Amber Grid

# THE TEN-YEAR (2024-2033) NETWORK DEVELOPMENT PLAN OF THE OPERATOR OF THE NATURAL GAS TRANSMISSION SYSTEM

Vilnius
2024

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# INTRODUCTION


AB Amber Grid (the "Company" or "Amber Grid"), a member of the EPSO-G group of companies, is the transmission system operator of natural gas ("gas") in Lithuania, responsible for the safe operation and development of the gas system, for creating favourable conditions for competition in the gas market and the development of renewable energy sources, and for closer regional integration.

The Gas Interconnection Poland–Lithuania (GIPL) was completed in 2022 (on the Lithuanian side, it was completed in 2021), connecting the Lithuanian transmission system to the European natural gas transmission system, and in late 2023, the implementation of the Enhancement of Latvia-Lithuania Interconnection Project (ELLI) increased the capacity of the interconnection between the two countries, thus creating the broadest possible opportunities for gas market participants to access diversified sources of gas supply, to trade in gas in the Baltic region and the wider European market, to use the Inčukalns underground gas storage facility in Latvia, and for regional partners to use the capacity of the LNG terminal.

One of the Company's future strategic directions is to enable producers of green gas (in particular biomethane and green hydrogen) to connect their systems and transport gas from renewable sources through transmission pipelines. Amber Grid's short-term goal is to transform the natural gas system by 2030, adapting it to the safe transport of renewable energy sources in Lithuania and abroad, contributing to the creation of a climate-friendly economy, and to reducing the impact of climate change by focusing on energy from renewable sources.

In addition to the main objectives of gas transmission activities and energy transformation, given the complex geopolitical situation, the Russian aggression in Ukraine and other regions, a very important direction of the Company's activities is to increase the resilience of the Lithuanian transmission system in case of crises.

Amber Grid, taking into account the provisions of strategic state documents, the Company's strategy and environmental policy, the needs of Lithuanian natural gas consumers, the objectives of ensuring the reliability of supply and the efficient operation of the transmission system, has prepared a ten-year (2024-2033) network development plan of the operator of the natural gas transmission system (the "Plan"). The Plan is based on the long-term objectives set out in the National Energy Independence Strategy as well as on the provisions of other existing and forthcoming legislation defining the activities and principles of transmission system operators and the gas industry.

# 1. NATIONAL OBJECTIVES: ENERGY TRANSFORMATION, REDUCED POLLUTION AND SECURITY OF ENERGY SYSTEMS

## 1.1. National Energy Independence Strategy

The National Energy Independence Strategy (NEIS) identifies the following key objectives to be achieved by 2050 (in the NEIS version approved in 2018):

- Energy from renewable energy sources (RES) will become the mainstream energy source in all sectors—electricity, heating and cooling, and transport—in Lithuania.
- 100 percent of the country's total electricity consumption will come from locally produced energy.
- 80 percent of the country's energy needs are planned to come from non-polluting (low greenhouse gas and air pollutant quantities) sources.
- 50 percent of the energy consumed in the transport sector will come from RES.

On 19 December 2023, the Seimas of the Republic of Lithuania adopted a law on amending Articles 1, 2, 5, 11, 13, 14, 20-1, 20-2, 22, 22-1, 26, 49, 64 and adding Articles 14-1 and 20-4 to Law No XI-1375 of the Republic of Lithuania on Energy from Renewable Sources, and, in Article 1(5), the Seimas set the renewed objective of aiming at the share of electricity generated from renewable energy sources in the country's total final consumption of electricity comprising at least 100% in 2030.


Ministry of Energy, National Energy Independence Strategy

The programme of work of the VIII (spring) session of the Seimas of the Republic of Lithuania foresees the consideration of the updated NEIS to be adopted in 2024 (a draft of the NEIS was published for public comment in March 2024). One of the main strategic objectives of the new NEIS is to achieve 100% climate-neutral energy for Lithuania and the region. This will be achieved mainly by focusing on the development of climate-neutral technologies and energies, with a strong focus on the production of hydrogen and hydrogen derivatives in the region.

It also focuses on reducing GHG emissions, preparing for crises and ensuring a resilient energy infrastructure, maintaining industrial competitiveness and ensuring the availability of energy resources to consumers.

