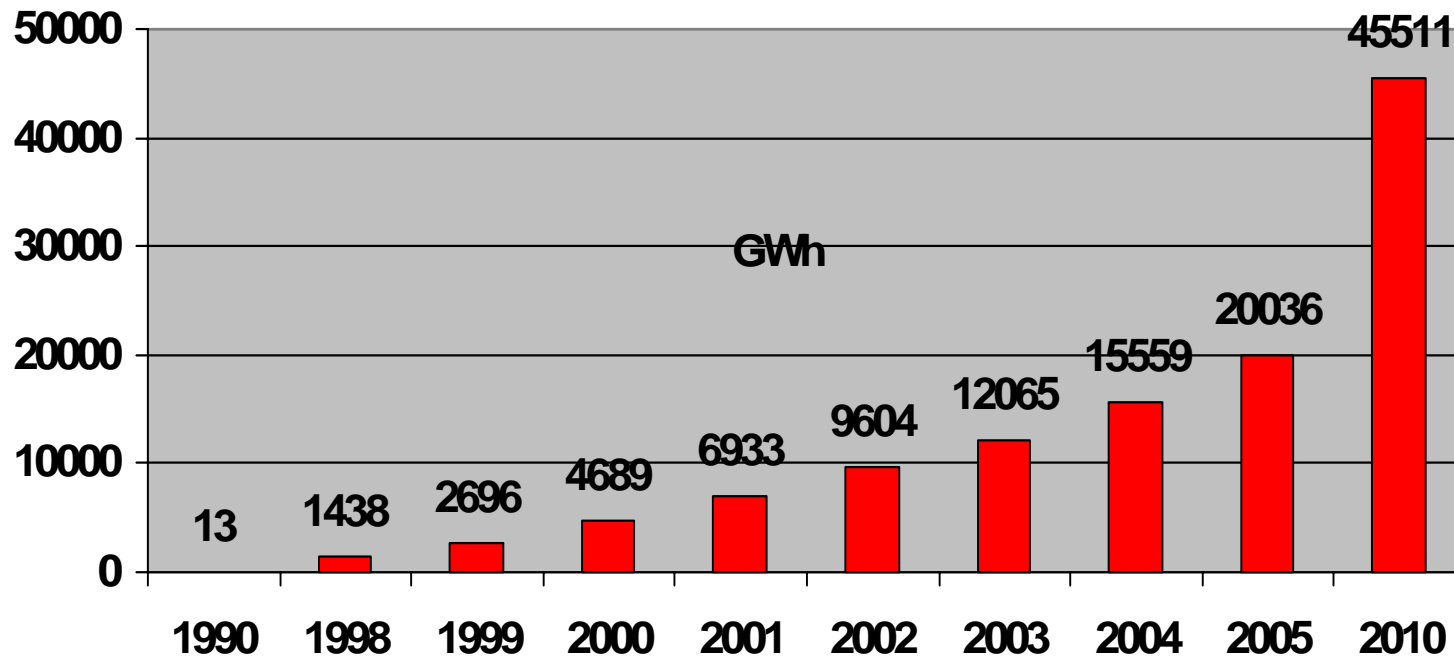
starting position in the energy market 2:

Annual and cumulated growth of the installed wind capacity in Spain 1986 - 2005



starting position in the energy market 2:

Wind power production 1990, 1998 – 2005 & target for 2010 (AEE 2006: 54; IDAE 2005: 134 et sq.)



