Nordic and Baltic Sea Winter Power Balance 2022–2023 presentation

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Agenda

1. Realised and identified adequacy risks in the region
2. Approach to estimate resource adequacy
3. Winter Power Balance 2022–2023
   - Methodology
   - Results
4. Winter Energy Balance 2022-2023
   - Methodology
   - Results
5. Risk mitigations
6. Conclusions
7. (Country comments)

1. Many adequacy risks realised and identified in the Baltic Sea region

Energy import restriction from third countries

Fossil fuel supply challenges in Poland and risks in Germany, Finland, and the Baltics

Low hydro reservoir levels

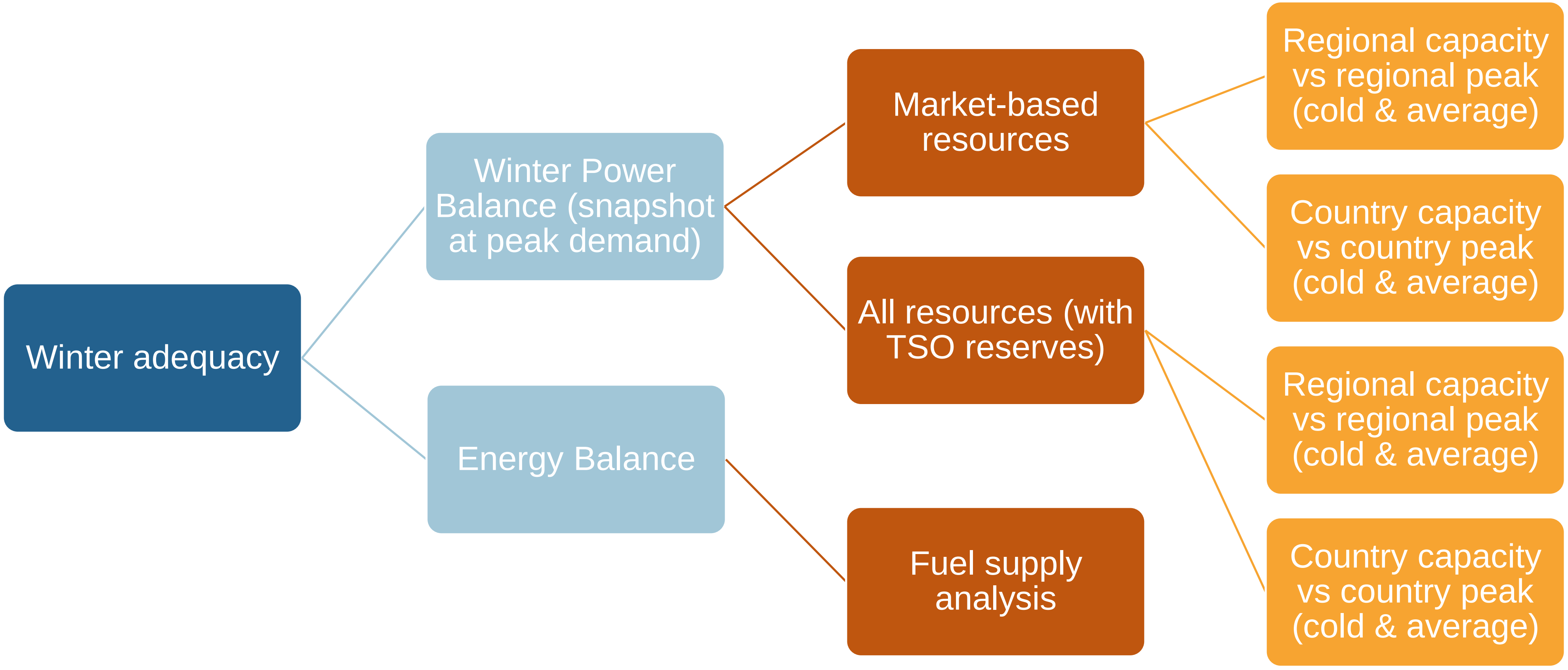
Nuclear generation outages and/or risks for delays in start-ups

Grid bottlenecks

Risk of Baltic countries desynchronisation from Russian electricity system

2. Approach

Adequacy of electricity is analysed with a power & energy balances



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3. Winter Power Balance 2022–2023

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3. Analysis methodology

3. Determining demand

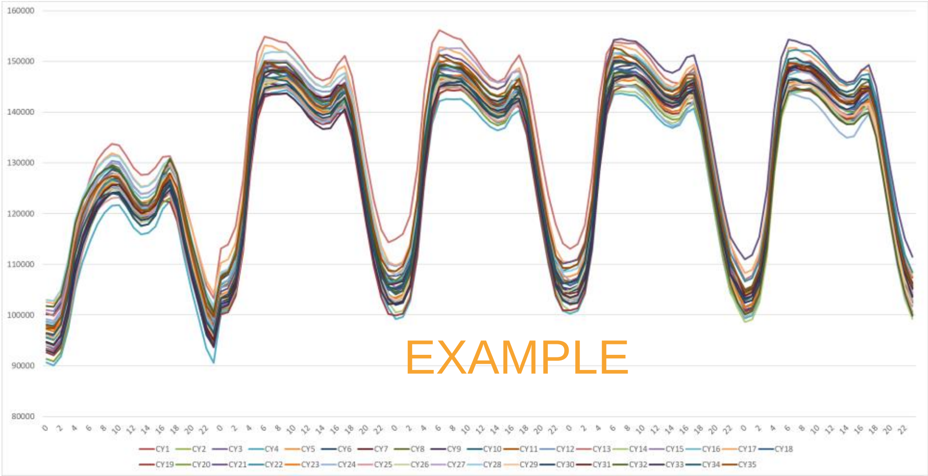
Country demand	Simultaneous region demand

EXAMPLE

„cold winter“ peak demand could be for:

- Estonia CY (climate year) 17 at 18.00 on December 20
- Poland CY 2 at 09.00 on January 1
- Sweden CY 10 at 17.00 on November 29
- Finland CY 10 at 17.00 on November 29
- Lithuania CY 8 at 20.00 on February 2
- Germany CY 3 at 10.00 on January 17
- etc.

These are usually happening at different times, and they cannot be summed together later.

