Nordic and Baltic Sea Winter Power Balance 2021–2022

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ENTSO-E Regional Group Baltic Sea (RG BS)

Overview of the report

- Executive summary
- Regional review of Winter Power Balance 2021–2022
  - Methodology description
  - Probabilistic analysis
    - Main findings of ENTSO-E Winter Outlook
  - Deterministic analysis
    - Main findings of power balance
    - Power balance: Average winter
    - Power balance: Severe winter
    - Input assumptions and other notes
  - Country comments

Executive summary

- Aim of the analysis was to review, validate and give regional insight on the state-of-art resource adequacy assessment[1] for upcoming winter, and provide an easy-to-understand overview of upcoming winter power balance for an average winter and severe winter peak demand situation
- Resource adequacy is on a sufficient level in the Nordic and Baltic Sea region for the winter 2021–2022
  - No adequacy problems were identified in the region on the pan-European probabilistic analysis[1]
- The Nordic and Baltic Sea region is expected to rely on electricity imports during high demand
  - Imports are required from other countries in the region and on the wider geographical area
  - Availability of dispatchable generation plays an important role in the power balance
- High availability of dispatchable generation and cross-border transfer capacity is important to mitigate adequacy risks
  - In addition, TSOs have reserves that can be procured to try to avoid load curtailment in the case where market-based available capacity is not sufficient to meet the demand
  - High prices are likely in scarce situations, but this is not seen to affect resource adequacy

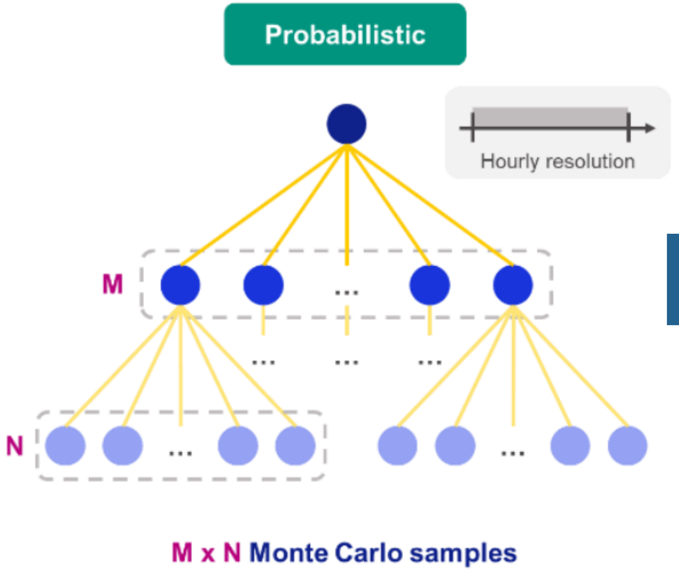
1: ENTSO-E (2021), Winter Outlook 2021-2022

Regional review of Winter Power Balance 2021–2022

Methodology description

Probabilistic analysis: ENTSO-E Winter Outlook

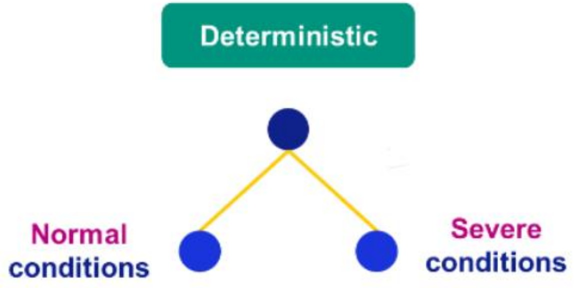
- Probabilistic approach assesses resource adequacy on an hourly resolution in the upcoming winter, from the beginning of November 2021 till the end of March 2022, in Europe
  - Pan-European scope: ENTSO-E member countries in Europe, and each Member States TSOs submit inputs for the analysis
  - Considers M (=35) years of interdependent climate data and N random draws for unplanned outages, which are combined for M x N ‘Monte Carlo samples’
  - Simulates electricity market on an hourly resolution, including demand, generation and imports/exports between the countries



