Iberian Electricity Market

Difficulties, Advantages and Challenges

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Iberian Electricity Market

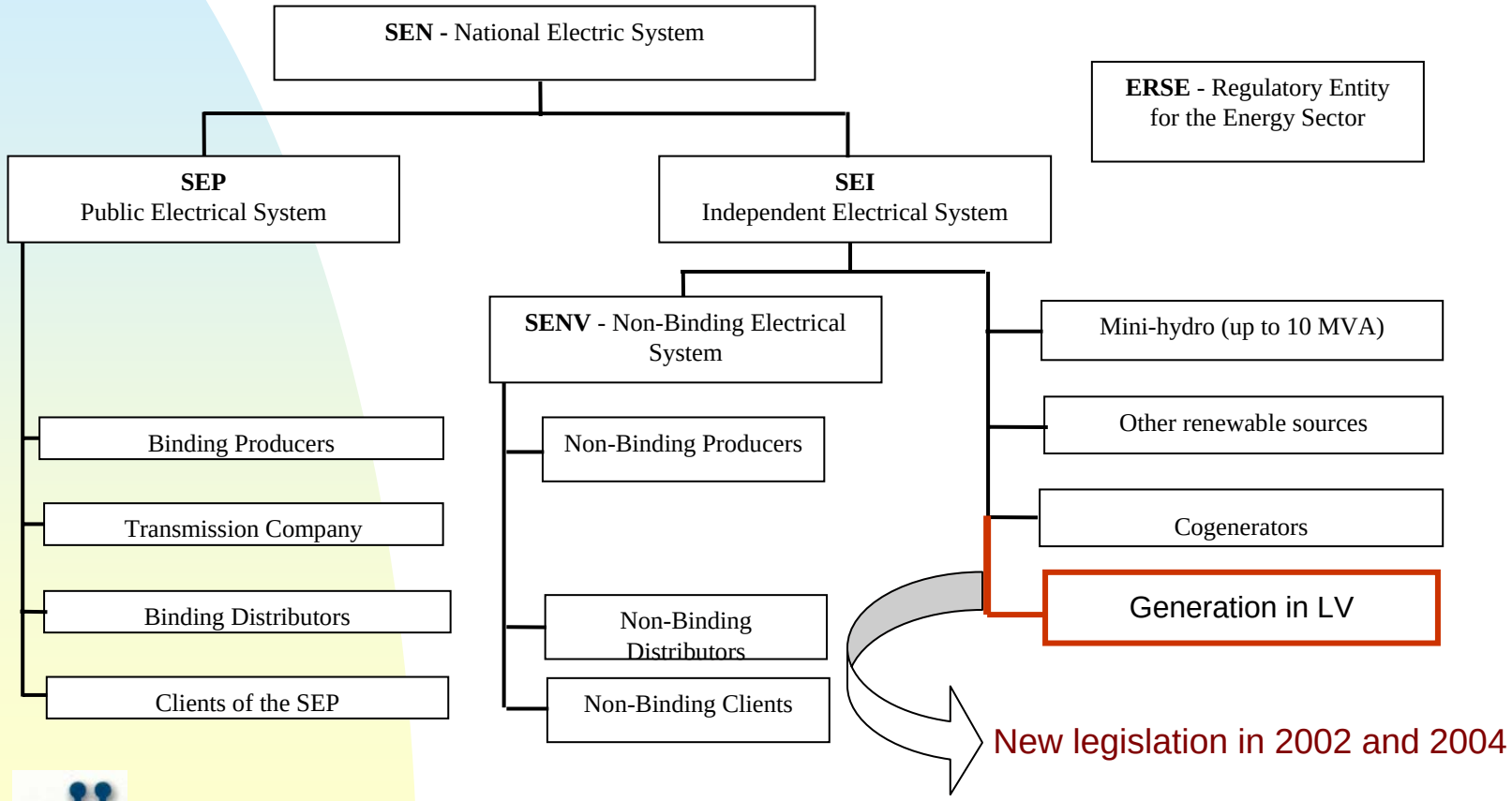
- Topics
  - The electricity industry in Portugal
  - The electricity industry in Spain
  - The MIBEL – Iberian Electricity Market
  - Advantages, difficulties and challenges

The Portuguese Electricity Sector

- Organization
  - Till 1995, there was a vertically integrated company;
  - Renewables and cogeneration were liberalized in 1988;
  - In 1994/5, it was passed new legislation:
    - EDP child companies:
      - 4 distribution companies;
      - a transmission provider;
      - a large thermal and hydro company;
    - Creation of ERSE - Regulatory Agency;
    - New Regulations;
    - Market driven sector and regulated sector;
  - EDP holding started to be privatized.
    - Since 2000, the majority of the shares are private;
  - In July 2000, transmission was separated from EDP;
    - **30% of the shares will be privatized today.**

The Portuguese Electricity Sector

- Organization - Law of 1995



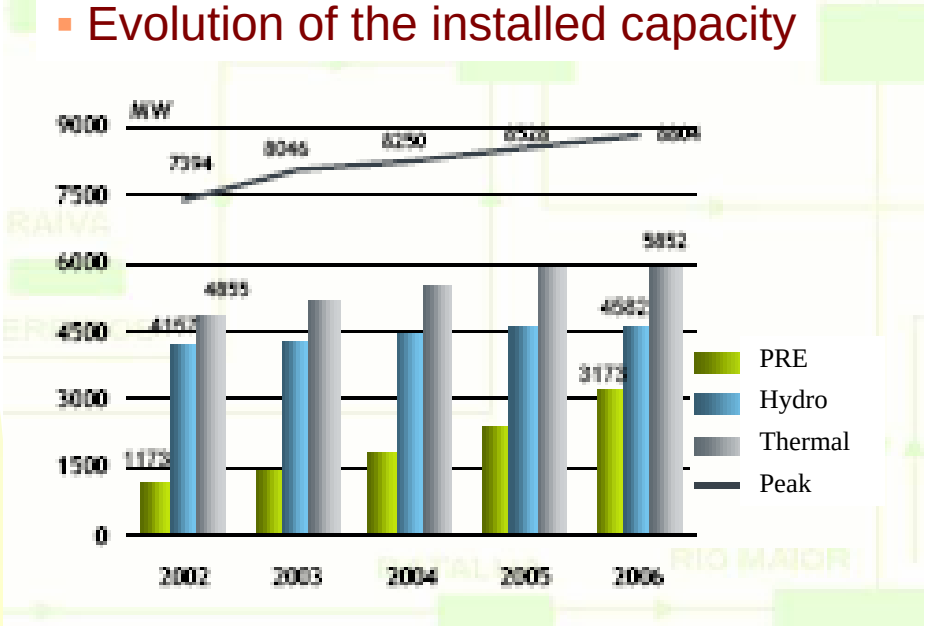
The Portuguese Electricity Sector

- February 2006 – New electricity law:
  - Generation – competition;
    - Normal regime – organized markets or bilateral contracts;
    - Special regime – renewables and cogeneration;
  - Transmission and distribution – regulated public service concessions;
  - Retailing – competition + regulated retailer;
    - Separation between network and retailing activities;
    - Right to choose the retailer;
    - Change of supplier:
      - clients have the right to change of supplier free of charge for 4 times during each period of 12 consecutive months;
      - change takes in average 10 days.

