

Key EU energy market developments in 2022 - What can we learn for this year?

15 May 2023



I. Looking back on 2022

1. Russia's energy warfare – European gas markets in turmoil
2. Main developments in the EU power sector

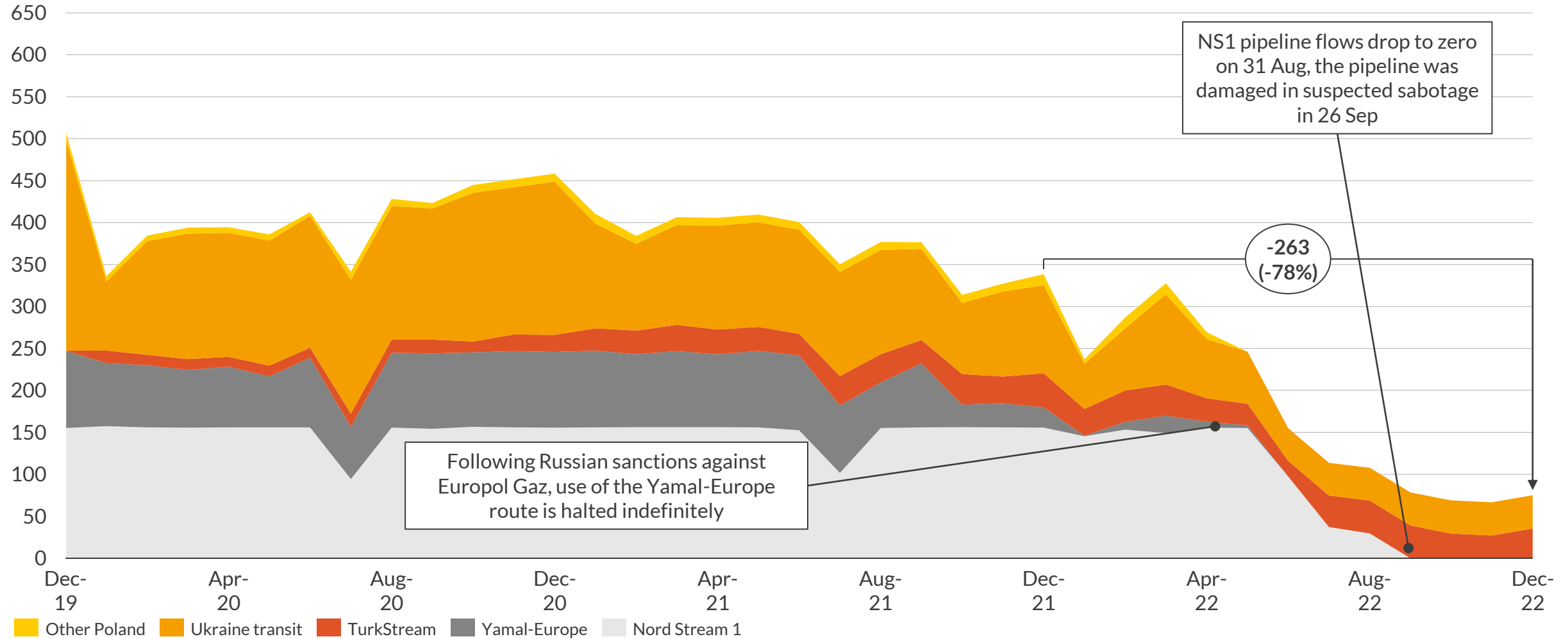
II. What to expect for 2023 and the next winter?

1. Gas supply scenarios
2. Power supply

Russian gas deliveries to Europe of 75 mcm/d in Dec-22 were 78% lower than a year earlier

Monthly averages of daily Russian gas deliveries to Europe¹ since Jan 2019

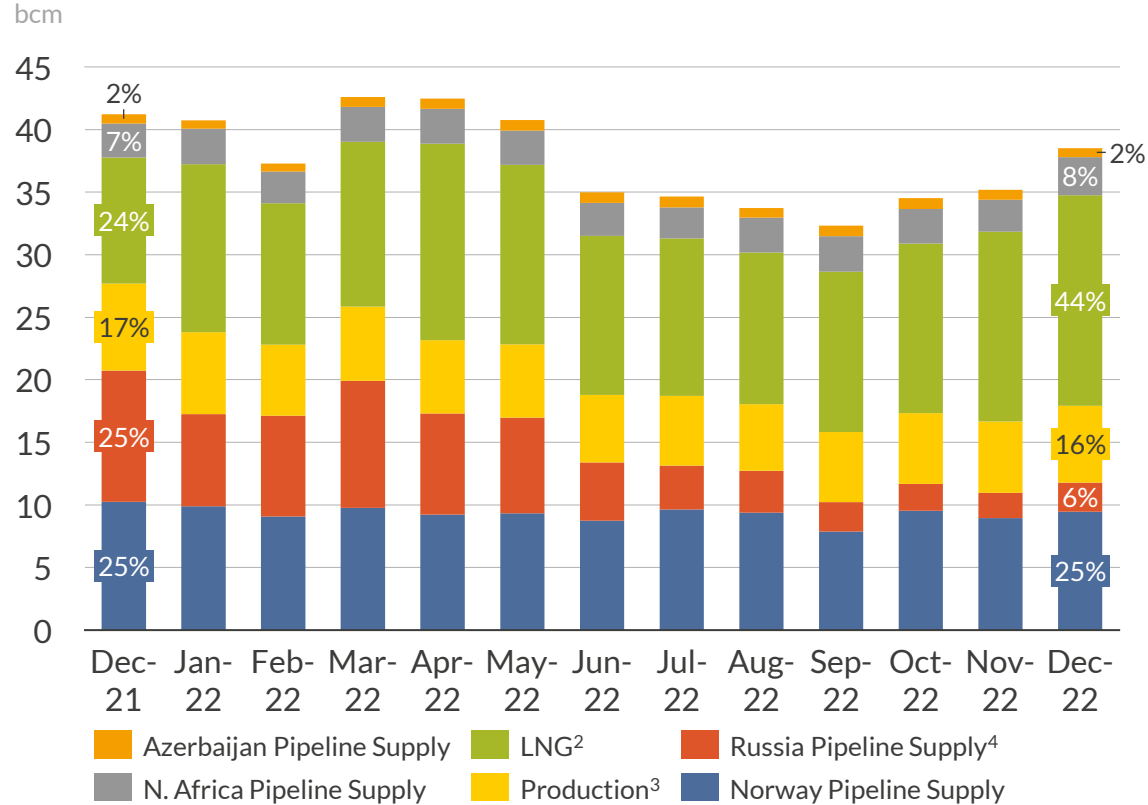
mcm/d



1) Other marginal routes, including about 15.7mcm/d of additional capacity at the Belarus-Poland border, were excluded. Deliveries to Turkey and the Baltics have been excluded as well.

