

Results scenario comparison WP 5.2

European sustainable electricity; comprehensive analysis of future European demand and generation of European electricity and its security of supply (EU-SUSTEL)

Half year and Consultative Committee meeting,
20 June 2006, Eurelectric, Brussels

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5.2 Comparison and evaluation of simulation models & codes and existing scenarios for electricity generation

Comparison and evaluation of five existing studies regarding electricity generation within the European Union until 2030. Analysis of main differences in results and their major reasons, taking assumptions on fuel prices, technological development, policies, etc. into consideration.

1. World energy, technology and climate policy outlook – WETO 2030
2. World Energy Outlook – WEO
3. European energy and transport – Trends to 2030
4. Assessing Climate Response Options: POLIcy Simulations – ACROPOLIS
5. Systems Analysis Promoting Induced Energy Technology progress – SAPIENT

Scenario framework

Scenario limits

- Geography: Global/Europe
- Sectors: Energy sector/Electricity

The studies specified for WP5.2

- WETO, 2003
- World Energy Outlook, annually
- ACROPOLIS, 2003
- Trends to 2030, 2003
- SAPIENT, February 2005

Other current studies

- Scenarios on key drivers, September 2004
- SAPIENTIA, December 2005
- NEEDS, forthcoming 2007
- IEA-ETSAP, G8 Gleneagles Programme to 2008

5.2 ACROPOLIS and WETO: Main Focus of the Studies (1)

- *ACROPOLIS: Application and comparison of energy models to assess the impact of energy technologies and policy measures on greenhouse gases emissions and on sustainability in a global system analysis perspective. (Horizon: 1995 to 2030)*
- *WETO: Provide a reference scenario (business as usual) over the period 2000-2030 based on the POLES model. Contribution to the design of EU energy policy. Special focus was on the EU gas market and the GHG development in the business as usual scenario. Uncertainties have been analysed regarding resource estimates for oil and gas as well as technological development in electricity generation.*

5.2 ACROPOLIS and WETO: Scenario Variants beside BAU (1)

ACROPOLIS:

- Renewable Portfolio Schemes and Green Certificates
- International Flexible Mechanisms
- Efficiency Standards
- Internalisation of External Costs

WETO:

- Low oil and gas resources to evaluate the impact of higher fuel prices
- High gas resource case to evaluate the impact of structurally lower gas prices than oil prices
- Four technology development scenarios, regarding electricity generation
- GHG abatement scenario, implemented by a carbon value

World Energy Outlook

- IEA flagship publication since 1993
- Long-term energy projections using a World Energy Model (WEM)
- WEO 2000: Global trends to 2020. Assessment of WEO projections since 1992
- WEO 2001: Main message: Abundant supplies of energy, but massive investment in energy infrastructure will be needed
- WEO 2002: Project horizon to 2030. Highlights the importance of China.
- WEO 2003: World Energy Investment Outlook.
- WEO 2004: Short-term risks to energy security. Oil prices have broken \$50 a barrel.
- WEO 2005: “Middle East and North Africa Insights”

World Energy Outlook 2005 - Scenarios

- Reference scenario: Forecast of adopted policies
- Alternative policy scenario: Policy issues for consuming countries – Climate Change, Energy Security
- Deferred investment scenario: Impact of too little investments in upstream sectors (focusing on Middle East and North Africa)

Global scenarios covering all energy sectors

World Energy Outlook 2004 – Reference scenario

| Indicator | | Fuel | Baseyear | 2010 | 2020 | 2030 |
|---|-----------------|---------|----------|--------|--------|--------|
| Cost of Electricity Generation [Euro ₂₀₀₀ /MWh] | | | n.a | n.a | n.a. | n.a |
| Installed Electricity Generation Capacity and Production in Europe by Fuel | GW _e | Coal | 187 | 180 | 181 | 183 |
| | | Gas | 119 | 165 | 269 | 399 |
| | | Oil | 78 | 81 | 67 | 32 |
| | | Nuclear | 133 | 124 | 93 | 71 |
| | | RES | 164 | 221 | 308 | 376 |
| | TWh | Coal | 920 | 969 | 1099 | 1076 |
| | | Gas | 521 | 715 | 1071 | 1458 |
| | | Oil | 182 | 143 | 107 | 59 |
| | | Nuclear | 961 | 964 | 728 | 560 |
| | | RES | 401 | 626 | 890 | 1118 |
| CO ₂ Emissions by Electricity Generation [Mt] | | | 1308 | 1466 | 1650 | 1669 |
| Share of Domestic Primary Energy Supply [%] | | | 35.06% | 36.01% | 37.51% | 37.19% |

WEO 2005 Reference scenario

- Coal: Constant base load capacity to be modernised
- Gas: Huge investment in new capacity - with some reduced utilisation time
- Oil: Negligible and decreasing share
- Nuclear: Partial phase out
- RES: Substantial capacity increase – utilisation limited by resources (e.g. wind)

| Utilisation times - Total demand | | | | |
|----------------------------------|-------------|-------------|-------------|-------------|
| Fuel | Baseyear | 2010 | 2020 | 2030 |
| Coal | 0.56 | 0.61 | 0.69 | 0.67 |
| Gas | 0.50 | 0.49 | 0.45 | 0.42 |
| Oil | 0.27 | 0.20 | 0.18 | 0.21 |
| Nuclear | 0.82 | 0.89 | 0.89 | 0.90 |
| RES | 0.28 | 0.32 | 0.33 | 0.34 |
| Total TWh | 2985 | 3417 | 3895 | 4271 |

Gas will be the main source for meeting the increased electricity demand

Trends to 2030, SAPIENT

Energy and Transport: Trends to 2030

- Based on Annual Energy Reviews – includes Accession Countries etc.
- Demographic and economic assumption
- Energy balances and indicators

SAPIENT

- Various model approaches
- Focusing on endogenous technology learning
- Carbon constrained reference case
- Carbon constrained impact on power generation

NEEDS – forthcoming 2007

- Reference scenario: EC 2003, 2004, Kyoto to 2012, BAU.
- 1 Post-Kyoto climate policy: Long-term target 550 ppm CO₂ equivalent concentration
- 2 Enhancement of endogenous energy resources: Renewables, Bio-fuels, Energy conservation. (general constraint on input dependency)
- 3 Local pollution policy targets, cf. CAFE (Clean Air for Europe)
- Variants: oil prices

Conclusion on the availability of scenario data

Good data for scenarios on:

- Reference scenario with conventional assumptions
- Scenarios concerning the economic framework, i.e. growth, fuel prices etc.
- New technologies and technology progress

Weak data for scenarios on

- Electricity demand variations
- New demand segment with special characteristics concerning load variations, e.g. space cooling and transport.
- Heat market infrastructure, i.e. district heating and industrial heat/steam demand.
- Distributed electricity generation