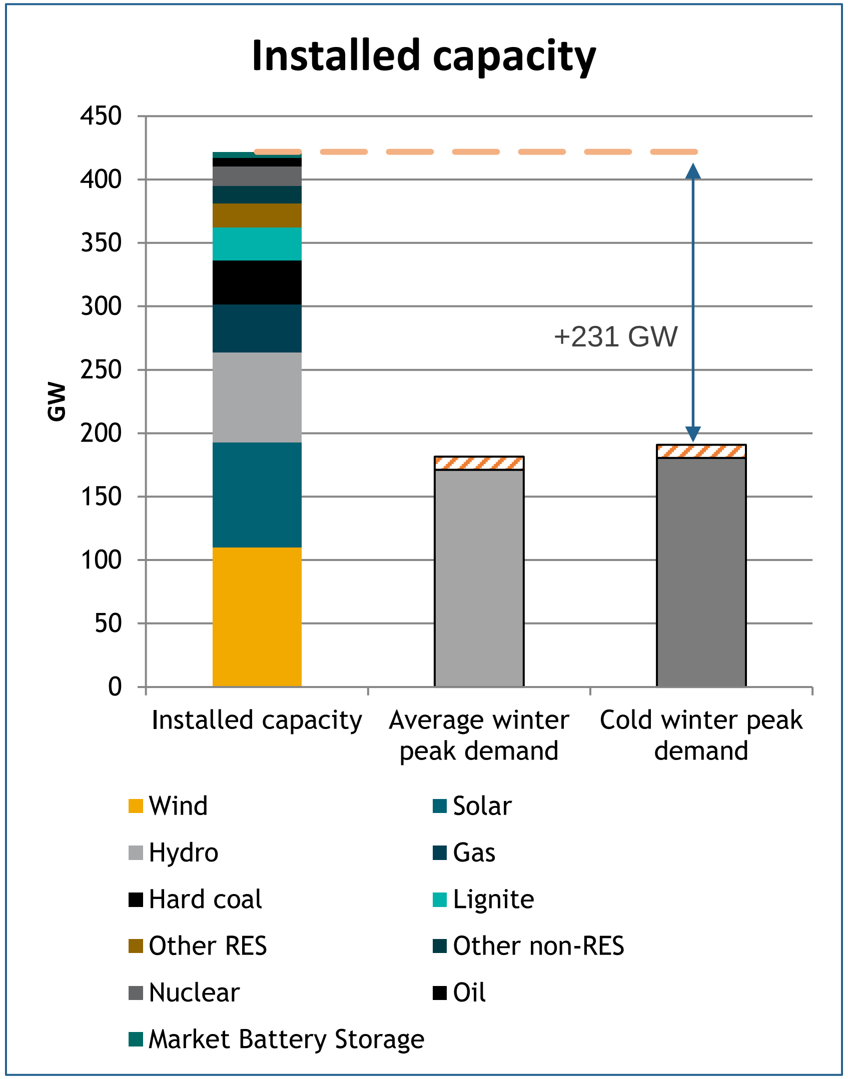


Average winter highest peak (One climate year specific date and hour)= 182 GW

Cold winter highest peak (One climate year specific date and hour)= 191 GW

Regional peaks mostly take place mid-January

3. Determining supply



- planned outages
- expected amount of unavailable capacity due to unplanned outages
- expected amount of unavailable capacity due to other reasons (TSO experience)
- decreased production due to weather conditions
- scenario specific capacity

3. Power Balance Results

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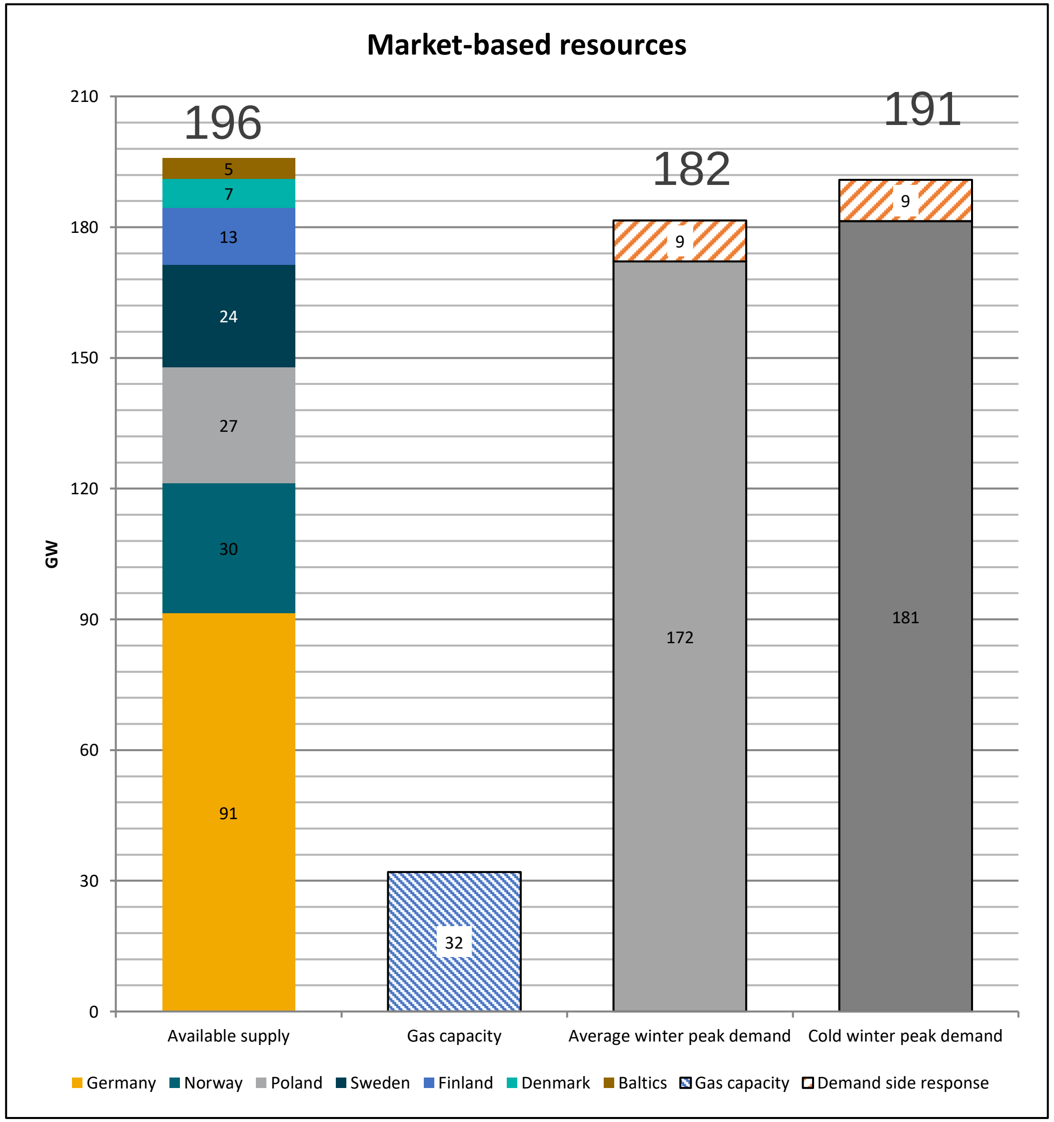
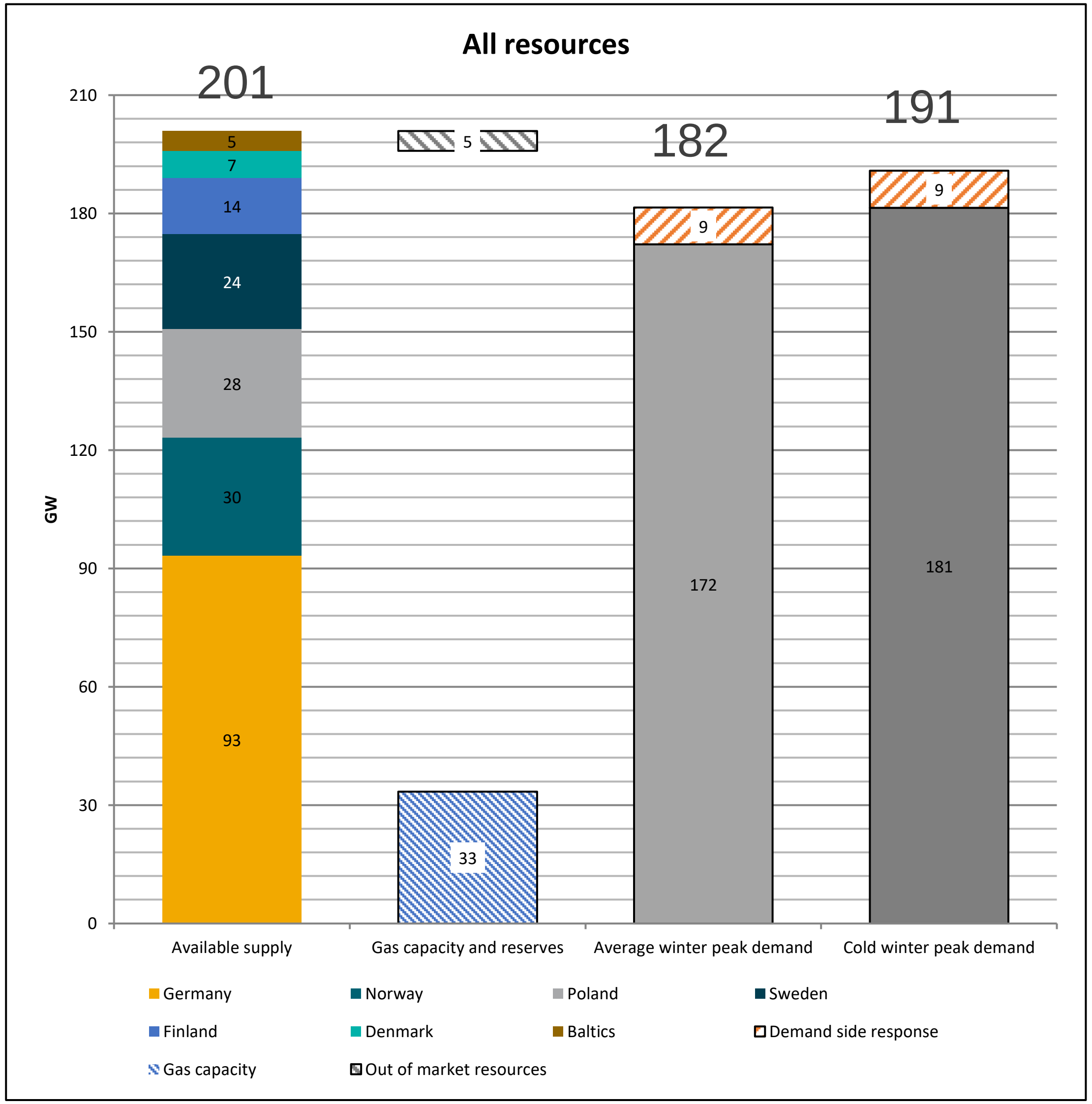
3. Regional power balance