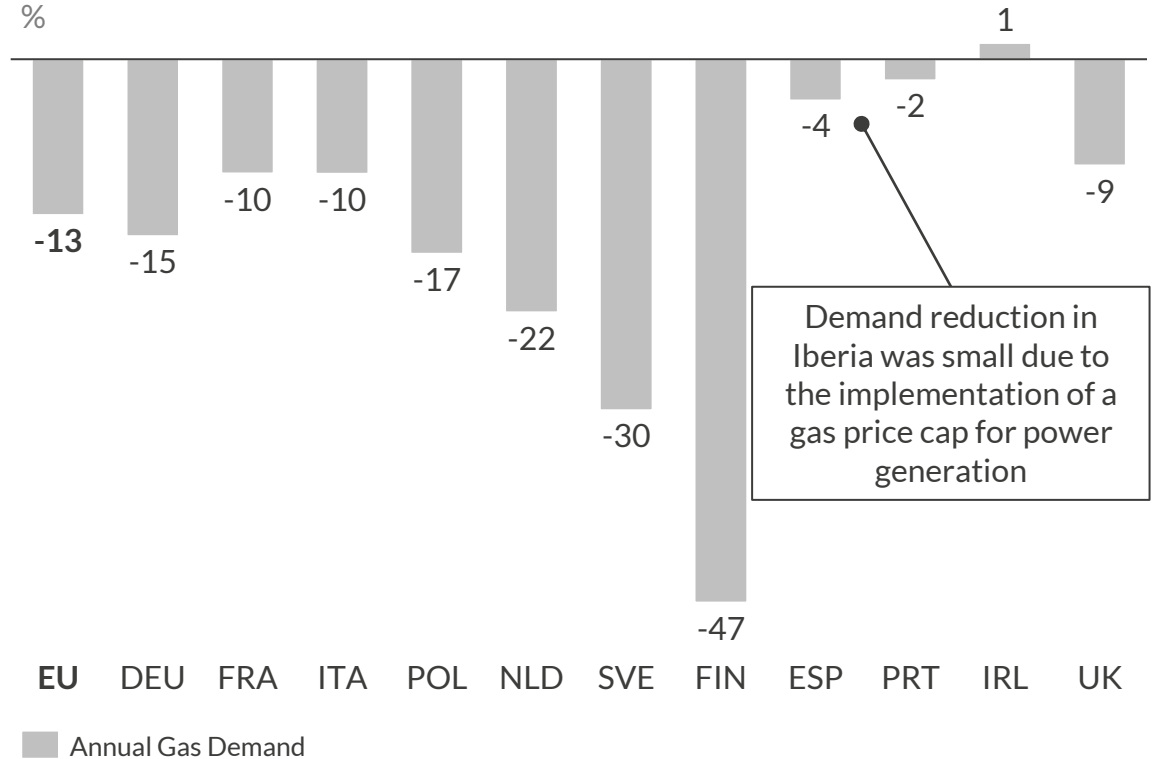
Responding to the Russian war, European countries shifted their gas supply sources and lowered their consumption

Share of Europe's natural gas supply¹



- Russian natural gas imports have been falling throughout 2022, as a reaction to Russia's invasion of Ukraine. The share of Russian gas in European supply fell from 25% to 6% by December 2022.
- At the end of 2022, Russian pipeline gas was only delivered through TurkStream and Ukraine transit.

Change in annual natural gas demand between 2022 and 2021

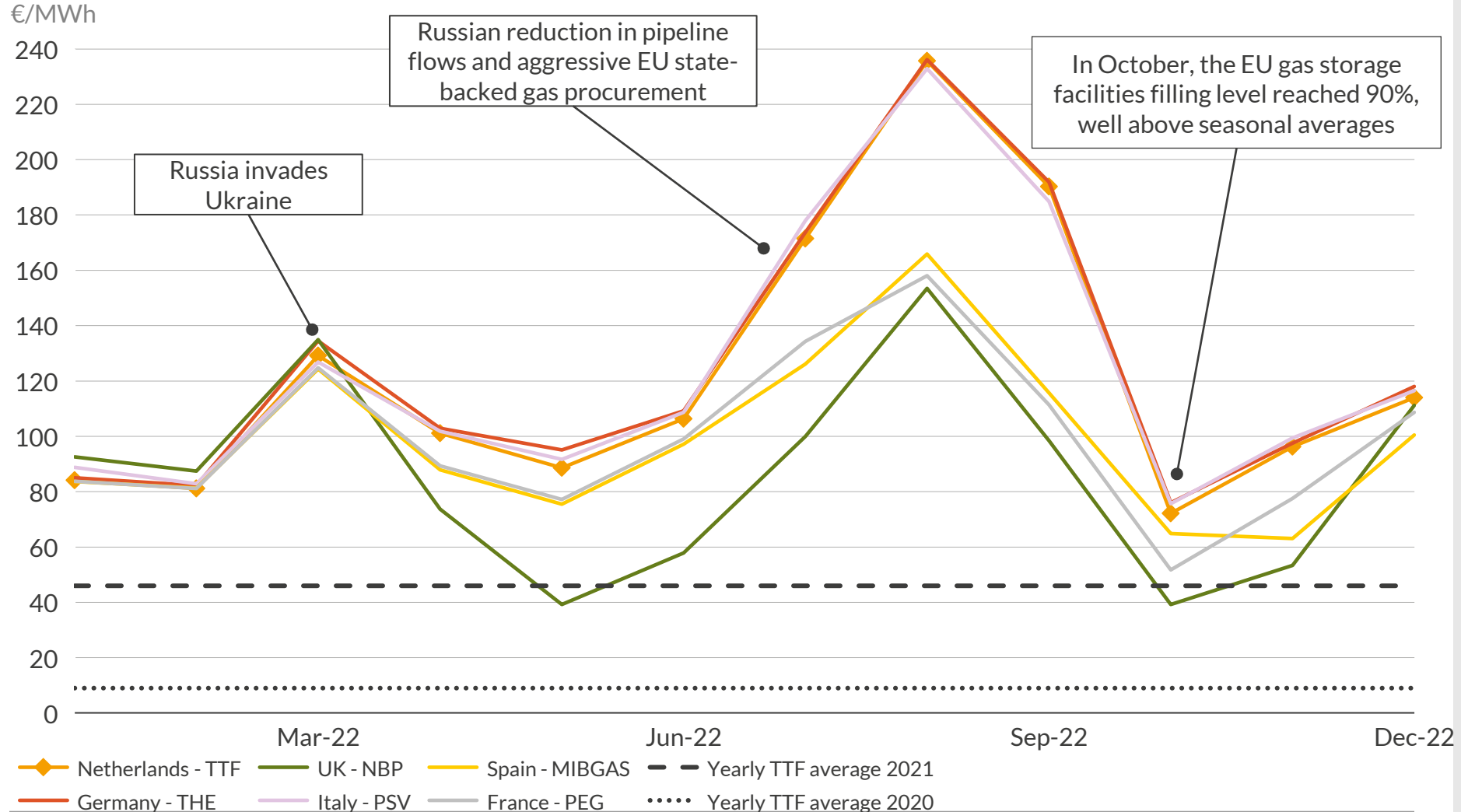


- Natural gas demand reductions across countries mainly came from the industry and household sectors, rather than from the power sector.
- Countries with high dependence on Russian gas, like Finland and Sweden, reduced their natural gas demand the most.