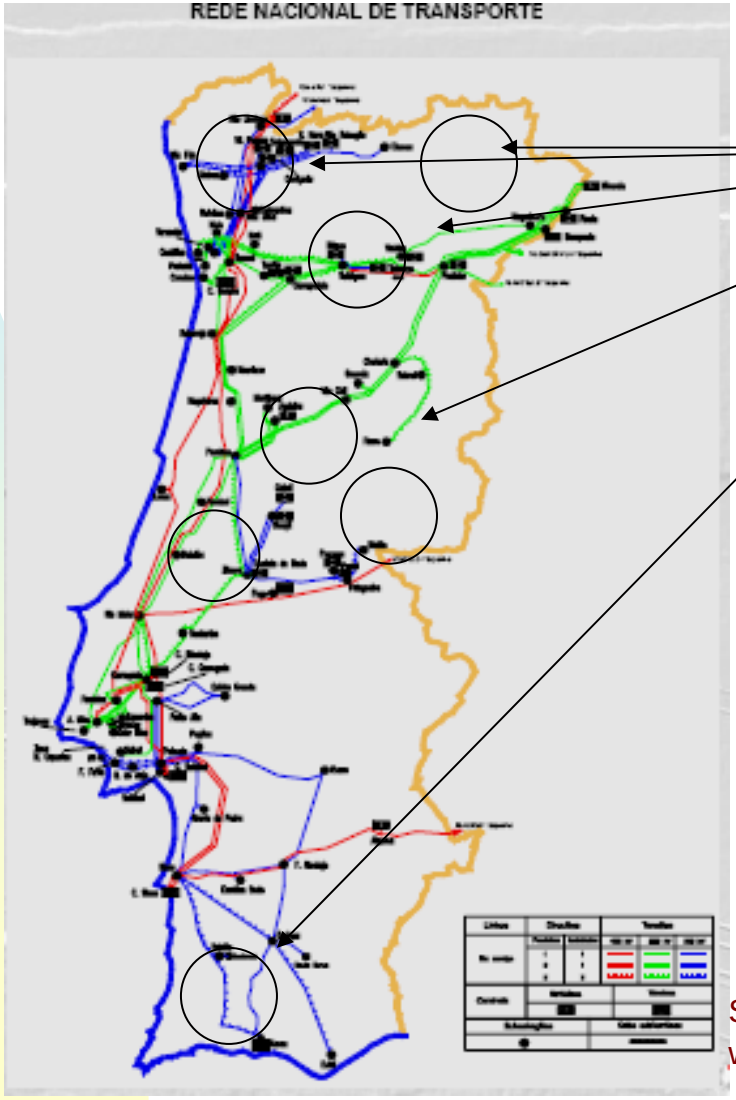
The Portuguese Electricity Sector

- The industry in Dec. 2006:
  - Installed capacity – 13.607 MW;
  - Total hydros – 4.947 MW (36,4 %);
  - Dispersed generation – 3.173 MW (about 24,0 %);
- The current value of wind power is 1800 MW (about 14,0%);
  - +90% regarding Dec. 2005.

- Evolution of the installed capacity



The Portuguese Electricity Sector



Location of wind parks

Generators from 20 kW to 2,0 MW

Demand:

- 2002 – 40664 GW.h;
- 2003 – 43061 GW.h (+5,9%);
- 2004 – 45511 GW.h (+5,7%);
- 2005 – 47971 GW.h (+5,4%);
- 2006 – 49188 GW.h (+2,5%)

Source: Rede Eléctrica Nacional web site www.ren.pt

The Portuguese Electricity Sector

- **Eligibility level**
  - Till September 2006:
    - all EHV, HV, MV and LV with contracted power higher than 41,4 kW;
    - about 52.000 consumers / 55% of the demand;
  - From September 2006 – full eligibility.

- **Market supplied clients**

	Dec 2001	Dec 2002	Dec 2003	Dec 2004	Dec 2005	Dec 2006	May 2007
no. of clients	33	494	1927	4865	13226	26194	57445
demand (GW.h)	714	2055	5660	8376	10420	6500	2900 till May
% of total demand	1,78	5,05	13,14	18,40	21,70	11,00	13,70

  - 90% corresponds to MV and LV (>41.5kW of contracted power);
  - 65% of the free market is supplied by EDP Comercial, 30% by ENDESA and 5% by Iberdrola;
  - In May 2007, 11499 clients moved to the free market and 237 returned to the regulated system.

The Portuguese Electricity Sector

- Tariffs
  - ERSE – Regulatory Agency for Energy Services is responsible for tariff setting in an independent way from the government;
  - A new Tariff Regulation was passed in 1998:
    - Access tariffs:
      - Tariff for the Global Use of the System - TGUS;
      - Tariff for Use of the Transmission Networks - TUTN;
      - Tariffs for the Use of Distribution Networks - TUDN;
      - Network Retailing - NR;
    - Integral regulated tariffs:
      - Access plus Energy, E, and Regulated Retailing, RR, tariffs;
    - Tariffs are set according to a Postage Stamp Basis;
    - Tariffs are paid by consumers;
  - TGUS:
    - It includes a price per kW.h;
    - Feed-in tariffs – subsidies to Special Regime Generation;
    - Control Centre and ancillary service costs;
    - Regulation and market operator costs.

The Portuguese Electricity Sector

- Transmission activity
  - TUTN:
    - It is set on a Cost of Service/Remuneration Rate, CoS/RoR, basis;
      - The current rate is 7% (9% till 2005)
    - It includes:
      - High Voltage and Extra High Voltage Terms;
      - prices for power (€/kW.month) and for reactive energy received or supplied;
  - Expansion planning:
    - The transmission provider submits 5-year expansion plans to the Regulatory Agency;
    - These plans are prepared in order to meet security indices agreed with the Regulatory Agency;
    - If the plan is accepted, the investment costs are included in the TUTN;

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - The revenue of the distribution company (wiring) is set according to an RPI-X incentive approach;

$$R_t^D = \sum_{j=1}^{2}\left(F_{j,t}^D + P_{j,t}^D . E_{j,t}^D - \Delta_{j,t-2}^D\right)$$

j=1 – HV and MV
j=2 – LV

Fixed component of the revenues in year t. Evolution by RPI-X.

Per unit variable component of the revenues in year t. Evolution by RPI-X.

Supplied energy per voltage level j in year t

Correction to include in year t, regarding the revenues in year t-2

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - Evolution along each regulatory period (3 years):

$$F_{j,t}^{D} = \begin{cases} F_{j,t}^{D} & t = 1 \\ F_{j,t}^{D} \cdot \left(1 + \dfrac{IPC_{t-1} - X_{F,j}^{D}}{100} \right) & t = 2,3 \end{cases}$$

$$P_{j,t}^{D} = \begin{cases} P_{j,t}^{D} & t = 1 \\ P_{j,t}^{D} \cdot \left(1 + \dfrac{IPC_{t-1} - X_{P,j}^{D}}{100} \right) & t = 2,3 \end{cases}$$

- Values for P (2002-2004):
  0,0102 €/kWh in HV and MV;
  0,0252 €/kW.h in LV;
- Values for X (2002-2004):
  7,5% in HV and MV;
  6,6% in LV;

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - Evolution along each regulatory period (3 years):

	2002/2004	2006/2008	2007
F(HV&MV) t=1	0.0	136.409.000€	139.410.000€
X(HV&MV) t=2	0.0	0.5 %	---
X (HV&MV) t=3	0.0	0.8 %	---
F(LV) t=1	0.0	266.223.000 €	272.080.000€
X(LV) t=2	0.0	0.5 %	---
X (LV) t=3	0.0	0.2 %	---
P(HV&MV) t=1	0.010232 €/kW.h	0.005600 €/kW.h	0.005499 €/kW.h
X(HV&MV) t=2	7.5%	4.5 %	---
X (HV&MV) t=3	7.5%	4.9 %	---
P(LV) t=1	0.025287 €/kW.h	0.013605 €/kW.h	0,013441 €/kW.h
X(LV) t=2	6.6 %	3.9 %	---
X (LV) t=3	6.6 %	4.2 %	---

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - Adjustment term:

Interest rate indexed to Euribor

$$\Delta^{D}_{j,t-2} = \left(\ldots - PP_{j,t-2} - RQS_{t-2} - Amb^{D}_{j,t-2}\right)\left(1 + \frac{i^{D}_{t-1}}{100}\right)$$

    - Incentive to reduce losses:

Variations limited to 1%

$$PP_{j,t-2} = V_{p,t-2} \cdot \frac{P^{*}_{j,t-2} - P_{j,t-2}}{100} . E^{D}_{j,t-2}$$

Value of Losses in year t-2 in Euro/kWh

Level of reference of losses in %. Set in 8,6% for 2002-2004.