Deterministic analysis: Power balance

- Deterministic approach assesses power balance (domestic generation – domestic consumption) of the expected annual peak demand hour for the upcoming winter in the Nordic and Baltic Sea countries
  - Focus is on Nordic and Baltic Sea region which comprises of Norway, Sweden, Finland, Denmark, Germany, Poland, Estonia, Latvia and Lithuania.
  - Normal conditions refer to an expected (median) peak demand during winter months for each country. Severe conditions refer to a highest expected (P95) peak demand for each country.
  - Available generation capacity is based on ENTSO-E Winter Outlook data with a conservative assumption on wind generation in the region
  - Does not consider unplanned outages or demand-side response
  - No interconnectors or imports are included in the quantitative analysis, but these are considered qualitatively

Single peak demand hour for each country



The probabilistic analysis uses state-of-the-art methodology and it should be considered as a primary tool for analysing the regional resource adequacy.
The deterministic analysis is prepared to support the probabilistic analysis and to visualise the power balance in each country at a peak demand situation.
TSOs have agreed to move from deterministic analysis to the state-of-art probabilistic analysis. Effort is made to prepare stakeholders of this change and to introduce the new approach.

Probabilistic analysis

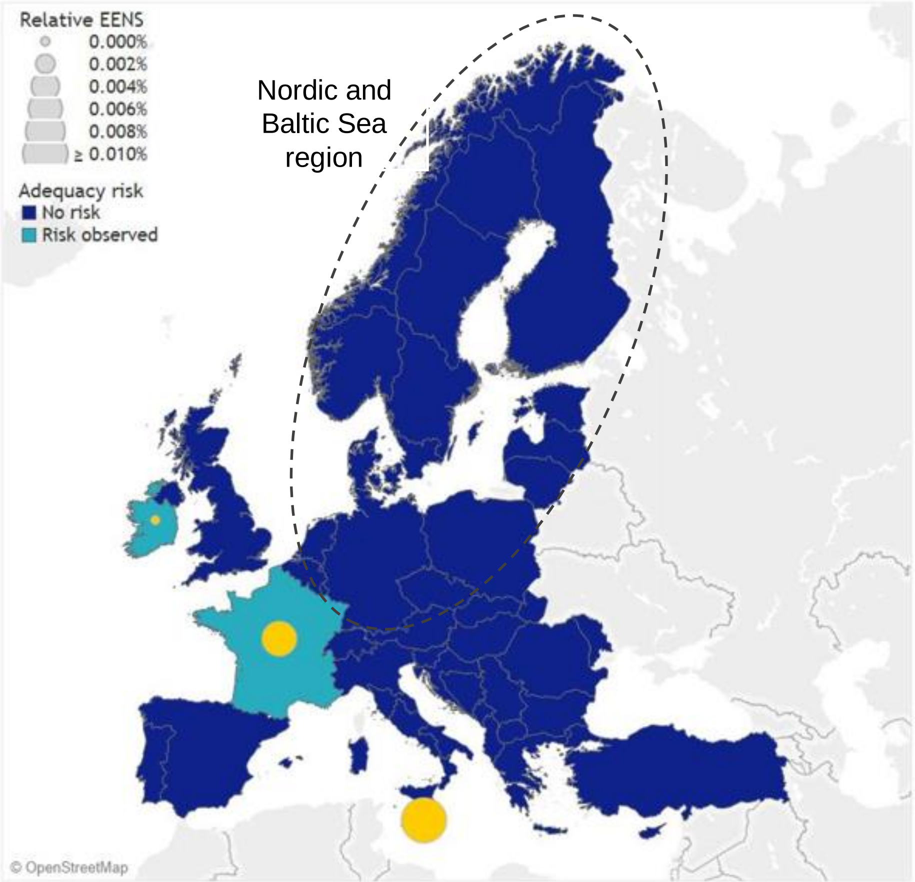
Main findings of ENTSO-E Winter Outlook

Regional review

- There are no resource adequacy risks identified in the Nordic and Baltic Sea region in the analysis, which uses state-of-the-art, probabilistic approach
  - The analysis results observes Expected Energy Not Served (EENS, MWh) for each country in the winter 2021-2022 season, which was zero for all the countries in the Nordic and Baltic Sea region
- Resource adequacy margin is the smallest during hours with high demand and low wind generation, or in case a large generation unit or interconnector is on an unplanned outage
  - The analysis takes different weather conditions and unplanned outages into account and found no loss of load taking place – resource adequacy was sufficient despite challenging conditions
- Resource adequacy is highest during low-demand and high wind generation hours – wide geographical coverage of the wind resources improves adequacy
  - Available cross-border transfer capacity is used to balance the system areas with uneven generation and consumption

For more information, please see ENTSO-E (2021), Winter Outlook 2021-2022. Available from: *https://www.entsoe.eu/outlooks/seasonal/*