## 1.2. The EU Decarbonisation Package


*www.freepik.com*

On 8 December 2023, the European Parliament and the Council of the European Union reached an agreement on the Hydrogen and Decarbonised Gas Package (the "Gas Decarbonisation Package"). The package includes a Regulation and a Directive on the internal markets for gas produced from renewable energy sources, natural gas and hydrogen. The Directive and Regulation proposals aim to facilitate the integration of renewable and low-carbon gases, in particular hydrogen and biomethane, into the energy system, as well as to provide a regulatory framework for the development of a pure hydrogen infrastructure and market and an integrated grid.

One of the main objectives of the Gas Package is to create a market for hydrogen, to create the right environment for investment, and to enable the development of the respective infrastructure and trade with third countries. Firstly, market rules will apply to access to hydrogen infrastructure, the unbundling of hydrogen production and transport activities and the setting of tariffs. The European Commission has proposed to improve the resilience of the gas system and strengthen existing security of supply provisions. No European household will be left alone in the event of shortages, and cross-border automatic solidarity will be reinforced through new predefined measures and adjustments to control and compensation in the internal energy market. The Gas Package extends the current rules to cover renewable and low-carbon gases and includes new provisions to cover emerging cyber-security risks. The Gas Decarbonisation Package was approved in May 2024:

1) The Directive (*Directive of the European Parliament and of the Council on Common Rules for the Internal Markets in Renewable and Natural Gases and in Hydrogen*) aims to reduce the European Union's greenhouse gas emissions while ensuring security of supply and the efficient functioning of the internal markets for natural gas and hydrogen. The provisions of the Directive will allow for the progressive achievement of climate neutrality through the creation and growth of hydrogen market capacity.
2) The Regulation (*Regulation of the European Parliament and of the Council on the Internal Markets for Renewable and Natural Gases and for Hydrogen*) aims to create a regulatory framework that enables and encourages market players to move away from fossil fuels, move towards climate neutrality, ensure the development of the hydrogen market, and ensure the use of renewable and low-carbon gases, as well as hydrogen, in the energy system.
3) The Methane Regulation was agreed at the end of December 2023 and is expected to enter into force in July 2024. The Methane Regulation (*Regulation of the European Parliament and of the Council on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942*) aims to reduce methane emissions through specific measures.

## 1.3. Transformation of Lithuania's Energy Sector

### 1.3.1. Biomethane Development

*Tube Green plant in Pasvalys*

Investment in biomethane production is growing rapidly in Lithuania. Large industrial companies and new entrants are actively exploring the possibility of installing biomethane plants, connecting them to the gas transmission system, and supplying the biomethane to the local and foreign markets by participating in the trade in the green gas guarantees of origin. The integration of biomethane into the common energy system is now one of the most important energy goals of European countries and therefore a major future opportunity for the Company's customers.

The development of potential of Lithuania's biomethane sector was strengthened by the adoption of the Law on Alternative Fuels in 2021. It aims to achieve at least 15% renewable energy use in the transport sector by 2030 by increasing electrification of transport, promoting the use of gaseous fuels and hydrogen gas produced from biomass, and increasing biofuel blending requirements. This will encourage investors to build biomethane plants, connect them to the gas transmission network and produce green energy. The share of green gas transported through the transmission system will grow.

According to the connection agreements concluded in early 2024, the production of biomethane to be injected into the gas transport system(s) in Lithuania is expected to reach 1.4 TWh in 2030 (with the potential to reach up to 2.5 TWh if other potential biogas producers decide to develop this business) and 3.4 TWh from 2040.