Level of losses in year t-2 on the voltage level j, in %.

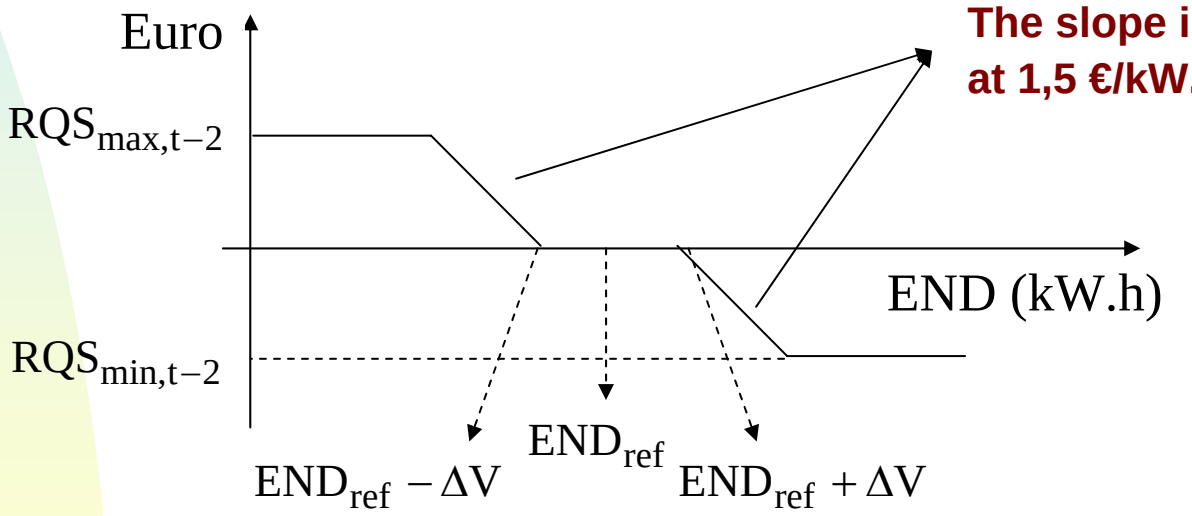
Supplied energy at voltage level j, in year t-2.

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - Incentive to Quality of Service improvement in MV networks

Maximum value of the prize to give in year t-2.

Maximum value of the penalty to impose in year t-2.



The slope is fixed at 1,5 €/kW.h

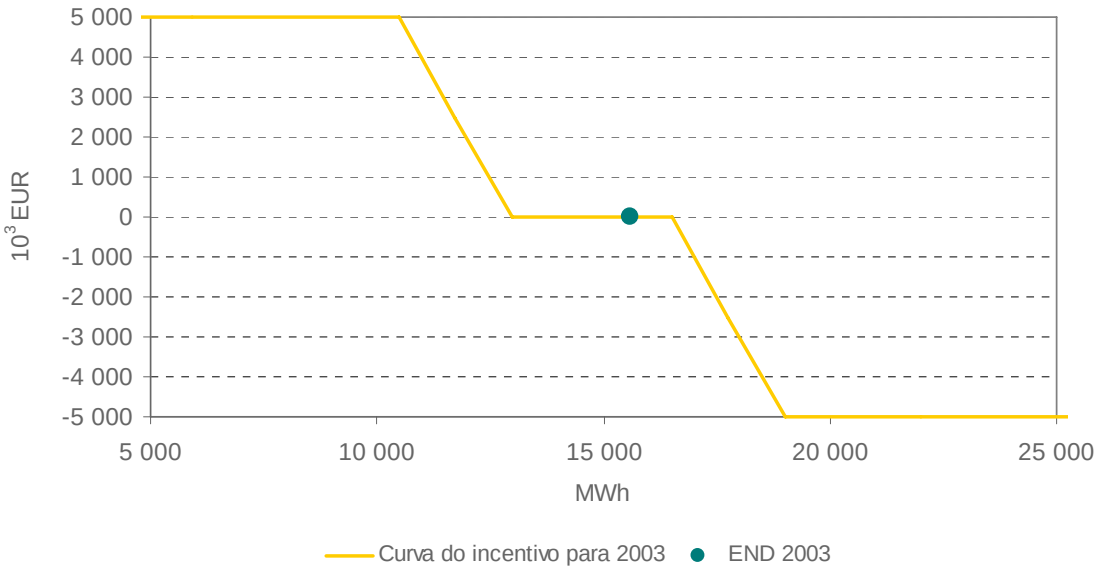
$$END = ED \cdot \frac{TIEPI}{T}$$ → Equivalent Interruption Time of the Installed Capacity

The Electricity Industry in Portugal

- Distribution Activity
  - TUDN:
    - Values used till 2005:
      - Value of the slope – 1,5 €/kW.h;
      - END ref – 0,0004.ED in MV networks;
      - ΔV - 0,000048.ED in MV networks;
      - RQS max and min – 5.000.000 €;
    - As a result:
      - In 2003, the mechanism was neutral;
      - In 2004, the Distribution Company received a prize of 5.000.000 € to be included in the tariffs in 2006;
  - TUDN includes:
    - Prices for HV, MV and LV networks;
      - prices for contracted and peak power (€/kW.month);
      - prices for reactive energy received or supplied;

The Electricity Industry in Portugal

- Distribution Activity
  - Application of the incentive to improve Quality of Service in 2003 to be included in the tariffs for 2005 (process to be conducted by the end of 2004).