2005: 7.78% of gross electricity consumption

division of the different phases of wind power development in Spain:

- ➔ Division in 3 phases & 2 sub-phases (main criteria of distinction: annually installed capacity & major changes in the promotion system or other trend reversals)
- **phase 1: 1979-1994 ➔ R&D&D and initial market development**
 - a) 1979 – 1991: Research & Development & Demonstration
 - b) 1991 -1994: initial market development
- **phase 2: 1994/5 – 2004 ➔ accelerated market introduction & wind boom**
 - a) 1994/5 – 1998: accelerated market introduction
 - b) 1999 – 2004: boom of the wind market
- **phase 3: since 3/2004: increasing integration of wind power into the market**

Phase 1 (1979-1994): R&D&D and initial market development -1-

- **main regulative/steering impulses:** Law 82/1980 (Energy Conservation Act) → right for grid access, investment subsidies up to 30% of investment costs & a first remuneration for wind power (surplus power) to be fixed by ministerial orders on a yearly basis
- **main (driving) actors:** state agents, like MINER (promotion schemes), IDAE or CIEMAT (R&D&D and project financing), together with the then public utility Endesa + first private actors as Ecotècnia and Abengoa (in the development of the first Spanish WPPs) + APPA (mainly by its lobbying during the formulation of a new promotion system for RES power in 1994 in the transition to the 2nd wind development phase)
- **technological development:** interplay of public R&D&D projects in cooperation with Endesa, Ecotècnia and Abengoa + relatively early international cooperation (Spain-Germany) and technology transfers (Abengoa – US Wind Power) → WPP development mainly orientated by Danish technology (asynchronous generators, constant rotor speed, fixed blades) with a continual growth of turbine sizes (from 10 – 100 kW during 1980s up to 300 kW in 1994)

Phase 2 (1994/95-2004): accelerated market introduction & wind boom -1-

- ***main regulative/steering impulses:***

- Energy Act 40/1994, establishing a special (promotion) regime for RES-E producers, regulated by the RD 2366/1994, including a 5 year minimum length of purchase contracts;
- RD 2366/1994: fixed and technology differentiated REFITs (wind: 6.5 – 6.9 €/kWh between 1995-1998), transmission of approval competencies for RES-E plants < 25 MW to the regional governments;
- special regional regulation of permit procedures for WPPs (since 1995) laying down general rules for the approval of WPPs + established the steering instrument of “strategic wind plans” (explaining the technological and industrial purpose of the respective wind park)
- Electricity Law 54/1997: establishment of a new remuneration option based on a mix of the market price & a green bonus, a RES target for 2010 (12% share on primary energy consumption until 2010), a minimum/maximum margin of the remuneration levels for RES-E (80-90% of the AET) + a new capacity limit for RES-E installations to be supported publicly (< 50 MW) + the announcement of a long term RES promotion plan;

Phase 2 (1994/95-2004): accelerated market introduction & wind boom -2-

- RD 2818/1998: option of choice for RES-E producers between REFITS or mix of market price & green bonuses) with the possibility to switch once per year & coupling of purchase guarantee with the fulfilment of the 12%-target for 2010

- RES promotion plan PFER 2000-2010: technology targets (wind: 8,974 MW) & investment subsidies or soft loans

- EU-RES-E-Directive 2001/77/CE (setting indicative RES-E targets – Spain: 29.4%)

- Gas & Electricity Infrastructure Plan (until 2011) with a new wind target of 13,000 MW until 2011

• **main (driving) actors:** MINER (RES-E promotion schemes) + IDAE, big utilities (Iberdrola, Endesa, Unión Fenosa, HC), national WPP producer (Gamesa, MADE, Ecotècnia), independent wind power producers, regional governments/development institutions (i.e. SODENA in Navarra) banks (Central-Hispano, etc.), AEE (since 2003)

