Preliminary results and findings

Energy perspectives for the Kaliningrad Region as an integrated part of the Baltic Sea Region

BDF Summit
Vilnius, 2 June 2010

Anders Kofoed-Wiuff,
Ea Energy Analyses
Stakeholder process

PHASE I
- Review of current energy situation

PHASE II
- Detailed scenarios of the electricity markets in the region 2010-2030

PHASE III
- Kaliningrad region as integrated part of the Baltic Sea Region

Dec 2008 Oct 2009 June 2010
Development gross energy cons.
Gross energy consumption in the Eastern Baltic Sea Region (2005 data)

- Estonia
- Latvia
- Lithuania
- NW Russia, incl. Kaliningrad

- Renewable Energy forms
- Electricity import
- Nuclear
- Natural gas
- Coal, oilshale
- Oil
A region with many plans … how do they interact?
6 scenarios for 2020

• A *Baseline scenario* for a development without new nuclear power plants in the region.
• Three *Nuclear power scenarios*, assessing the impact of a nuclear power plant in Kaliningrad and/or in Lithuania.
• A *Higher Efficiency Scenario* illustrating the effect of lower electricity demand than in the Baseline scenario.
• A scenario with *RE-subsidy and CO₂-quotas in Russia*, illustrating the consequences of equal RE-subsidy and CO₂-quota price in all simulated countries.

Using the Balmorel model to simulate investments in power capacity and the dispatch. Nuclear is not an investment option.

"Optimal" operation and investments given framework conditions: fuel prices, CO₂-cost, technology costs etc.
The baseline 2020

- Baltic Energy Ring established
- No new nuclear power capacity
- Fuel prices from World Energy Outlook (lower gas prices in Russia)
- RE-subsidy and CO2-quotas in 2020

<table>
<thead>
<tr>
<th></th>
<th>RE subsidy to electricity generation</th>
<th>CO$_2$-cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU countries</td>
<td>30 €/MWh</td>
<td>25.0 €/ton</td>
</tr>
<tr>
<td>Russia</td>
<td>15 €/MWh</td>
<td>12.5 €/ton</td>
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<tr>
<td>Source Type</td>
<td>Baseline 2010</td>
<td>Baseline 2020</td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>Estonia</td>
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<td>Latvia</td>
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<td>Lithuania</td>
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<tr>
<td>Kaliningrad</td>
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<td>NW Russia</td>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Estonia</strong></td>
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<td><strong>Latvia</strong></td>
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<tr>
<td><strong>NW Russia</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Shale</strong></td>
<td>4.6</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td>0.4</td>
<td>3.8</td>
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<tr>
<td><strong>Biogas</strong></td>
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<td>1.2</td>
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<tr>
<td><strong>Hydro</strong></td>
<td>0.5</td>
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<td><strong>Nuclear</strong></td>
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<td>2.1</td>
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<tr>
<td><strong>Natural gas</strong></td>
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<tr>
<td><strong>Oil</strong></td>
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<td>0.6</td>
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<tr>
<td><strong>Coal</strong></td>
<td>2.3</td>
<td>1.8</td>
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<tr>
<td><strong>Municipal waste</strong></td>
<td>0.1</td>
<td>0.3</td>
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</tbody>
</table>

TWh/year
Development in the baseline

- Estonia: oil shale down 60 %, replaced mainly by biomass and wind (1500 MW)
- Latvia: gas replaced by biomass, waste and wind (500 MW)
- Lithuania: gas replaced by biomass and wind (1050 MW)
- Kaliningrad: gas replaced by coal
- NW Russia: more coal and gas power
Transmission on Baltic Energy Ring

NordBalt (Swedish export)

Estlink 1 & 2 (Estonian export)

Lit-Pol (Lithuanian export)
Scenarios variations

• Three nuclear power scenarios:
  – *Kaliningrad nuclear*: 2300 MW in Kaliningrad, 1500 MW interconnector from Kal. to Lithuania (upgrade), 1000 MW interconnector Kal. to Poland (new).
  – *Lithuanian nuclear*: 2300 MW at Visaginas. No need for upgrade of transmission grid.
  – *Combination*: 2300 MW at both locations.
• A *Higher Efficiency Scenario*. 10 % lower electricity demand than in the Baseline scenario.
• A scenario with the same *RE-subsidy and CO₂-quotas in Russia* as in the EU.
Electricity generation

