AUSTRIAN ENERGY AGENCY

Austria: Strategic options for gas supply without imports from Russia

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T. +43 (1) 586 15 24, fax ext. 340, office@energyagency.at | www.energyagency.at

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Preamble

The current geopolitical situation with Russia's war of aggression in Ukraine has led to extraordinary conditions that require comprehensive measures for the permanent substitution of natural gas imports from Russia. In addition to overcoming the climate crisis, high gas prices and the particularly uncertain future of its supply status are now brought into focus.

From today's perspective, it can be assumed that gas prices will remain at a high level in the mid-term, which is why there are also considerable economic incentives to reduce gas consumption overall and to partly substitute natural gas with domestic renewable energy sources. For the remaining gas imports, the supply sources must be diversified. The present analysis outlines strategic options for action for phasing out gas imports from Russia.

The initial situation

Natural gas accounts for 22% of gross domestic consumption in Austria (Statistik Austria, 2019), or 89 TWh. Because of the pandemic, gas consumption fell in 2020, and in 2021 it was back at the level of 2019. Natural gas is therefore the second most important energy source after oil (37%). On average, around 10 TWh were obtained through domestic extraction of natural gas over the last five years. Domestically produced amounts of bio-methane have so far been negligible (0.14 TWh). The remainder of the natural gas used is imported (79 TWh), of which around 80% come from Russia and 20% from other countries. Thus, it is assumed below that the annual natural gas imports from Russia amount to approx. 63 TWh.

Approach for the period up to 2030, gas independence from Russia by 2027

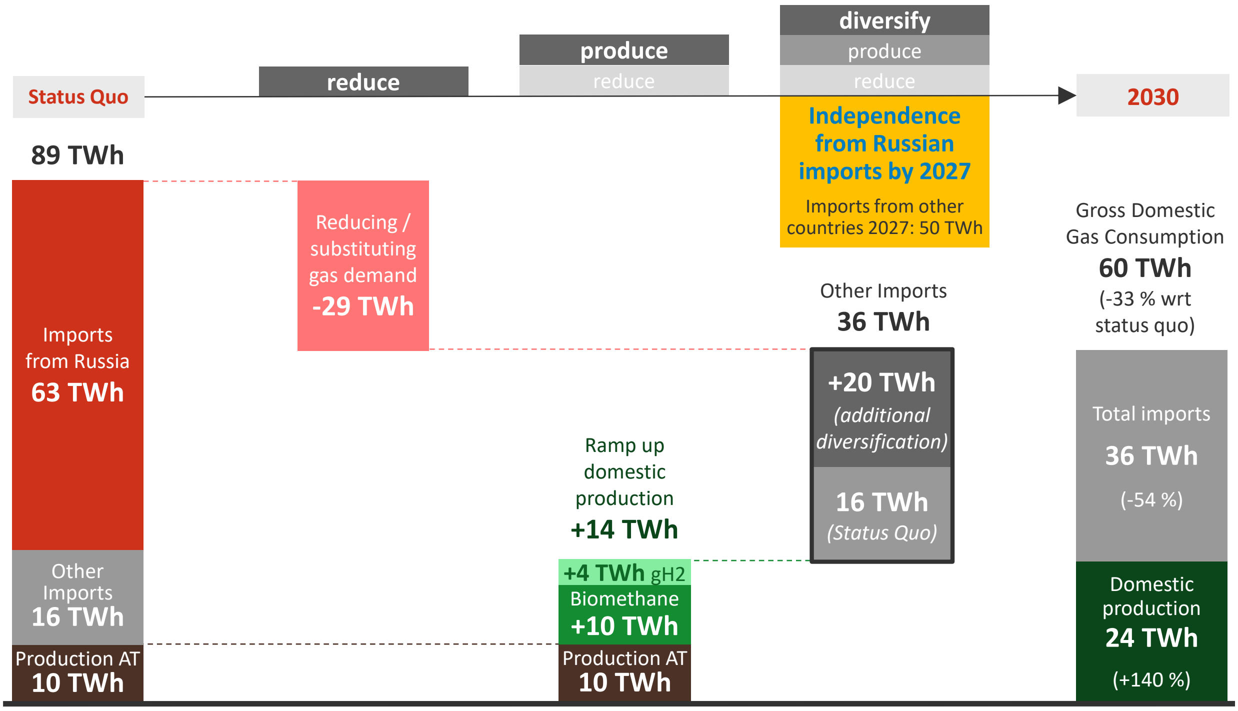
The imports of natural gas can neither be substituted immediately nor in the short term. For this reason, a solution for the period up to 2030 is sensible. In order to reduce gas imports from Russia, a combination of consumption- and supply-side measures is necessary.

