Times-Spain, an analytical tool for energy policy assessment in Spain

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TIMES-Spain

- TIMES-Spain is a techno-economic energy optimization model belonging to the TIMES family of models developed by the International Energy Agency (IEA) in the Technology Collaboration Programme ETSAP
- It represents the Spanish energy system from 2005 to 2030/2050
- It has been used in:
  - 3 European projects:
    - NEEDS
    - RES2020
    - COMET
  - 1 PhD thesis
  - 1 R+D National Plan project;
- Now it is being used in the context of SINERGIA project
Pan European TIMES (PET) model

NEEDS project

RES2020 project

REACCESS project

PET-RES2020 model

PET-REACCESS model

TIMES-Spain model

INER project

COMET project

SINERGIA project

Energy corridors included

RES representation improved

Plan Nacional de I+D+I 2008-2011

INER project

COMET project

SINERGIA project

SINERGIA model

COMET model

2004-2007
TIMES-Spain STRUCTURE

- Base year information
- Technological database
- Demand Projections
- Endogenous ener. poten.
- Policy constraints
- Energy prices
- Primary energy supply: Refinery, imports and renewable energy
- Electricity generation
- Transport: road passengers (car – short / long distance, bus – urban / intercity, moto), road freight, rail (passengers / freight), aviation, navigation
- Industry: Iron & Steel; Non-Ferrous metals; Chlorine&Ammonia; Other Chemic.; Cement; Lime; Glass: Hollow/Flat; Ceramics; Pulp & Paper; Other
- Residential: Existing & New - Rural/ Urban /Multi appartment
- Commercial: Large and Small
- Agriculture

Min. cost techn profile
Material and Energy flows
Emissions
- Final energy prices
- Costs
- Installed capacity

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Technological database

More than 935 base technologies and 851 new technologies (total 1786) divided in 6 main sectors

- **NEEDS**
- **RES2020**
- **COMET**
- **INER**

**National updates/validation:**

- **Electricity Generation:** BCG 2011, Protermosolar, Bioplat
- **Industry:** national stakeholders (main changes in cement sector): OFICEMEN.
- **Residential and Commercial:** SPAHOUSEC (2010)
- **Insulation and energy saving potentials:** National Energy Saving and Efficiency Action Plan 2011
Assumptions

- Industry and Agriculture demand follows the sectoral production evolution.
- Residential demand: for the basic needs, the drivers are the evolution in the number of households or the population growth. For the other demand categories, the evolution in income is the dominant factor.
- Commercial demand follows the sectoral activity.
- Transport demand. For passengers (pkm) the drivers are the income for private cars and population for public transport. For freight (tkm) the driver is the transport sector activity.

Demands projections will be validated using results from MEDPRO in the framework of SINERGIA.
TIMES-Spain | Other details

- 2005 but moving to 2014

- Depending on the research objective but TIMES-Spain has considered:
  - GHG, NOX, SO2 and PM2,5 caps
  - CO2 taxes
  - EU European Trading System (assuming a fix CO2 price)
  - Renewables feed-in-tariffs
  - 2020 and 2030 Climate and Energy targets
  - Internalization of external costs
  - ...
Emissions disaggregated by:

- **Pollutants:** GHG (CO2, CH4, N2O), NOX, SO2, PM2.5;
- **Source:** Process and Combustion;
- **Sector:** Agriculture, Residential, Services, Electricity, CHP, Refinery, Industry (Iron and Steel, Chemical, Cement, Ceramics, Glass, Paper, Lime, Other industries);
- **European Emissions Trading System:** EUETS and Non EUETS.
- Validated with National Emission Inventories
Some applications of Times-Spain
4 Scenarios: to examine the achievement of the 2020 renewable targets.

- **Reference Scenario (BaU):** No enforcement of the targets for renewable energy sources in 2020
- **RES Reference Scenario (RES-Ref):** Enforcement of the target for renewable energy sources and CO₂ targets in 2020
- **RES Statistical Transfer Scenario (RES-Trade):** Same as RES Reference, including a virtual trade of “RES rights”
- **RES-30 Scenario (RES-30%):** Same as RES Reference, but enforcing a 30% reduction target for CO₂ emissions over the whole European Union.