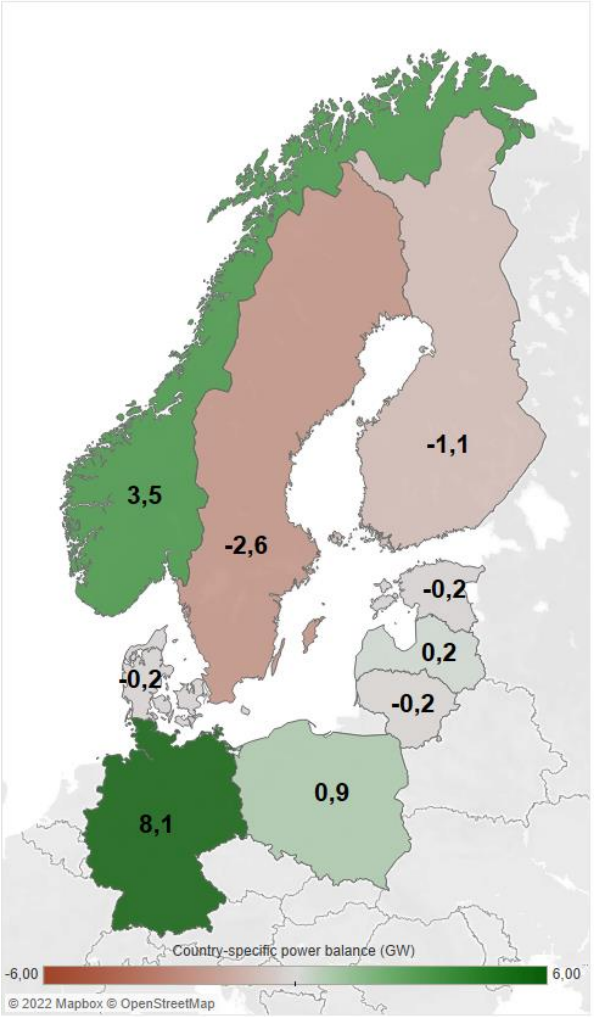


Market-based power balances by countries

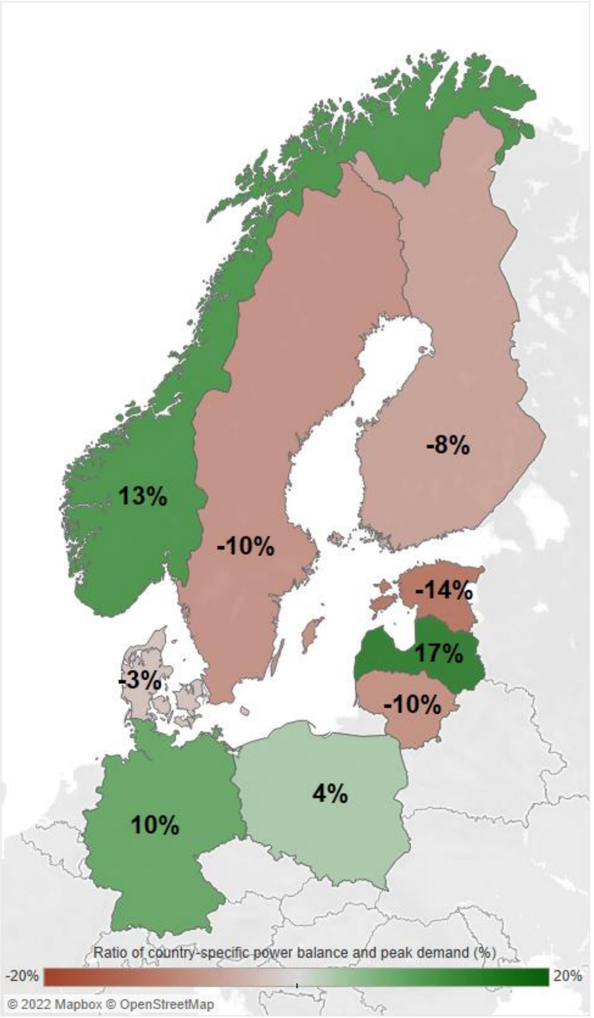
These peaks do not take place at the same time

Average winter peak demand

Power balance (GW)

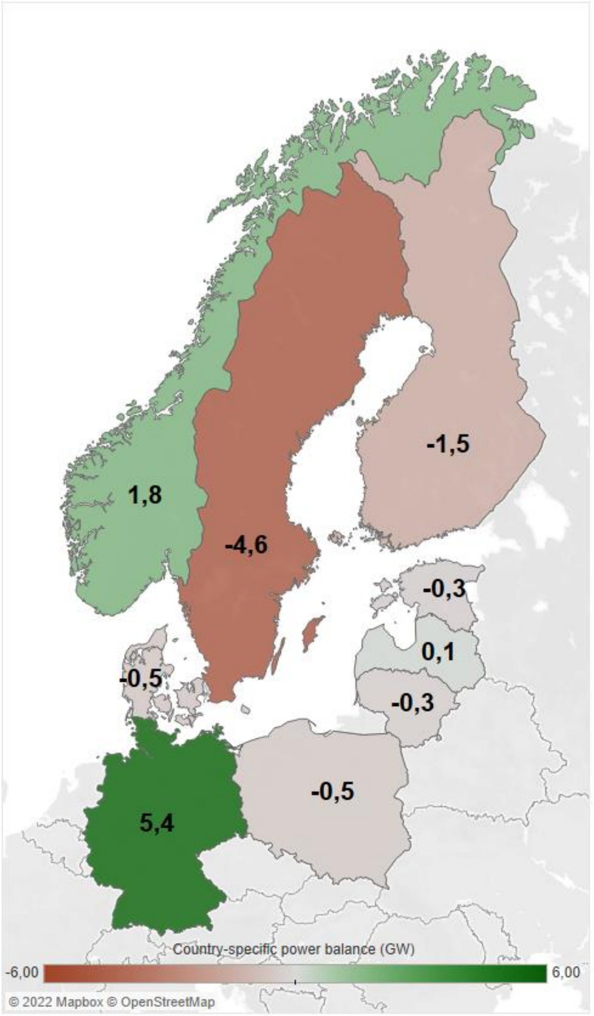


Ratio of power balance and peak demand (%)