Adequacy in normal market operations



ENTSO-E (2021), Winter Outlook 2021–2022

Deterministic analysis

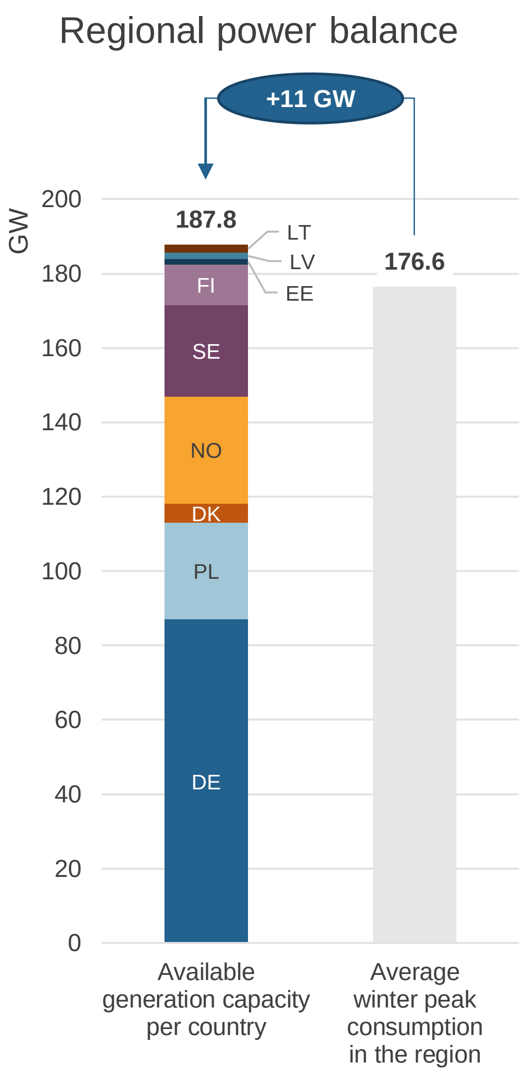
Main findings of power balance

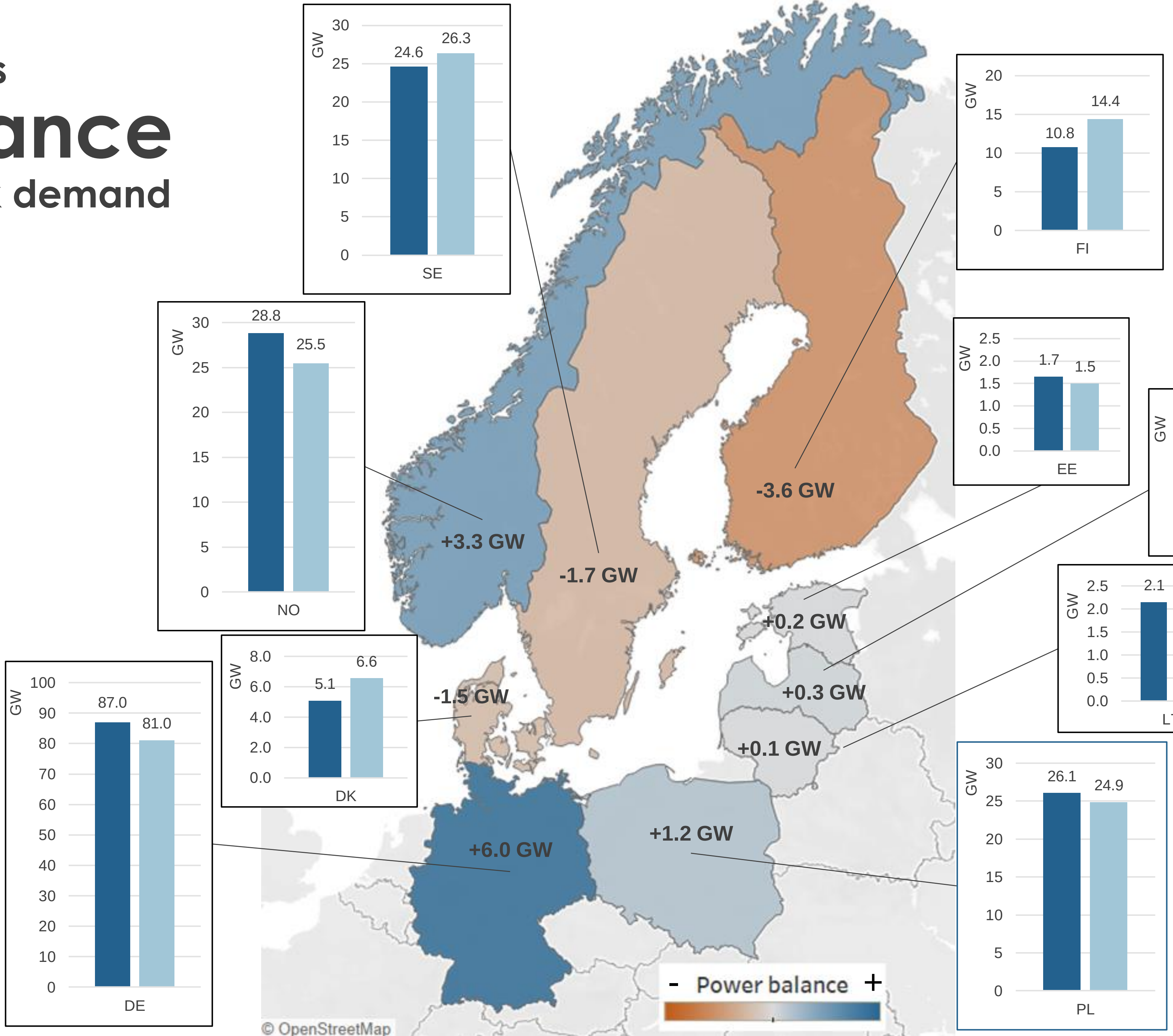
- Many countries rely on imports from surrounding countries to meet the peak demand
  - Especially Finland, Sweden and Denmark are dependent on imports as their power balance is negative during a cold and calm weather period with high demand and low wind generation
  - Other countries have sufficient generation capacity to meet the expected peak demand by their own in case there are no major outages, however, the surplus is quite modest in the Baltic countries and Poland especially in case of severe winter – Norway and Germany have the highest surplus
- Imports are available from other countries in the region and on the wider geographical area
  - Regional power balance is expected to be positive during a peak demand: the power balance is +11 GW during an average winter peak demand, and +5 GW during a severe winter peak demand in the region
  - The expectation of the peak demand in the region is lower compared to the sum of country-specific peak demands, as it's highly unlikely the peak demand takes place simultaneously on every country
- Availability of dispatchable generation and cross-border transfer capacity is important for security of supply in the region
  - In addition to the available generation capacity presented, TSOs have reserves that can be procured to try to avoid load curtailment in the case where market-based available capacity is not sufficient to meet the demand
  - In scarce situations with high demand and low wind generation it is expected that prices increase momentarily as more expensive bids are activated, but this is not seen to have an impact on resource adequacy