Conclusions:

- The existing policy incentives for REN help penetration of renewable but remain insufficient to reach the objectives
- Additional RES deployment should be oriented mainly to bioenergy use in transport and industry, as well as the implementation of conservation measures
- Renewable and climate targets do not contribute to the implementation of new renewable electricity plants compared to the incentives already included in the BaU and representing the existing policies.
4 Scenarios: to understand the role of CCS in Spain.

- **Conservative CCS**: 40% emissions reduction in 2050 high GDP growth
- **High mitigation**: 80% reduction in 2050 high GDP growth
- **Low economic growth**: 40% reduction in 2050 low GDP growth
- **No-CCS**: 40% reduction in 2050 high GDP growth and no CCS

Conclusions:

- CCS timidly starting in 2020 in the Conservative CCS scenario, 120 Mt (31% of total gross emissions) captured by 2050
- The same amount when frontiers are crossed but 148 Mt are stored
- 106 Mt (34%) in the HM, and 62 Mt (33%) in the LEG

- Main sectors: electricity and cement
- New sectors at long term

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[http://comet.lneg.pt](http://comet.lneg.pt)
Estimation of the external costs and development of 3 Scenarios: to examine the deployment of REN technologies.

- **BASE**: National REN and climate policies in place
- **ZERO**: no restrictions nor targets to emissions and renewable technologies penetration
- **INTER**: internalization of the environmental and socioeconomic external costs for all the electricity technologies

**Conclusions:**

- The positive impact on social welfare associated to the renewable energies is higher than the impact associated to fossil energies.
- **RES support expenditures largely surpass the avoided external costs** considered in the analysis – despite this is a partial CBA, results seem to indicate that the level of the FIT was too high.
- It is possible to meet the objectives of renewable technologies penetration and emission reductions set by the European Directives internalizing the external costs and benefits of electricity technologies. Thus, renewable support policies through **financial instruments which reflect the external benefits** with respect to fossil technologies should be reestablished.
5 Scenarios: to understand the implications of the 2030 objectives
- **BAU**: 2020 objectives maintained
- **Climate scenarios**
  - **CO2LOW_NOEFF**: 27% ETS emissions reduction, 15% NonETS emissions reduction, 20% efficiency improvement
  - **CO2_HIGH_NOEFF**: 30% ETS emissions reduction, 20% NonETS emissions reduction, 20% efficiency improvement
- **Efficiency scenarios**
  - **CO2_LOW_EFF27**: 27% ETS emissions reduction, 15% NonETS emissions reduction, 27% efficiency improvement
  - **CO2_HIGH_EFF30**: 30% ETS emissions reduction, 20% NonETS emissions reduction, 27% efficiency improvement

Conclusions:
- The new 2030 climate targets alone produce a reduction in FEC of around a 10% compared to the BaU scenario in 2030 which is further encouraged when efficiency policies are put in place.
- There is a tendency to a higher electrification of the energy system from 2020 especially when the efficiency policies are imposed.
- The sector which makes the biggest effort to meet the efficiency targets is the residential sector in which a transition to heat pumps and renewable sources is observed.
- Increasingly renewable and decarbonized electricity system.
- As for energy dependence, the scenarios with higher efficiency targets result in lower energy dependence.
LCA of electricity generation technologies and 2 Scenarios: to understand the implications of electricity generation on the WEL nexus

- **BAU**: 2020 objectives maintained
- **TARGET2030**: 30% ETS emissions reduction, 20% NonETS emissions reduction, 27% efficiency improvement

Conclusions:

- The reduction in electricity production with coal leads to **lower acidification and eutrophication impacts**
- Aquatic ecotoxicity impacts tend to rise in both scenarios due to the increase in wind and solar
- Impacts on water consumption and land use are also reduced despite the penetration of renewable technologies
- However, impact on the use of resources increases due to the use of elements such as silver or zinc in PV panels

http://www.fundacioncanal.com/nexo-ate/index.html
TIMES-Spain | NEXT STEPS in the framework of SINERGIA

• Update and recalibrate the base year
• Validate demand projections and technology information included in the model using data from national authorities and stakeholders
• Use the model to prepare the Energy and Climate Plan for Spain
• Enhance cooperation between energy stakeholders in Spain