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Athens, February 16th

# Policies and Initiatives for the Promotion of Renewable Energies in Portugal

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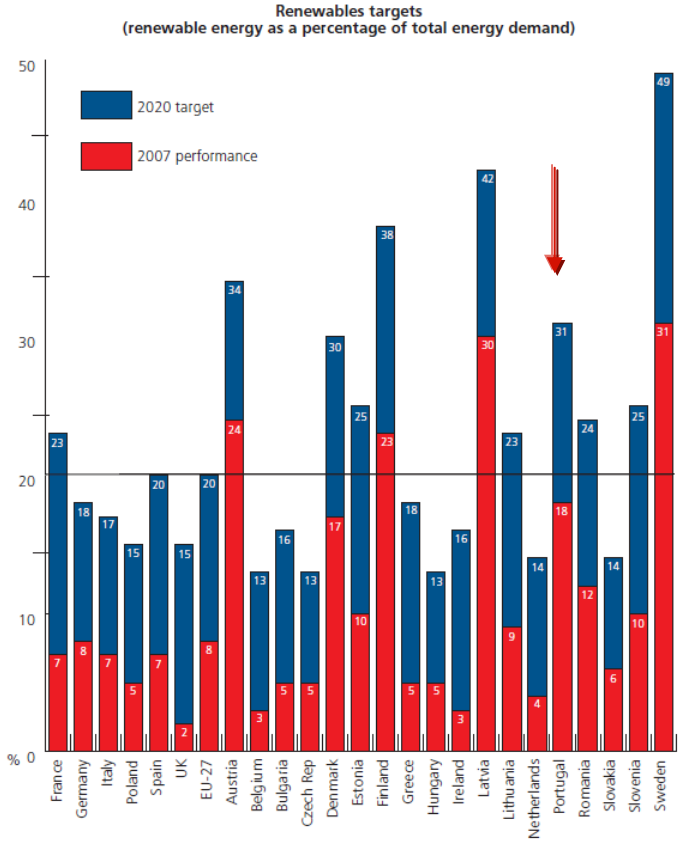
# Introduction

- **Past and Future challenges in Energy:**
  - European Directive of Renewable Energies imposed to Portugal that, by 2011, 39% of the produced electricity has to have renewable origin;
  - Europe has agreed to a legally binding objective:
    - meet 20% of European energy needs with renewable energies to put the EU on track to a low-carbon economy by 2020.

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# Introduction – The new targets on RES

- European member states with a significant share of electricity requirements being met by renewable power sources




**50% - 55% target on electricty generation from renewable power sources defined for Portugal [REN]**

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# Developed related policies

- Sustainable energy policy:
  - Invest largely in wind generation;
  - Invest in large hydro dams (new 2000 MW)
  - Promote cogeneration and biomass.
  - Invest in microgeneration (and solar heat water)
  - …
  - Complementary measures for consumption efficiency increase
  - …
  - Electric mobility (Mobi_e program)
  - Fiscal measures communication initiatives

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# Portuguese Electric Power System

## Basic information from 2009

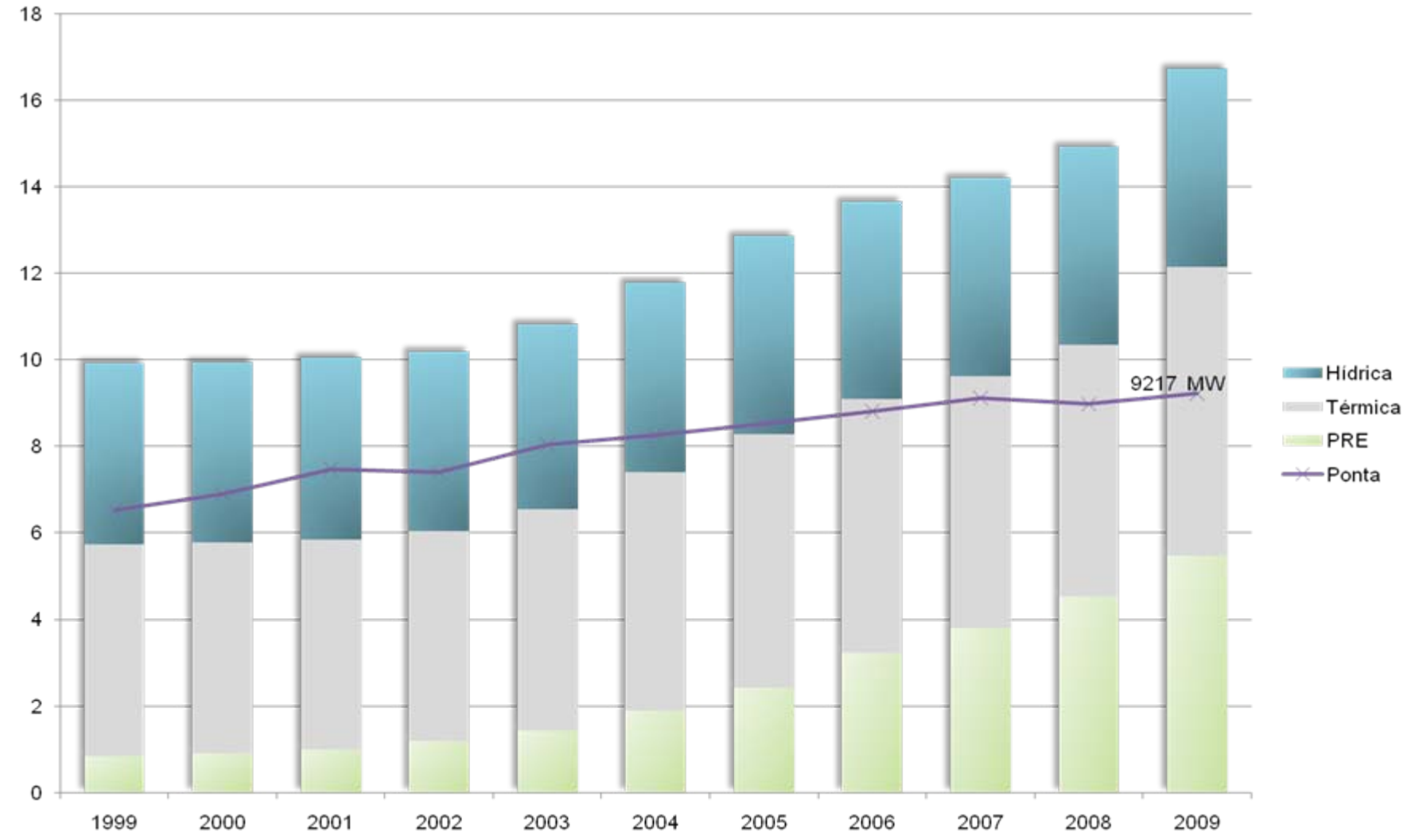
| | |
|---|---|
| Consumption (incl. pumping): | 50,7 TWh |
| Production: | 45,9 TWh |
| Import: | 4,8 TWh |
| Average price In the daily market: | 37,6 €/MWh |
| Installed capacity: | 16,4 GW |
| Number of consumers: | ~ 6,1 millions |