Source: ERSE web site, Portuguese Energy Regulatory Agency
www.ERSE.pt

The Electricity Industry in Portugal

Distribution Activity

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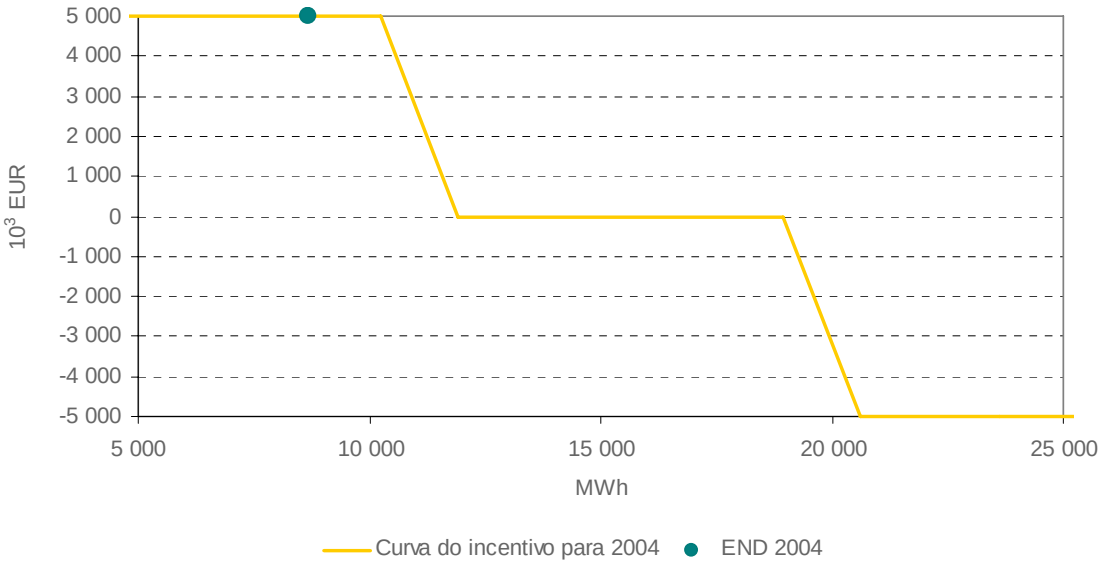
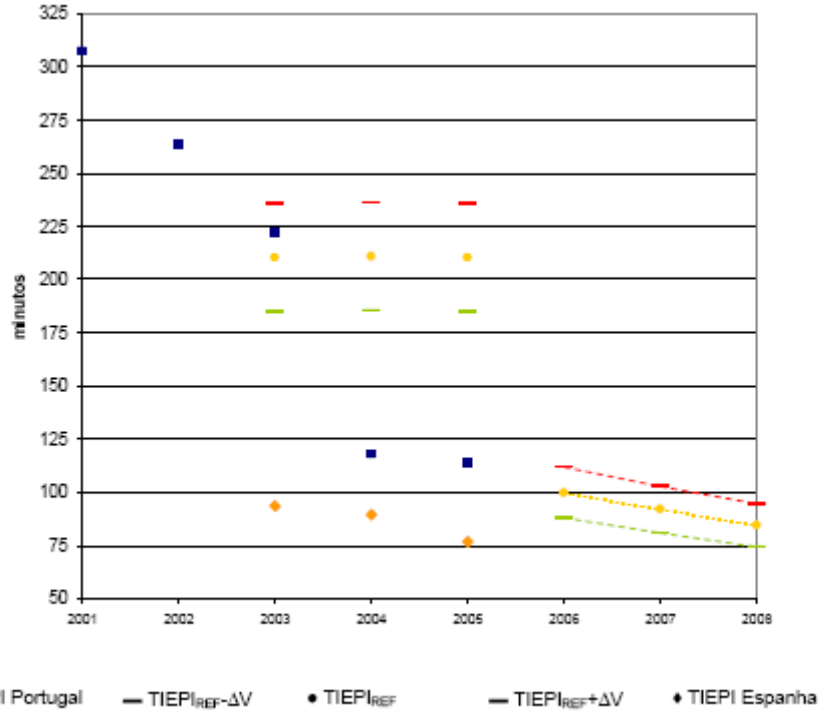


Source: ERSE web site, Portuguese Energy Regulatory Agency
www.ERSE.pt

The Electricity Industry in Portugal

- Distribution activity
  - TIEPI values in Portugal and in Spain:

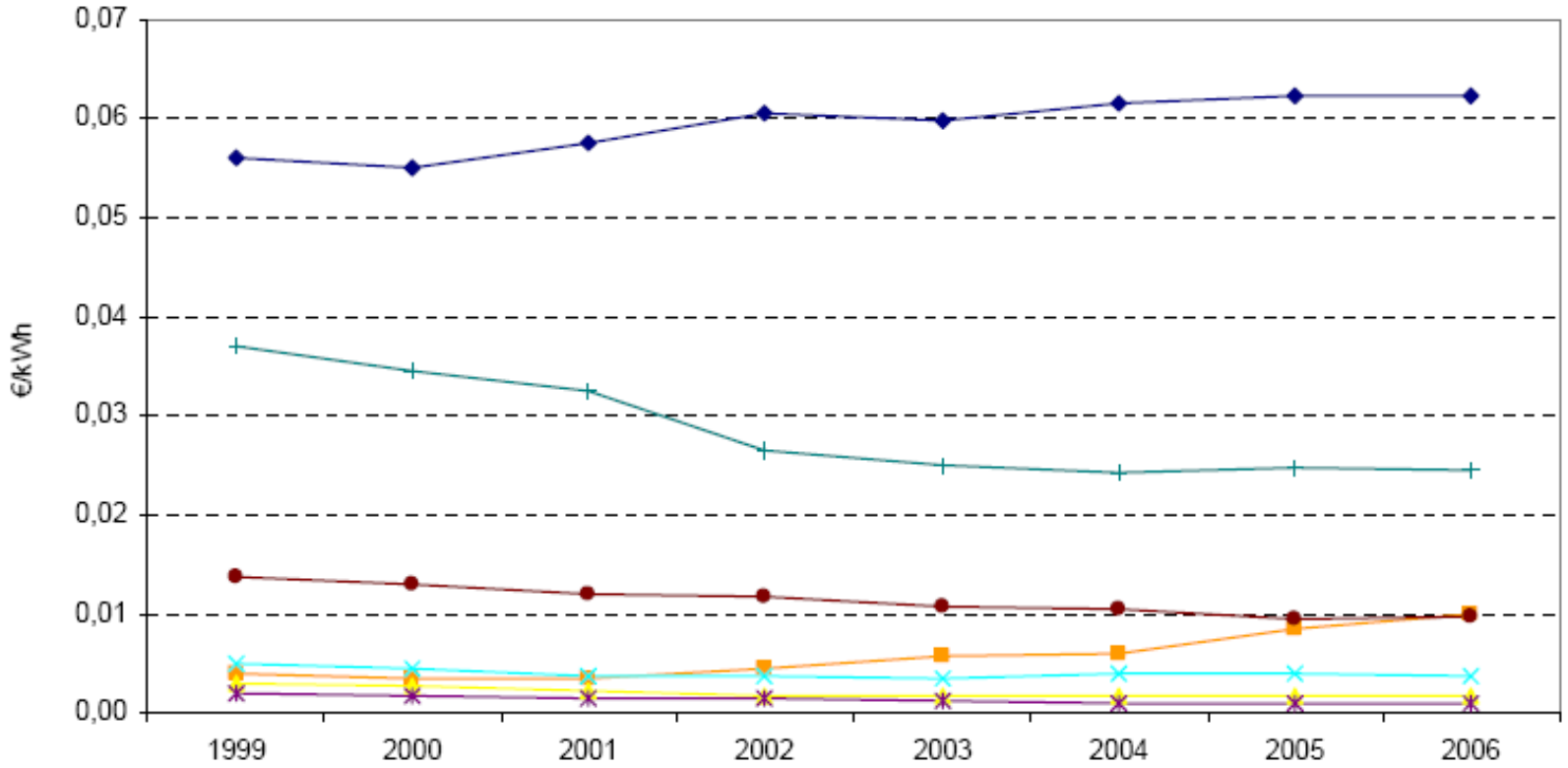


Fonte: EDP Distribuição, http://www.mityc.es/es-ES/Index.htm

  - Reduction of END at the averge rate of 8% a year;
  - Get in 2008 the TIEPI value that Spain had in 2005.

