Natural gas supply for Europe: an analysis with TIAM-IER

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Natural Gas reserve and resources

- Russia and the countries of the middle east control more than 75% of the natural gas reserves and resources

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Gas prices in Europe
22 January 2010
Natural gas consumption by source in Europe

- Growth of import dependence of Europe from Russia

Historical development of the natural gas price

The long term average share of the gas price compared to the oil price was 0.77.
The role of transport infrastructure

Oil market model LOPEX

Global energy system model TIAM

Modelling approach

Cartel rent for crude oil, Gas price linked to oil price

Reference point (crude oil consumption and price) for demand function
What is the maximum profit of the natural gas exporting countries to Europe?

- Profit of the gas exporting countries modeled as add on-costs.
- Profit of the exporting countries = (gas price Europe – gas cost) x import quantities
- Variation of the add on costs depending of different cost profiles

Profiles of cost shares of natural gas related to oil
Global energy system model: TIAM-IER

- **TIMES Integrated Analysis Model**
- **Based on TIMES model generator:**
  i. Developed by ETSAP
  ii. Dynamic partial equilibrium model approach with inter-temporal objective function (perfect foresight) minimizing total discounted system costs
  iii. Technologically detailed “bottom-up” model for each region
  iv. Covering energy flows from the useful energy demand over end-use sectors and conversion sector to the primary supply
- **Time horizon 2000 – 2100**
- **17 world regions with**
  i. Bilateral trade in hard coal, pipeline gas, LNG, crude oil, petroleum products (distillates, gasoline, heavy fuel oil and naphtha) and bioethanol
  ii. Global trade in emission permits possible
- **Emissions: CO$_2$, N$_2$O, CH$_4$**
  i. Carbon capture and sequestration (power generation and alternative fuel production)
  ii. Mitigation options for N$_2$O and CH$_4$
- **Climate module** (3-reservoir model for calculating atmospheric CO$_2$ concentrations)
- **Multi-stage stochastic programming** (uncertainties in emission targets, demands, bounds)

Regional coverage of the TIAM-IER model

- New regions: RUS (Russia), UBM (Ukraine, Belarus, Moldova), CAC (Central-Asia, Caucasus), EU (EU-27 + norway, swiss, Iceland), BLK (Balkan state)
- Replaced region: WEU (West Europe), EEU (East Europe), FSU
Scope of scenario analysis

- Scenarios analyzed:
  
  i. REFERENCE scenario: Long-term equilibrium on oil market incl. OPEC’s cartel behavior

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<tr>
<td>Global GDP growth</td>
<td>3.1%</td>
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<td>2.6%</td>
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<tr>
<td>Global population growth</td>
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<td>Maximum liquid supply [million bbl/d]:</td>
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ii. CO2 or climate policy scenario: Introduction of a CO2 price of up to 350 $/t by 2050

Profit of the gas exporting countries depending on the scenario
Development of price of natural gas in the reference scenario

![Chart showing the development of gas price and oil price over time in the reference scenario.](chart_reference_scenario)

Development of price of natural gas in the CO2 scenario

![Chart showing the development of gas price and oil price over time in the CO2 scenario.](chart_co2_scenario)
Conclusion

- In the long term based on efficiency improvement in the conversion sector and in the heat market the total amount of gas consumption in Europe will be reduced.

- In the conversion sector this reduction is only possible if CCS will be successful.

- Also if there will be a gas cartel the oil - gas price binding will not be substituted.

- Under a climate regime the share of coupling gas and oil price will increase to 1 compared with the long average of 0.77 in the past.