Deterministic analysis

Power balance

Average winter peak demand





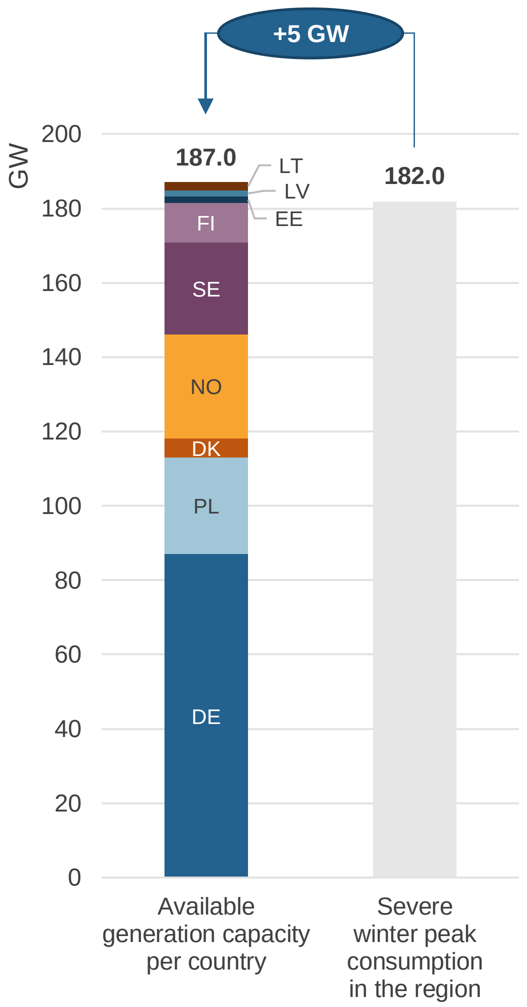
Note: Power balance for countries (see map) is presented as peak demand in each individual country, while the regional power balance (see bar graph on the left) considers simultaneous regional peak demand. The simultaneous peak demand is always lower than the sum of individual peaks as it is unlikely that the peaks happen at the same time for all the countries.