1) Excluding storage withdrawals/injections. 2) LNG reflects sendout to the high-pressure network. 3) Excludes Ukraine. 4) Excludes Russian gas deliveries to Finland and the Baltic states

TTF natural gas prices surged between June and August 2022 following the Russian reduction of pipeline flows

Traded average monthly gas prices¹



1) Monthly average of daily DA prices.

- The European benchmark TTF averaged 123 €/MWh in 2022, up from an average of 46 €/MWh in 2021 and 9 €/MWh in 2020
- The NBP, PEG, ZEE, and MIBGAS had held large discounts to the TTF in summer and early winter, as the Dutch and German hubs disconnected from other west European markets
- The start up of new regasification capacity in the Netherlands and Germany has eased import bottlenecks that had kept the region from importing more LNG and led to a re-conversion of prices

I. Looking back on 2022

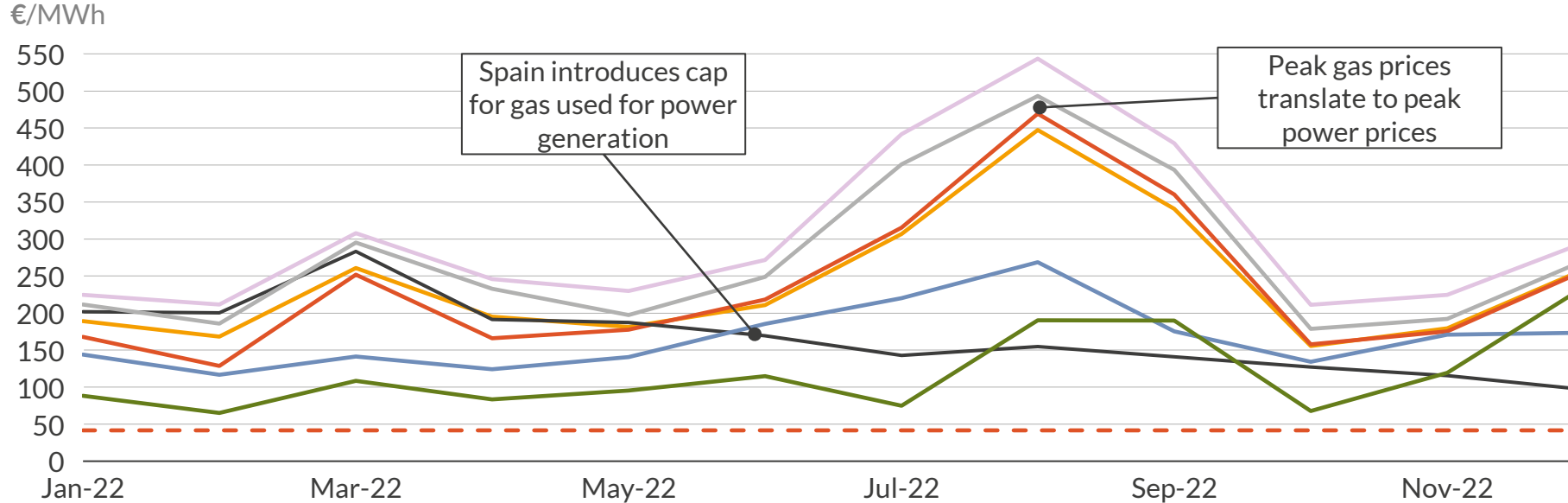
1. Russia's energy warfare – European gas markets in turmoil
2. Main developments in the EU power sector

II. What to expect for 2023 and the next winter?

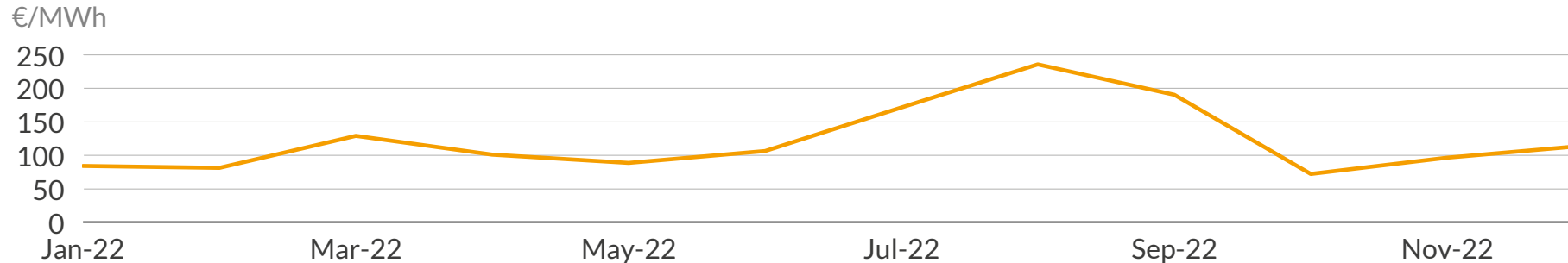
1. Gas supply scenarios
2. Power supply and demand

Power prices in the EU were driven up by high gas prices, price divergence between Member States was significant