The electricity industry in Portugal

Structure of the final average price (constant prices of 2005)



Ascending order in 1999:
TUD(HV), TUT(EHV), GUS, TUT(HV), TUD(MV), TUD(LV), Energy and Power

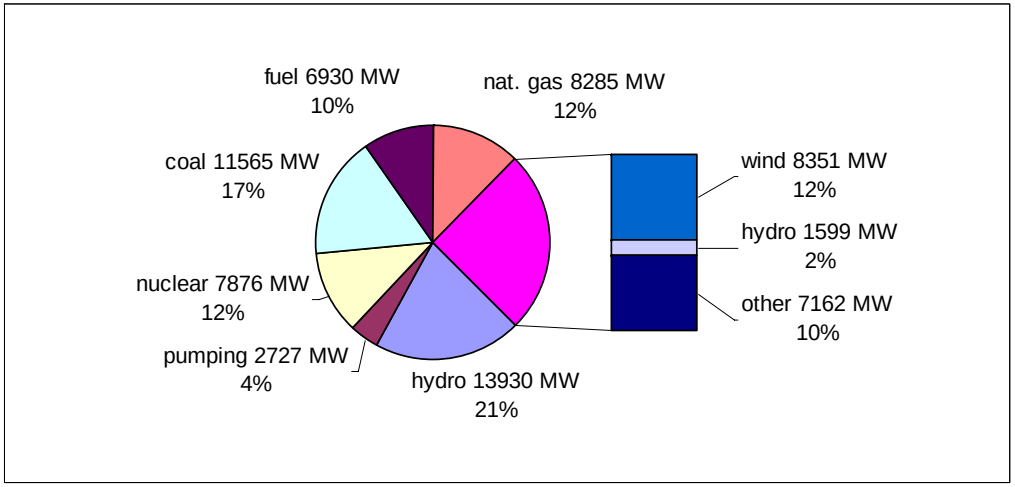
Source: Tariffs and Electricity Prices to 2006, ERSE

The Electricity Industry in Spain

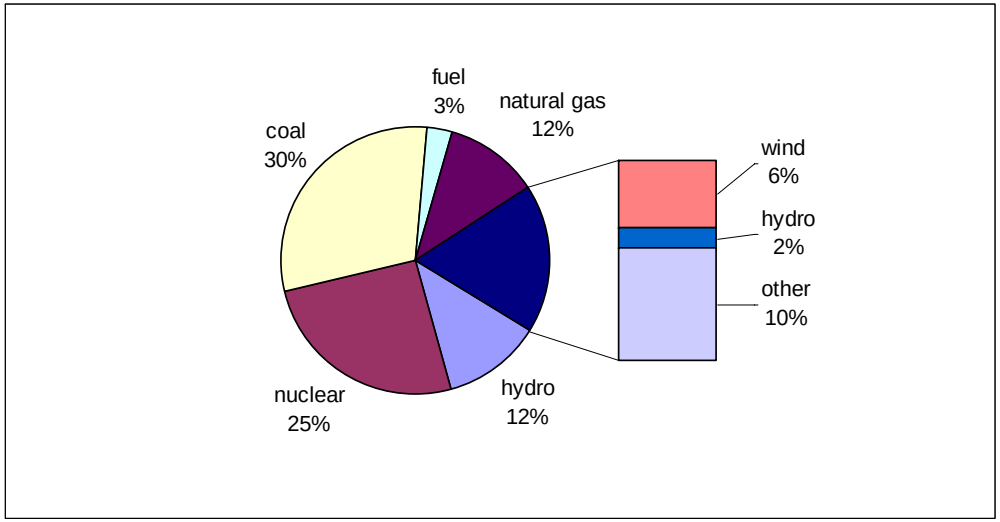
- Till 1995 – monopoly system, with several companies in franchised areas;
- In 1995 – new law – LOSEN;
  - Creation of CNE;
  - Public and market driven systems;
- *Ley 54/97, de 27 Nov, del Sector Eléctrico* - liberalization;
  - Day ahead market, intraday markets and bilateral contracts;
  - Markets for some ancillary services;
  - Eligibility:
    - since 2004 – all consumers including LV.

The Electricity Industry in Spain

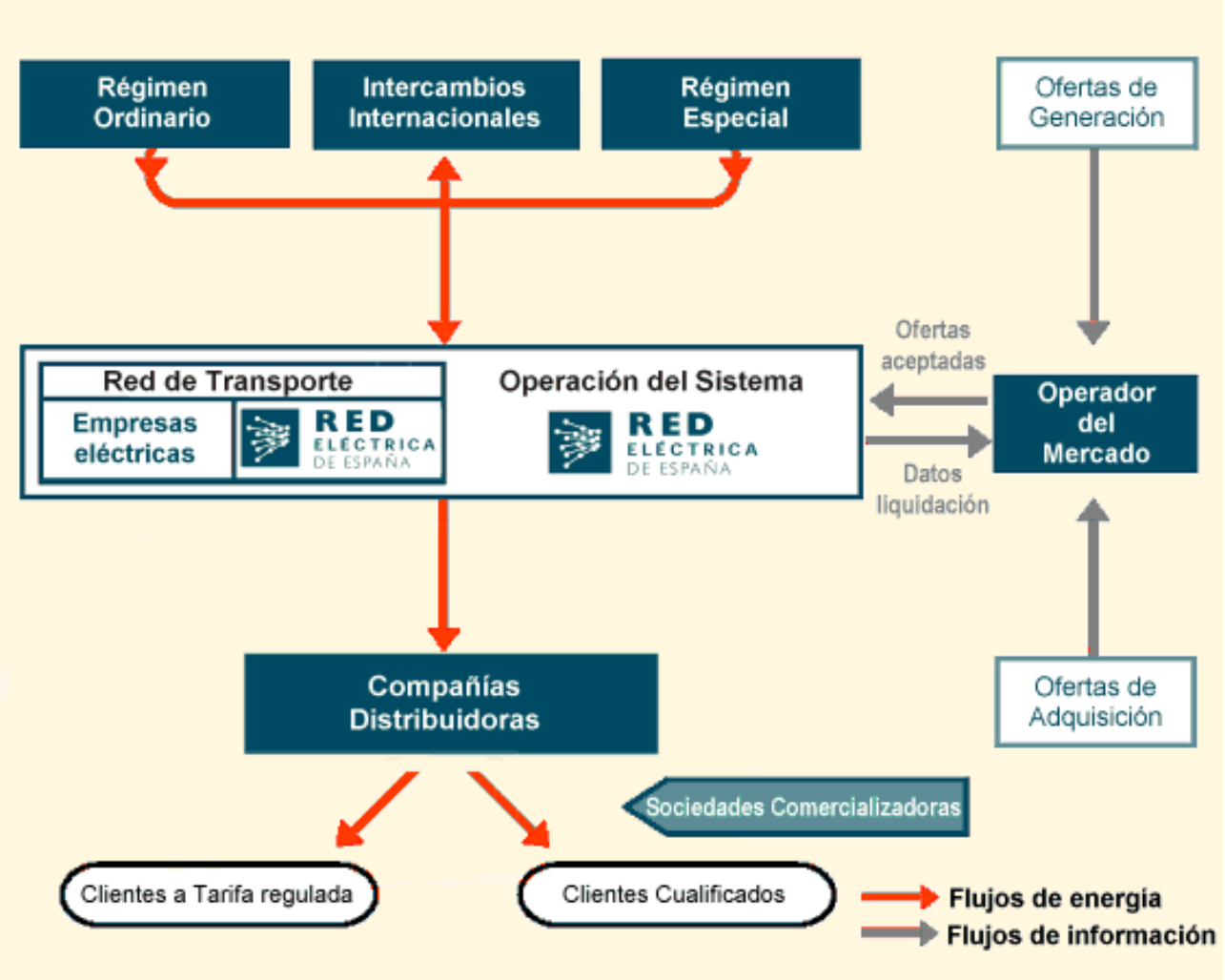
Installed capacity
68.425 MW in Dec. 2004



