EFDA TIMES and ETSAP-TIAM Workshop

EFDA-TIMES model presentation

Helena Cabal
Yolanda Lechón

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Socio-Economic Research on Fusion

SERF studies brief history

From 1997 to 2002: SERF 1,2,3
- Direct Costs of Fusion Power production
- External Costs of Fusion Power Production – ExternE methodology
- Cost-effective European Energy Scenarios
- Social Acceptability of Fusion

From 2004 to 2013: SERF 4-13
- EFDA-TIMES model. Topics:
  Fusion as an energy option, fusion and energy scenarios, resources and potentials update, fusion economics, model development and improvements, model recalibration and new regionalization
Model description

The EFDA Times Model

✓ Built in the framework of the European Fusion Development Agreement, within the Socio-Economic Research on Fusion project (SERF)

✓ TIMES model generator developed by IEA-ETSAP

✓ Multi-regional, global, and long-term energy model of economic equilibrium

✓ Optimization model

✓ Bottom-up, technology rich model

Main ETM objective

To develop consistent long-term energy scenarios containing fusion as an energy option, and showing the potential benefits of fusion power as an emission free energy source

ETM strengths

ETM describes the whole fusion fuel cycle from Lithium extraction to electricity production by fusion plants, but also

Advanced nuclear fission fuel cycle including spent fuel reprocessing
ETM 2012 characteristics

- Time horizon: 2100
- Six time slices: three seasons (winter, summer and intermediate), and day/night
- Demand sectors: residential, commercial, agriculture, industry, and transportation
- Supply sectors: electricity and heat production, and upstream
- Demand scenarios: energy demand driver projections from the general equilibrium models GEM- E3 and Gtap
- Trade: inter-regional exchange process (trade of commodities) among the different regions
- Fusion technologies in ETM to be presented next

ETM 2012 recent developments

- Expanded number of regions 15 to 17 with representation of each of the BRIC countries: Africa, Australia-New Zealand, Brazil, Central Asia and Caucasus, Canada, China, Europe, India, Japan, Middle East, Mexico, Other Developing Asia, Other Eastern Europe, Other Latin America, Russia, South Korea, and United States
- Base year from 2000 to 2005 based on IEA statistics

developed by Antti Lethila
ETM 2012 recent developments

- Enhancement of the description of technologies that are competing with fusion:
  - Renewable energy
  - Nuclear fission
  - And other such as new biofuels and electric vehicles
- Sensitivity analyses on:
  - Technology investment and operation and maintenance costs
  - Critical technologies
  - Regions, and
  - Fusion track

Some results

Sensitivity analysis on fusion track

BASE CASE
550 ppm in 2100
Fusion fast track (2050)

FUSION 2070
550 ppm in 2100
Fusion start 2070

Fusion 2070
550 ppm in 2100
Fusion start 2070
If fusion is not available, fission technologies take most of its production along with other renewable technologies.

Fusion share in 2100 goes down to 11%, being substituted by fission and, in a lower degree, by renewables.
Some conclusions

• New version of ETM available from 2012 with new regionalization and recalibration and other improvements on technologies

• Preliminary results show that:
  • The costs of fusion power plants are competitive enough to allow the deployment of the technology once it is available in the market reaching a significant share (33%) in 2100 in the context of an almost fully decarbonized electricity system
  • A sharp increase in the investment costs (+50%), that could be originated by a great escalation of the costs of materials, has a big impact on the penetration of the technology. The deployment of the technology is delayed and the share in the market only reaches 11% in 2100

Thank you!

Helena Cabal, helena.cabal@ciemat.es
Yolanda Lechón, yolanda.lechon@ciemat.es