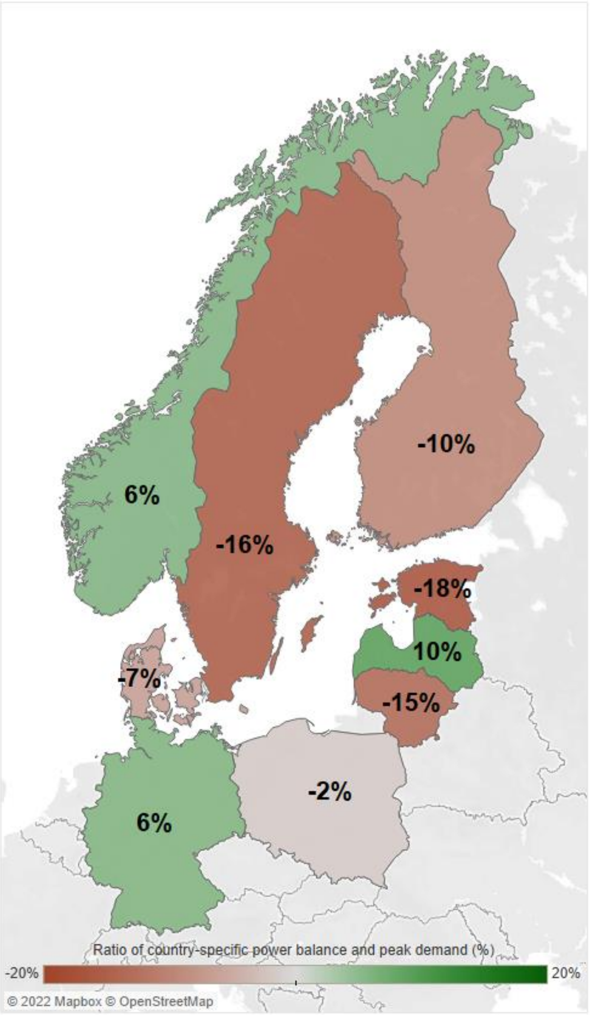


Cold winter peak demand

Power balance (GW)



Ratio of power balance and peak demand (%)



Winter energy balance 2022-2023

Methodology: Energy balance

How much electricity can be produced from sources without fuel supply issues?

- Two scenarios are chosen:
  - average winter consumption of 620 TWh
  - highest expected winter consumption of 646 TWh
- Time periood is from October until April.
- Available resources based on TSO estimates
- Simplified merit order based on whether we see a shortage of such a fuel
  - The last fuels in the merit order are gas, coal, and lignite, which were identified as critical.
- In this balance interconnector limits and hourly demand is not considered which simplifies the balance significantly, but still enables an overview of what sources of energy are available in the region.
- The average and cold winter were analyzed by
  - Assessing the theoretical maximum production from different sources if there would not be any shortage of fuel. This was based on known availability of power plants, their forced outage rates and availability profiles depending on the weather.
  - Considering the known restrictions of fuel supply and seeing how much critical fuel would be needed in the Baltic Sea region to cover its consumption for the winter.

3. Energy Balance Results

Regional energy balance based on only availabilities

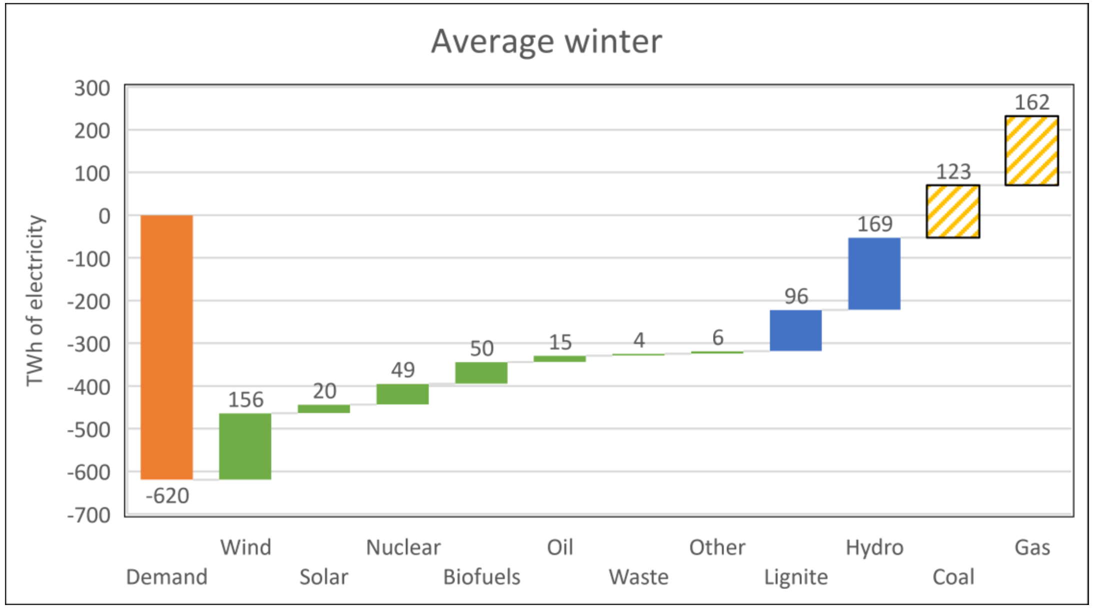
Infite amount of fossil fuels; no limits on transfer capacities; time resolution is 6 months (October until April)

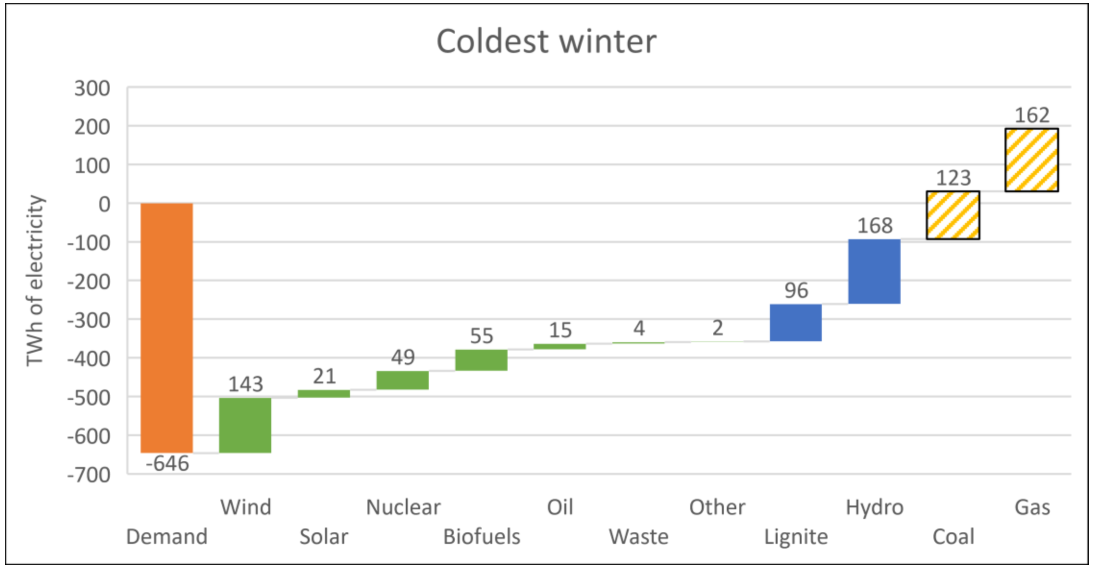
Average winter

- Hydro resources could produce around 169 TWh,
- Gas generation could produce around 162 TWh,
- Wind generation could produce around 156 TWh,
- The contribution from renewables is significant and every MWh of energy produced from these sources means that fuel for dispatchable generation can be saved for times when intermittent renewables are not producing.

Coldest winter

- Wind generation produces 13 TWh less than average winter
- Production from biofuels increases by 5 TWh.
- Thermal plants that use nuclear, oil, lignite, coal and gas have the same availability as during an average winter. Their importance increases with a cold weather as demand grows and the share of renewable sources decreases.