Generation mix
251.741 GW.h in 2004

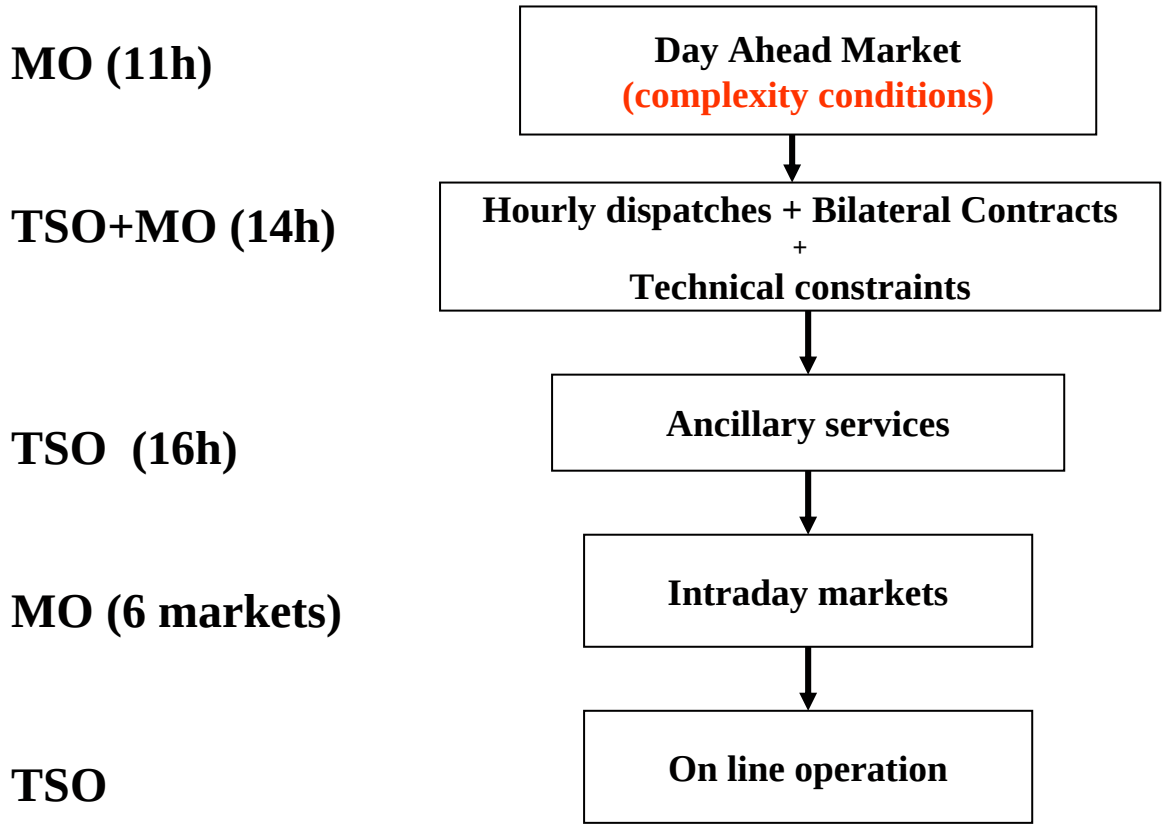


The Electricity Industry in Spain



Source: Red Eléctrica de Espana web site
www.ree.es

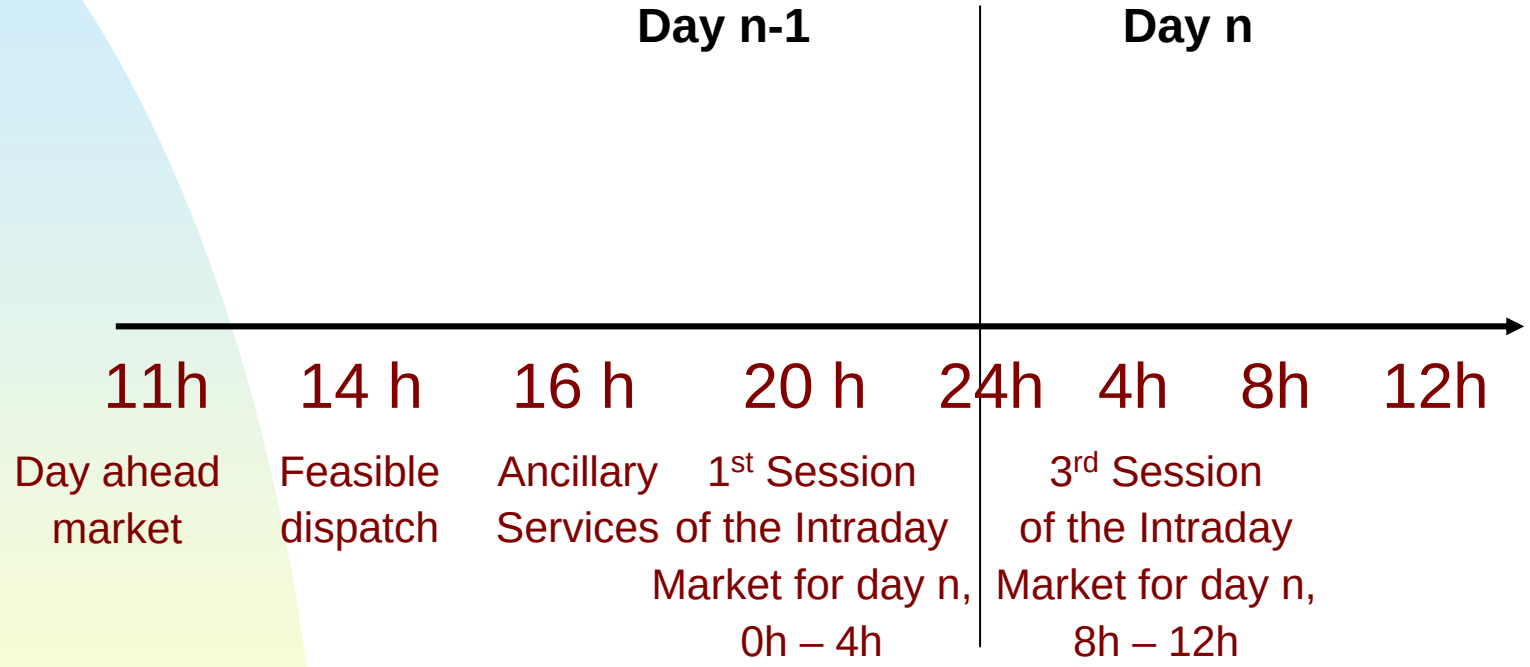
The Electricity Industry in Spain



- Average daily dispatched energy – 550.000 MW.h;
- Average price in the daily market – 4 c€ to 7 c€, spikes in December 2001.