Sources: *REN, EDPSU*

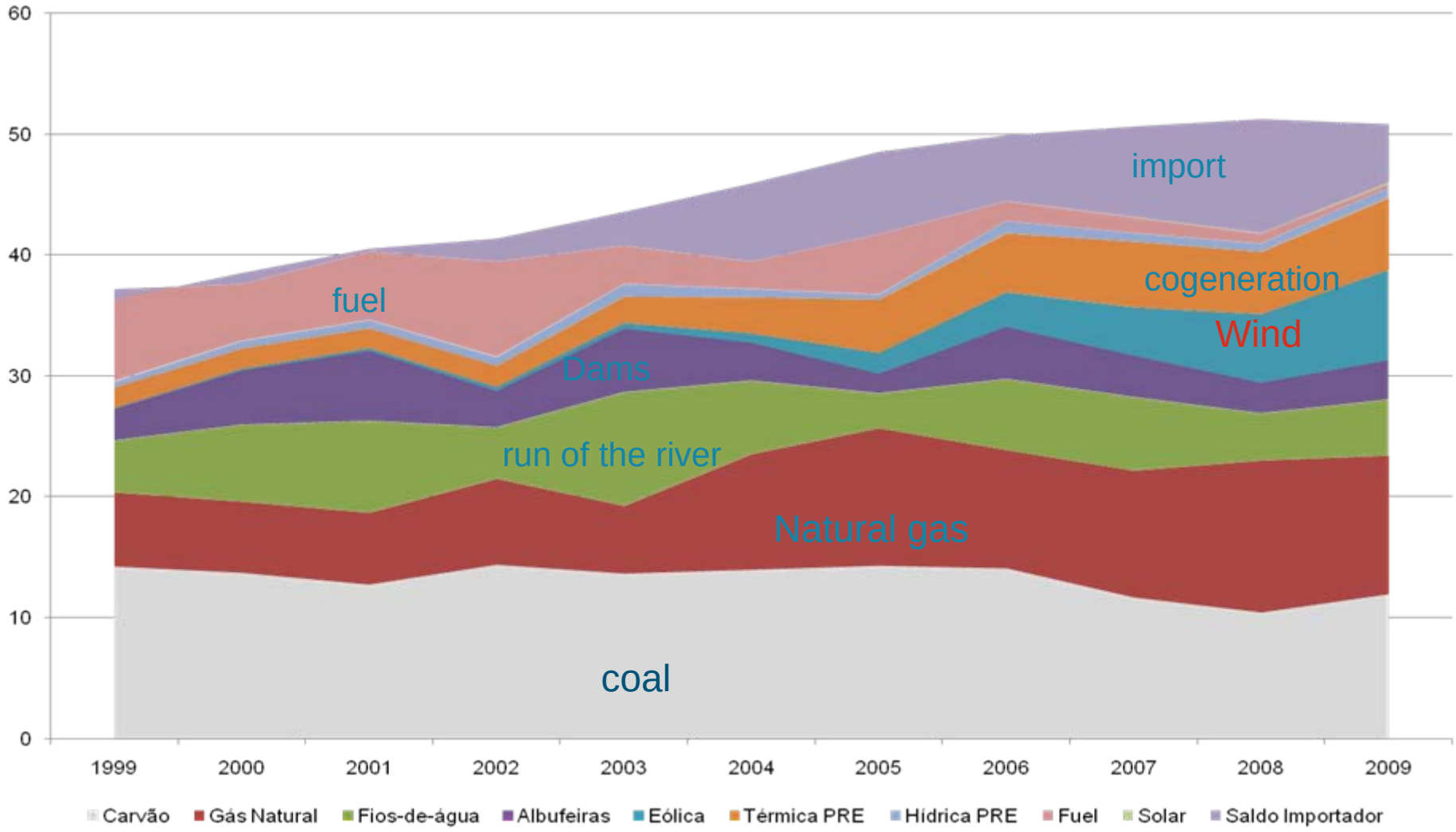
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# Evolution of the installed capacity and peak power (GW)




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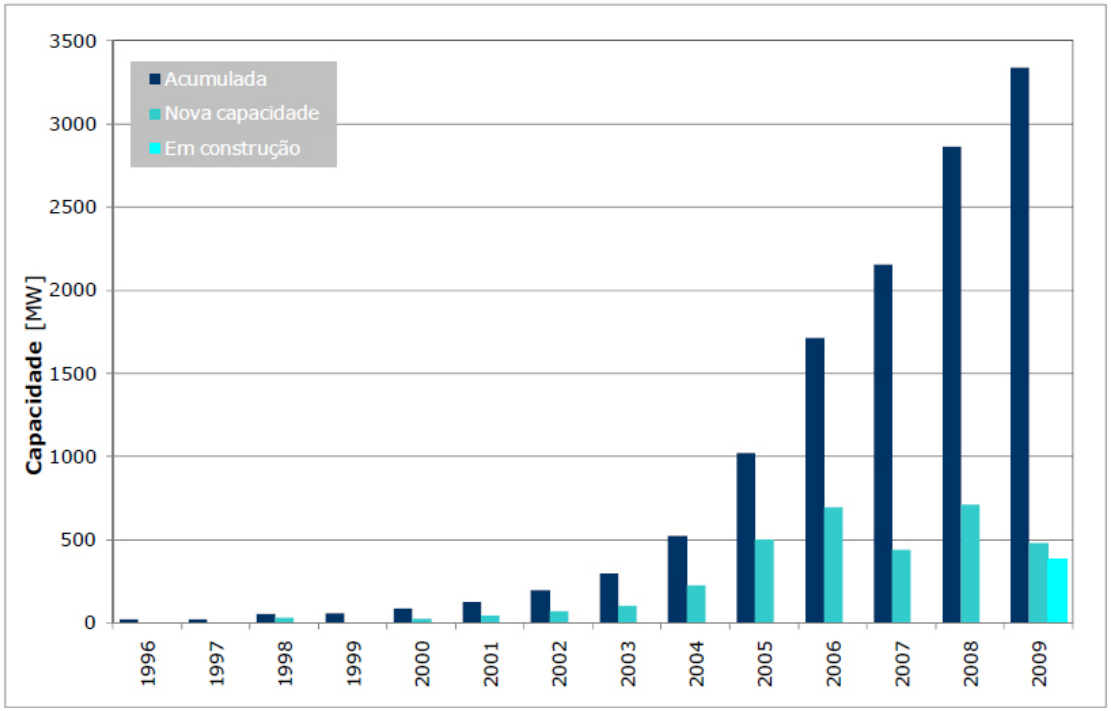
# Production of Electricity in Portugal (TWh)




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# Wind Generation - Situation in Portugal

- **Evolution of wind power generation in Portugal**




In Jan 2010
>3500 MW

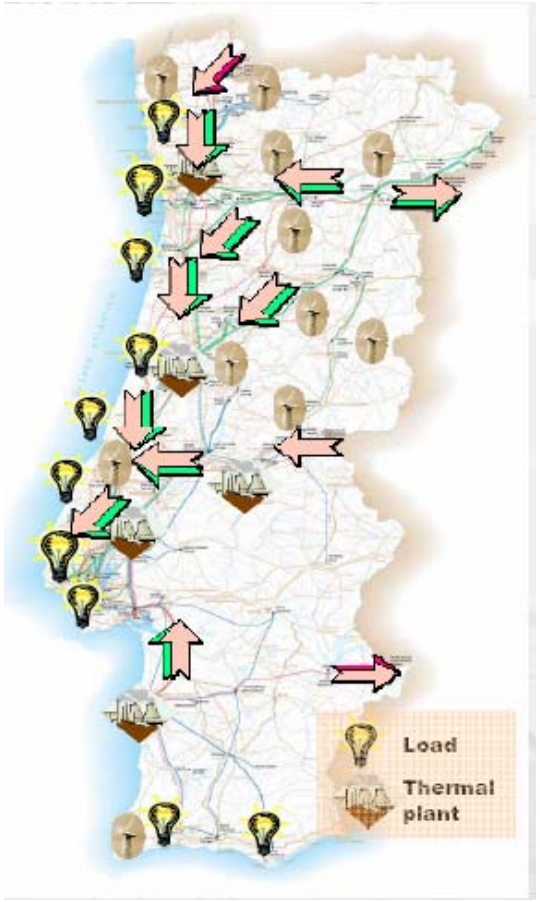
Accumulated installed capacity in Portugal

