Gas scenarios from November 2023 to March 2024

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The Bundesnetzagentur has created gas scenarios for the current winter. The aim of them is to better classify the supply situation and potential challenges so as to identify and quantify the remaining risks to supply this winter.

Germany uses natural gas storage facilities because, while gas imports to Germany are subject to rather minor fluctuations, consumption can vary greatly depending on the temperature or time of year. During the summer months, more gas is imported than is consumed overall, whereas during the winter it is the other way around. The difference is made up for by filling storage facilities in summer and taking gas out of them in winter. Germany, along with all other EU countries, was able to fill its storage facilities almost completely for both last winter and this winter.

The gas scenario model

The gas scenario model is a Germany-wide balancing model. It checks Germany‘s gas balance, that is to say, whether enough gas is being injected into the country‘s gas system to cover the gas being taken out of it at all times. The scenarios cover the period from November 2023 to March 2024.

Some scenarios were calculated that could jeopardise Germany‘s supply security. Some measures that contribute to upholding security of supply were also evaluated.

Changes from the modelling for 2022/2023

Unlike the modelling for winter 2022/2023, the current modelling focuses exclusively on a „cold year“. The year 2012 was taken as the reference for such a year.

This approach was based on the assessment that the risk of a gas deficit affecting the whole of Germany in a normal year is low due to the additional possibilities for gas to enter the system created in recent months and the commissioning of further LNG terminals this winter. However, there are residual risks in the event of:

- temperature-driven higher consumption;
- reduced imports; and
- higher exports, especially to supply those European countries still heavily dependent on Russian gas deliveries.

The modelling therefore focuses on the influence of these factors.

In contrast to last winter, the Bundesnetzagentur has based this modelling on flows for an entire heating season without Russian gas supplies. The modelling therefore uses the import and export flows from last winter.

How is the model calculated?

The model simulates the balance of all entry and exit points in the German natural gas network.
As input data, the current storage levels as well as different values for imports, exports and consumption depending on the scenario are taken as input parameters. Using historical, daily flow data, the flows at entry and exit points are compared with the average daily temperatures to derive temperature-dependent approximation functions. Such approximation functions are held for:

- domestic consumption
- injection/withdrawal of gas to/from storage facilities
- domestic production
- gas imports
- exports (transits) of gas to neighbouring countries.

A temperature model is then used to forecast future daily average temperatures.
Future flows at all entry and exit points are then forecast based on the future temperature forecasts and the temperature-dependent approximation functions. The model considers

- domestic consumption
- injection/withdrawal
- domestic production
- imports/exports (transits) in aggregated form.

The result is a daily balance of forecast injections and withdrawals for the period from November 2023 to March 2024. Differences in these daily balances will be smoothed out using the storage facilities as far as technically possible (gas being withdrawn from storage in the event of a shortfall but also put into storage if there is a surplus).

Which assumptions are the entry and exit points based on?

Domestic production

Future domestic production is forecast using historical data (2018 - 07/2022), as in the previous modelling, and factored into the daily balances in aggregated form. The data is not broken down by individual production sites, as this is not necessary to show the situation in the whole country. The declines in production in recent years are reflected in the model.

Consumption

To calculate consumption, historical daily consumption data and the corresponding daily temperatures are first used to find the relation between daily temperature and consumption. To draw conclusions about a cold year, this relation is used to calculate the daily consumption that would have occurred if the temperatures of a cold year had happened instead of the temperatures actually measured during the period. The temperatures from 2012 are used to model the cold year. In that year, there was a short cold spell in December and a period of intense cold in January and February, during which daily temperatures fell to nearly minus 14 degrees Celsius.

The Bundesnetzagentur has modelled two different consumption approaches. The **„a“** scenarios are based on **consumption that is 10% lower** than consumption adjusted for a cold year. Modelling of a 20% drop in consumption was not carried out. The reduction assumption should not be understood as a „recommendation“ for how much gas users should save. The

approach was taken because attempts to use less gas are heavily influenced by the prevailing external temperatures. The colder it is, the more difficult it is for consumers to adjust their heating behaviour to save more gas. That is why a saving of 10% is assumed for the months relevant to the modelling in the modelled cold year, in order to adequately reflect this effect.

In addition, the **„b“** scenarios assume the calculated consumption of a cold year **without any reduction**. The „a“ and „b“ scenarios thus cover a range of potential consumption in a cold year.

These consumption figures are not broken down by individual consumers – industry, households or power plants – as this is not necessary to show the situation in the whole country.

LNG (Liquified Natural Gas)

LNG volumes that are increasingly brought to Germany from neighbouring countries are included in the forecast imports in the model.

LNG volumes from currently available and future German terminals are included in the daily balances in aggregated form. A utilisation rate of between 50% and 90% is assumed for the terminals depending on the scenario. The modelling further takes account of the fact that some terminals are currently subject to technical restrictions on the entry side, meaning they might not be able to achieve the assumed utilisation. In that case, the amount that can be injected into the system is capped at the capacity currently technically possible.