Domestic production of natural gas must be kept at a level that corresponds to that of recent years (10 TWh). In addition, imports from regions other than Russia (Norway and other European countries) should be maintained at 16 TWh. The EU target of ending imports from Russia by 2027 also results in an additional need for diversification of 20 TWh, bringing the total import requirement up to 36 TWh in 2030. According to the ramp-up curves of technologies for substituting natural gas, the import requirement from other supplier countries is higher in the years before, whereas the additional demand for diversification reaches its maximum of 34 TWh in 2027 (see “schematic diagram” below). Options are alternative import routes for both pipeline gas and liquefied natural gas (LNG).

However, the import of natural gas cannot be a permanent solution in connection with achieving the goal of climate neutrality by 2040. To this end, import options for renewable gases such as green hydrogen should be developed at an early stage, in the period up to 2030.

In order to reduce import requirements, **the domestic generation of renewable gases must be driven forward (plus 14 TWh)** and **an overall reduction in gas consumption (minus 29 TWh)** must be achieved, namely through the implementation of additional energy efficiency measures and accelerated substitution of natural gas in different sectors. This significantly reduces both gas consumption (60 TWh instead of 89 TWh, minus 33% compared to the status quo) and gas import requirements (36 TWh instead of 79 TWh, minus 54% compared to the status quo). The figure below shows an estimate of the quantity structure for the effects of the measures that are feasible up to 2030 and the remaining need for gas imports, for which diversification is necessary.

Overview of options for action to replace natural gas imports from Russia



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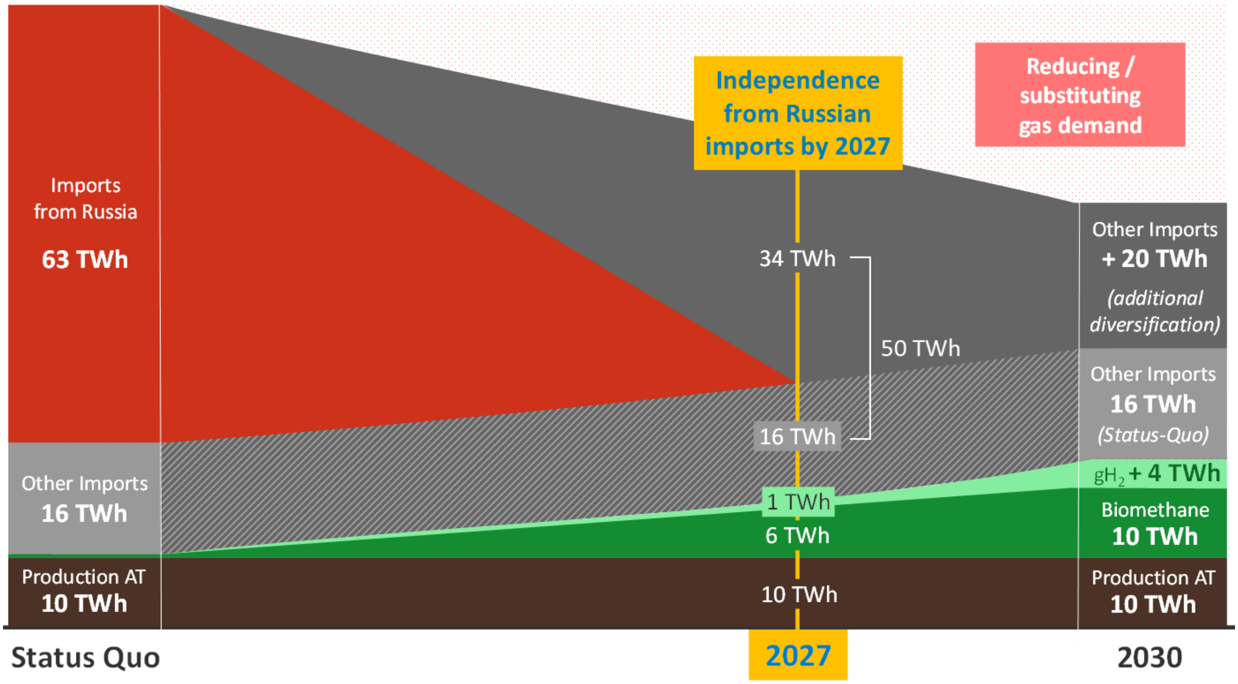
The **additional diversification** of natural gas imports from other supplier countries will play an important role in reducing imports from Russia by the end of 2027 and will amount to up to 34 TWh. In the period between 2027 and 2030, this will decrease again due to the ramp-up of domestic renewable alternatives and the reduction in gas demand, and will drop to 20 TWh by 2030. The following figure shows this schematically.