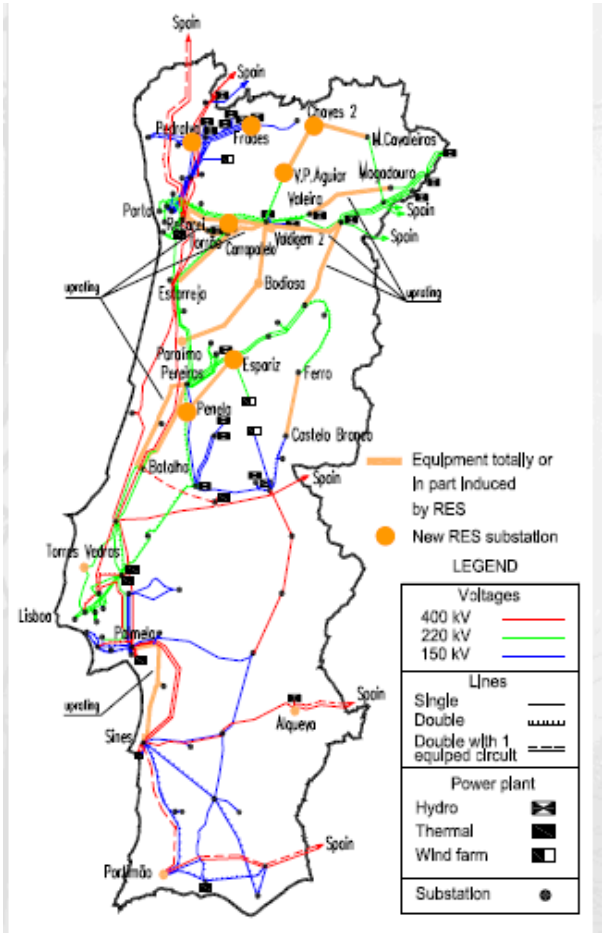
About 4000 MW will be operating until the end of 2010

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# Procedure adopted by the TSO: Identification of the Capacity to Receive Wind Power Generation (WPG)

## 1. Identification of resources 2. Plan for the expansion of the grid



# Solutions adopted to accept new power

- Identification of the Transmission System Operators' capacity to receive Special Regime Generation (SRG), (information provided on the Internet).
- Ways to allocate power according to Decree-Law312/2001:

  1. Distributing power to applicants by managing waiting lists
  2. Public Tender

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# Situation in 2005/ Tender Solution

- In the beginning of 2005, the Portuguese Government decided to go forth with a public tendering procedure for the allocation of wind power.
- At the time, the situation was as follows:
  - About 700 MW were installed;
  - About 800 MW were under construction;
  - About 1900 MW had been allocated;
  - Generators without special technical requirements were being used;
  - There was no Grid Code
  - It was necessary to coordinate the integration of WG regarding technical aspects and possible limitations resulting from Spanish objectives;

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# Public Tender Solution

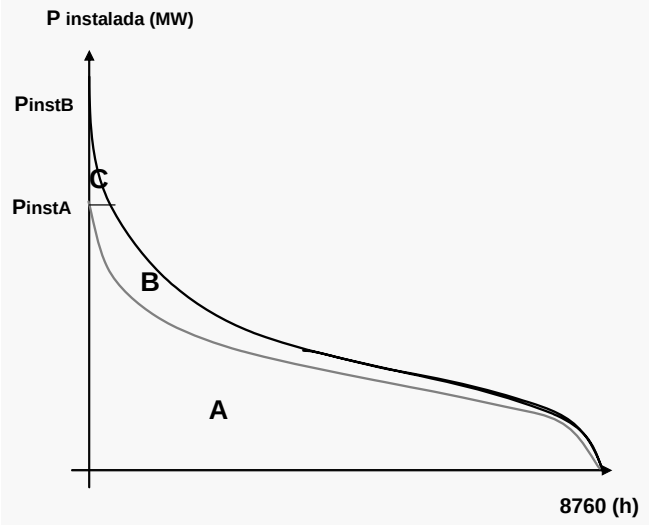
- Important topics for the public tender
  - Technical Valorization factors (technical robustness and management of the grid)
  - Social and Economic Valorization Factors:
    - Develop an industrial cluster
    - Promote and finance R&D
  - Possibility of over-equipment in wind farm capacity

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# Tender Solution – Wind farm over-equipment

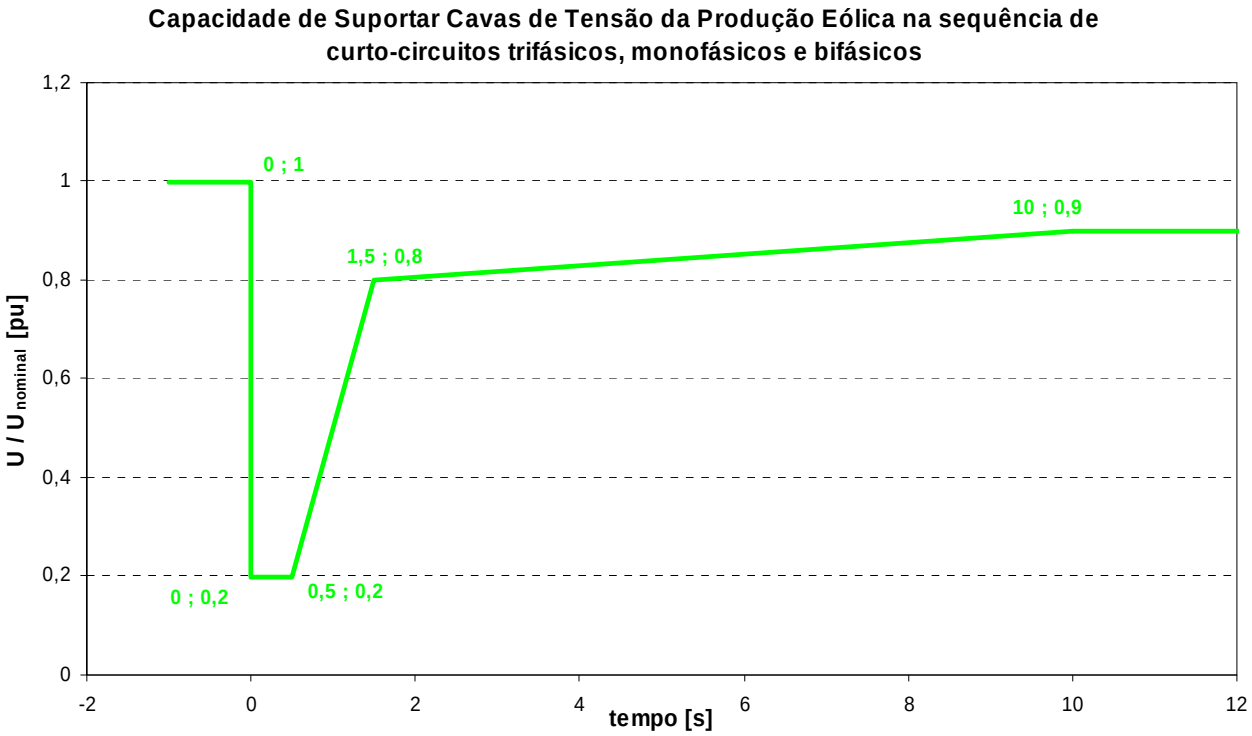
- It was suggested that the existing wind farms or the new ones could be over-equipped in generating capacity
  - Doing this, it was possible to reach the 39% goal without having to make high investments in grid infrastructures;
  - The over-equipment volume of the farms was involving a risk for the promoters;