Average monthly wholesale power prices for selected countries¹



Traded monthly average of day-ahead TTF gas prices



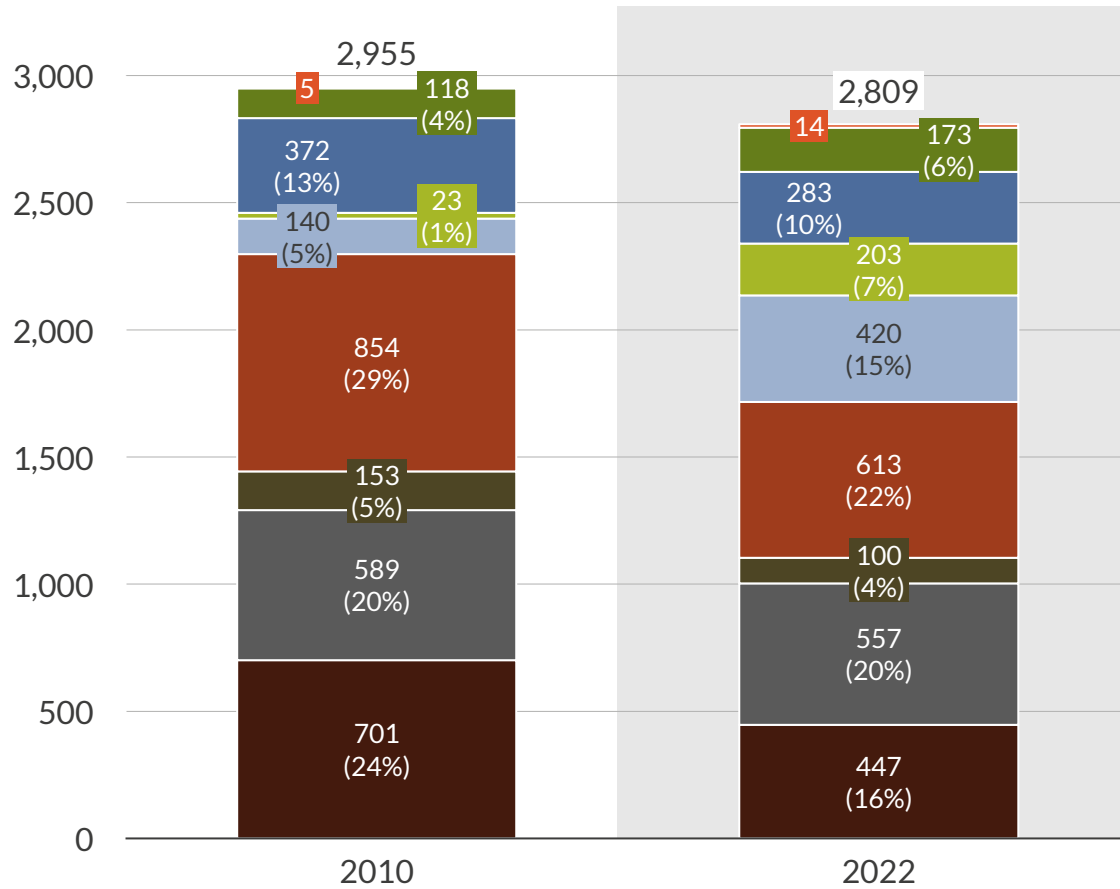
— Netherlands — Germany — Italy — Spain — France — Poland — Sweden — Average DEU price (2015 - 2019)

1) Monthly average of daily DA prices.

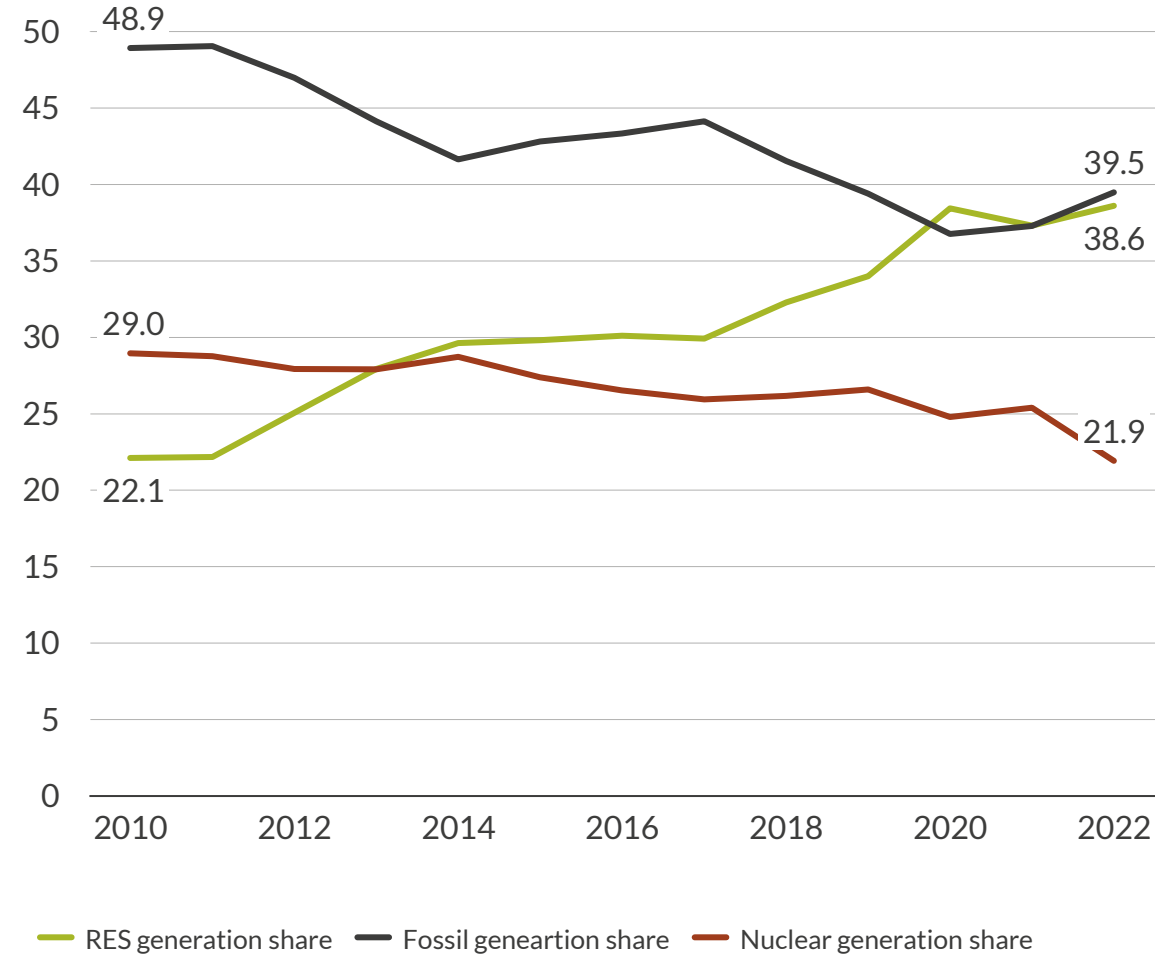
- Power prices were already on a very high level at the beginning of the year when compared to the average of previous years
- The development of power prices was closely linked to gas prices, causing record power price levels
- In countries with a lower dependence on gas for power generation such as Poland and Sweden, power prices were significantly lower
- The Spanish and Portuguese governments implemented a market intervention to cap the price of gas used for power generation

Fossil energy sources accounted for the largest share of power generation in 2022, closely followed by renewables