Schematic diagram| Substitution of natural gas imports from Russia by 2027 and reduction of import dependency by 2030



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A 29 TWh reduction of gas consumption by 2030

- **Accelerated phase-out of gas in space heating, entry into renewables**
  minus 9 TWh of gas from Russia
  In the space heating sector, there are sufficient alternatives to gas heating systems. A comprehensive phase-out of gas heating for space heating and hot water can reduce gas consumption by around 9 TWh. Most of the reduction can be achieved in residential buildings by 2030. By 2030, half of the current 1.2 million gas heating systems can be replaced. Accompanying regulatory measures are necessary to achieve this. Space heating and hot water preparation in the commercial and industrial sector also play a role. A total of 24 TWh of gas was used for space heating, hot water and cooking in all sectors in 2020. A reduction of around 9 TWh by 2030 can be estimated as a result of the accelerated phase-out of gas heating. Alternatives to be driven forward are geothermal, groundwater and air heat pumps as well as local/district heating and biomass boilers. In order to be able to implement the reduction, additional measures for a more flexible and accelerated funding process as well as programmes to ensure the availability of skilled workers and the development of climate-friendly solutions from Austria (keyword: standardisation of the replacement of heating systems, "plug & play") are necessary.

- **Accelerated refurbishment of buildings**
  minus 1–2 TWh of gas from Russia
  Starting with buildings in the lowest efficiency classes and public buildings, accelerated efforts are needed at a federal and state level to renovate the building stock. This area includes subsidies, state

building regulations and further support programmes similar to the phase-out of gas in space heating (skilled workers, development of standardised solutions for faster renovations, reduction of transaction costs, etc.). Building renovations result in reduced gas consumption due to a lesser use of gas heating, a decreased need for district heating (which is largely generated through natural gas in urban areas) and electrical energy (in the winter half-year the share of gas in the electricity mix is particularly high). Around 21 TWh of gas were used exclusively for space heating in 2020 (excluding electricity and district heating, where 24 TWh of natural gas were used). By accelerating the renovation of the building stock, the annual demand for gas can be reduced by an additional 1 to 2 TWh by 2030.

- **Switching to renewables in industry and commerce**
  minus 6 TWh of gas from Russia
  An accelerated switch from gas boilers to high-temperature heat pumps, biomass, electrode boilers, district heating and other renewable energy technologies, especially for applications providing temperatures below 200°C, can lead to a significant reduction in the use of gas (estimate based on the "Scenario Exergy Efficiency" from AEA, MUL, JKU (2021); only available in German). 27 TWh of natural gas were used for process heat in the pre-Corona year 2019 (2020: 26 TWh). Compared to 2019, about 6 TWh can be reduced by 2030 by switching to renewables and/or local/district heating. An accelerated ramp-up of heat pumps, but also the use of electrode boilers, biomethane and other renewable gases is of utmost importance. The current situation in particular shows that the focused use of hydrogen and biomass in the industrial sector is crucial.

- **Reducing the industrial use of natural gas (efficiency)**
  minus 4 TWh of gas from Russia
  Natural gas is used in the industrial sector for energy and non-energy purposes. Currently, around 4 TWh of natural gas are used for non-energy purposes. For example, a more efficient use of fertilisers or adapted production processes can save up to 1.5 TWh of natural gas by 2030.

  In the manufacturing sector alone, around 31 TWh of natural gas were used for energy purposes in 2020 (2019: 32 TWh). High natural gas prices, subsidy and support programmes specifically related to industry, such as a transformation fund, not only improve the economic viability of energy source changes but also that of investments in energy efficiency measures. The implementation of measures is accelerated, and previously uneconomical actions now pay off. In the cases where a particular industrial process can also run on renewables, incentives should prioritise the switch to renewable energy. Educational programmes such as klimaaktiv "energy-efficient companies" serve as accelerators and multipliers, and the Energy Efficiency Act as a regulatory framework. In this area, an absolute saving of 2.5 TWh can be estimated by 2030. Overall, the yearly use of natural gas in the industrial sector can thus be reduced by 4 TWh.

