The European Commission’s science and knowledge service
Joint Research Centre

JRC-EU-TIMES updates and outlook

Unit C.7 - Knowledge for Energy Union

Wouter Nijs
17/11/2016
The JRC develops models for the energy system and interlinked sectors

Model landscape

- **Regional Holistic Global Equilibrium (RHOMOLO)**
- **Energy Services Demand**
- **Energy System Optimisation (JRC-EU-TIMES)**
- **Power System Unit Commitment (Dispa-SET)**
- **Asset Optimisation Price Taker Models (SPIRIT)**
- **Global Energy (TIMES-TIAM)**
- **Land use & forestry (LUISA, CBM, GFTM)**
- **Hydrology (LISFLOOD)**

**Models and Tools**

- **ERIBE-LAND¹**
- **JRC TIMES TRADE**
- **BIO-MASS²**
- **WATER-FLEX³**

**Software Tools**

- **BIO MASS²**
- **WATER-FLEX³**
- **ERIBE LAND¹**

**European Commission**
To analyse the **role of energy technologies and their innovation** in meeting the Energy Union's objectives by modelling possible future pathways for low-carbon technologies at system level.

**Objective**
- Minimise total energy system costs

\[
NPV = \sum_{r=1}^{R} \sum_{y=YEARS} (1 + d_{r,y})^{REFY_{r,y}} \cdot ANNCOST(r, y)
\]

**Constraints**
- Demand and supply balances: Transport, industry, buildings, agriculture - primary energy (RES, fossils), refineries and electricity
- Impacts of high variable RES-e
  - Flexible use possible excess RES-e: curtailment, Power2gas and storage
  - Reduced operation dispatch. power

**Align to latest EU Energy Reference Scenarios**
- Energy services demands (pkm, tkm, PJ, Mt)
- Resources and costs
- Technologies
- Policies (GHG and energy target, subs.)
JRC-EU-TIMES and some applications

**IMPROVED RES-e POTENTIALS**
Updated biomass, solar and wind potentials

**NOVEL INTEGRATION OF Var. RES**
Linear operative relations based on EHMIMRES and DISPA-SET

**OTHER DEVELOPMENTS**
New base year 2010+
Endogenous power plants lifetime
Power2Gas
Water - Energy

**SENSITIVITY**
Impact of policy context and techno-economic assumptions

**BIOMASS**
Impact of alternative biomass supply and demand
Coupling with carbon balance and wood markets forestry models

**HEATING AND COOLING**
Explicit representation of insulation options in buildings
Link with EnergyPLAN and FORECAST
What is EMHIRES?

EMHIRES is a publically available European dataset on wind and PV power generation as well as temperature corrected power demand, derived from meteorological sources that is available on several geographical levels: country, bidding zone, NUTS-1, NUTS-2.

The wind data are meteorologically derived wind power time series at high temporal and spatial resolution.

Increased accuracy
• Generation adequacy assessments
• RES-E integrations studies
• Studies on flexibility technologies, e.g. storage
Reconstructed wind farm database

Current methods
Approximations of few (5-10) power curves at averaged hub heights (80 and 100m)

EMHIRES:
1061 specific power curves of the 160 manufacturers registered in Europe at the precise hub height of the wind farm

Improvement: matching 95% of ENTSO-E 2015 factsheet statistics, while the original database matched 89%

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6 Primary data: The Wind Power
Dispa-SET 2.1 is a state of the art unit commitment and dispatch model

Dispa-SET model logic

Objective
- Minimise variable system costs

Constraints
- Hourly demand balances (power and reserve)
- Ramping constraints, minimum up and down times
- Storage balances (PHS, CAES)
- NTC based market coupling
- Curtailment of wind, PV and load shedding (optional)

Formulated as a tight and compact mixed integer program (MIP)
Implemented in GAMS, solved with CPLEX
Dispa-SET 2.1 Current coverage

Legend
- Included in the main model
- Isolated simulation
- Work in progress
JRC-EU-TIMES integration of Var. RES

- Parametrization for each timeslice based on **statistical analysis**
  - of Dispa-set **operation results**
  - for a wide set of **exploratory configurations** of the power system.

Parametrization:
- Power Capacities
- Flexible demand
- Electricity for heating
- Electricity for hot sanitary water
- Power Storage
- Excess power for curtailment or transformation Power to Fuels
- Operation of dispatchable plants.
JRC-EU-TIMES integration of Var. RES

- Parametrization for each timeslice based on statistical analysis
  - of Dispa-set operation results
  - for a wide set of exploratory configurations of the power system.
Sensitivity to policy context and techno-economic assumptions

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Sensitivity to policy context
Power production today (up) and in 2050 (middle and lower)
Sensitivity to policy context
Total energy use today (up) and in 2050 (middle and lower)
Forestry wood use by source in 2030

- **CBM potential harvest**
  - Thinnings, Final Fellings, Growing stock
  - Stumps, Tops & Branches, Precommercial Thinnings

- **GFTM material use**
  - V. Sawlogs & Pulp

- **BAU - CPI**

- **Scenario**

- **Source**
  - Sec. sawdust domestic / GFTM
  - Sec. woodchip domestic / GFTM
  - Stem and other wood from harvesti...
**H&C in JRC-EU-TIMES: the residential sector**

**New bottom-up estimation of thermal requirements**
Based on EUROSTAT building categories (detached, semidetached, flats), building vintage (6 groups), and insulation measures (roof, walls, windows).

**Calibration to the JRC-IDEES** database based on HDD, building geometry, insulation, and occupancy rates.
Heating: preliminary Sankey diagram
Stay in touch

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Thank you!

Comparing policy routes for low-carbon power technology deployment in EU – an energy system analysis

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ARTICLE INFO

Keywords:
Power sector
Low-carbon
Energy system model
TIMES
EU28
Energy technology policy

ABSTRACT

The optimization energy system model JRC-EU-TIMES is used to support energy technology R&D design by analysing power technologies deployment till 2050 and their sensitivity to different decarbonisation exogenous policy routes. The policy routes are based on the decarbonised scenarios of the EU Energy Roadmap 2050 combining energy efficiency, renewables, nuclear or carbon capture and storage (CCS). A “reference” and seven decarbonized scenarios are modelled for EU28. We conclude on the importance of policy decisions for the configuration of the low carbon power sector, especially on nuclear acceptance and available sites for new RFS plants. Differently from typical analysis focusing on technology portfolio for each route, we analyse the deployment of each technology across policy routes, for optimising technology R&D. R&D priority should be given to those less-policy-sensitive technologies that are in any case deployed rapidly across the modelled time horizon (e.g. PV), but also to those deployed up to their technical potentials and typically less sensitive to exogenous policy routes. For these ‘no regret’ technologies (e.g. geothermal), R&D efforts should focus on increasing their technical potential. For possibly cost-effective technologies very sensitive to the policy routes (e.g. CSP and marine), R&D efforts should be directed to improving their techno-economic performance.