Nordic electricity generation

<table>
<thead>
<tr>
<th>Country</th>
<th>Installed capacity</th>
<th>Statkraft</th>
<th>Production (TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>~28.200 MW (hydro 99,8%)</td>
<td>~35%</td>
<td>119 TWh</td>
</tr>
<tr>
<td>Statkraft</td>
<td>~35%</td>
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<td></td>
</tr>
</tbody>
</table>

- Installed capacity: ~28.200 MW (hydro 99,8%)
- Production: 119 TWh

Nature at work
The Norwegian System

• Big oil and gas reserves offshore – one of the largest exporters in the world

• Large potential for renewable energy
  - Hydro power
  - Wind power onshore
  - Wind power offshore
  - Bio energy
  - Wave and tidal power
  - Osmotic power

• The future of hydrogen processed from renewables
Average Annual Growth in Electricity Demand & Generation Capacity *).

Norway 1960 - 2005

Average increment in generation capacity *)
Average increment in electricity demand

Modest investments in new capacity since deregulation

*) Increase in mean annual generation capacity
The Nordic System 2008

Energy balance
Normal inflow year
Power production in OECD-Europe


Some renewables in Norway – new capacity

Potential

SUM: 200 TWh +/-
Good wind conditions in Norway

Blue and green  < 5.5 m/s
Yellow  5.5-6.5 m/s
Red  6.5-7.5 m/s
Purple  > 7.5 m/s
Wind Energy Variations - Norway

![Graph showing normalized data for Wind energy, Water inflow, and Load over weeks. The graph indicates fluctuations in wind energy with a peak around week 19, while water inflow shows a different pattern with a peak around week 25.]
Wind Power Projects

- In operation
- Planning in progress
- Concession applied
- Concession given

The official target is 3.0 TWh/year in 2010
Installed capacity 350 MW
Licenses for totally 850 MW given
Another 5.000 MW under licensing process

Kilde: NVE, august 2006
Main Challenges

• Get permission/concession to build

• Get positive cash flow – ensure the project economy and return of investment

• Technology itself is usually not the limiting factor
Spot Prices Nordic market

Need added value to implement more renewable energy

Support schemes are needed
Support schemes for renewable energy in EU-15 (15 EU countries)

- Fixed production support
  - DK
  - FR
  - LU
  - AT
  - GE
  - PT
  - ES
  - NL

- Volume based
  - SE
  - UK
  - IT
  - BE

- Certificate approaches
  - IE
  - FR

- Bidding
  - NL
  - FI

- Tax incentives
  - UK

Source: EU DG TREN
## Support to renewables in the EU

<table>
<thead>
<tr>
<th><strong>REFIT (Feed-in tariffs)</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highly effective. Highly efficient due to the low risk for investors. Permits strategic support for technology innovation.</td>
<td>More difficult compatibility with the internal market. Needs regular adjustment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Premium</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highly effective. Efficient due to the medium risk for investors. Good compatibility with the internal market.</td>
<td>Risk of over-compensation in the case of high electricity prices without appropriate adjustment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>TGCs (Green certificates)</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good compatibility with the internal market. Competition between generators. Supports the lowest-cost technologies.</td>
<td>Currently less efficient due to higher risks and administrative costs. Not very appropriate for developing medium- to long-term technologies.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Tendering</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fast development with political will.</td>
<td>Stop-and-go nature causing instabilities. If competition is too severe, development is blocked.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Investment subsidy</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good complement for some technologies.</td>
<td>Inefficient as a main instrument.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Fiscal measures</strong></th>
<th>PROs</th>
<th>CONs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good secondary instrument.</td>
<td>Good results only in countries with high taxation and for the most competitive technologies.</td>
</tr>
</tbody>
</table>

Kilde: EU DG Tren
Changing economic support for renewable energy
- lack of predictability
Economic support for Wind Power
- Present Status

- The proposed common market for green certificates between Sweden and Norway was abandoned winter 2006

- Minister of Energy stated, March 15th:
  "I will within short time present an alternative [to green certificates] which secures the goal for new energy production based on renewable energy"

  "There is no reason to postpone the investments in wind power"

- October 2006:
  - Wind Power: 1,2 cents/kWh (8 øre/kWh)
  - Bio Energy: 1,5 cents/kWh (10 øre/kWh)
  - Small hydro: 0,7 cents/kWh (4 øre/kWh)

- This will not ensure investments
The Licensing process becomes more complicated: e.g. for Wind Farms

- Notification
  - Public inquiry
- Application for license including impact assessment
  - Public inquiry, the public hearing process becomes more challenging
  - Opponents are increasing in number and ‘power’
- Evaluation of the application by the authorities (Water and Energy Directorate – NVE) including thematic assessment of conflicts.
- Consession given by NVE
- If complaints - the final decision by the Ministry of Oil and Energy
- Total time frame: 2 – 5 years: tends to reach 4-5 years in average
Technical Challenges
- Grid Connection and lack of transmission capacity

Power grid: 132 kV (200-400 MW)
Wind power applications: app. 4000 MW

Reference: NVE, April 2006
Reference: Nordel, April 2006
Wind Turbines
- Beauties or Beasts?
Classical challenges:

- Nature and environment
- Birds and wind turbines
Challenges up North:
- Reindeer vs. Wind Power
"Hardware" challenges:
- Noise
- Shadow Effects
- Icing
Common Challenges:

- Landscape
- Cultural Heritage
- Cultural Environment
”New” challenges:
- Tourism
Not In My Back Yard?
Summary:

- Norway has large potential for renewable energy
  - Wind power
  - Bio Energy
  - Wave and Tidal
  - Osmotic
- Also huge oil and gas reserves
- The future of hydrogen?
- Main challenges
  - Economy
  - Permission to build
- Opponents are increasing in number and power
  - Organizing against wind power