- **Substitution of natural gas power plants through the development of renewable electricity**
  minus 4 TWh of gas from Russia
  In 2019, almost 12 TWh of electricity were generated on the basis of natural gas. In particular, the use of wind power, but also photovoltaics and hydropower substitute natural gas power plants and thus reduce their necessary running time to cover the residual load. This also decreases natural gas consumption in the power plants. Flexibilisation measures can further cut the hours in which gas-fired power plants are necessary. The expansion of cross-border transmission capacities also makes

it possible to reduce gas consumption in domestic power plants. Currently, the Renewable Energy Expansion Act stipulates an additional 27 TWh of electricity from renewable sources by 2030. However, it is recommended to raise the level of ambition for the expansion of wind power and photovoltaics significantly. Additional amounts of electricity from renewable sources are also necessary in regards to the domestic production of green hydrogen and the electrification of heat applications in households, commerce and industry (heat pumps and electrode boilers). The goal of establishing and operating an electrolysis capacity of 1 GW by 2030 alone requires 5 to 6 TWh of electricity based on renewable sources.

- **Geothermal, solar thermal, biogenic energy and heat pumps for district heating**
  minus 2 TWh of gas from Russia
  Especially in cities, natural gas for district heating can be significantly reduced. The decarbonisation roadmap of the Association of Gas and District Heating Supply Companies (Austrian Energy Agency, 2020) envisages a reduction in the use of natural gas of around 2 TWh by 2030. The progressive decarbonisation of district heating in Vienna alone will lead to a reduction in the use of natural gas of 1 TWh by 2030. Tapping the already identified geothermal potential is paramount for this development, which requires an amendment of the Mineral Resources Act in addition to the appropriate framework for subsidies and licensing. The accelerated use of solar thermal energy and heat pumps as well as the targeted use of biogenic residues further reduce the demand for gas.

- **Seasonal use of biomass CHP plants**
  minus 1 TWh of gas from Russia
  This lever includes increased electricity generation from biomass CHP (Cogeneration / combined heat and power) in the winter half-year, while the annual use of biomass remains constant. In this way, biomass CHP plants replace natural gas power plants in the necessary power plant complex during the cold season and reduce their required running time (and thus also natural gas consumption). In the summer half-year, electricity is increasingly generated from PV and hydropower, in addition to wind. The current legal framework does not provide any incentives for seasonal flexibility. The Renewable Energy Expansion Act and other legal matters would have to be adapted. Currently, around 4 TWh of electricity is generated from solid biogenic energy sources.

- **Energy end-use efficiency (appliances, operational optimisation, behavioural change)**
  minus 1 TWh of gas from Russia
  In addition to the above-mentioned structural measures (such as thermal building renovations or the substitution of natural gas with renewable energy sources/district heating as a result of heating system conversions), gas savings can also be achieved through more efficient appliances (reducing electricity demand and thus gas use in power plants). Moreover, optimisation of the existing heating system (e.g. hydraulic balancing for gas heating systems or district heating, insulation of heating pipes, energy-efficient positioning of furniture) and changes in user behaviour (energy-saving practices, reduction of room temperature, night setback, etc.) are viable options. Mid-term savings of around 1 TWh are realistic.

Accelerated domestic generation of renewable gases (plus 14 TWh by 2030)

According to the Renewable Energy Expansion Act (EAG), the share of nationally produced renewable gas (biomethane, green hydrogen, synthetic methane) in the Austrian gas supply has to be increased to 5 TWh by 2030. Against the backdrop of a strategy to accelerate the phase-out of Russian gas imports, raising this target is advisable. At the same time, it should be examined how further support measures can be designed to supplement the investment grants according to the Renewable Energy Expansion Act. In addition to gaining greater independence from gas imports, the accelerated domestic production of renewable gases is also associated with an increased value added and the creation of jobs in Austria.

Replacing imports from Russia requires an accelerated phase-out of the use of gas in space heating and in industrial processes with lower temperature requirements (up to approx. 200 °C). The additionally mobilised quantities of renewable gas should be used mainly in areas where the use of gas is the only option in the period up to 2030. This particularly applies to the substitution of natural gas with renewable gas in the industrial sector and to the generation of electricity and district heat in peak times. Biomethane is to be fed into the grid. In the area of substituting natural gas-based hydrogen with green hydrogen (gH2) in the industrial sector, production will also be decentralised, with these quantities not primarily fed into the natural gas grid, but being used on site.