Duration curve of a wind farm's annual generation




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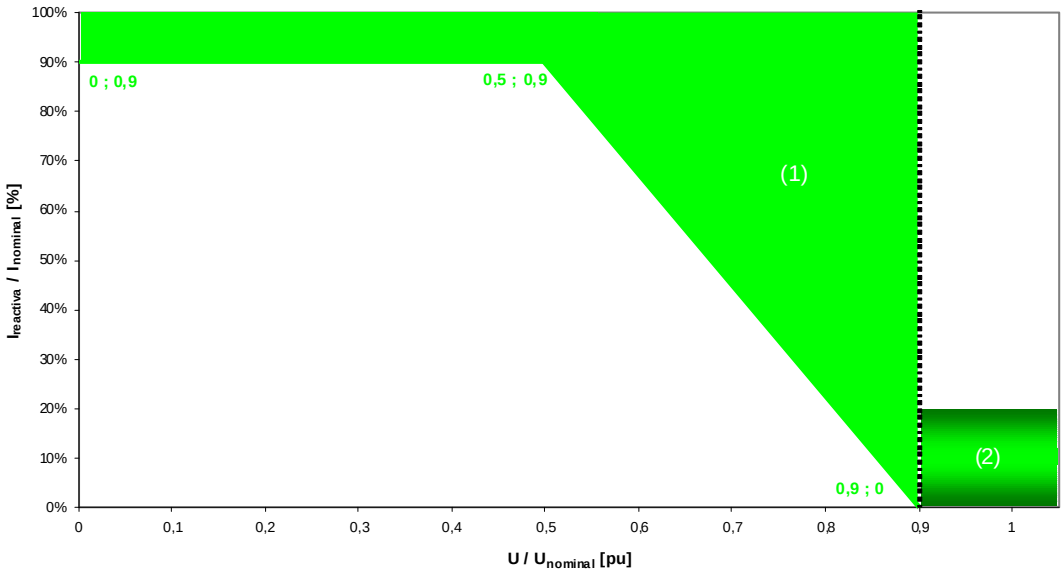
## 1. Surviving voltage sags – Ride through fault capability




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# Minimum Technical Requirements

2. Ability to supply reactive power during voltage sags for grid voltage support

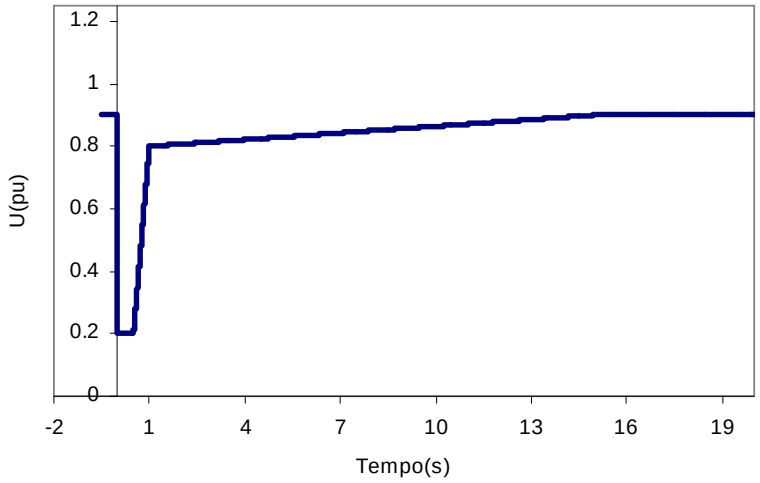


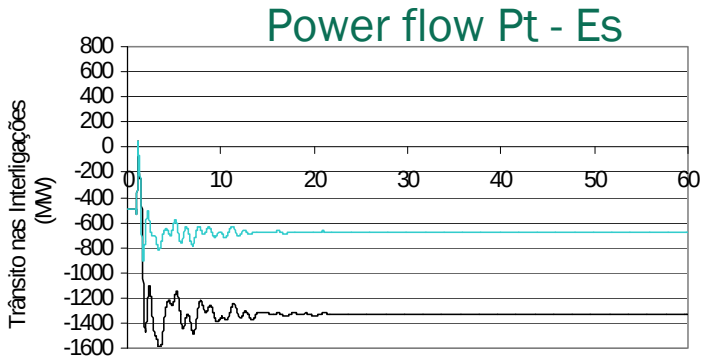

3. Wind power conversion systems' ability to adjust, as requested by the system operator, the reactive power injected for values corresponding to tg(φ), with variation on interval [0, + 0,2].

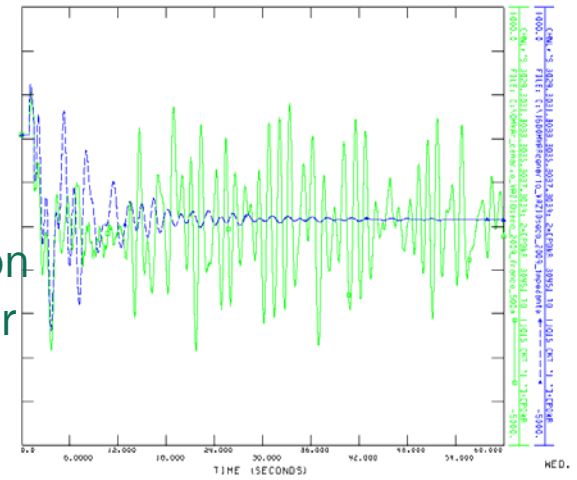
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# Robustness of Operation

- **Demonstrating the wind power conversion system's ride through default capabilities**




Power flow in the interconnection between Spain and France after SC in the grid with loss of WPG

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# Additional Technical Requirements

- **Ability to manage Wind Farm clusters**
  - Controllability management of the wind power conversion systems;
  - Integrated and optimized management of the reactive power generated by wind farm clusters;
  - Ability to provide wind power forecasts, for time horizons up to 48 h;
  - Ability to define future participations in markets, through the aggregation of wind power generation through hourly aggregated proposals to be presented to the market;
  - Ability to adjust by remote control, and whenever required by the SO, the regulation parameters of the conversion systems participating in the primary frequency control and in management tasks.

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# Additional Technical Requirements

- **Additional Control of Reactive Power,**
  - Ability to control the reactive power injected for tg(φ), with variation on interval [-0.2, 0], to be provided by wind farms. The use of FACTS was also possible.

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# Additional Technical Requirements

- **Wind Power Generation Management**
  - Ability to accept, in off-peak hours, the reduction wind power generation. The offer for this solution should be expressed in terms of hours for the Reception Capacity (annually) during off-peak hours.

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# Additional Technical Requirements

- **Energy Storage Solutions**
  - Ability to provide an integrated management of wind power generation and storage, expressed in energy that the applicant would be capable of transferring. This capacity should be associated to services for reserves management systems in the control area of Portugal.
  - The valorization of the storage would depend on the energy E (MWh) to be transferred, and on the reference value Eref (MWh), which is the energy that corresponds to 1 hour of operation for the power to which the applicant was applying. (The aim was to improve the system's capacity to manage system reserves – secondary and terciary reserves).

