Climate change, energy security and prospective energy scenarios in Spain

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Objective

To explore some possible futures of the Spanish energy system

To identify the key factors of the energy system (need for better data, policy-decision to be taken?)

Taking into account the European climate change and Renewable energy frameworks, as well as energy security preoccupations
Spanish context

Spain is strongly dependent on energy imports (75% of primary energy): Very scarce in domestic fossil resources

Uncertain future nuclear policy (20% of elc in 2006): no clear position, unpopular but industry pressure
29/06/2008: 'We are committed to respecting the normal life-span of the plants unless there are urgent energy needs, and to not building new nuclear plants'
2009-2011: to renew the authorization licenses

Good potential for renewable (solar, wind) with dynamic wind and solar industries and ambitious targets
Spain has become the world’s second largest producer of wind energy, behind Germany, and ahead of the United States
Regional development, energy security and climate change are the drivers
Changing energy system from year to year

Strong increase of emissions with difficulties in complying with any strong reduction target: European country with the highest distance to its Kyoto target
Spanish context

Kyoto target: +15% above 1990 emissions by 2008-2012
- Cut the GHG emissions to 37% above 1990 level by 2008-2012
- International carbon permits (20%) and sequestration (2%)

Renewable Energy Plan 2005-2010
- RNW=12% of the primary energy / 30% of the elec (hydro excl)
- Biofuels = 6% of the gasoline & diesel consumed by transport
- Next plan?

Fiscal incentives / Strategy for Energy Saving and Efficiency 2012

European targets
- Renewable in 2020: 20% (Spain allocation)
- GHG reduction in sectors not included in the ETS: -10% wrt 2005
- Limited use of the flexible mechanisms

Strong need to better understand the dynamics of the energy system and the strategic directions to follow
The modeling exercise: **TIMES-Spain model**

- **TIMES is a bottom-up, technology rich model** for representing, optimizing and analyzing the production, conversion, trade and end-use of various forms of energy.

- Driven by the demands for disaggregated **energy services** (eg. Mt iron and steel, short distance Pass-km by cars, etc.) themselves resulting from macro-economic drivers (GDP, POP, etc.)

- Supply-demand **partial equilibrium** on energy markets

- **Perfect foresight & information** : 2000-2050

- Greenhouse gases (CO2, CH4, N2O…) and other pollutants (NOx, particulates, …). The current study focuses on **CO2 only**.
The TIMES-Spain model

PAN-EUROPEAN TIMES (PET)

NEEDS project
New Energy Externalities Developments for Sustainability
(6th Framework Programme)

RES2020 project
Monitoring and Evaluation of the RES directives implementation in EU27 (Intelligent Energy Europe)

Mitigation options available
• Energy substitution
• Technology substitution (efficiency)
• Capture and sequestration of CO2
• Biological absorption of CO2
• International carbon credits (optional)

Country Model TIMES-SPAIN used in a standalone manner

The version of the model used in this exercise does not reflect all the new data from RES2020
What options and at what cost to reduce CO2?

**Scenarios:** Tax 20 to 200$/tCO2 from 2008

**Options:**
Shutdown of coal power plants from 2015 and of gas plants from 2020, substitution by renewable (*rem*: wind is competitive in the base case in the longer term)
Penetration of biofuels in transportation (moderate)
Substitution coal/gas/biomass in other end-use sectors

**Emissions:** remain higher than 1990 emissions

Contribution to **energy security** (reduced imports)?
What is the highest domestic reduction?

Scenarios:
Kyoto forever
Kyoto + Stabilization to 1990 levels
Kyoto + “-10% vs 1990 in 2020-2050”
up to Kyoto + EU targets (-20% in 2020, -30% in 2030, -50% in 2050)

Any target (-30%, -20%) fixed in 2020 and kept constant until 2050: impossible with only domestic measures ⇒ international carbon permits are required

Breakpoint between “Stabilization 1990” and “-10% over 1990”

![Graph showing CO2 price over time with different scenarios]
Is the Renewable Energy Plan a step in the right direction?