- **Use of biomethane from current biogas electricity generation**
  plus 1 TWh of biomethane from Austria = minus 1 TWh of gas from Russia
  Currently, around 2 TWh of biogas are used for the production of electricity. Instead of being exploited for the generation of electricity, part of the biogas can be upgraded to methane quality and fed into the gas grid.

- **Additional mobilisation of biomethane**
  plus 9 TWh of biomethane from Austria = minus 9 TWh of gas from Russia
  In 2021, 0.14 TWh of biomethane were produced and fed into the gas grid. According to AEA, MUL, JKU (2021; only available in German), the total realisable potential for biomethane from domestic production is 20 TWh and comes roughly equally from anaerobic digestion (53%) and biomass gasification (47%). In order to increase the realisable potential of biogenic methane, the value chains for the utilisation of biogenic residues need to be redesigned (e.g. increase in collection rates, anaerobic digestion before composting, composting of solid digestate, mobilisation of wood residues for gasification, etc.). Through subsidies and additional ramp-up and support programmes, an additional 9 TWh of biomethane can be realised by 2030, based on initial estimates.

- **Production of green hydrogen for industrial purposes (gH2)**
  plus 4 TWh of green hydrogen from Austria = minus 4 TWh of gas from Russia
  By building up 1 GW of electrolysis capacity by 2030, around 4 TWh of green hydrogen can be produced in Austria. This hydrogen can replace a large part of the 140,000 tonnes (4.7 TWh) of grey hydrogen currently produced on the basis of natural gas in the industrial sector. Thus, domestically produced green hydrogen significantly reduces the quantities of natural gas that have to be imported. It should be noted that the production of 4 TWh of green hydrogen requires about 5 to 6 TWh of electricity based on renewable sources. These additional quantities of electricity are very unlikely to be covered by the EAG expansion target of 27 TWh by 2030. An intensified and accelerated realisation of existing potentials in Austria, especially hydropower, photovoltaics and wind power, is necessary. The currently known technical potential for electricity generation from renewable energies in Austria is more than 120 TWh, which means that it is basically possible to tap into this potential if the corresponding land is available.

Additional diversification through other gas imports (plus 20 TWh by 2030)

- **Other supplier countries**

  plus 6 TWh of gas from Norway, LNG and other sources = minus 6 TWh of gas from Russia
  (in addition to the current 16 TWh already imported from other countries)

  Austria already obtains around 16 TWh of natural gas from European countries (primarily Norway). These quantities must be increased or supplemented by new import routes. The following options are available in the short and mid-term:

  Previously unused routes for imports from northern Europe can be exploited more widely for existing gas fields as well as increases in gas production announced by some companies.

  Liquefied natural gas (LNG) offers further potential for additional alternative sources of supply. Since Austria, as a landlocked country, has no access to LNG terminals, strategic partnerships with coastal countries are necessary. Italy in particular could play a major role here. The additional gas imports could be brought from there via the Trans Austria Gas Pipeline (TAG) to Austria, more specifically to the Market Area East.

  In addition to diversifying import routes for natural gas, renewable gaseous energy sources such as biomethane should be prioritised over natural gas against the background of the climate crisis. Due to its high agricultural importance, Ukraine, for example, has great biomethane potential. The gas could be produced on the basis of biogenic residues. With regard to the realisation of these potentials, Austria could signal its willingness to cooperate by supporting Ukraine with resources, know-how and technologies. In the event that Ukraine were to offer the export of biomethane in the mid-term, it would be an interesting option for Austria to curtail the purchase of natural gas and import biomethane from Ukraine instead.

- **Import of green hydrogen**

  plus 14 TWh import of green hydrogen = minus 14 TWh of gas from Russia

  The manufacturing sectors of steel, metals, chemicals, glass, cement and stone alone consume more than 16 TWh of natural gas annually. In these sectors, gaseous energy sources are not easily replaceable due to the required high temperatures. In addition to the use of biogenic or synthetic methane, green hydrogen is also suitable as a natural gas substitute. However, it should be noted that hydrogen has a lower volume-related energy density: to replace 1.55 billion m³ of natural gas, more than three times the volume of hydrogen is needed, namely about 5 billion m³ – a challenge for the transport infrastructure, which also has to be converted for these purposes.

  For the import of hydrogen to the extent of 14 TWh, corresponding strategic cooperations with potential export countries must be established by 2030 and a hydrogen-compatible transport infrastructure must be created.