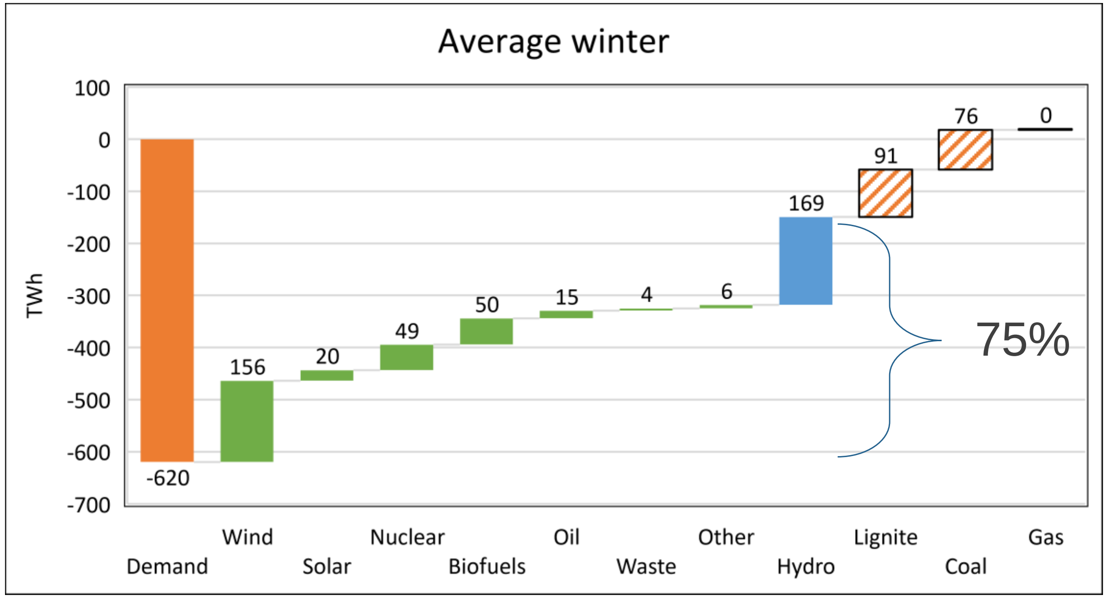
Regional energy balance considering known restrictions

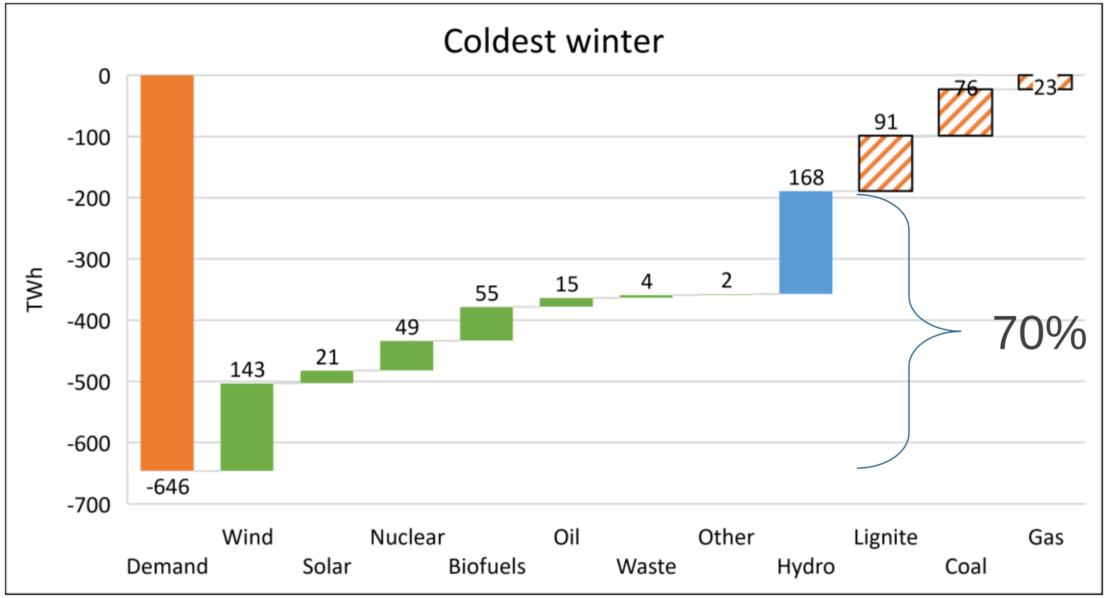
Average winter

- Reduction in the fuel supply for coal and lignite it can be seen that Baltic Sea region could cover all of its consumption without gas if there were no transfer capacity bottlenecks or hour-by-hour dispatch.

Coldest winter

- In this case around 23 TWh of electricity is needed from gas, which translates to around 48 TWh of gas for the winter.
- For reference as of 11th October there is 291 TWh of gas stored in gas storages around the Baltic Sea area countries





Risk mitigation actions

What is being done to lower the risks?

Short term

- Several communication campaigns are ongoing which will inform the public of the awaiting challenges; guides on how to save energy and lower energy bills; how to act during crisis etc.
- Electricity saving measures are being implemented. A mandatory 5% reduction in peak hours and additional voluntary target of 10% reduction for overall electricity consumption will be implemented in all Member States.
- Contingency plans during gas shortage and/or electricity shortage are developed, rehearsed and improved.
- Preparations of administrative actions in the energy market to save fuel or redistribute it if the need arises.
- Decommissioning plans are being reviewed.
- The transmission system operators are closely monitoring all the developments in the electricity system. Security of supply analyses for gas and electricity are made on a European level together with ENTSO-E and ENTSO-G. The system operators are also doing analyses on a regional and country level to identify risks before they occur.
    - Insights from these will be shared with the public and market participants in the form of press releases, webinars, published analyses, interviews and social media.

Long term

- The dependence on Russia in the energy sector is being decreased. The Baltics are preparing for desynchronization from the Russian grid. Fuel supply chains are being diversified.
- Coordination between TSOs on unit outages is being developed
- More ambitious plans on RES deployment and grid reinforcements are developed.
- Flexibility markets are being developed and matured.

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Conclusions

What are the takeaways?

- The Nordic and Baltic Sea region will experience one of the most challenging winters in recent history due to several unfavourable conditions in the European energy markets.
  - The war in Ukraine is causing a lot of uncertainties in the electricity, gas, and coal markets as imports from Russia have been reduced or ended.
  - Long drought during the summer in Europe has left hydro reservoir levels lower than usual before the winter.
- Positive power balances for both average and cold winter, however, the margins are small (3…8%) with many uncertainties which could change the balance significantly.
  - The regional excess is not distributed evenly between the countries- good coordination between system operators and high availability of the transfer capacities is needed.
  - Out-of-market resources might be activated to avoid demand curtailment. An analysis of this resolution cannot identify whether there is need for demand curtailment, but TSOs are informing the public and making contingencies to be prepared for it.
- It is expected that the electricity prices will be high throughout the winter due to fuel prices and uncertainty in the energy markets. Around 5% of demand is price sensitive. More flexibility in the demand sector could lowers prices and help during peak demand hours.
- Average regional electricity consumption will be around 620 TWh and cold winter consumption around 646 TWh.
  - Around 70…75% of this does not have any issues with fuel supply. Remaining 25…30% would need to be generated from coal, lignite, or gas and this fuel supply this can be found in the region.
  - Wind and hydro production contribute the most to the energy balance during both average and coldest winter. This helps to conserve fossil fuels like coal, lignite and gas which can be used during times with low renewable production.

END OF PRESENTATION

Thank you!

Country comments

Country comments

Germany

- In Germany, coal-fired reserve power plants have been permitted to return to the market and coal-fired power plants that were planned to be shut down in the next few months can be kept in the market a little longer with the aim to reduce the gas demand for electricity generation.
- The decision whether the German nuclear power plant deployment reserve is activated will be taken until the end of the year 2022. The deployment reserve consists of the two German nuclear power plants Isar 2 and Neckarwestheim and is available until mid-April 2023. (link)
- The probabilistic approach of the ENTSO-E Winter Outlook 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.

Country comments

Denmark
“The Danish Energy Agency has imposed on Ørsted to continue and reestablish the operation of the following three power plants: Esbjergværket Blok 3, Studstrupværket Blok 4 and Kyndbyværket Blok 21.

- Esbjergværket Blok 3 were supposed to be decommissioned on March 31st in 2023 and is consequently already counted in the power balance due to the cut-off date of 1st of January.
- The two remaining power plants are currently being prepared to be recommissioned until 30th of June 2024 and Esbjergværket Blok 3 will continue operation until this date as well. However, Ørsted has not yet given a final date for when Studstrupværket Blok 4 and Kyndbyværket Blok 21 will be ready to produce - currently they are undergoing maintenance and being readied for operation as soon as possible. Consequently, their availability at the cut-off date of 1st of January is associated with some uncertainty, though as a best estimate their combined 620 MW of electricity capacity has been counted in the power- and energy balance.”

Country comments

Norway

There is a worry about reservoir levels in Southern Norway for the winter. The reservoir fillings are at very low levels due to low precipitation and high export caused by high continental fuel and power prices since previous winter and up to now. Also limited transfer capacity from north to south in Norway and between Norway Sweden may have affected this situation.