**Helps reduce emissions**
142% emissions of 1990 (150% without the PER): direct result of the forced renewable power plants (shutdown coal plants) and biofuels in transport, few effects in other sectors

**However:**
Delay in the development of the renewable plants in Climate strategies without the REP (Kyoto for ever)
Delay in the penetration of biofuels without the REP
Emissions compensated by a higher sequestration
Cost of the system higher with REP (35% in Kyoto for ever, doubling in EU-Renew-Design)

*The REP might not be the most efficient option package to meet the scenario ‘Kyoto for ever’*
What about *Imports, Nuclear, Renewable potentials* (sensitivity analysis)?

Possible to reduce the fossil imports up to 50% of the levels of the Reference case:
- much higher renewable power plants
- industry and transport = captive sectors with non-compressible demands
- penetration of H2 (hydrolysis production)

**Free nuclear plants help reduce the total cost of the system**, but not systematically the marginal cost of CO2. Does not penetrate for loose targets.

**Lower renewable potentials** makes even smaller the available domestic reduction (no impact on the reference case)

**Free imports of biomass/biofuels**: biomass used first of all for electricity generation and heat production! Review the chain of production of biofuels for transportation.
Conclusions

- **Challenge ahead for Spain** in reducing its CO2 emissions and developing a sustainable energy system
- The **Renewable Energy Plan** is useful. However, more efficient options might be available to reach the Kyoto target and the EU Renewable target.
- **Carbon permit trade** is crucial for any CO2 target more strict than “-10% above 1990”. Impossible to reach with domestic actions only. Some other studies evaluate that international carbon permits could contribute to 80% of Spain objectives!
- What are the **risks** inherent in a high reliance on wind and hydro (climate dependency) for electricity?
- **Updated version** of the TIMES-Spain – need to get better data about the key factors: nuclear, renewable potentials and costs, future GDP, international prices of energy and carbon permits)
“Hot topics” for most of countries

- Future **nuclear** policy within climate framework? What is the option value of renewables if nuclear is available or not as a mitigation option?
- Availability and price of **sustainable biomass**? Of **other renewable energy**? Differences between the data recommended in RES2020 (EREC – ECN) and the data recommended at the national level (local estimations)
- **CCS? Forestry?**
- What future **GDP** growth?
- What **sharing** of EC 2020 targets amongst the countries?
- **RES2020**: interactions between Spain and rest of Europe
- National project: explore the next targets of the Renewable Energy Plan and the future of nuclear
Thank you!

Questions or comments
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NEEDS and RES2020 projects
www.needs-project.org
www.res2020.eu
Appendix
### PLAN DE ENERGÍAS RENOVABLES EN ESPAÑA 2005-2010

<table>
<thead>
<tr>
<th>Electricity generation</th>
<th>2004 situation</th>
<th>Goal for 2010</th>
<th>% INCREASE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>POWER (MW)</td>
<td>PRODUC (GWh)</td>
<td>KTEP</td>
</tr>
<tr>
<td>Hydraulic (&gt;50Mw)</td>
<td>13521</td>
<td>25014</td>
<td>1979</td>
</tr>
<tr>
<td>Hydraulic (10-50 Mw)</td>
<td>2897</td>
<td>5794</td>
<td>498</td>
</tr>
<tr>
<td>Hydraulic (&lt;10 Mw)</td>
<td>1749</td>
<td>5421</td>
<td>466</td>
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<tr>
<td>Biomass</td>
<td>344</td>
<td>2193</td>
<td>680</td>
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<tr>
<td>Biomass centrals</td>
<td>344</td>
<td>2193</td>
<td>680</td>
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<tr>
<td>Co-combustion</td>
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<td>SUR</td>
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<td>1223</td>
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<td>Wind</td>
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<tr>
<td>Solar P.V.</td>
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<tr>
<td>Bio-gas</td>
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<tr>
<td>Thermosolar</td>
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<td>1298</td>
<td>5973</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
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<td>60096</td>
<td>5973</td>
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