Total power generation in the EU by type of energy source in 2022
TWh

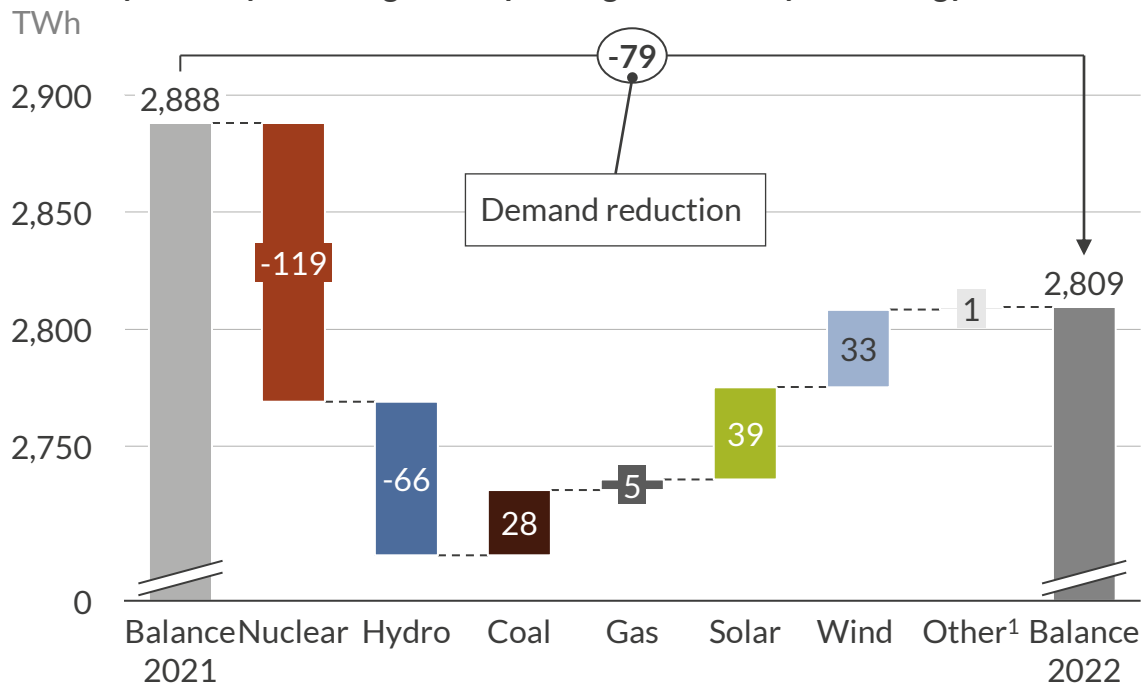


Power generation share by type of energy source
%



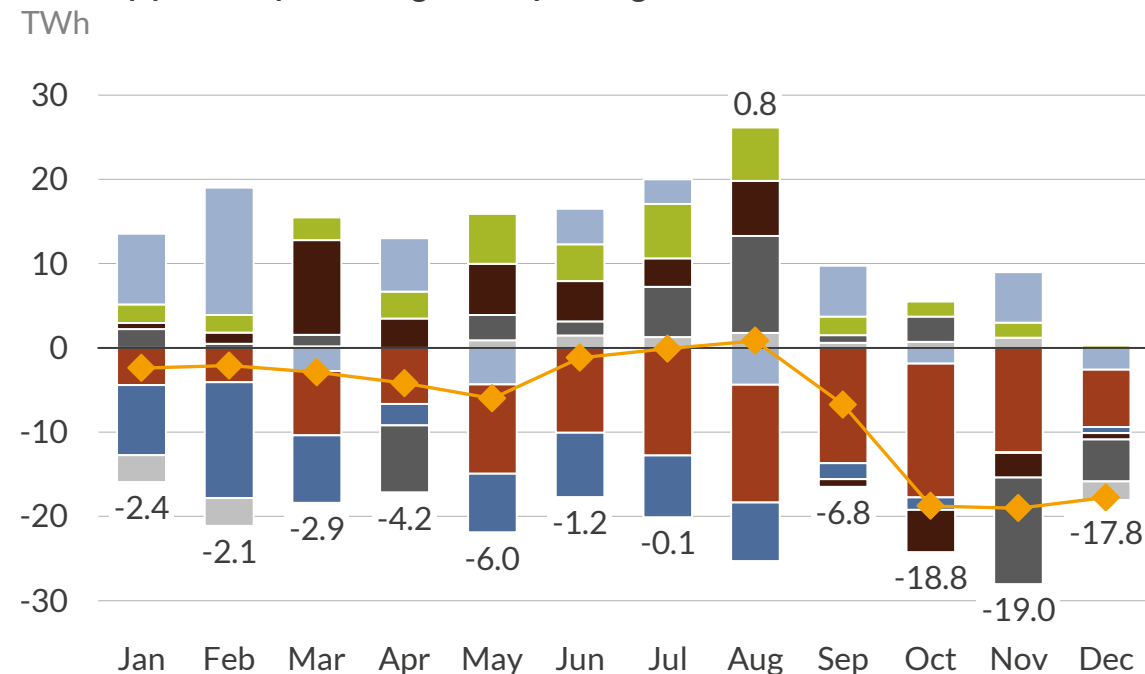
Historically low levels of nuclear and hydro power generation were partly compensated by increases in solar, wind, and coal generation

Annual year-on-year change in EU power generation by technology

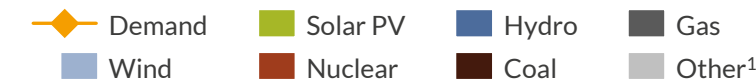


- Nuclear generation plummeted by 119 TWh (-16%) caused by a combination of maintenance, unplanned outages and lack of cooling water in France as well as the decommissioning of 3 reactors in Germany
- Hydro power generation hit a 20-year low due to low precipitation in large parts of Europe which led to dramatically low river levels
- Increases in solar, wind, and coal generation partly closed the gap

Monthly year-on-year change in EU power generation and demand



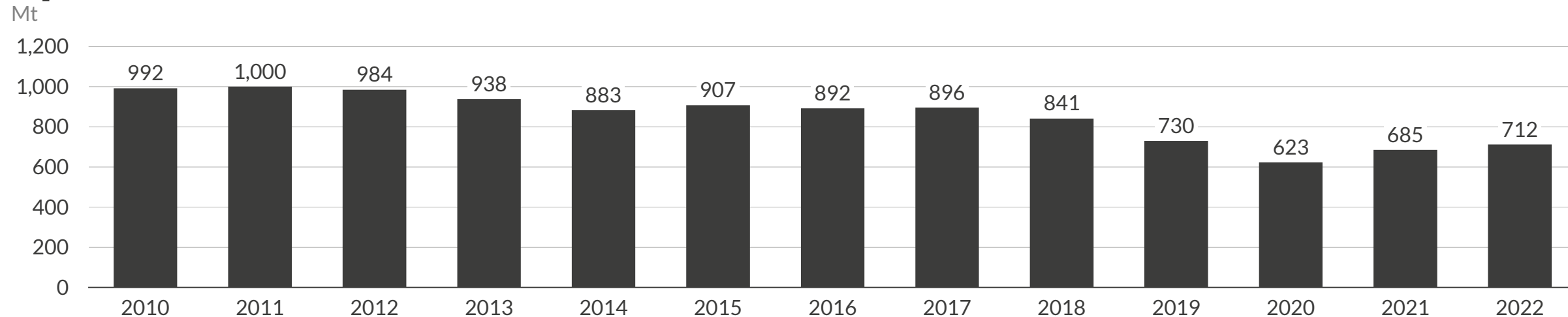
- Hydro generation was particularly low in the first half of the year, nuclear generation remained consistently below 2021 levels
- Coal generation was only higher in the first three quarters of the year
- Demand was significantly lower compared to 2021 from September to December 2022 due to high prices and a mild winter