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# Additional Technical Requirements

- **Primary Frequency Control,**
  - Wind Power Conversion Systems' ability to participate in the primary control of frequency, when requested by the SO (by providing less than 5% deload relatively to the maximum power extraction curve).
  - It can be activated by the system operator in situations to be defined in the Grid Code. It should always correspond to cases where the levels of wind power integration are very significant.

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# Organization of the Contract Award Process

- The Contract Award Process was organized in two sequential Stages: the first is Stage A and the second is Stage B. Objectives:
  - Stage A: the aim was to select the best Tender for the allocation of Power up to 800 MVA.
  - Stage B: the aim was to select the best tender for the allocation of Power up to 400 MVA.

    The awarded amounts of power could be increased in 200 MVA in stage A, and 100 MVA in stage B, and up to 20% of Over-Equipment could be added to the awarded Power if the Applicant's Tender presented an exceptional value for the national energy policy.

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# Criteria for the Valorization of Proposals

| Criteria | Sub-criteria or factor |
|---|---|
| **A. Economic Impact** | A1. Discount on the power generated by the Wind Farms |
| **B. Creation of an industrial cluster to support the sector** | B1. Volume of Direct Investment of the Industrial Project |
| | B2. Volume of Indirect Investment generated by the Industrial Project |
| | B3. Direct Employment generated by the Industrial Project |
| | B4. Indirect Employment generated at the Industrial Cluster |
| | B5. Gross Added Value of the Industrial Cluster |
| | B6. Degree of coherence and solidity of the Industrial Project |
| **C. Technical Management of the System** | C1. Ability to technically manage the wind farm groups |
| | C2. Power generation management |
| | C3. Solutions for energy storage |
| | C4. Additional control of reactive power |
| | C5. Participation in the primary frequency control |
| **D. Support to innovation** | D1. Support to innovation |

(5% Maximum value)

Reference tariff: 73,4 €/MWh

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# Results of the Tender Procedure

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# Results of the Tender Procedure

- 1600 MW of wind power were allocated
  - Stage A – 800 MVA + 200 awarded MVA + 200 MVA over-equipment
  - Stage B – 400 MW.

- All applicants offered a 5% discount on the wind power remuneration.

  (Base tariff 73,4 €/MWh) → 70 €/MWh

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# Results of the Tender Procedure

- Both winners provided all the technical requirements



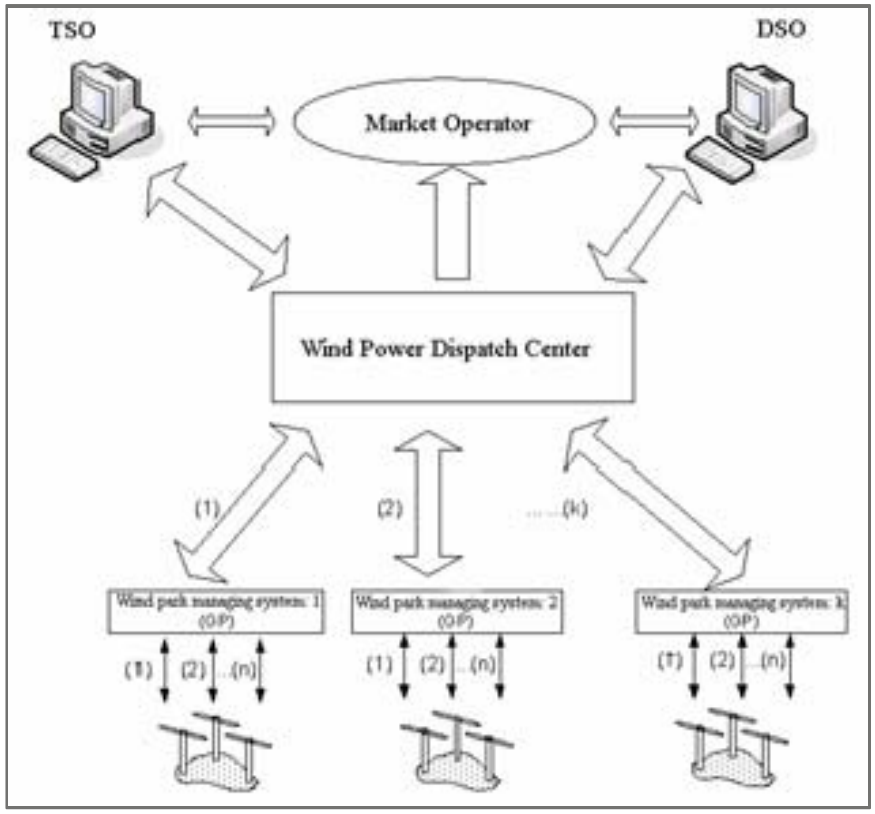
Making it possible to achieve a high level of system controllability and technical management

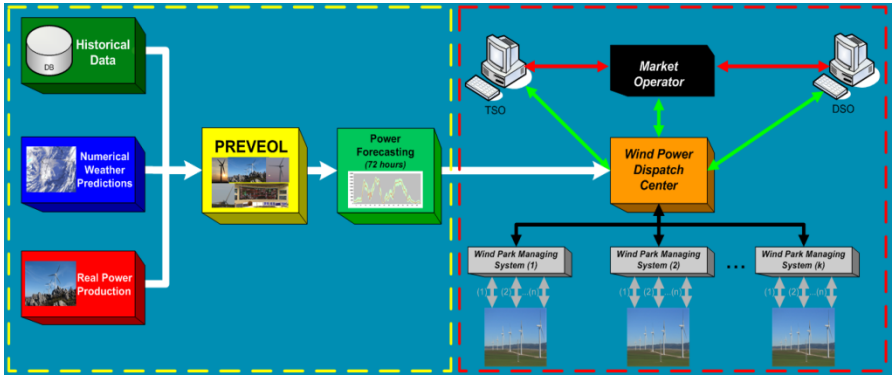
The component of reserve management was contractualized with a hydroelectric power plant with pumping and storage capacities.

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# Results of the Tender Procedure

- *Three dispatch centers: 2 from consortium A + 1 from consortium B.*






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# Results of the Tender Procedure

- Investment and employment (A)

| Region | Total Investment (€) | Employment to be generated | | | | |
|---|---|---|---|---|---|---|
| | | Non-differentiated | Specialized | Technical | Innovation | Total |
| Minho Lima | 120.546.149 | 179 | 728 | 171 | 24,5 | 1102,5 |
| Low Vouga | 6.359.693 | 45 | 20 | 1 | 0 | 66 |
| Great Lisbon Area | 8.753.115 | 11 | 6 | 0 | 0 | 17 |
| Setúbal Peninsula | 1.696.200 | 0 | 6 | 4 | 0 | 10 |
| Great Porto Area | 1.564.203 | 10 | 35 | 12 | 0 | 57 |
| Low Mondego | 559.100 | 9 | 11 | 1 | 0 | 21 |
| Ave | 10.203.232 | 135 | 7 | 8 | 0 | 150 |
| Cávado | 9.625.400 | 152 | 26 | 12 | 0 | 190 |
| Lezíria do Tejo | 1.687.220 | 13 | 16 | 6 | 0 | 35 |
| Pinhal Interior Norte | 805.933 | 19 | 41 | 0 | 0 | 60 |

161 M€

1708

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# Results of the Tender Procedure