- Some actions are taken by Statnett and the authorities, as rising attention level to yellow. There are still no restrictions on generation and/or export, but the producers are kindly requested to save water for the coming winter. To secure the supply in case of reduced import possibilities further actions may be taken. More restrictions may be imposed by the authorities during the autumn. Recently the authorities have increased the monitoring of the generation from the major reservoir generators in Southern Norway. This is reported by Statnett. Statnett has also been instructed to work out an analysis of extremely severe situations (SAKS) which was finished within 1st October.

- Under normal situations, there should be enough import capacity to cover any deficit. But if there is no generating surplus in other countries to export to Norway, there may be a problem. Rationing of demand may then be necessary in a short period before the snow melting starts in the spring. Especially if there will be low precipitation during the autumn and winter. Anyhow the high power prices are expected to lower the demand somewhat, both by customers reducing the demand and companies shutting down. And the demand is usually lower in spring than mid-winter.

- Before reservoirs run empty, available generating capacity is only reduced by minor amounts due to reduced head of water etc. If the reservoirs are empty, the generating capacity will be reduced dramatically. This capacity will then not be available in the market. Hence the issue in Norway is more lack of energy or water resources during the spring, rather than an adequacy problem during the winter. In many ways this is a similar problem as gas shortage in Europe. There is a significant higher level of uncertainty of several factors important for the energy sectors in the coming months.

Country comments

Sweden

- Sweden's power balances show need for import during peak conditions. The power sector in Sweden is only to a very limited degree dependent on fossil fuel. However, the development in other countries may affect adequacy in Sweden, mainly relating to the availability of import.
- The Swedish Energy Agency has launched an information campaign to lower demand, and routines for load shedding are rehearsed.
- Northern Sweden (SE1 and SE2) have a strong surplus, while southern Sweden (SE3 and SE4) has a large power deficit. As such, transfer capacity from north to south is critical for adequacy, and very often runs at max available capacity. At times, southern Sweden is dependent on imports from other countries as well.
- The nuclear reactor Ringhals 4 is currently unavailable and is not included in the power balance figures in this report. The plant is planned to return on Jan 31, but the outage period could be prolonged which would lower adequacy for the late winter.
- Sweden has a strategic reserve of 562 MW, which is not included in the figures for market-based power balance.

Country comments

Finland

Fingrid has informed consumers that they should be prepared for power shortages in case of unfavourable scenarios. In typical and mild winters, the risk of power shortages is comparable to the previous years. However, there are several uncertainties that increase the risk of a power shortage. These and other notable developments affecting adequacy include:

- Schedule for the commissioning of the Olkiluoto 3 nuclear power plant. A possible delay in the commissioning of the plant would significantly reduce the adequacy of electricity in Finland.
- Availability of imports from Sweden and Estonia. In previous years during peak consumption, significant amounts of electricity have been imported from Sweden and Estonia, as well as from Russia.
- Possible failures of significant domestic power plants or electricity transmission connections in operation, as well as problems with the availability of power plant fuels, especially natural gas.
- The rapid growth in wind power capacity contributes to improving the availability of electricity in Finland, but the impact of wind power on the adequacy of electricity is determined by wind conditions.
- Energy saving and timing the use of electricity outside of peak morning/afternoon hours improves adequacy of electricity significantly. Finnish electricity use decreased by around 7 % in September 2022 compared to last year, and therefore the peak demand expectation during cold winter was decreased from around 15 100 MW to around 14 400 MW.

Country comments

Estonia

We see that there is enough generation to meet the peak demands, however, compared to previous years the risks have increased significantly which is mainly caused by the Russian aggression in Ukraine.

To accelerate the independence from Russia in the energy sector a close collaboration between European countries is a must.

The probability that demand curtailment is needed during the winter is low, however, should the risks realize we have developed contingency plans which least affect the consumers.

Country comments

Latvia

- During the coming winter Latvian TSO is ready to cover the peak demand. According to plans for winter there should be enough available generation capacity to cover the peak load and to provide system services. Due to gas import restriction from Russia and higher gas prices in gas wholesale markets in Europe the total amount of produced energy from gas CHPs is going to be reduced, but still the high-capacity gas CHPs in Latvia will be in operation and available for the high demand hours and very critical periods. The run of river power plants on Daugava river are back in operation after maintenance works during the summer period when the production from hydro was lower as usual.
- TSOs of the Baltic States and Poland have prepared an emergency synchronization solution in case if this could become necessary. In addition, steps had been made to accumulate a substantial amount of gas in the Latvian Inčukalns underground gas storage necessary for the 2022/2023 heating season. But, possible unplanned desynchronization from IPS/UPS power system could lead to increased generation and reserves adequacy risks during the next winter.

Country comments

Lithuania

- Since the basis of traditional production in Lithuania is a few old gas-fired units, sufficiency is ensured by imports. During the winter period, similar as last winter period, the adequacy of the Lithuanian electricity system will be negative and ~200 MW of import capacity will be needed to meet the peak demand. Therefore, we see the risk that the situation in other power systems may lead to restrictions on import possibilities (cascading effect).

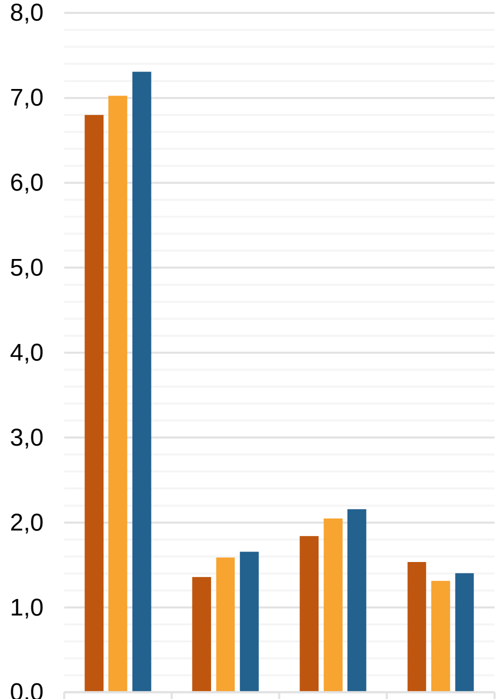
Country comments

Poland

- Current tight adequacy situation and concerns on coal and also gas supply availability makes all dispatchable generation to be very important for being able to ensure secure and adequate operation of the Polish power system. Significant reduction of coal supply will negatively affect the Polish load/generation balance and threaten security of supply.
- The exact extend of potential electricity generation shortages in the winter period will depend of the situation with respect to gas supply to EU. Also, in case of significant gas shortages in Europe, affecting gas generation in a number of EU countries, we expect a change of power flows pattern across Europe (transfer capacities for the market purpose).

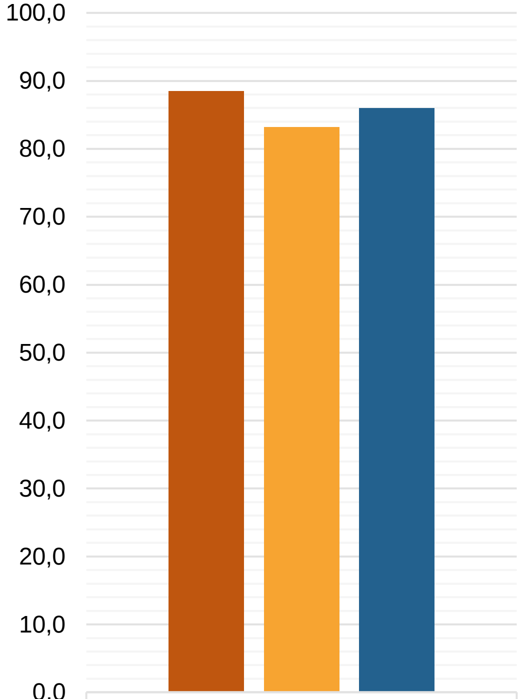
Appendix:
Supporting illustrations of the report