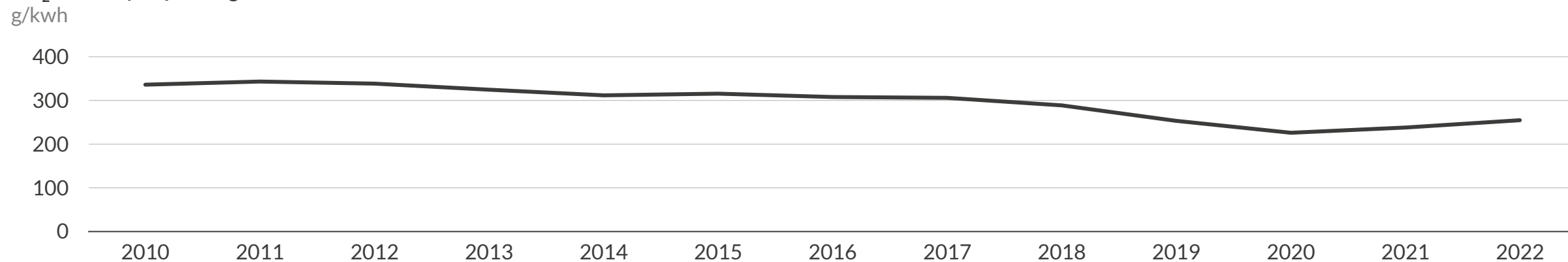
1) Includes Other fossil, bioenergy and other renewables, and net imports

CO₂ emissions of the EU power sector increased for the second consecutive year but remained below pre-pandemic level

CO₂ emissions of power generation in the EU27



CO₂ intensity of power generation in the EU27



I. Looking back on 2022

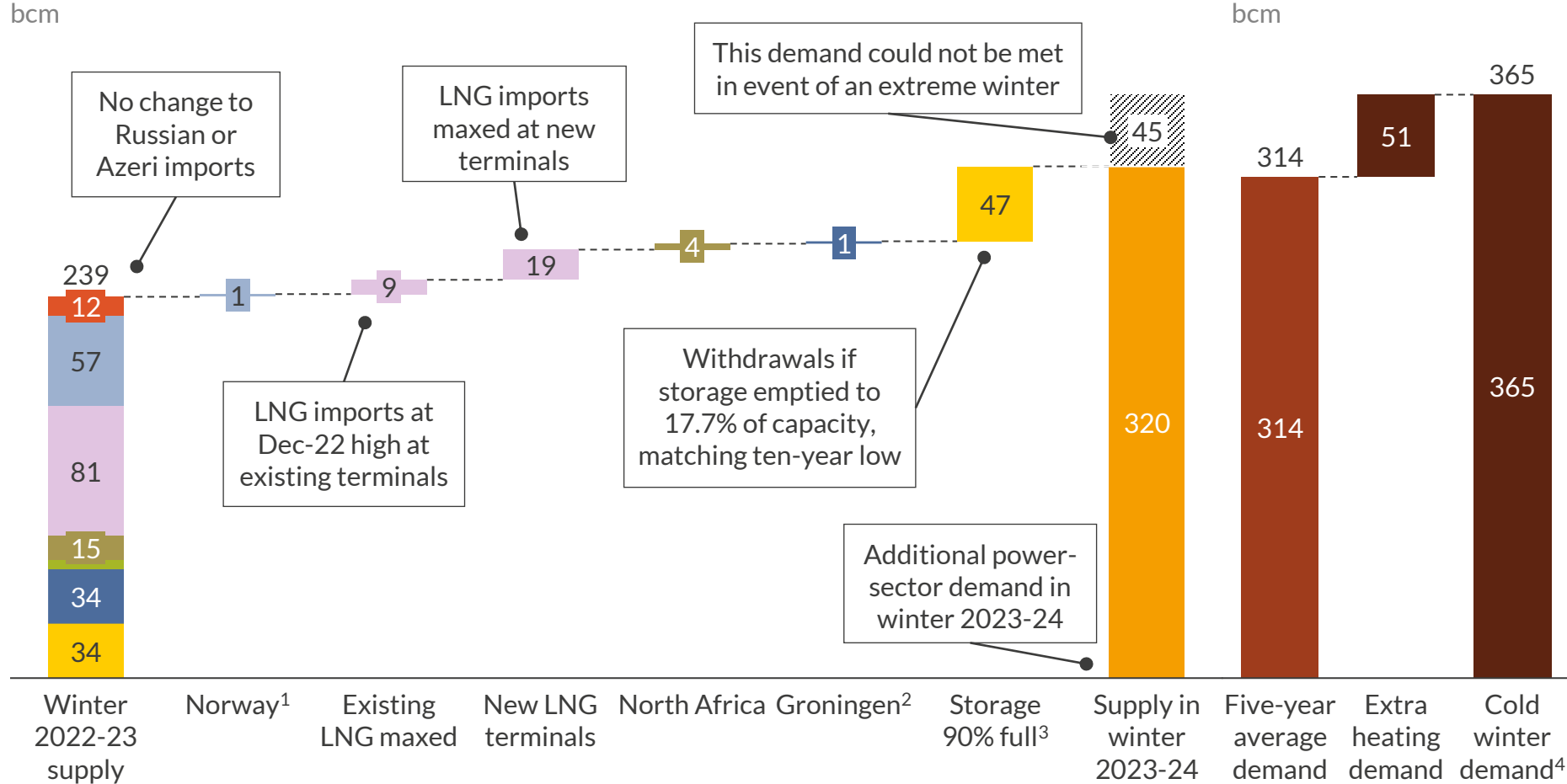
1. Russia's energy warfare – European gas markets in turmoil
2. Main developments in the EU power sector

II. What to expect for 2023 and the next winter?

1. Gas supply scenarios
2. Power supply

Europe will likely have more than enough gas to cover average demand next winter, but could struggle in an extremely cold winter