- Investment and employment(B)

| Region | Total Investment (€) | Employment to be generated | | | | |
|---|---|---|---|---|---|---|
| | | Non-differentiated | Specialized | Technical | Innovation | Total |
| Dão Lafões | 31.683.756,05 | 60 | 336 | 40 | 18 | 454 |
| Low Vouga | 26.832.707,00 | 205 | 410 | 51 | 5 | 671 |
| Great Lisbon Area | 320.000 | 7 | 24 | 3 | 0 | 34 |
| Great Porto Area | 3.893.000 | 17 | 47 | 5 | 0 | 69 |
| Tâmega | 515.346 | 34 | 2 | 2 | 0 | 38 |
| Ave | 1.049.000 | 11 | 5 | 3 | 0 | 19 |
| Lezíria do Tejo | 493.911,70 | 0 | 11 | 3 | 0 | 14 |
| Pinhal Interior Norte | 1.567.807 | 5 | 21 | 2 | 0 | 28 |

66,3 M€

1327

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# Results of the Tender Procedure

- Summary:
  - Installation of 1600 MW of WG
  - Incorporation of advanced control requirements
  - Development and installation of an industrial cluster that makes it possible to:

- *Increase exports*
  - More than 60% of the generation will be exported
- *Reduce imports of wind power components*
  - National incorporation will go from the current 20% to practically 100%
- *Reduce imports of raw materials*
  - More than 100 million Euros per year

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# Results of the Tender Procedure







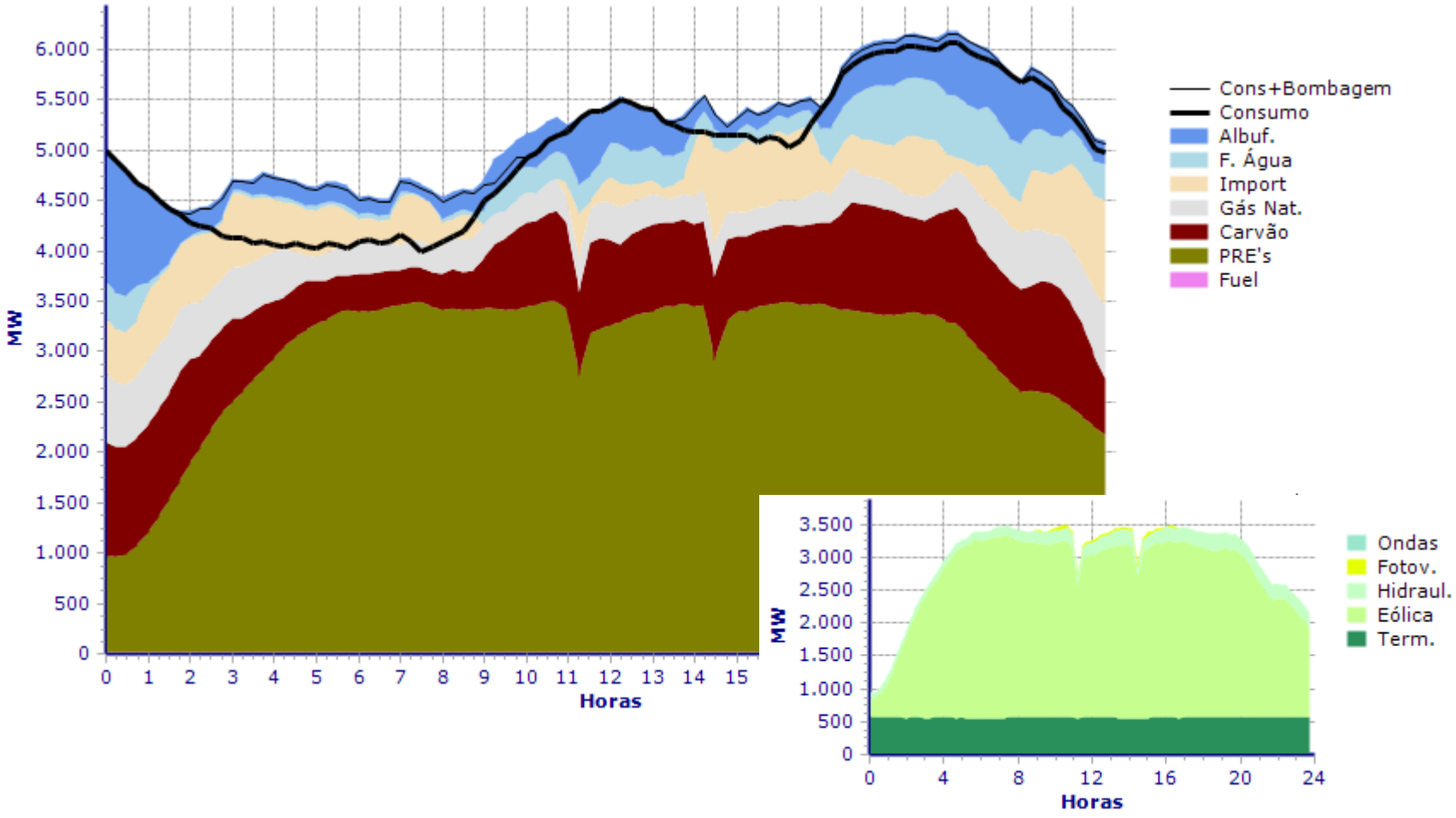



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# Operational Issues

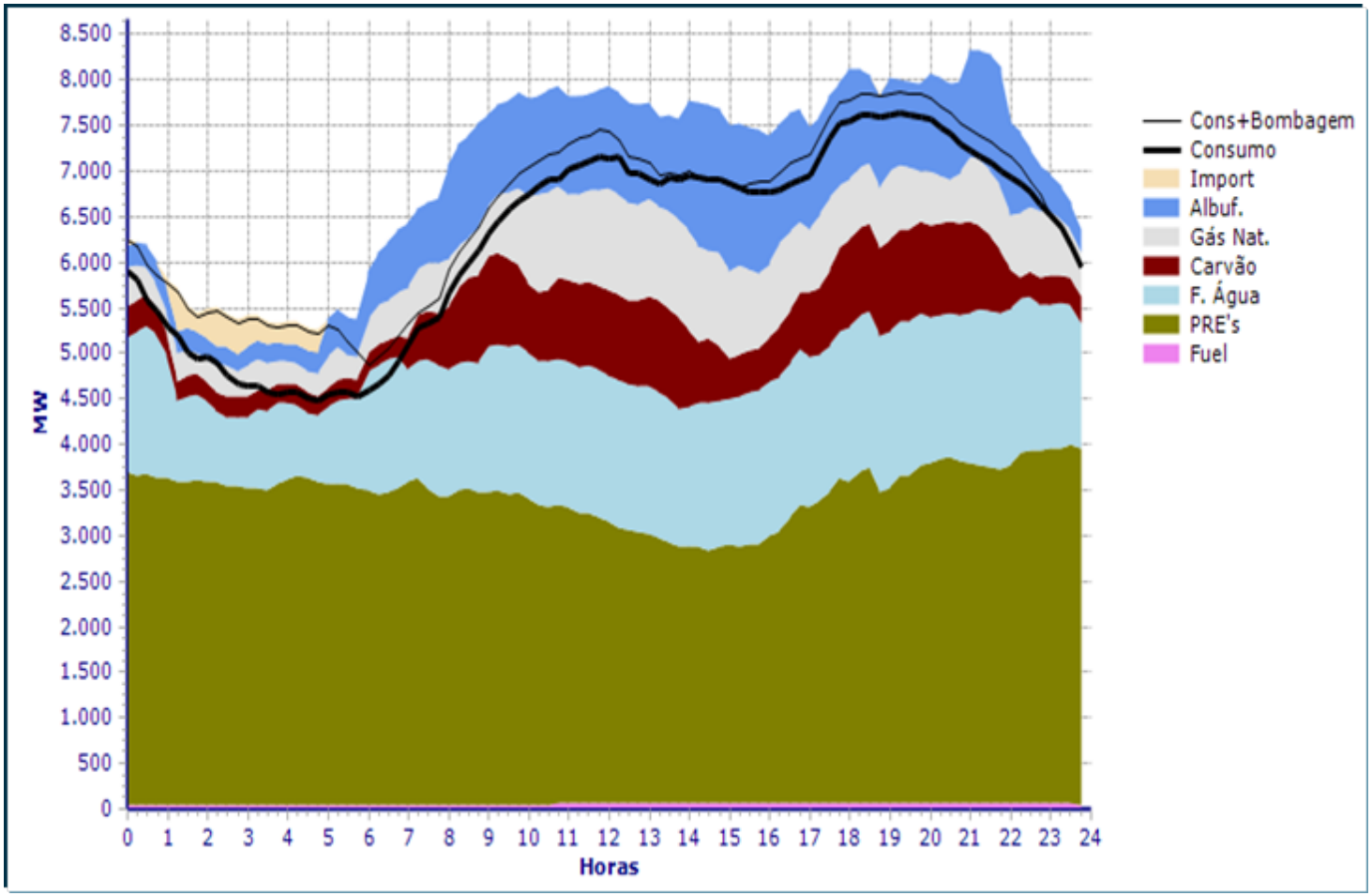
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# Example of a winter windy day in 2009