Market-based power balances by countries



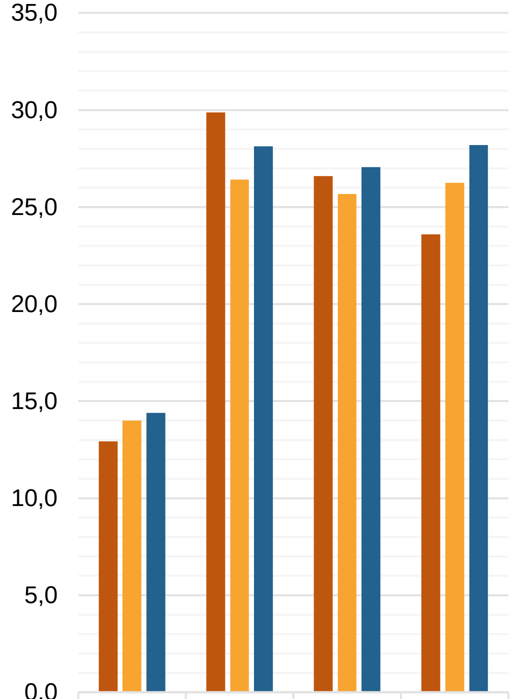
	DK00	EE00	LT00	LV00
Supply	6,8	1,4	1,8	1,5
Average winter peak demand	7,0	1,6	2,0	1,3
Cold winter peak demand	7,3	1,7	2,2	1,4

Supply Average winter peak demand Cold winter peak demand



	DE00
Supply	88,5
Average winter peak demand	83,2
Cold winter peak demand	86,0

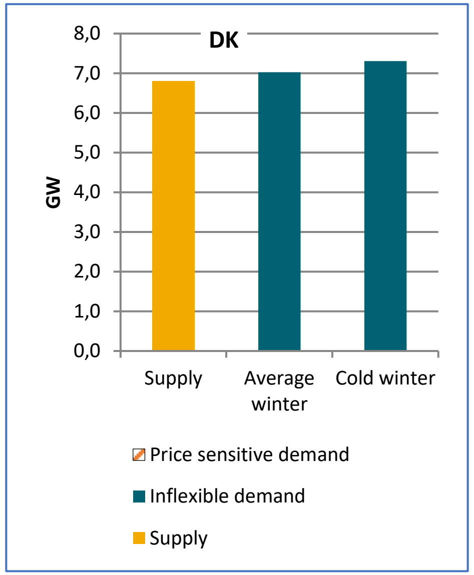
Supply Average winter peak demand Cold winter peak demand

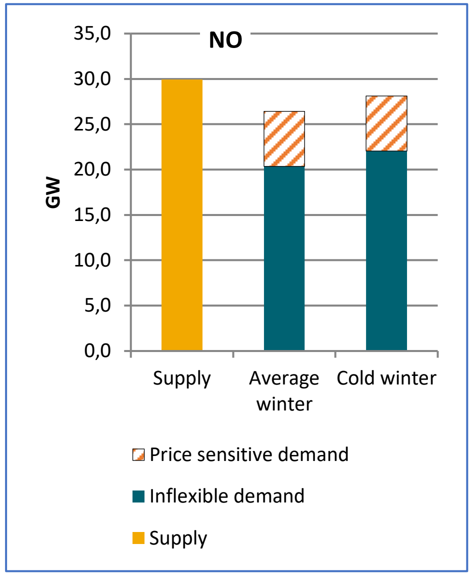


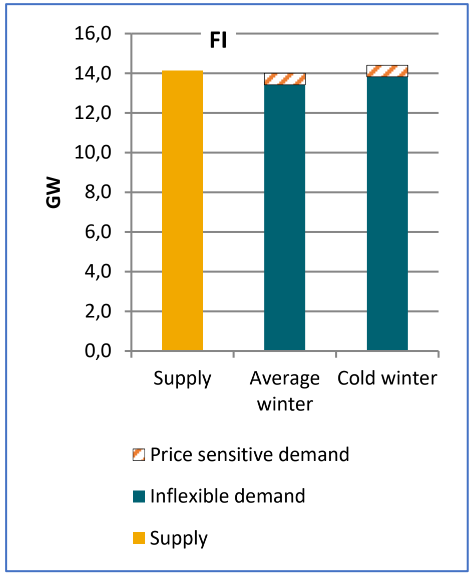
	FI00	NO00	PL00	SE00
Supply	12,9	29,9	26,6	23,6
Average winter peak demand	14,0	26,4	25,7	26,2
Cold winter peak demand	14,4	28,1	27,1	28,2

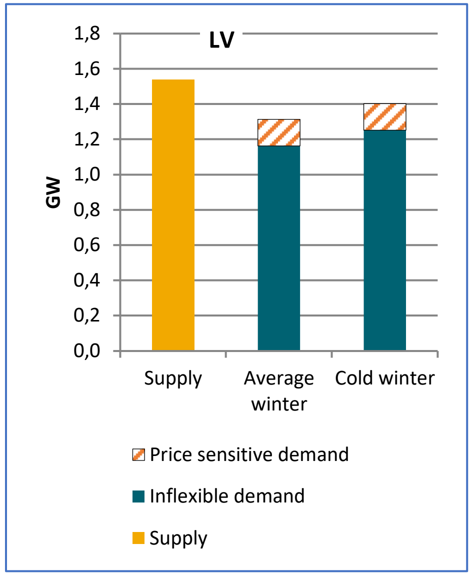
Supply Average winter peak demand Cold winter peak demand

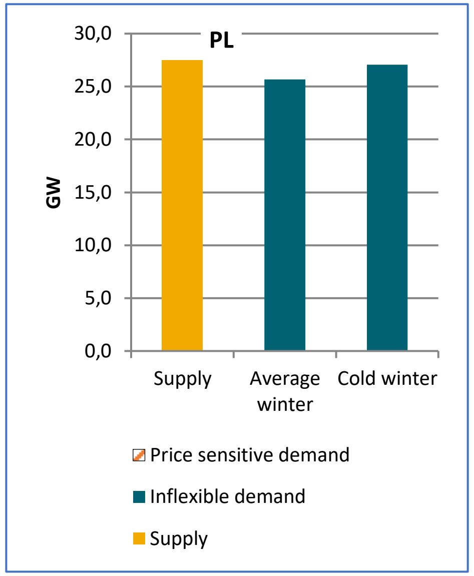
All resources available before demand curtailment