Baseline 2010 vs Baseline 2020

- Kaliningrad nuclear
- Luthuaninan nuclear
- Nuclear combination
- Improved efficiency
- Identical subsidies and quotas

TWh/year

- Shale
- Wind
- Biogas
- Biomass
- Nuclear
- Natural gas
- Oil
- Municipal waste
- Coal
- Municipal waste

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CO$_2$-emissions

**Baseline 2010**

**Baseline 2020**

Kaliningrad nuclear

Lithuanian nuclear

Nuclear combination

Improved efficiency

Identical subsidies and quotas

- **Shale**
- **Natural gas**
- **Municipal waste**
- **Oil**
- **Coal and lignite**
Transmission on NordBalt

Lithuanian nuclear (Lithuanian export)

Kaliningrad nuclear (Lithuanian export)

Combi nuclear (Lithuanian export)
PRELIMINARY FINDINGS
• The Baltic Energy Ring (BER) has a high utilization rate – indicating that the investments are of high value to the electricity system
• The ring enables the system to integrate large amounts of both nuclear and wind power
• Kaliningrad nuclear is mainly motivated by the possibilities of export of electricity from Kaliningrad. The plant only influences the generation in the Baltic States in a moderate way.
• Introduction of nuclear power in Lithuania reduces the use of biomass and import from Sweden.
• Wind power is a viable on market terms when subsidies and CO₂ quotas are included. Expansion with wind power in the Baltic countries will take place regardless of the introduction of new nuclear power capacity in region.

• A significant potential for biomass and wind could be utilised if Russia, including Kaliningrad, introduces the same subsidies and CO₂-quota regulation as in the EU. Reduces coal consumption.

• Efficiency measures (10%) will reduce the demand for investments in new thermal capacity by approx. 1900 MW.

• Integrating electricity markets between the Baltic countries and Russia could bring benefits without any additional costs.
Next steps

- Final report ready by end June
- Data from Kaliningrad will be more detailed
- Comments are much welcomed

Suggestions for further analyses
- Is nuclear, wind and energy efficiency measures feasible?
- Wind power integration on a regional level
- Economic case analyses of concrete projects
- Explore benefits (and costs?) from more integrated electricity markets
THANK YOU!
Average annual electricity market prices

Capital cost of investments in new generation capacity and interconnectors are not directly reflected in the electricity market prices.
Investments (not including nuclear)

<table>
<thead>
<tr>
<th></th>
<th>Baseline 2020</th>
<th>Kaliningrad nuclear</th>
<th>Lithuania nuclear</th>
<th>Nuclear combination</th>
<th>Improved efficiency</th>
<th>Identical subsidies and quotas</th>
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<tbody>
<tr>
<td>Biomass</td>
<td>1830</td>
<td>1439</td>
<td>745</td>
<td>306</td>
<td>1493</td>
<td>2111</td>
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<td>Wind</td>
<td>2400</td>
<td>2400</td>
<td>2400</td>
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<td>Natural gas</td>
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<td>5975</td>
<td>5941</td>
<td>5308</td>
<td>4083</td>
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<td>453</td>
<td>453</td>
<td>453</td>
<td>453</td>
<td>453</td>
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<tr>
<td>Coal</td>
<td>1705</td>
<td>1490</td>
<td>1394</td>
<td>1497</td>
<td>1923</td>
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<td>Biogas</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>68</td>
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</tr>
</tbody>
</table>

Biomass, Wind, Natural gas, Municipal waste, Coal, Biogas

Investments (not including nuclear):

- 700 MW less thermal
- 1400 MW less thermal
- 2300 MW less thermal
- 1900 MW less thermal
- 1650 MW less thermal

Investments (not including nuclear) and Improved efficiency.