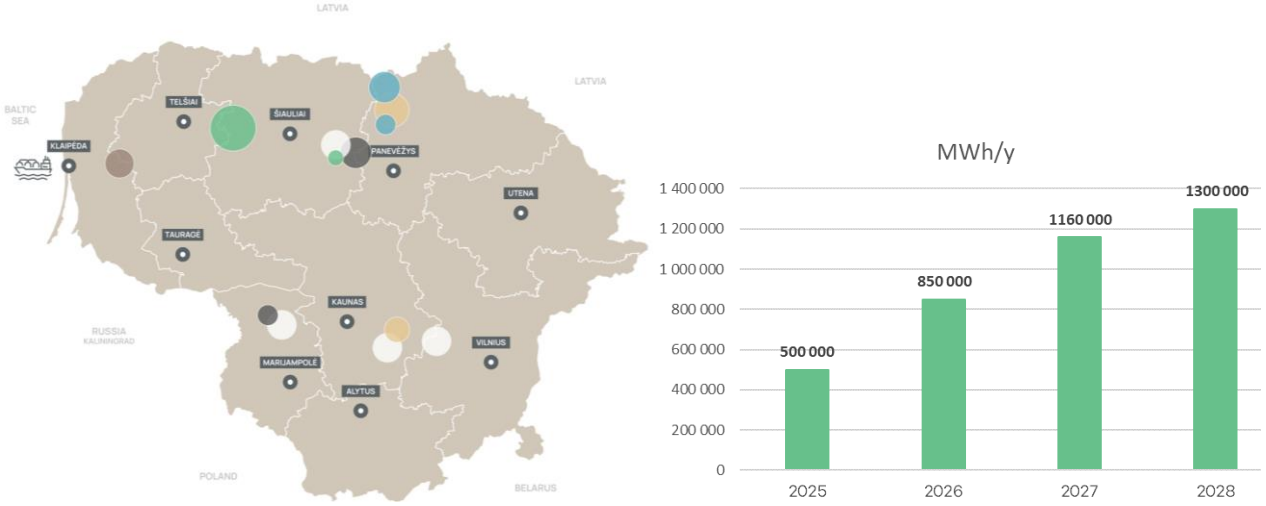
In the ten-year perspective, it is expected that part of the gas transported through the transmission system (around 10% in comparison with Lithuania's demand) will be domestically produced from renewable sources. In order to attract green gas supplies to the gas transmission networks, decisions have been taken on the adaptation of the national registry of guarantees of origin to the international trade in guarantees of origin, the implementation of a demonstration project on the blending of green hydrogen into the gas networks is continuing, and there is a close cooperation with biogas producers on the connection of biogas production facilities to the gas transmission networks in Lithuania.

The existing legal framework and the prospects for doing business in the EU provide a favourable environment for the development of alternative energy sources, such as biomethane production. Amber Grid received nearly 20 customer applications for preliminary connection conditions between 2022 and 2023, following the allocation of EUR 14.35 million from the Recovery and Resilience Fund (RRF) for the financing of the installation of biomethane gas production and purification facilities.

In 2023, green gas produced from RES in Lithuania was fed into Amber Grid's gas transmission network. Biomethane is fed into the transmission network by the newly opened Tube Green biomethane plant in Pasvalys District.

As at Q2 2024, 13 connection conditions have been issued and are valid, of which 7 customers have already signed connection agreements with Amber Grid. Most of them are planning to connect their biomethane plants to transmission systems in 2025, with an expected biomethane volume of ~0.5 TWh/y to be feed in to the transmission grid. Further, based on the submitted applications, a steady increase in biomethane feed-in capacity is planned, reaching ~1.3 TWh in 2028.

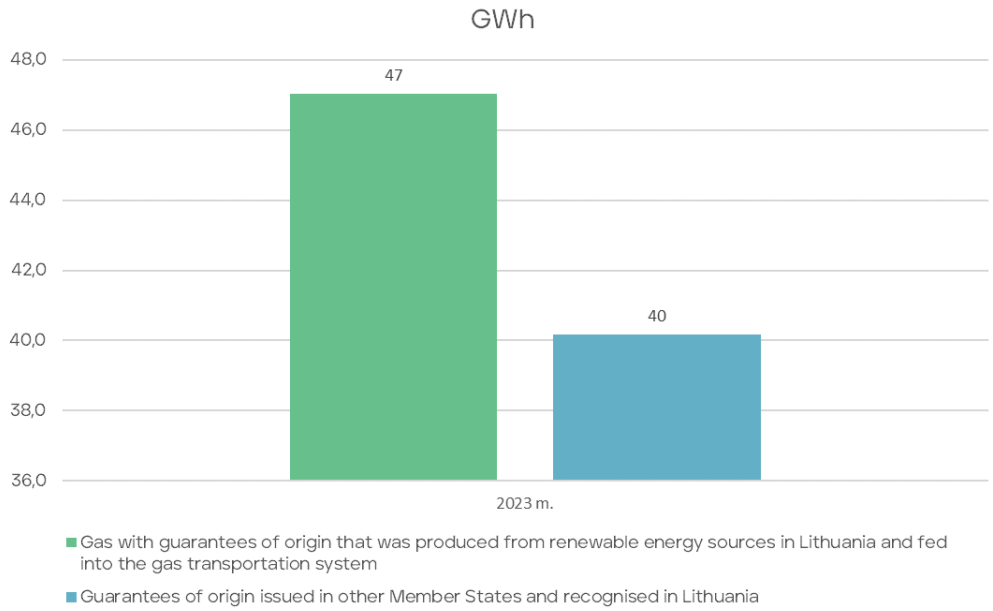
Fig. 1. Distribution of connection conditions in force in Q1 2024 by location and projected biomethane feed-in volumes into the transmission network in 2025-2028, MWh/y.