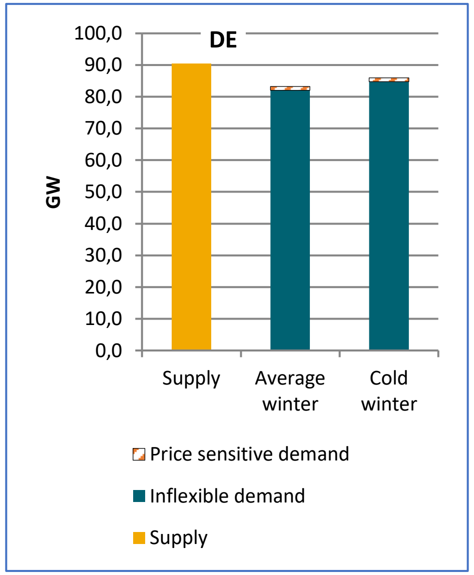


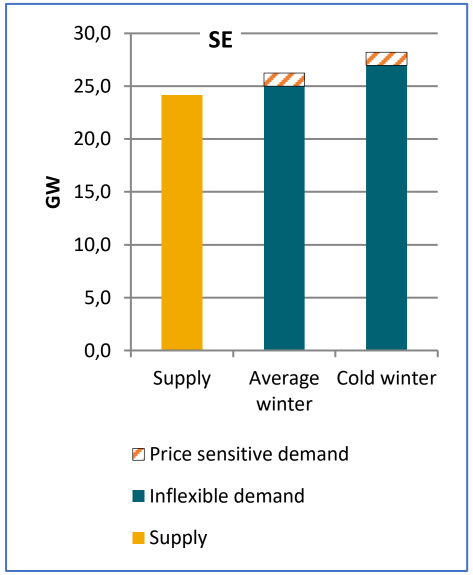


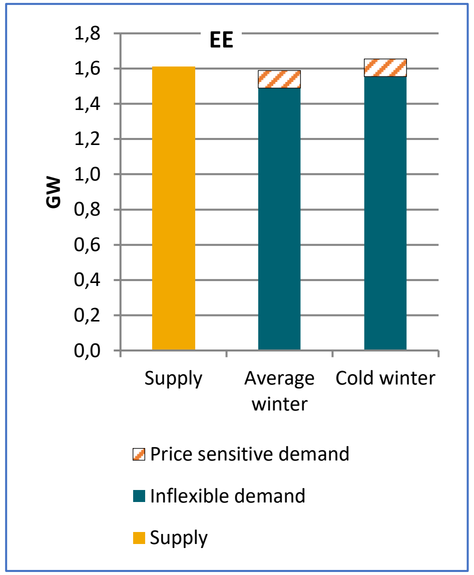


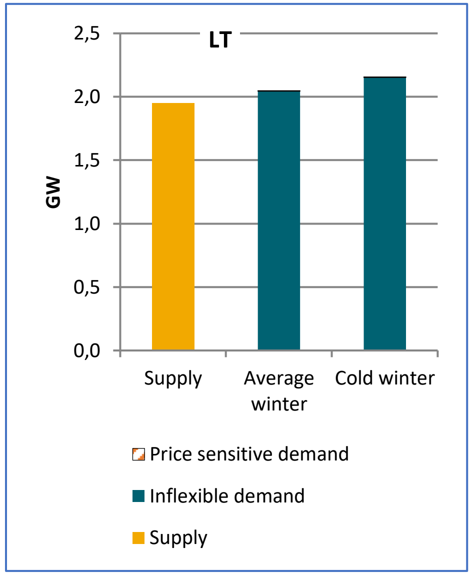




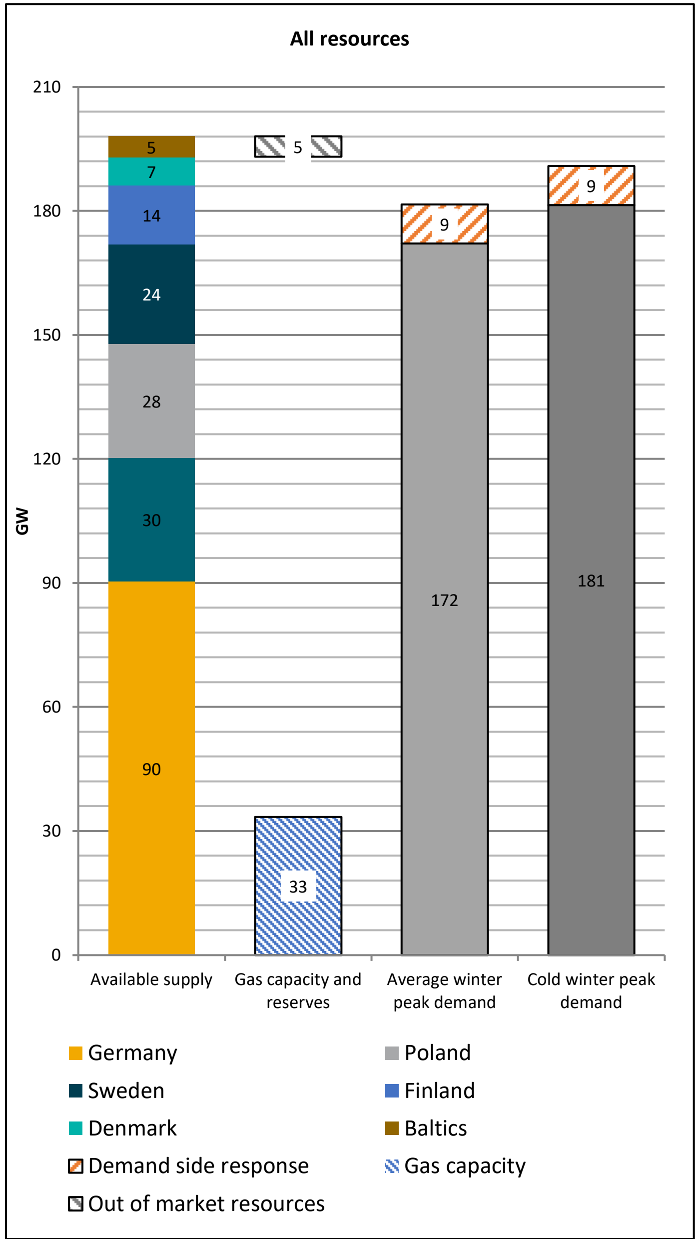


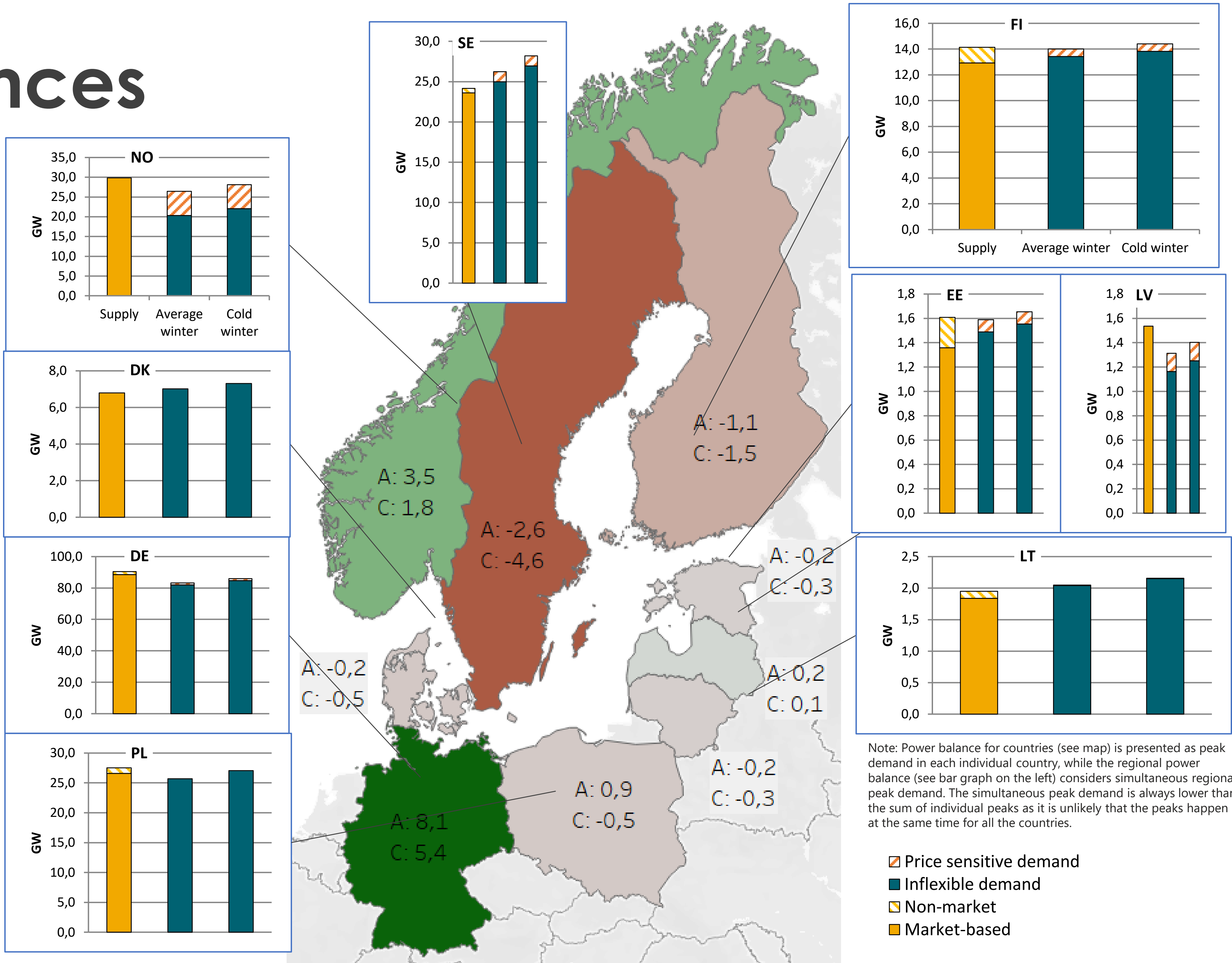






Power balances





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.

- Price sensitive demand
- Inflexible demand
- Non-market
- Market-based