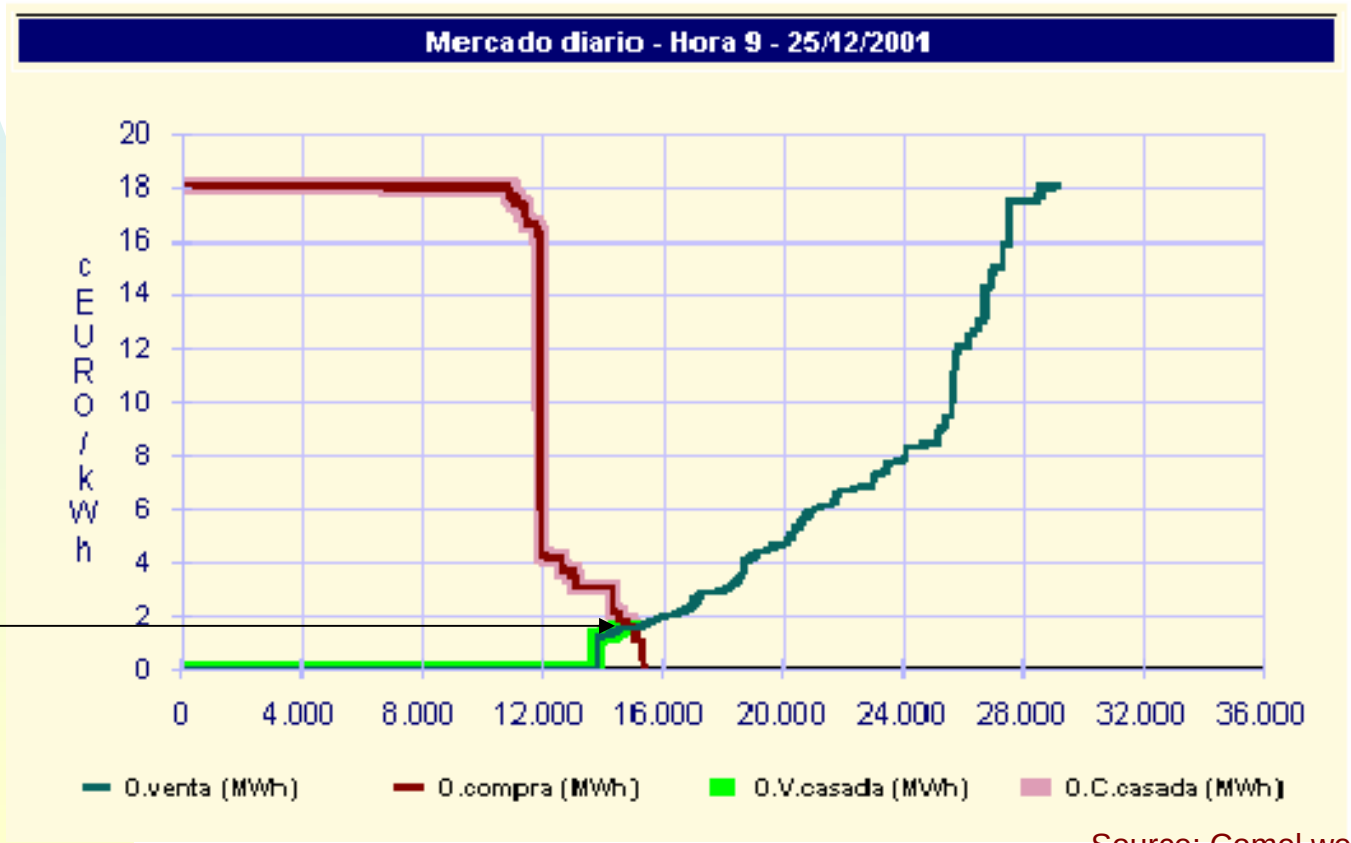
The Electricity Industry in Spain

- Sequence of activities in days n-1 and n



The Electricity Industry in Spain

- Aggregated demand and supply curves on the day/hour of minimum price



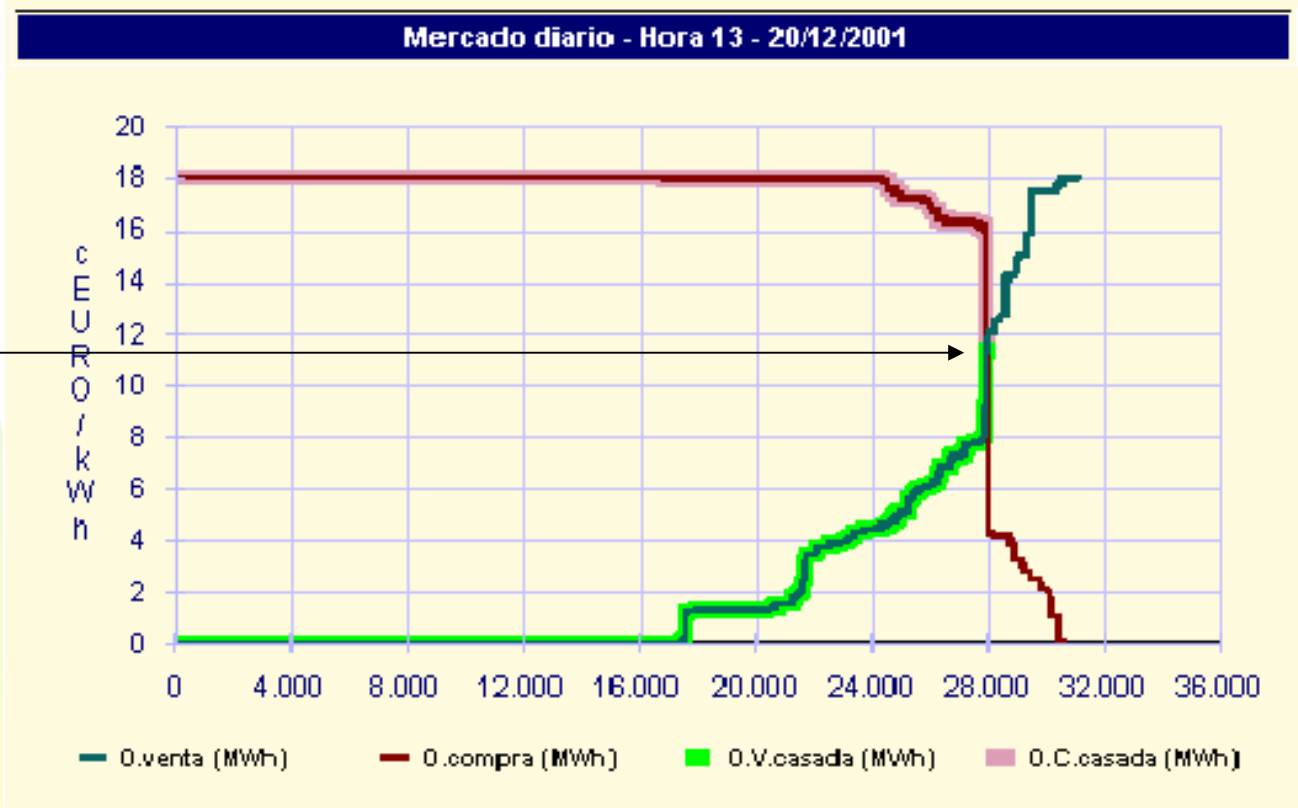
1,528 c€/kW.h

Source: Comel web site www.comel.es

The Electricity Industry in Spain

- Aggregated demand and supply curves on the day/hour of maximum price

11,325 c€/kW.h



Source: Comel web site
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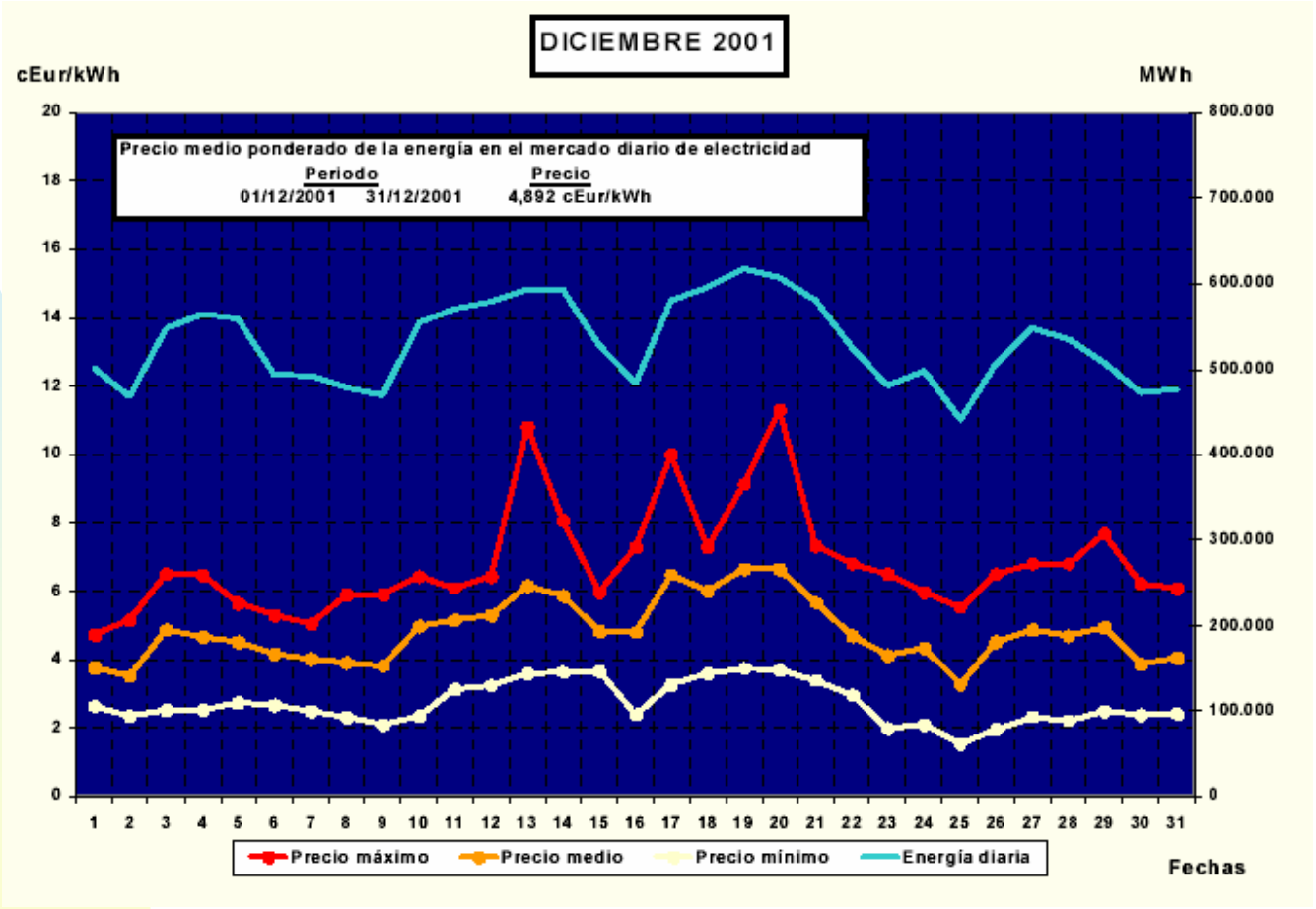
The Electricity Industry in Spain



- The average weighted price was 30% higher than in the previous month;
- Since 1998, the average price of 6c€/kW.h was only over passed once. This month it was over passed 6 times (days 13, 14, 17, 18, 19, 20)

Source: Comel web site
www.comel.es

The MIBEL – Iberian Electricity Market

- 14th November 2001 – memorandum between the Portuguese and Spanish administrations to create a common Iberian Electricity Market starting at January 2003;
- Negotiations between:
  - TSO – REN SA and REE SA;
  - Regulatory Agencies - ERSE and CNE;
  - Governmental agencies – General Directorates for Energy;

The MIBEL – Iberian Electricity Market

- General aspects:
  - Liberalization and equal access conditions to all agents and negotiation platforms;
  - Gradual transition from existing systems;
  - Ensure transparency, liquidity and stability of the markets;
  - Concern with guarantee of supply;
  - Treatment given to Special Regime Generation;
  - Treatment given to inter or inner area congestion;
  - Implementation of mechanisms to recover stranded costs;
    - Elimination of PPA's in Portugal;
    - Elimination of CTC´s in Spain.

The MIBEL – Iberian Electricity Market

- Important aspects:
  - Definition of the model:
    - Mixed model – common pool and bilateral contracts;
    - Intraday markets for adjustments;
    - Common forward market;
  - System Operation:
    - Two operation zones – evaluation of ATC;
    - Common management of interconnections and congestion – capacity auctions or market splitting;
  - Legal and regulatory changes:
    - Tariffs in Spain;
      - Elimination of cross subsidies;
    - Eligibility and quality of service in Portugal;
  - Investments in generation:
    - Creation of a capacity tariff?

The MIBEL – Iberian Electricity Market

- Ancillary services:
  - Under the responsibility of the two TSO's;
  - Harmonization of mandatory and voluntary services;
  - How will they be allocated?
    - Primary reserve – mandatory non paid service;
    - Secondary and tertiary reserves – voluntary services to be allocated in specific auctions in each control area, according to security margins defined by the two TSO's;
    - Curtailment Contracts – they will be accepted as a resource related with secondary or tertiary reserves;
    - Reactive power:
      - Minimum amount – mandatory service for dispatched generators;
      - Remaining amount – to be contracted in the market;

The MIBEL – Iberian Electricity Market

