The Electric Power System

- Norway -

Norwegian Power System
Basic facts

- Area: 323 886 km²
- Population: 5 186 802 (1.1. 2015)
- Number of electricity consumers: 2,938 million
- 1 TSO
- Number of DSOs: 129
- Peak load: 24,18 GW (23.01. 2013)
- Average interruption of electricity: See next page
Basic facts

- Average interruption of electricity:

### Short term interruptions ≤ 3 min
- Number of interruptions per end consumer
- Average duration of interruption (minutes)

### Long term interruptions > 3 min
- Number of interruptions per end consumer
- Average duration of interruption (hours)

Source: NVE
Norway in the European grid

- **Interconnectors with:**
  - **Sweden**
    - 4x420 kV, 1x220 kV, 2x132 kV and 1x66 kV
  - **Finland**
    - 1x220 kV
  - **Russia**
    - 1x132 kV
  - **Denmark**
    - 4xHVDC 1700 MW
  - **The Netherlands**
    - 1xHVDC 700 MW
  - **Germany (planned)**
    - 1xHVDC 1400 MW
  - **Great Britain (planned)**
    - 1xHVDC 1400 MW
## Grid facts and characteristics (2014)

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Total length (approx.)</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Grid 420 kV</td>
<td>2810 km</td>
<td>TSO</td>
</tr>
<tr>
<td>Transmission Grid 300 kV</td>
<td>4850 km</td>
<td>TSO</td>
</tr>
<tr>
<td>Transmission and Regional Grid 132 kV</td>
<td>2742 km</td>
<td>TSO and DSO</td>
</tr>
<tr>
<td>High Voltage DC 250 kV - 450 kV</td>
<td>1300 km</td>
<td>TSO</td>
</tr>
<tr>
<td>Medium Voltage 1 kV - 66 kV</td>
<td>125 260 km</td>
<td>DSO</td>
</tr>
<tr>
<td>Low Voltage 230 V or 400 V</td>
<td>194 250 km</td>
<td>DSO</td>
</tr>
</tbody>
</table>
Structure of electrical power system

Power plants and load can be connected to any grid, depending on size and location.
The high voltage grid
Information on TSO

- Name: Statnett SF
- Network length 11 800 km
- 150 Substations
- Served area 323 886 km²
- Annual transmitted energy 128 TWh (2013)
- Website: http://www.statnett.no
Responsibilities of TSO & DSOs

**TSO:**
- Is responsible for the reliability and the balancing of the power system. This includes operational planning, balancing services, supervision of the system, maintenance coordination and in the long run construction and development of the grid and development of electricity markets.

**DSO:**
- The distribution grids have an area licence for their service area from the Norwegian regulator NVE. As a monopoly they have to connect electricity producers and consumers to the grid and transmit electricity through it. A regional task is to take care of the voltage quality.
Installed capacity with reference to primary resources

- Installed capacities (GW), year 2014
  - Hydro power: 31,094
  - Wind power: 0,856
  - Thermal: 0,652
Energy production with reference to primary resources

- Electricity generated (TWh), year 2014
  - Hydro power: 137
  - Wind power: 2
  - Others (Thermal): 4

Norwegian Power System
Development of hydro generation capacity

![Graph showing the development of hydro generation capacity from 2003 to 2013. The capacity increases gradually over the years, reaching approximately 30,000 MW by 2013.]
Energy Consumption per customer groups

- Public administration and military
- Education, health and social
- Transport
- Other service industries
- Commodity trade, accommodation, service
- Construction
- Energy, water supply, waste management
- Industry
- Mining, oil and gas production inclusive services
- Agriculture, forestry, fisheries

Kilde: Energiregnskapet. Statistisk sentralbyrå
Development of wind power

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Price development for industry consumers

- Electricity prices for industry customers are not public information

- Grid tariffs for industry customers, average figures for 2015:
  
  (1 Euro = approximately 10 NOK)

- Grid tariff converted and calculated based on power and energy consumption
  
  - Medim voltage (Customer with maximum 400 kW and 1,6 GWh/year): 842 NOK/kW/year
  
  - Low voltage (Customer with 40 kW and 160 MWh/year): 1087 NOK/kW/year

- Grid tariff converted to øre/kWh based on power and energy consumption
  
  - Low voltage (Customer with 40 kW and 160 MWh/year): 27,2 øre/kWh
Price development for households

Electricity price including grid tariff and taxes in øre/kWh (1.1. 2012 – 1.4. 2015) (10 øre = approx 1 euro cent)
Energy balance in 2013

- Generation (TWh): 133 975
- Consumption (TWh): Gross 128 970  Net: 119 540
- Imports (TWh): 10 135
- Exports (TWh): 15 140
- Losses total (TWh): 8 024
- Losses transmission grid (TWh): 2 497
- Pump storage consumption (TWh): 1 406
Norway is part of the Nord Pool Spot (NPS) electricity market area. NPS has together with the power exchanges mentioned below, developed the market solution called Price Coupling of Region (PCR).
Electricity market organisation

After the launch in February 2014, PCR has developed to what is named Multi-Regional Coupling (MRC). The status of MRC is shown here.

- Development since the first launch 4 February 2014

<table>
<thead>
<tr>
<th>Expansion of MRC</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWE, Baltic, GB</td>
<td>4 Feb 2014</td>
</tr>
<tr>
<td>Austria, Poland</td>
<td>Partial solutions, from Feb 2014 linked to NWE (MRC)</td>
</tr>
<tr>
<td>SWE</td>
<td>May 2014 – with NWE Full Coupling</td>
</tr>
<tr>
<td>Italian Borders</td>
<td>Launched 24 FEB 2015 as Full Coupling with MRC</td>
</tr>
<tr>
<td>4MMC</td>
<td>Separate PCR solution, NOV 2014 (later to join MRC)</td>
</tr>
</tbody>
</table>

Source: Price Coupling of Regions

Norwegian Power System
Electricity market organisation

- Norway is part of Nord Pool Spot electricity market area
- Nord Pool Spot offers Elspot Day-ahead market and Elbas Intra-Day market
- Statnett as TSO operates several reserve markets for balancing purposes:
  - A capacity option market for regulating power (RKOM)
  - A regulating power market (Tertiary reserves)
  - A market for FCR (Primary reserves)
  - A market for FRRa (Secondary reserves)
- In addition to the Nordic countries, Nord Pool Spot offers a day-ahead market in the Baltic states and in UK (N2EX), and an intra-day market in the Nordic, Baltic, UK and Germany