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Considerations of climate related policies and vulnerability of Estonian electricity and heat system development

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Agenda

• Overview of Estonia’s electricity and heat market
• Current policies and considerations of climate change related events
• Examples of possible climate related events
• Future options
Estonia

- Small Nordic country: population 1.34 million, area 45,227 km²
- The average population intensity: 30 persons per km²
- The average temperature in the summer months is typically 15 – 18°C; in winter, –4 – –5°C
- Domestic energy resources: oil shale and its products, peat, wood or other biomass, wind, hydro
- Imported resources: oil products, gas, coal

Electricity market

- Net installed capacity in 2008: 2362 MW
- Production in 2008: 9498 GWh
- Consumption in 2008: 7427 GWh
- Losses in 2008: 10.7%
- The difference was exported to Latvia and Finland
- Most of the electricity is produced by two oil shale fuelled power plants located in Northeast Estonia

Electricity production in 2008 according fuel (GWh)

Source: Statistics Estonia
Electricity grid

- Estonia’s grid is well connected to and also synchronized with the networks of Latvia, Lithuania, Belarus and Russia
- Sea cable Estlink between Estonia and Finland since 2006 – 350MW
- Another sea cable planned – 635MW

Source: Eesti Energia RAS
Heat market

• Production in 2008: 9240 GWh
• Consumption in 2008: 8284 GWh
• Losses in 2008: 10.3%
• Five CHPs with capacities varying from 23.5 to 100 MW
• Large number of small boilers – 81% <1 MW in capacity
• Most common fuels are gas and wood in boilers and oil shale and gas in CHPs
• Currently there is more capacity installed for heat production than real need

Source: Statistics Estonia
The energy policy up to this point

- Based on energy independence:
  - No strict CO$_2$ taxes (Kyoto protocol has no effect on Estonia)
  - Economic and social security
  - Existing capacities
  - Assumes little fluctuation in peak demand growth
  - Trying to decrease the share of gas due to security risks involving Russia as the sole supplier
Current state of analyses about possible effects of climate change related extreme events

- No impact expected in short term
- Hydro and wind plants are regarded as most vulnerable, but their share is insignificant
- Climate change caused extreme events are not considered in energy development plan nor any other long term plan
- Only possible climate change related threat considered is CO₂ tax
The model for Estonia's heat and electricity supply

- Estonian heat and electricity supply model was created with MESSAGE
- Modelling period 2007-2040, with results reported till 2035
- Entire country is modelled as a single homogeneous region
- Demand of electricity is expected to increase 1.5% annually, demand of heat is expected to stay same.
- Discount rate 5%, all costs in 2008 prices
- Imported fuels prices based on Energy Outlook 2009, investment and operation costs on IEA’s *Projected costs of Generating Electricity, 2010* edition
- CHPs and PPs modelled separately, boilers aggregated by fuel
- CO$_2$ tax of 20 Euros per tonne starting from 2013 was assumed for base cases
Business-as-usual
Electricity production by fuel

![Graph showing electricity production by fuel from 2008 to 2035. The x-axis represents the years from 2008 to 2035, and the y-axis represents the electricity production in MW/yr. The graph includes data for various fuels such as Oil shale, Gas, Coal, HFO, Wood, Peat, Other biomass, Nuclear, Wind, and Hydro.]
Heat production by fuel
Estimated costs

- Estimated discounted cost of CO$_2$ emissions from 2008-2035 with tax 20 Euros per tonne starting from 2013 – 2.59 billion Euros
- Estimated with tax 45 Euros per tonne – 5.82 billion Euros
Demand shocks

- Current system can accommodate winter demand increases up to 50%.
- Uncertain economic profitability makes building excess capacity in future questionable.
- Imports during demand shocks caused by weather are unlikely, because whole region will experience the same shock.
Demand shock at 2012
Conclusions

• Continuing current policy can incur considerable costs
• Only economic indicators are not enough to guarantee the supply of electricity and heat in future
Other technology options for the future

- Increase the share of renewable energy
  + Low CO\textsubscript{2} emissions
  - Increasing vulnerability to weather related extreme events as main available renewable resource is wind
  - Need to build extra capacity for stabilising windmills
Wind distribution in Estonia
Other technology options for the future

- Nuclear power
  + Low CO$_2$ emissions, better capability to deal with demand shocks
  - High investment cost
  - No legislative framework yet
Thank you for your attention!