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# Example of a winter windy day in 2010




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# Microgeneration

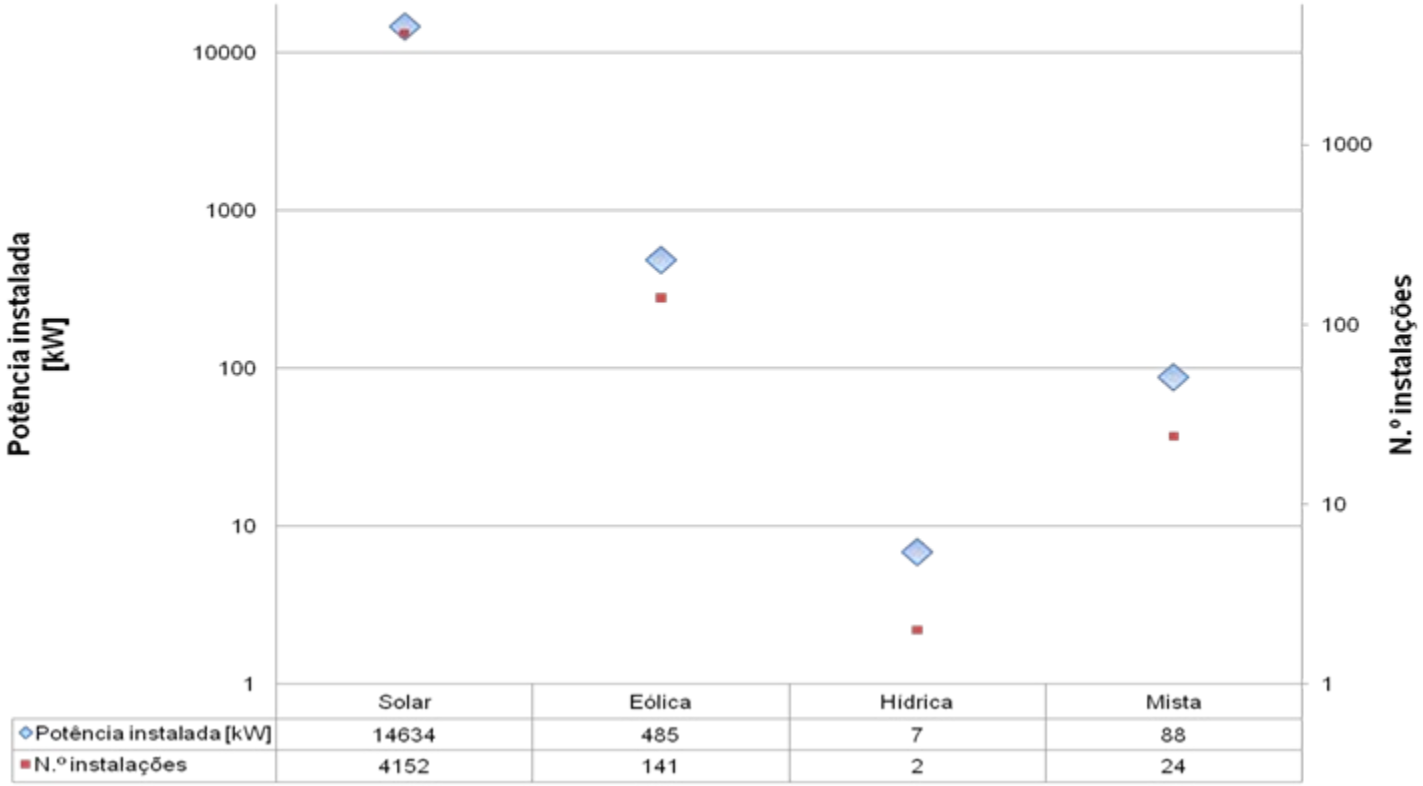
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# Microgeneration

- A new law was passed in 2008:
  - P< 5,75 kW
  - Internet based application procedure
  - Maximum of 10 MW (1st year); next years + 20%
  - Remuneration at 65 c€/KWh (solar PV); less 5% in the coming years
  - Install up to 50.000 microgeneration units until 2020
  - Microgrid concepts will be needed to manage the LV grids with such a high level of μG penetration

