The Electric Power System

- Netherlands-
Basic facts

- Area: 41 543 km²
- Population: 16 877 351 (2014)
- 1 TSOs
- 10 DSOs (source: NetbeheerNederland)
- Peak load: approx. 20,3 GW (source: TenneT TSOs)
- Average interruption of electricity (2014): 20 min (sBetrouwbaarheid elektriciteitsnetten 2014 (NetbeheerNederland)
Netherlands in the European meshed grid

- Interconnectors to:
  - Norway;
  - Belgium;
  - Great Brittan;
  - Germany;
  - Denmark (planned);
Grid facts and characteristics

- The electricity grid in Netherlands is sub-divided into transmission grids (maximum voltage) and distribution grids (high, medium and low voltage)

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Total length (approx.)</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Grid</td>
<td>220 and 380kV</td>
<td>TSO</td>
</tr>
<tr>
<td>High Voltage</td>
<td>50 kV to 150 kV</td>
<td>TSO/DSO</td>
</tr>
<tr>
<td>Medium Voltage</td>
<td>3 kV to 25 kV</td>
<td>DSO</td>
</tr>
<tr>
<td>Low Voltage</td>
<td>230 V or 400 V</td>
<td>DSO</td>
</tr>
</tbody>
</table>

Source: Netbeheer Nederland
Structure of electrical power supply

TSO

380 kV

220 kV

150 kV or 110 kV

50/10 kV or 50/23 kV

380 V

Utilities

Dispersed Generation

Households

DSO

Bulk-Industry

Conventional Generation

Dispersed Generation

Source: Amprion GmbH

Dutch Power System
High Voltage Grid

Source: TenneT TSO
In case of (n-1)-security violations in the EHV-grid due to high dispersed generation TSO and DSO collaborate to lower the infeed of renewable generation in DSOs grid. TSO initiates and DSOs operate these measures according following cascade:

Cooperation of TSO and DSO:
Cascade in Generation Dispatching of Renewables

Source: BDEW
Responsibilities within the cascade

- TSO monitoring the overall system
- Responsibility for SoS*
- Operative contact to DSOs / generators on TSO-Level
- Requests support by the DSOs

- Monitoring own system
- Operative contact to generators on DSO-Level
- Support of TSO to operate the cascade

- Support of industrial customers to SoS through decreasing / increasing load
- End user can be disconnected

- Support of TSO / DSO to SoS through decreasing / increasing the power of generation units

*SoS = Security of Supply
Trend Power production Netherlands

Source: Umweltbundesamt

- Green
- Remaining
- Nuclear
- Natural gas
- Heavy oil
- Coal
- Natural gas
- DG
- Natural gas
Profile Energy consumption 2013

Verdeling over sectoren van het verbruik van elektriciteit

- Refinery: 3%
- Service: 43%
- Fishing industry: 0%
- Water distribution and waste water: 1%
- Food industry: 7%
- Metal industry: 7%
- Chemical industry: 15%
- Paper industry: 3%
- Remaining metal industry: 4%
- Civil construction: 2%
- Remaining industry: 3%
- Construction: 1%
- Agriculture: 10%

Source: Netbeheer Nederland
Renewables
A Amsterdam (NH): the number of inhabitants (790,110)
B Súdwest Friesland (FR): largest area (813.05 sq km)
C The Hague (ZH): most addresses with solar panels (2790)
D Schagen (NH): most addresses with solar panels per 10,000 inhabitants (286)
E Delft (ZH): most addresses with solar panels per km² (45)
F Amsterdam (NH): most recorded PV capacity (4934 kWp)
G Eersel (NB): Most PV capacity per capita (246 Wp / inhabitant)
H Veenendaal (Ut): Most PV capacity per square kilometer (96 kWp / km²)
I Eersel (NB): highest average plant size (27.5 kWp / address)

Source: IWES
Development of Wind Power

Realised onshore wind power

Realised wind power and targets 2020 and 2023

Source: CBS
Development PV Power

Source: CBS

Bron: CBS
Market
Price development for electricity

Average price including tax cent/kWh

Source: Eurostat

Dutch Power System
Cross-border markets

The following cross-border market improvements are established the following cross-border systemic improvements or is still working on the implementation:

- Market coupling Germany - Belgium - France - Netherlands (2010)
- Intraday Cross Border (2011)
- Intraday with Norway (March 2012), in England (May 2012)
- Northwest European market coupling: Scandinavia, Great Britain and Central West Europe (Feb 2014)
- Multi-Regional Coupling (MRC): Southeast Europe and Southwest Europe (May 2014). The MRC is the target model for further expansion in Europe into a single integrated cost-connected European day-ahead market.
German EEG concept

Electricity Energy Market

Power Exchange

Energy supply

Connection and compensation obligated SO

RES

Connection and compensation obligated SO

Final consumer with own power production

Privileged final consumer

Supplier

EEG apportionment

EEG apportionment to own consumption

Upon application: EEG apportionment costreduction to energy price

EEG apportionment nationwided to energy price

Energy supply

Federal and financial funding grouted under EEG

Proceeds from direct marketing

Proceeds from direct marketing

Marketing through control area TSO

Costs / Proceeds marketing

Vertical balancing adjustment

Horizontal balancing adjustment

Control area TSO

Physical compensation

Federal and financial funding less network charges

Financial Compensation

EEG apportionment

EEG Account

EEG apportionment to own consumption

EEG Account

EEG Account

EEG Account

EEG Account

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German EEG concept

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