- Biomass: 1830 MW
- Kaliningrad nuclear: 1439 MW
- Lithuania nuclear: 745 MW
- Nuclear combination: 306 MW
- Improved efficiency: 1493 MW
- Identical subsidies and quotas: 2111 MW

- Biomass: 2400 MW
- Kaliningrad nuclear: 2400 MW
- Lithuania nuclear: 2400 MW
- Nuclear combination: 2400 MW
- Improved efficiency: 2400 MW
- Identical subsidies and quotas: 16727 MW

- Biomass: 5948 MW
- Kaliningrad nuclear: 5975 MW
- Lithuania nuclear: 5941 MW
- Nuclear combination: 5308 MW
- Improved efficiency: 4083 MW
- Identical subsidies and quotas: 4641 MW

- Biomass: 453 MW
- Kaliningrad nuclear: 453 MW
- Lithuania nuclear: 453 MW
- Nuclear combination: 453 MW
- Improved efficiency: 453 MW
- Identical subsidies and quotas: 453 MW

- Biomass: 1705 MW
- Kaliningrad nuclear: 1490 MW
- Lithuania nuclear: 1394 MW
- Nuclear combination: 1497 MW
- Improved efficiency: 1923 MW
- Identical subsidies and quotas: 157 MW

- Biomass: 68 MW
- Kaliningrad nuclear: 68 MW
- Lithuania nuclear: 68 MW
- Nuclear combination: 68 MW
- Improved efficiency: 68 MW
- Identical subsidies and quotas: 68 MW

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<table>
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<tr>
<th></th>
<th>Short description</th>
<th>Target timescale</th>
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<tbody>
<tr>
<td><strong>Electricity interconnections</strong></td>
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<tr>
<td>LitPolLink</td>
<td>400 kV, 2x500 MW</td>
<td>2015/2020</td>
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<td>Estlink 2</td>
<td>650 MW</td>
<td>2014</td>
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<td>NordBalt</td>
<td>HVDC 700 MW</td>
<td>2015</td>
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<td><strong>New generation capacity</strong></td>
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<td>OL 3, Finland</td>
<td>Max 1600 MW, nuclear</td>
<td>2012</td>
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<td>OL 4, Finland</td>
<td>1450-1650 MW, nuclear</td>
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<td>Fennovoima, Finland</td>
<td>1500-2500 MW, nuclear</td>
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<td>Visaginas, Lithuania</td>
<td>Max 3400 MW, nuclear</td>
<td>2018</td>
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<td>Bechatow thermal plant, Poland</td>
<td>Max capacity 858 MW, lignite with CCS</td>
<td>2010</td>
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<td>1-2 nuclear power plants</td>
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<td>Lithuanian Power Plant, thermal</td>
<td>444 MW, combined cycle, gas turbine</td>
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<td>Kurzeme, thermal power plant, Latvia</td>
<td>400 MW, coal and biomass</td>
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<td>Riga 2, thermal plant, Latvia</td>
<td>420 MW, gas</td>
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<td>Kalinigradskaya TETs-2, Kaliningrad</td>
<td>450 MW, gas</td>
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<td>Baltic Power plant, Kaliningrad</td>
<td>2*1150 MW, nuclear</td>
<td>2016/2018</td>
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<tr>
<td><strong>Trade</strong></td>
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<td>Electricity market</td>
<td>Integration of Baltic markets with Nord Pool Spot Exchange</td>
<td>2013-15</td>
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# Investments 2010-2020

<table>
<thead>
<tr>
<th></th>
<th>Estonia</th>
<th>Lithuania</th>
<th>Latvia</th>
<th>NW Russia</th>
<th>Kaliningrad</th>
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<tbody>
<tr>
<td>Biomass</td>
<td>306</td>
<td>1266</td>
<td>257</td>
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<tr>
<td>Wind</td>
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<td>783</td>
<td>433</td>
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<tr>
<td>Natural gas</td>
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<tr>
<td>Municipal waste</td>
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<tr>
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<td>1325</td>
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<tr>
<td>Biogas</td>
<td>68</td>
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</tr>
</tbody>
</table>

**Baseline 2020**

![Bar chart showing energy investments by region and type between 2010 and 2020.](chart.png)