European supply measures available in well supplied October 2023 – March 2024



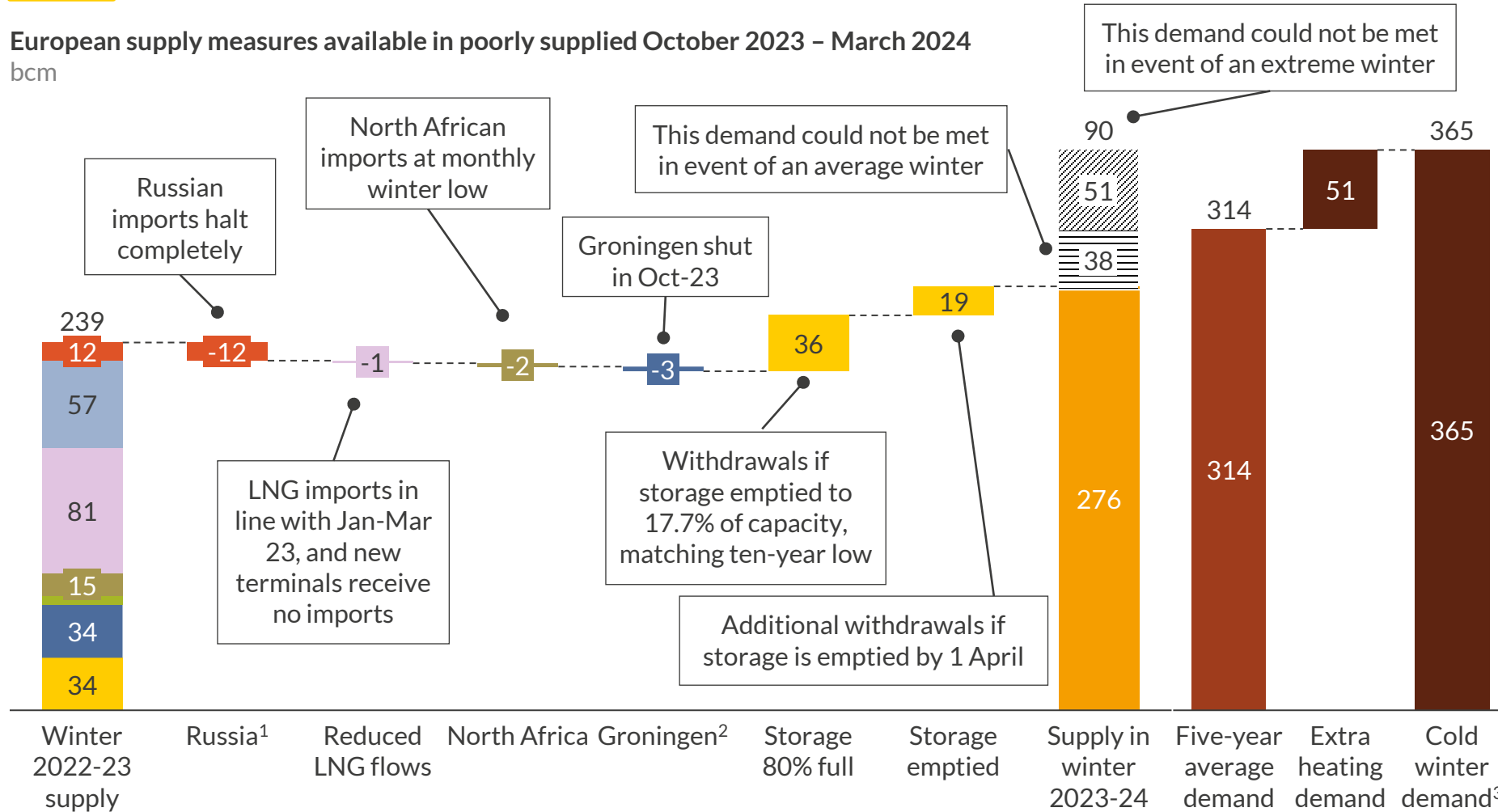
- Europe could meet gas demand in line with the five-year average without emptying storage or maximising LNG imports next winter.
- However, if demand is much higher, in line with extreme cold weather, supply would likely not be enough to meet demand.
- This could require cuts to consumption, similar to winter 2022-23, when high prices drove industrial demand destruction and power-sector fuel-switching away from gas.
- The gap in demand that would not be met in an extreme winter is 45bcm (14% of projected supply for winter 2023-24), although this could be partly mitigated by emptying storage.

■ Max potential winter supply
 ■ Norway
 ■ North Africa
 ■ Production
 ■ Russia
 ■ LNG
 ■ Azerbaijan
 ■ Storage
 Extreme winter demand gap

1) Planned maintenance is 0.4bcm lower in winter 2023-24, there was also about 1 bcm of unplanned maintenance last winter. 2) According to GTS' recommendations to keep Groningen online next winter. 3) Assumes storage is drawn down to 17.7% of capacity, matching the lowest in the last ten years. 4) EntsoG estimate with a probability of occurrence once in 20 years.

A halt to Russian gas imports and increased competition for LNG would require sharp demand cuts next winter

European supply measures available in poorly supplied October 2023 – March 2024
bcm