• **technological development:** steady growth of turbine sizes (1995: 500-600 kW, 2004: 1,5 MW or bigger), growing share of innovative domestic elements of WPPs (i.e. Ingecon since late 1990s,, productions sites in many Spanish regions

phase 3: since 3/2004: increasing integration of wind power into the market -2-

- **main regulative/steering impulses:**

- new RES-E promotion approach via RD 436/2004 (concrete percentage coupling of the payment levels with the AET + establishment of a additional market incentive; guaranteed purchase of the whole power output during the whole plant's live; technology differentiated degressive remuneration; binding production forecast (from 2006 onwards) and penalties if deviating this forecast higher than an allowed margin, from 2006 on periodical progress reports every 4 years; 5% AET extra remuneration (for 4 years) for WPPs equipped with necessary technology for surpassing voltage dips; bonus or malus for reactive power (- 4% - +8% of AET)
- New RES promotion plan 2005-2010 (with a new indicative wind target of 20,155 MW until 2010)

phase 3: since 3/2004: increasing integration of wind power into the market -3-

- RD 1454/2005: new calculation modus for payment of deviations of WPPs in the wholesale market (payment of real costs instead of sum of the daily deviations x 10% AET → much higher now (up to ~0.6 €/ct/kWh at the end of 2005) → increased importance of most exact production forecasts
 - RD-Law 3/2006: price cap of 4.235 €/ct/kWh in the pool market (in contrast to average wholesale market price in 2005 of 5.573 €/ct/kWh) → loosing of attractiveness for wind power producer to participate in the market
 - RD-Law 7/2006: announcement of a new price calculation for RES-E producer → decoupling of tariffs/bonuses from the 80-90% margin of the AET → end of investment/planning security?!
 - **main (driving) actors:** MITYC, IDAE, big utilities, national & foreign WPP producer, independent wind power producer, APPA, AEE, regional governments/development institutions
 - **technological development:** further growth in turbine sizes, new domestic innovations regarding production forecasts and technologies to surpass voltage dips (cooperation between national TSO (REE) and AEE with regard to a new grid code)
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main findings of wind power development in Spain

- In all 3 phases of wind power development in Spain, legislator as the main driving force of wind power promotion by setting attractive and increasingly stable and long-term promotion measures for wind power producers (from tariffs on a yearly basis for surplus electricity to life-long remunerations coupled with the AET)
- Wind power promotion a priority for all Spanish governments – independent of the political party – with the political will to built up a domestic wind industry at the latest since mid 1990s
- Spanish regions also very active in wind power promotion, mainly by setting the permit procedures for wind parks since the mid 1990s → first mover advantages
- from the very beginning cooperation took place between government and private actors (mainly Endesa/Made, Ecotècnia, Abengoa in the 1980s, followed by EHN and Gamesa, Iberdrola, etc. since the mid 1990s) to create a domestic wind industry
- relatively early co-operations (AWEC-60), technology transfers (Abengoa – US Wind Power or Gamesa Eólica – Vestas) or joint ventures (Gamesa Eólica – Vestas, Izar – Bonus => Navantia – Siemens) with foreign partners

main findings of wind power development in Spain

- External drivers also influenced the Spanish wind power development (oil price crisis in the 1970s, EU White Book on RES 1997, EU-Directive 2001/77/CE, EU ETS, Spanish commitments to reduce GHG emissions)
- steady technological development mainly orientated on Danish WP technology with adaptation to the domestic market conditions and steady growing turbine sizes
- changing contexts of motivation/justification for wind power promotion over time: from diversification needs and the reduction of energy import dependency to wind support because of climate change => since a couple of years main motivation again the diversification of the energy mix / reduction of energy import dependency / increase of supply security + job creation
- growing market integration of wind power since 2004 => only the big players will survive?
- growing insecurities during last months: between the need of grid upgrades and technical necessities to adapt WPPs for a better market integration and legislative interventions which jeopardize the future growth of wind power

main differences to the wind power development in Germany, Denmark and the UK

- Broad and still growing engagement of all big utilities in the Spanish wind market (mainly Iberdrola, increasingly Endesa)
- bigger installed capacity per wind park/feeding point
- weak grid infrastructure & only few interconnections with the UCTE grid
- hardly any wind park financed by citizens, but mainly by big (utilities) or medium-sized (independent developers) players
- fast growing energy/electricity demand of Spain => facilitated the market entry of new players (like independent wind power producers) in the electricity market

Thank you very much for your attention!