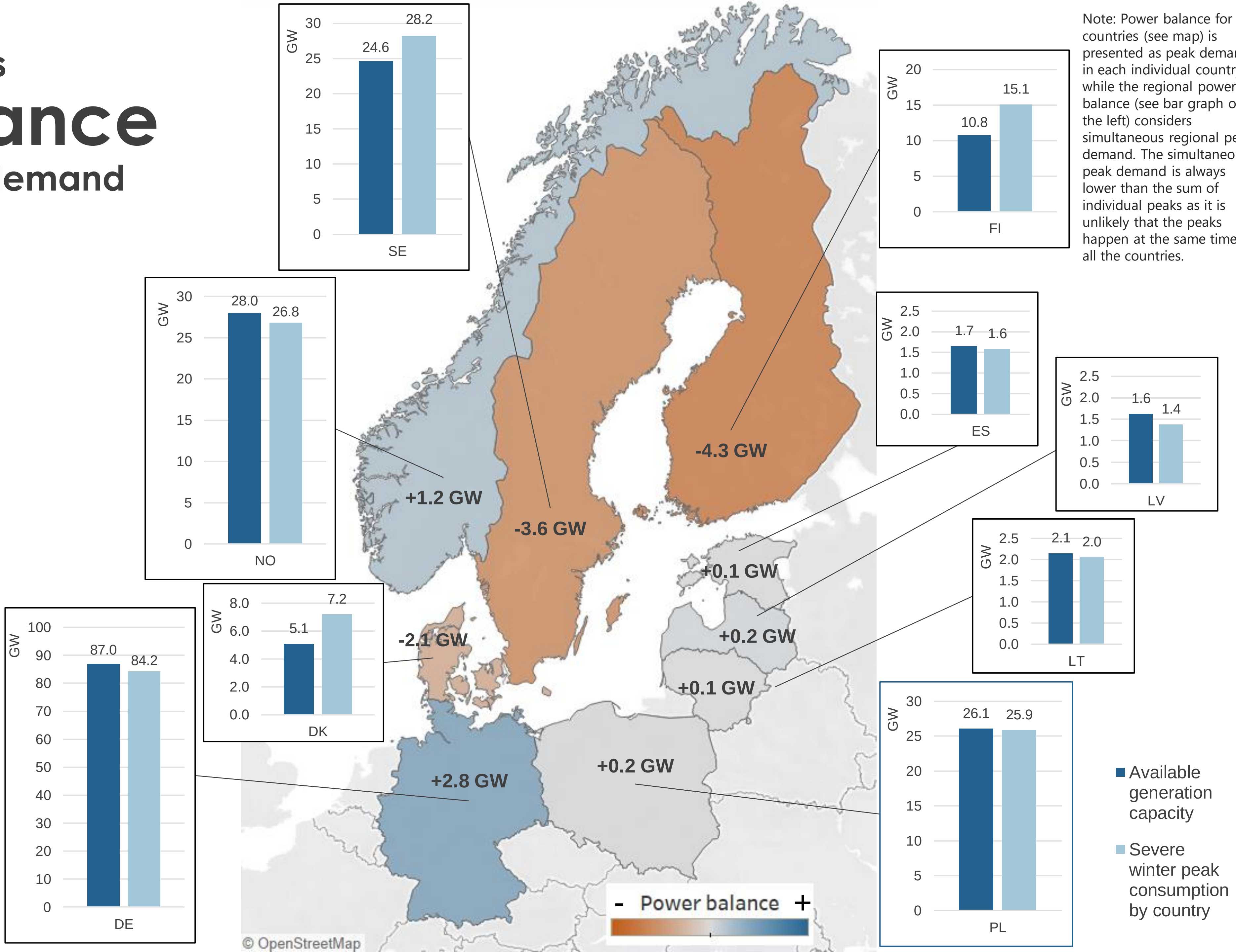
Deterministic analysis

Power balance

Severe winter peak demand

Regional power balance





Note: Power balance for countries (see map) is presented as peak demand in each individual country, while the regional power balance (see bar graph on the left) considers simultaneous regional peak demand. The simultaneous peak demand is always lower than the sum of individual peaks as it is unlikely that the peaks happen at the same time for all the countries.

Deterministic analysis

Input assumptions and other notes

Production

- Net generation capacity is based on each TSOs data, which has also been submitted for the ENTSO-E Winter Outlook analysis
  - Generation capacity does not include reserve capacities, such as strategic reserves or balancing reserves
- Available generation capacity during peak demand period in January-February has been assessed for the analysis, which considers:
  - Planned unavailability of generation units
  - Country-specific availability of thermal and hydro generation is based on each TSOs estimates
  - Region-specific availability of wind generation is based on regional analysis conducted by the TSO experts. Availability of wind generation is set to 11% for each country, which reflects the lowest 5th percentile of wind generation in the region during January-February according to ENTSO-E Winter Outlook/Pan-European Climate Database data
  - Assumption of availability of solar generation, which is set to 0% for each country
  - Average availability of weather-dependent other non-RES and other RES generation in January-February based on ENTSO-E Winter Outlook data

Consumption

- Peak demand of each country is based on ENTSO-E Winter Outlook demand data, which considers 35 interdependent climate data and is adjusted according to expectations of the upcoming winter season
  - Average winter power balance considers expected peak demand. P50 peak demand is the 50th percentile i.e. median of annual peak demand over the 35 climate years
  - Severe winter power balance considers highest expected peak demand. P95 peak demand is the 95th percentile of annual peak demand over the 35 climate years and roughly equals to the coldest winter out of 20 years. Replaces "coldest 1 of 10 winters" scenario from the previous Winter Power Balance reports.
  - Simultaneous region peak demand is the highest same-time peak for all countries during one climate-year. This is always lower than sum of separate peak demand per country and is mainly driven by countries with high demand.
- Price elasticity of consumption has not been considered
  - During high-price periods, the price elasticity of consumption might reduce the peak demand compared to the presented values

Country comments (1/2)

Norway

Norway does not expect any adequacy problems this winter. We expect to have a surplus which can be exported both under normal and severe conditions. Compared with the Winter Outlook, the hydro reservoir levels has improved significantly the last weeks. Anyhow we may expect reservoir levels in the lower bands through the winter due to high hydro generation and export. Highest uncertainty is allocated to the availability of small-scale and run-of-river hydro. Some emptied reservoirs also reduces availability from large-scale reservoir plants.