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# Microgeneration in 2009

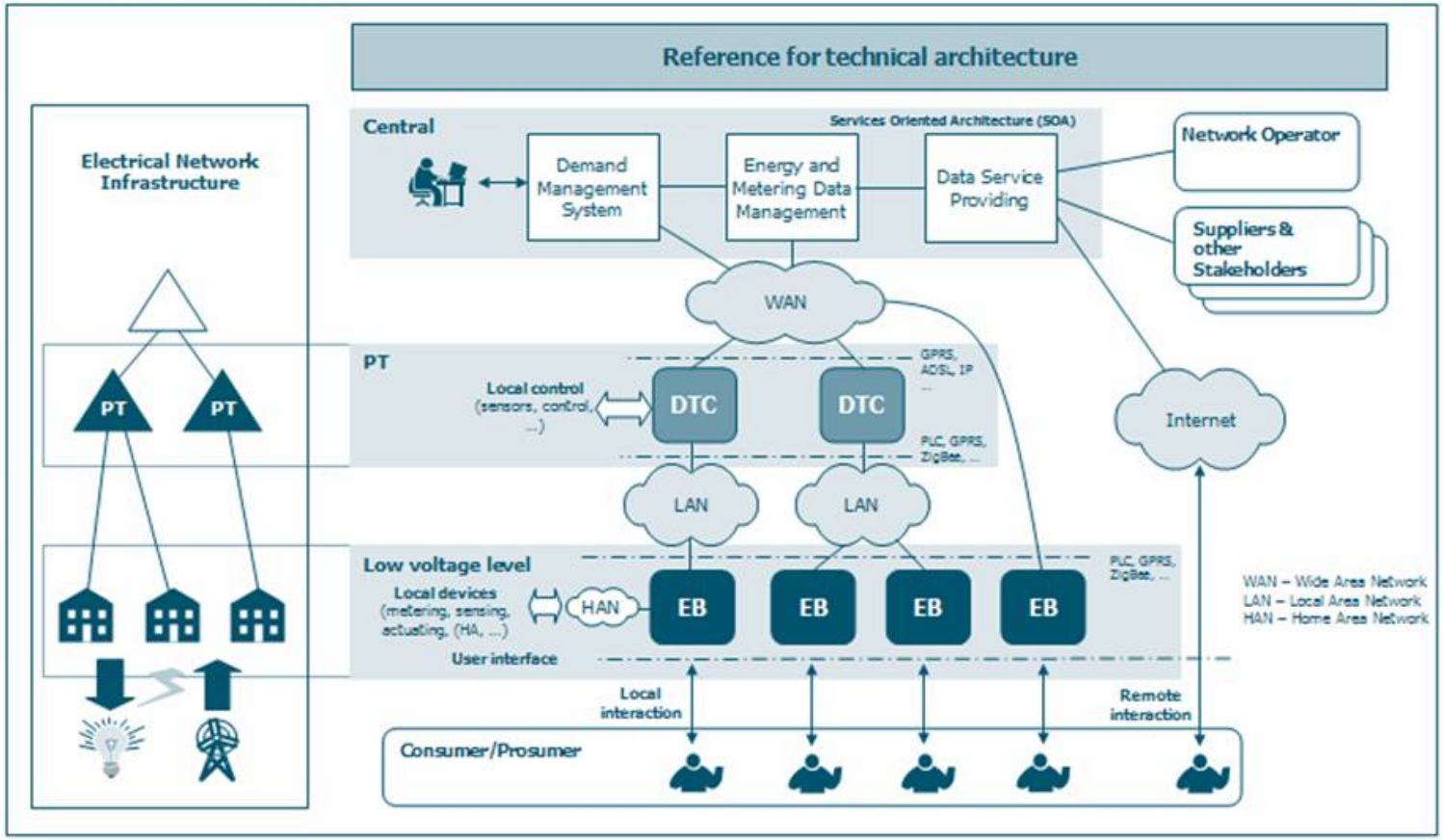



| | Solar | Eólica | Hídrica | Mista |
|---|---|---|---|---|
| Potência instalada [kW] | 14634 | 485 | 7 | 88 |
| N.º instalações | 4152 | 141 | 2 | 24 |

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# Smart metering – the InovGrid Project

- Project developed with a concern to manage also microgeneration



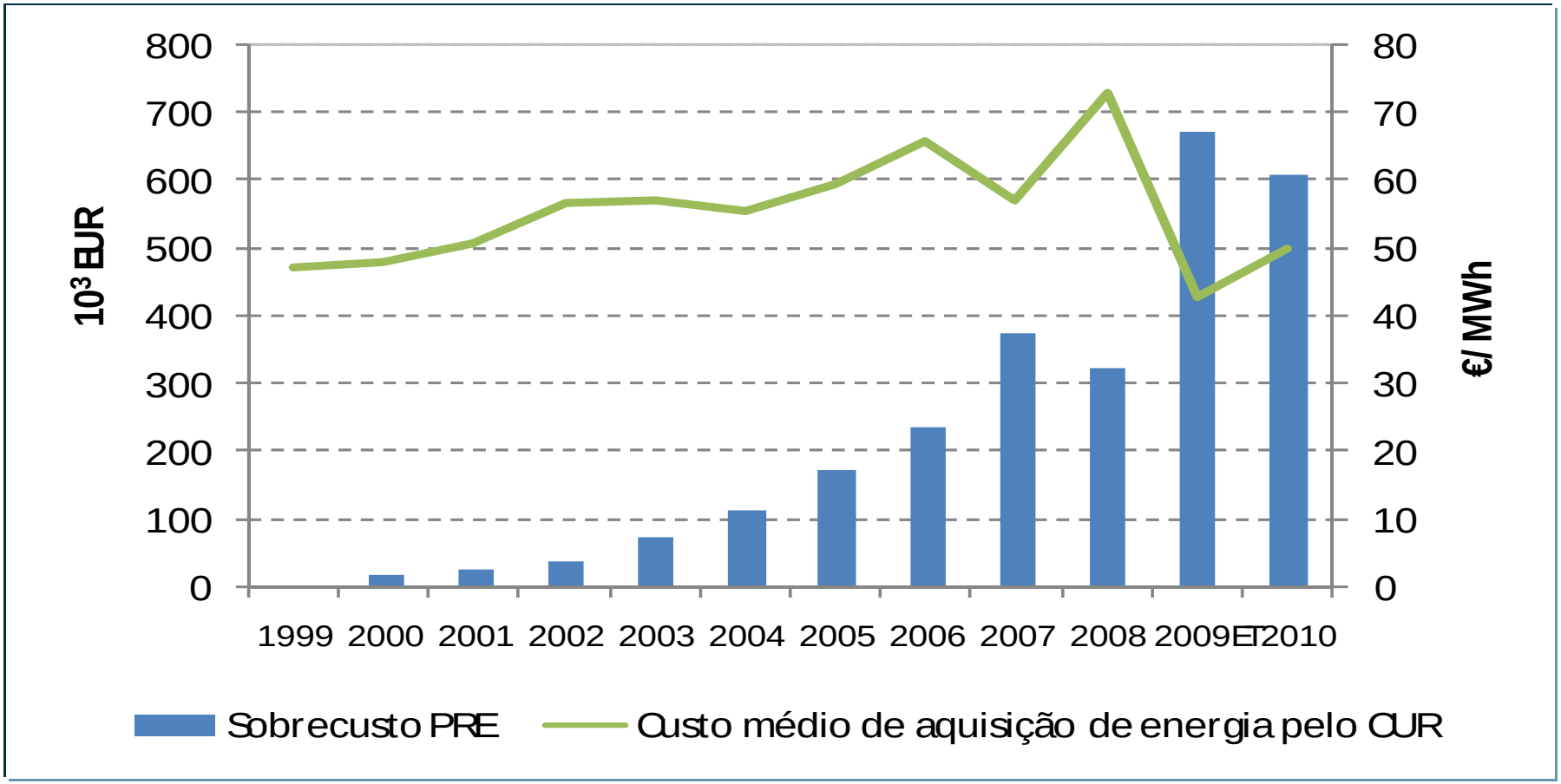

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# Electric Mobility

- The Mobi_e project
  - Dvelopment of solutions for charging Electric Vehicles
- R&D activities
  - The MERGE project (PPC, INESC Porto)

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# Evolution of the extra costs resulting from the SRG




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# Extra costs resulting from the SRG

- Renewable generation only (2008) extra costs:
  - 174 M€
  - However costs of filters of coal fired power plants are allowed to be passed to the systems costs
- Price market was reduced due to the presence of RG in about 180 M€
- → global reduction of the cost of electricity was achieved in 2008 because of the presence of RG. (However cost of oil was high in 2008).
- LV consumers were experimenting an increase in the regulated tariff of about 6€ per year because of the SRG

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# Conclusions

- A large investment in RE will be pursued for the next years in order to comply with the European targets
- Costs of CO2 will be avoided (Important: CO2 emission licenses will have be bought in the market – mandatory)
- R&D in the energy field became a pressing need (participation in FP7 projects is critical together with national R&D projects)
- The industry is being pushed to take profit from this opportunity:
  - Promotion of new projects
  - Creates new jobs and increases the export capability
- Electric mobility is a must for the future in order to globally reduce CO2 emissions

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