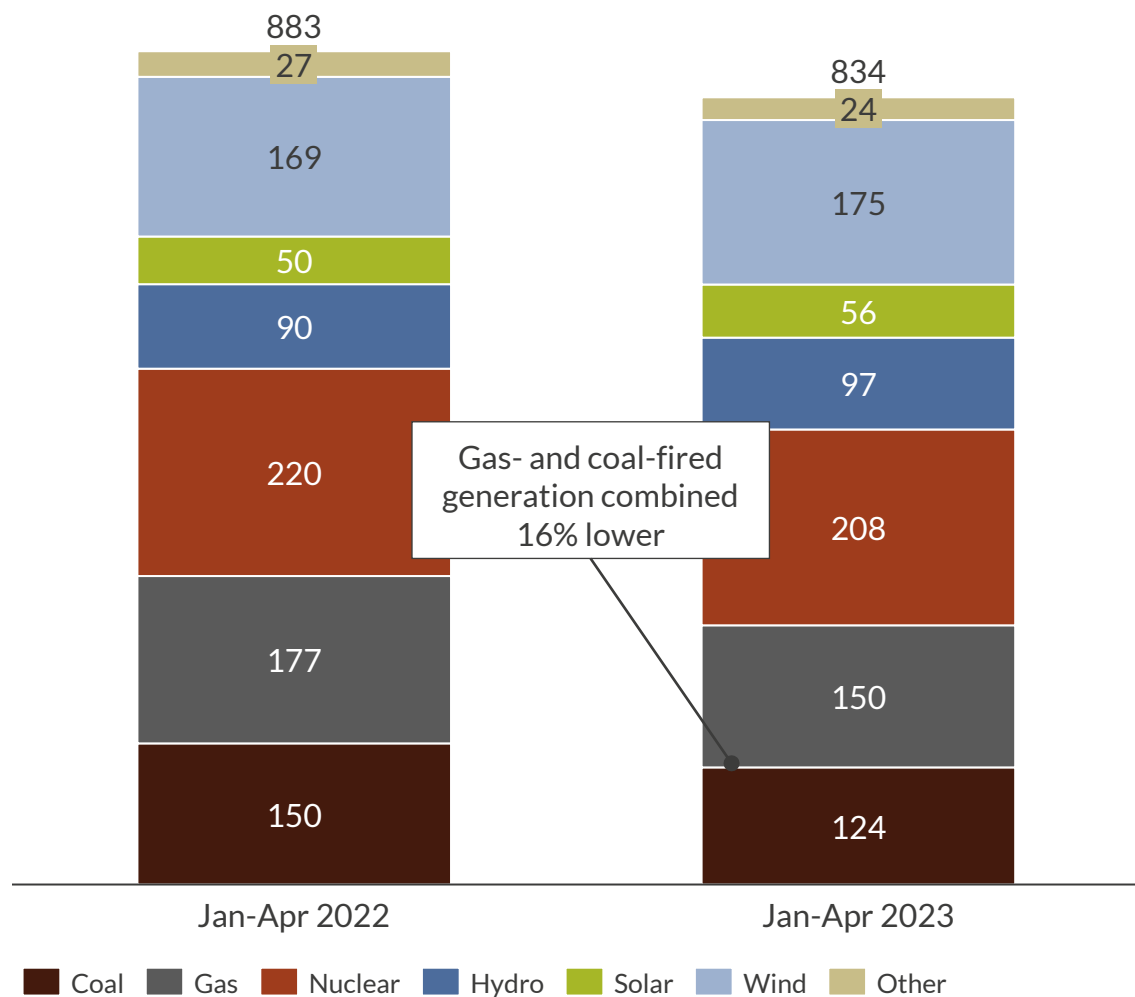
- Europe would have difficulty meeting gas demand in an average winter, if remaining Russian imports are cut and competition for LNG limits imports next winter.
- This could require significant cuts to consumption of around 38bcm, similar to winter 2022-23.
- If demand is much higher, in line with extreme cold weather, demand cuts would need to be far higher than they were this past winter, with up to 90bcm coming from power generation, industry, and households.
- Accelerated renewables deployment could limit power-sector demand needs, but not enough to avoid a cut.

■ Max potential winter supply
 ■ Norway
 ■ North Africa
 ■ Production
 ▨ Extreme winter demand gap
■ Russia
 ■ LNG
 ■ Azerbaijan
 ■ Storage
 ▨ Average winter demand gap

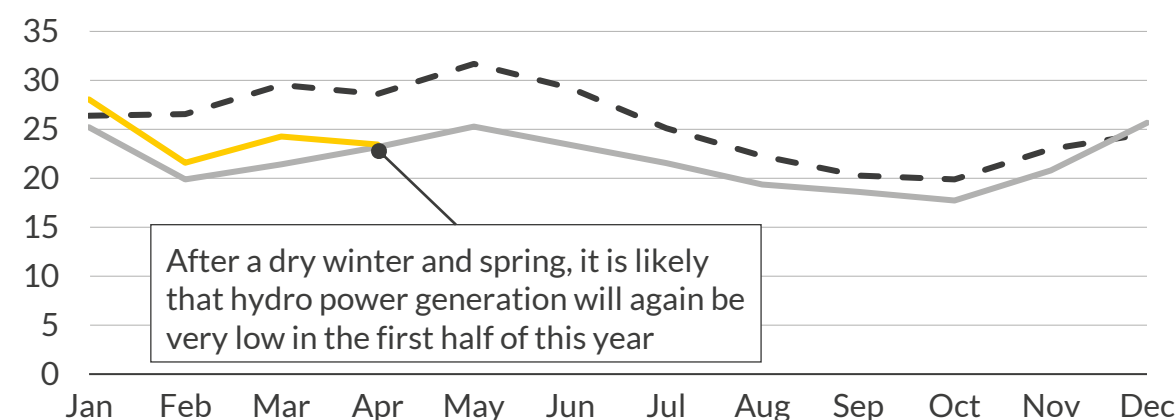
1) Cuts to Russian imports could also make re-filling storage more difficult in summer 2023. 2) The Dutch economic affairs ministry has expressed reluctance to extend Groningen's life beyond Oct-23 because of seismic activity, but would leave it online until Oct-24 if needed to ensure security of supply. 3) Entso-g estimate with a probability of occurrence once in 20 years.

Nuclear and hydro output will likely again be low, but mild winter and continuous RES buildout could lead to a y-o-y reduction in emissions

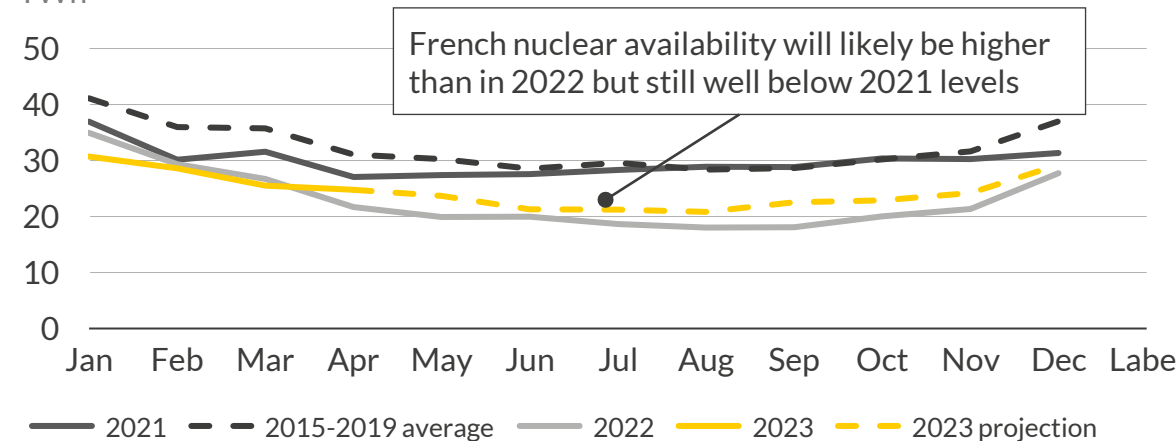
EU power generation mix Jan-Apr 2022 compared to Jan-Apr 2023
TWh



Monthly hydro power generation in the EU
TWh



Monthly generation of French nuclear power plants
TWh



AURORA



ENERGY RESEARCH