Sweden

During the most strained hours, imports are expected to play an important role in maintaining adequacy in southern Sweden (SE3 & SE4). To help secure adequacy during the winter, Svenska kraftnät contracts a strategic reserve. For the coming winter the capacity is 560 MW. In the national adequacy assessment, 9 % wind availability is used, which is similar to the 11 % used in this assessments.

Finland

Finland is strongly dependent of electricity import during peak hours with low wind generation. Compared to country-specific power balance, higher availability factor for wind increases estimated available generation capacity by 100 MW. The import capacity on interconnections, 5 100 MW, is sufficient to meet the deficit of around 4 000 MW and no adequacy issues are expected. In case of scarcity, there is also 611 MW of strategic reserve capacity available to be used that is not included in the figures.

Denmark

Over the next decade it is expected that Denmark will become more dependent on electricity imports to secure resource adequacy. Hence, the development in the resource adequacy situation across Europe, especially in Northwestern Europe, is very important for Danish resource adequacy assessments. For the winter 2021-2022, the import capacity is sufficient to meet the deficit and no adequacy issues are expected. The numbers reflected in this report are for the day ahead market. This means that no reserve capacity is included in the figures.

Germany

In cases of generation scarcity, the 'strategic reserve' for Germany can be activated. It contains lignite units in stand-by (1.8 GW), grid reserve (5.6 GW), Out-of-market demand side response (1.5 GW) and capacity reserve (1.1 GW).

Extensive conventional power plant unavailability abroad can lead to a high utilization of the German thermal power plant fleet at times of high residual load. In situations of high RES feed-in in the north and high demand in the south of Germany, the necessity of remedial actions to maintain (n-1)-security on internal lines and on interconnectors is expected.

Remark from 50Hertz: The probabilistic approach of ERAA is state-of-the-art. National and geographically limited analyses should also be conducted based on probabilistic methods, otherwise (e.g. using power balances) a limited and misleading view on adequacy is shown. This balance is also prepared by application of the deterministic method for communication issues during a transition phase from the deterministic country-based analyses to the European application of the probabilistic method.

Country comments (2/2)

Poland

Without considering the use of interconnections, a tight power balance is identified for Poland, especially during severe conditions. Therefore, in case of unfavourable conditions, i.e. weather conditions (low RES infeed, high load) and high level of outages, the adequacy may be endangered. Availability of import level then will be a key issue.

Additional risk comes from the current situation on gas and coal markets in Europe – in case of problems in fuel availability, adequacy level may substantially change.

Estonia

We believe ENTSO-E Winter Outlook's probabilistic methodology gives an accurate representation of the upcoming winter and that should be taken as the reference case.

Even though the power balance in Estonia is positive, we expect that during the majority of the winter we will be importing cheaper electricity. During demand peaks and situations described with the two deterministic scenarios we will probably export electricity. Additional out-of-market TSO reserves are available if needed to avoid EENS.

There have been concerns over high gas prices and lower-than-average gas storage levels for the upcoming winter around Europe. The Latvian gas storage, which is supplying gas for the Baltic States and Finland, has gas on an average pre-winter level and no shortage of gas is expected.

Latvia

In Latvia, the balance should be good and we don't expect system adequacy shortages. In the case of the lack of generation capacity we will be able to import this capacity by cross-border interconnectors.

Lithuania

The generation mix in Lithuania includes old and uncompetitive gas generation capacities with limited remaining residual operating resource. Despite a positive power balance in Lithuania during the winter peak period Lithuania will be dependent on import of electricity. However, the available interconnection capacity can ensure the import of required capacity if generation capacity is sufficient behind the interconnectors."

For country-specific comments on the probabilistic analysis, please see separately Country comments of Winter Outlook 2021-2022 by ENTSO-E.