Norway vs. EU / Europe - Perspectives from the Electricity Industry

Exec. dir. Networks and Markets Einar Westre
Agenda

• Reducing greenhouse gas emissions – perspectives from the electricity industry

• Norway vs. Europe – exchange of electricity, opportunities and challenges
RES Focus - Evolution of Generation

Source: Frontier Economics
EU Roadmap 2050 - closing the emission gap

80% domestic reduction in 2050 is feasible
- with currently available technologies,
- with behavioural change only induced through prices
- If all economic sectors contribute to a varying degree & pace.

Efficient pathway:
- 25% in 2020
- 40% in 2030
- 60% in 2040

Source: EC
How to achieve a carbon neutral sector by 2050

- Renewable energy production
- Nuclear
- Major push in Energy Efficiency
- Carbon Capture and Storage
Sustained European technology leadership

Total installed capacity (GW)

- 190 GW: 83%
- 40 GW: 17%
- Offshore takes off: 20% of EU electricity from wind
- 64.5 GW: 98%
- 1.5 GW: 2%
- 2006-2020

Technology leadership
Max. competitiveness

- 250 GW: 62%
- 150 GW: 38%
- Offshore is main market: 33% of EU electricity from wind

Source: EWEA

EnergyNorway
By 2020, many states will face significant problems in managing intermittency

Graph shows total wind capacity according to NREAPs, as a percentage of minimum demand & interconnectivity in summer 2020

Ref: EURELECTRIC/POYRY study, 2011
Photovoltaik wird zur tragenden Säule der Energieversorgung
Kosten-Begrenzung auf rund 2 Cent je Kilowattstunde

Entwicklung der installierten Solarstrom-Leistung (kumuliert in GWp, NAP-Szenario)

Anteil der Photovoltaik an der EEG-Umlage in Cent/KWh*

Quelle: Prognos, Roland Berger
Solar Power Systems - Desertec

- aims to source 15 percent of Europe's electricity supply from the deserts by 2050
The European power industry – action plan for renewable energy

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<tbody>
<tr>
<td>Regulation for Smart Grids.</td>
<td>Requirements for flexible back-up capacity.</td>
<td>Possible need of reviewing market design.</td>
<td>Harnessing EU synergies: cooperation mechanisms.</td>
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Comprehensive strategy and recommendations on the role and contribution of RES for EU energy policy goals in 2020 time horizon.
A system/market approach to managing variability needed for the continued growth of renewables in Europe
EU carbon-neutral power by 2050 is possible

- Expansion of the Emission trading scheme
- All power generation options needed
- Electrification of demand is essential
- Significant grid investments required
- Delay of CCS and/or nuclear phase-out = slower CO\textsubscript{2} reduction
- The major CO\textsubscript{2} reductions in power are achieved from 2025 onwards
- Energy efficiency plan

- **NB!** Efficient and reliable wholesale markets with trustworthy prices!
Europa vs. Norway - exchange of electricity, opportunities and challenges
Norway – “battery of Europe”? - supplier of balancing power
Norway has large potentials for flexible production

- Approx. 50% of Europe's hydro reservoir
- Installed capacity of approx. 30 GW
- Run time of approx. 3500 - 4000 hours
- Potentials for large increases of production capacity and increased pumped storage
<table>
<thead>
<tr>
<th>Power Station</th>
<th>Capacity Increase (MW)</th>
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<tbody>
<tr>
<td>Pump Storage Tonstad</td>
<td>1400</td>
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<tr>
<td>Pump Storage Holsen</td>
<td>700</td>
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<tr>
<td>Pump Storage Kvilldal</td>
<td>1400</td>
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<td>Capacity Jøsenfjorden</td>
<td>1400</td>
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<td>Pump Storage Tinnsjø</td>
<td>1000</td>
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<td>Capacity Lysebotn</td>
<td>1400</td>
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<td>Capacity Mauranger</td>
<td>400</td>
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<td>Capacity Oksla</td>
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<td>Pump Storage Tysso</td>
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<td>Capacity Aurland</td>
<td>700</td>
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<td>Capacity Tyin</td>
<td>700</td>
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<td><strong>Sum new capacity</strong></td>
<td><strong>11,200</strong></td>
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Ref.: CEDREN
Environmental impacts and social acceptance
Challenges

- Going from “reservoir corner” through the North European “wind belt”
- Business case and market models for interconnectors
- Capacity constraints
- Financing, hedging and cost allocation issues
- Political and regulatory framework (National and EU level)
Flow paths 2025 and planned interconnectors

<table>
<thead>
<tr>
<th>Existing Interconnectors</th>
<th>Maximum Capacity export (import)</th>
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<tbody>
<tr>
<td>Russland</td>
<td>50 MW</td>
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<tr>
<td>Finland</td>
<td>100 MW</td>
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<tr>
<td>Sverige</td>
<td>3,545 MW (3,795 MW)</td>
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<tr>
<td>Danmark</td>
<td>1,000 MW</td>
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<tr>
<td>Nederland</td>
<td>700 MW</td>
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<tr>
<th>Planned projects</th>
<th>Connection Country</th>
<th>Capacity</th>
<th>Operation</th>
</tr>
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<tbody>
<tr>
<td>Skagerak IV</td>
<td>Danmark</td>
<td>700 MW</td>
<td>2014</td>
</tr>
<tr>
<td>NorGer</td>
<td>Tyskland</td>
<td>1,400 MW</td>
<td>2016</td>
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<tr>
<td>NORD.LINK</td>
<td>Tyskland</td>
<td>1,400 MW</td>
<td>2017</td>
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<td>NorNed 2</td>
<td>Nederland</td>
<td>700 MW</td>
<td>2017</td>
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<td>Englandskabel</td>
<td>England</td>
<td>1,400 MW</td>
<td>2020</td>
</tr>
<tr>
<td>NorthConnect</td>
<td>Skotland</td>
<td>1,400 MW</td>
<td>2020</td>
</tr>
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Ref.: Statnett, ECgroup
The South region case study (Statnett)

- Exchange possibilities are reduced
  - 2014 only SK4 (700 MW)
  - 2018 additional 1000 MW (GB)
  - 2021 additional 1000 MW (Germany)

Ref.: Statnett
Possible solutions

• Point of connection
  • Avoid constrained areas
  • HVDC directly to power “strongholds”
  • Increased internal investments
• Merchant solutions
• Private – Public consortia’s
Summary

- Huge changes in the European electricity industry the next decades to reduce GHG emissions
  - Will represent significant challenges for markets and the technical system
  - Only a co-ordinated European approach will secure a sustainable solution!
  - Key challenges:
    - acceptance for developing more grid capacity
    - secure efficient and reliable wholesale markets
- Opportunities for a closer co-operation Continental Europe/UK - Norway on balancing power
  - Logical solution, but..
  - This requires clear political ambitions and commitments!