- What happened till now?
  - In Portugal:
    - PPA's were eliminated recently;
    - A revised and more demanding Quality of Service regulation was adopted in March 2006;
    - There is full eligibility;
  - In Spain:
    - It was recently published a White Book on the Spanish Electricity System;
    - There is full eligibility;
  - Two new 400 kV interconnections are in operation;
    - Currently 2xnorth, 1xcenter and 1xsouth 400 kV;
    - Plus 3x220 kV in the north;
  - The common forwards market is already in operation;
  - **The operation of the common pool started in the 1st of July.**

The MIBEL – Iberian Electricity Market

- The market already exists:
  - The common pool is already in operation;
  - A Portuguese utility owns a Spanish gen/dist company;
  - Spanish utilities supply 35% of the free market Portuguese clients (about 22% of the total demand in 2005);
- Energy flows in the interconnections:

Imports:
- 14,2% of the total demand in 2005;
- 11,1% of the total demand in 2006.

Source: Rede Eléctrica Nacional web site www.renl.pt

The MIBEL – Iberian Electricity Market

- Difficulties and Challenges:
  - Problems due to the connection of Dispersed and Wind generation to the grids;
    - Voltage drops, dynamic behavior, eventual congestion, degradation of quality of the wave;
    - Larger use of ancillary services;
    - Validation of operation plans by System Operators;
    - Difficulties in expansion planning;
    - Impact on the tariffs of the end consumers;
  - Improvement of wind forecasting tools;
    - Aggregation of wind parks – clusters of wind parks;
  - Joint operation of hydro + wind parks;
    - To reduce congestion and profit from daily tariff variations;
  - Training operators in view of the presence of large amounts of wind capacity;
  - Increase interconnection capacity;
  - Harmonize procedures, regulations, …;

The MIBEL – Iberian Electricity Market

- Advantages:
  - There is increased competition;
  - It was created a forward market;
  - The Portuguese Gen/Dist company is a player among others, diluting its share in the peninsula;
  - There was a pressure to improve Quality of Service, namely in Portuguese distribution networks;
  - There is a pressure to turn tariff setting more transparent in Spain, eliminating cross subsidies to industrial consumers;
  - Big Question: Will tariffs decrease? Most probably no!
    - Subsidies to renewables;
    - Mechanism already approved to eliminate PPA's.

Conclusions – How threats can be transformed into opportunities

- In several EU countries, wind power is the only available source to increase the share of renewables;
- New conceptual solutions have to be developed;
- New products and applications for grid management and control;
  - New forecasting tools;
  - New DMS and EMS applications;
  - Operator training applications.
- Systems to optimize the production and increase the robustness of operation;
- Development of studies:
  - Steady state behavior;
  - Transient analysis;
  - Evaluation of the security of supply;
  - Power system expansion planning.