MARKAL/TIMES in Sweden
- 2005 an update

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Monthly Electricity Demand in 2003 (TWh)

Source: Nordel 2004
Total electricity generation by energy source 2003

**Country**
- Norway: 107 TWh
- Sweden: 133 TWh
- Denmark: 44 TWh
- Finland: 80 TWh

**Energy Sources**
- Hydropower
- Nuclear power
- Natural gas
- Oil
- Coal
- Biomass & Peat
- Wind power
- Other

Source: Nordel 2004

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Total trade in year: 2003

<table>
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<tr>
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<th>To</th>
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<tbody>
<tr>
<td>Norway</td>
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<td>Norway</td>
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<tr>
<td>Sweden</td>
<td>7.3</td>
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</tr>
<tr>
<td>Sweden</td>
<td>7.5</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Source: Nordel 2004
Development of electricity grids
Trade of electricity
– Historical perspective

• Around 1960: "Samkörningsgruppen"

• 1995: Norway started Nordpool
• 1996: Sweden
• 1998: Finland
• 1999/2000: Denmark (West/East)
Model – MARKAL_Nordic

- Regions: Swe, Nor, Fin and Den
- Time Horizon: 1995-2051 (7 years step)
- Focus on Grid distributed energy carriers
- Demand Sectors: 12-28 / country (no Transport)
- El. Conversion Technologies: 7-33 / country
- Stepwise Trade with Northern Europe
- Example on Studies:
  - Nordleden (trade with green certificates and emission permits)
  - Effects on the Nordic Electricity system from trade with Northern Europe

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Ongoing Projects with MARKAL/TIMES

- MARKAL_Nordic (Chalmers and Profu)
- NEEDS/TIMES_SNI (Chalmers)
- Externalities (Chalmers/LTU)
- Transport Sector (Chalmers)
- TIMES_VG_region (Chalmers)
- ASEAN MARKAL modeling project (Chalmers, SEI & ASEAN partners)
- Profu Projects
Transport sector

- **Aim:** To analyze the competitiveness of carbon reductions in the transport sector.
- **Developed a separate Transport model:**
  - Five end use demands (of vehicle kilometers): cars, light trucks, heavy trucks, buses, MC.
  - Possible to link to MARKAL Nordic which enables comparison between CO2-reductions in stationary energy sector to reductions in transport sector.
- **Preliminary results:**
  - Few early actions in the transport sector.
  - Fuel cells and electric hybrids play important role in the last time period but strongly dependent on cost development.
  - Black liquor methanol more competitive in scenarios with no or low carbon constraints than in scenarios with high constraints.
  - Results strongly dependent on discount rate.

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Bio Refinery Rya project and the TIMES_VG_Region model

- **Aim**: To build a regionalized model for the greater Gothenburg Region (“Västra Götaland Region”) in order to analyze the importance of the district heat demand for distributed power generation.

- A part of a larger project were the possible role of biomass gasification are being explored.

- **Focus**: Comparing gasification technologies with other biomass technologies (especially CHP).

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ASEAN modeling project

- **Aim**: To study the importance of different energy scenarios for three ASEAN countries (VietNam, Philippines and Indonesia) from a European perspective.

- The modeling activities will build on a MARKAL model developed earlier in collaboration with Australian partners.

- **Focus**: Possible roles of renewable and in particular European renewable technologies.

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Profu - Studies with MARKAL

- A common Swedish-Norwegian market for Green Certificates – Focusing on the power production and certificate prices.

- New principle for allocation of emissions rights – A comparison between different allocation principles effects on the power production mix.

- Analyses for the forth Swedish Climate rapport – Focusing on the impact of different policy instruments on CO2-emissions since 1990 up to 2020

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Anna Krook Riekkola, Energy Systems Technology

Important Energy issues for Sweden:
- Nuclear Phase Out
  - Renewable Energy
  - Waste incineration (good or bad?)
  - Energy saving
- Carbon emission trading

Thanks!