Injection into/withdrawal from gas storage facilities (storage model)

The primary task of the storage model is to smooth out imbalances in the daily balances as far as possible by emptying and filling storage facilities (gas being withdrawn from storage in the event of a shortfall but also put into storage if there is a surplus). The model uses a storage model that spreads the necessary, aggregated injection and withdrawal volumes for balanced daily amounts among the individual storage facilities in Germany. Storage operation at individual facilities is thereby controlled by the overall storage level. If the storage level at an individual storage facility is lower than the overall storage level, gas will be put into storage there. If the storage level at an individual storage facility is higher than the overall storage level, gas will be taken out of storage there. The model also contains storage characteristics to take into consideration technical restrictions on gas entering and leaving storage depending on the storage level.

Gas imports and exports

Gas imports and exports were calculated using last winter‘s data. The usual figures were between 80 GWh/h and 100 GWh/h net, with balances of nearly 70 GWh/h observed on the coldest days.

Although imports and exports are not as heavily temperature-driven as gas consumption, a temperature-related pattern of imports and exports may still be seen in the figures from last year. To take account of this effect, the import/export balance was adjusted to the temperatures of a cold year and used as a starting point for the imports and exports modelled in the scenarios.

Results

A gas deficit can be avoided with similar imports and exports to last winter alongside a high level of utilisation of the new LNG facilities on the North and Baltic Sea coasts, provided sufficient LNG is available on the global market.
There is a remaining risk that gas demand cannot be fully met if:

- low temperatures in Germany and abroad lead to lower imports at the western cross-border interconnection points;
- there is higher consumption in Germany;
- there is higher demand in countries that have previously imported gas from Germany.

Negative effects on imports and exports could cause a lot of gas to be taken out of storage facilities.

Scenarios 1a and 1b

These two scenarios differ in the reduction of consumption assumed. Neither of these scenarios leads to a gas deficit situation, provided national LNG facilities are utilised to at least 50% and imports and exports remain at a level comparable to last winter.

Scenarios 2a, 2b and 2c

These scenarios build on scenarios 1a and 1b but with the addition of 20 GWh/h of higher demand from neighbouring countries. This could happen if there was a halt to Russian gas supplies via Ukraine, which primarily serve to supply south-east Europe. There would still basically be enough gas for this situation. High exports combined with higher national consumption could be covered by more LNG entering the system, provided there was enough available on the global market. Storage facilities could be empty by the end of the reference period. Depending on the specific demand situation, this sort of rise in exports might be restricted by the transport capability of the gas system, but this is not reflected in this modelling.

Scenarios 3a and 3b

These scenarios build on scenarios 2a and 2b with the addition of a 15 GWh/h reduction in imports to Germany. Last winter‘s imports largely took place on an „interruptible“ basis. That means that the networks in Germany and abroad providing the gas are not technically designed to be able to transport such large volumes at all times. An analysis of the flows last winter showed that at the western cross-border interconnection points, a flow of about 15 GWh/h on average was in the range of this transport risk. Consequently, the effect of reducing imports by this amount on the gas supply in Germany was also examined.

Questions on the model

Can the model be used to identify regional gas deficits as well?

No, the model is a Germany-wide balancing model. It does not show regional gas deficits, such as those that could occur due to technical restrictions in the gas network. These could happen if supply to a region could no longer be guaranteed due to a change in flows caused by the existence of bottlenecks in the system.

To what extent is the influence of flow mechanics included in the modelling?

This modelling is not intended to analyse flows from a flow mechanical perspective. It illustrates possible imbalances in the gas balance, that is, discrepancies between the gas imports available and the gas volumes needed.

Why does a gas deficit appear in the graphics even though the storage facilities are not empty?

The volumes that can be withdrawn from gas storage facilities depend on their filling level. To put it simply, gas storage facilities whose level is already low have less pressure and, for technical reasons, it is not possible to withdraw as much gas from them as might be necessary to meet demand. There is therefore less gas available even though some reserves still remain in the storage facilities.

What is it important to remember when looking at the results?

Gas exports from Germany to neighbouring countries cannot simply be reduced at will, because then it would no longer be possible to supply (protected) customers in neighbouring European countries. As well as domestic security of supply, the necessary supply for neighbouring countries to meet their essential needs must also be guaranteed in the form of exports. This is set out in European Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply, which requires European Member States to show solidarity in the event of supply shortages.

Which assumptions were made for the parameters imports, exports and consumption in the individual scenarios?

The modelling of gas balancing is largely determined by the input parameters „imports“ with „LNG deliveries“ and the two output parameters „exports“ (transit) and „domestic consumption“.

In its scenario modelling, the Bundesnetzagentur used these three parameters to provide an estimate of how storage levels could fluctuate if the parameters changed. It focused on how strongly these parameters could change as a result of external events and what consequences this could have for security of supply.

What is the meaning of the restrictions due to mining law shown in the storage curves?

A number of provisions of mining law must be observed to operate storage facilities safely on a permanent basis. Some of these provisions are „soft“ regulation. They provide a range within which gas can be put into and taken out of storage without requiring a specific minimum threshold for the filling level. In fact, storage facilities can drop below these levels. Depending on the local geological conditions, for example, it could be necessary to fill the storage facility again after some time to ensure the long-term functionality of the facility.

These requirements are specific to each facility. However, as a general rule a storage level of 15% in Germany may be regarded as the level at which many facilities would start to be affected by their restrictions under mining law. The modelling was carried out in three variants for which the relevant assumptions regarding imports, exports (transit) and consumption were taken as the basis.