In order to account for green gas fed into the transmission system and ensure its traceability in the EU, the Company administers the National Register of Guarantees of Origin ("GOs") for gas produced from Renewable Energy Sources ("RES"), established in 2019, which implements the functions of issuance of the GOs, their transfer and cancellation, supervision and control of the use of the GOs and the recognition of the GOs issued in other countries in Lithuania. This system is useful for energy consumers who want to use green energy produced in Lithuania or in another EU country in their business. The company is a member of AIB, the European organisation of GO issuing bodies, and ERGaR.

More than 40 GWh of green gas with GOs were imported into Lithuania through the GO system in 2023 (Fig. 2). This biomethane is used as a transport fuel, and the GOs are used in the system of fuel from renewable energy units, thus covering the obligations of fuel suppliers regarding the share of renewable fuels in the final fuel mix. In 2023, for biomethane (more than 47 GWh) produced in Lithuania and fed into the transmission network, GOs were issued.

Fig. 2. Guarantees of origin issued and recognised in 2023




In order to provide transparent services to market participants in the biomethane sector, in line with European and national legislation and best practices, the Company has updated the IT system of the Register of GOs of Gas from Renewable Energy Sources.

### 1.3.2. Integration of the Gas and Electricity Sectors

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The growth of electricity generation from renewable energy sources will lead to the accumulation of surplus energy in electricity grids because it is difficult to store electricity in long-term storage like gas – the electricity generated must be consumed immediately, or stored in short-term storage facilities, such as battery storage or the Kruonis Pumped Storage Hydroelectric Power Plant. It is hydrogen that solves the problem of using surplus green electricity beyond short-term storage capacity.

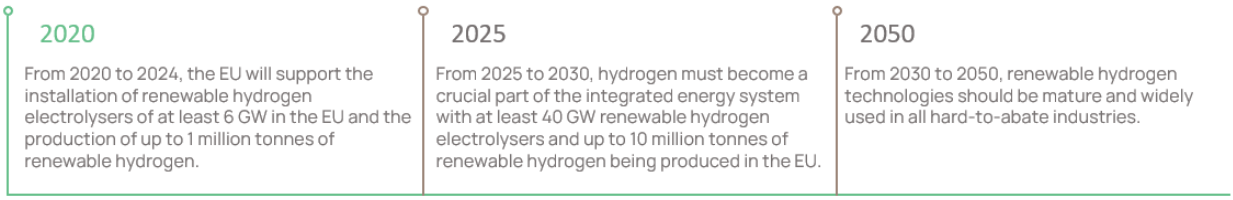
Once converted into green hydrogen, surplus electricity can be fed into a dedicated gas transmission system, stored in pipelines, and used again as necessary to generate clean electricity or heat, as a fuel in the transport sector, or as a raw material for a variety of industrial applications.

Hydrogen can be transported through the gas system (both transmission and distribution) (1) as a blend of natural gas and hydrogen, (2) by converting the gas system to transport pure hydrogen, (3) or by building new infrastructure to transport pure hydrogen.

In 2020, the European Commission presented a hydrogen strategy for a climate-neutral Europe. The strategy aims to promote the decarbonisation of Europe's industrial, transport and energy production sectors through the use of green and low-carbon hydrogen. The strategy looks at how to make the potential of hydrogen a reality by stimulating investment, market creation, research and innovation, and regulatory change.

On 18 May 2022, the European Commission unveiled the REPower EU Plan to end the EU's dependence on Russian fossil fuels and accelerate the fight against climate change. The proposed targets include: saving energy, diversifying energy supplies and accelerating the use of renewable energy. Hydrogen is also a key component of the plan, with production targets almost twice as ambitious as those in the European Hydrogen Strategy: 10 million tonnes of green hydrogen to be produced and imported in Europe by 2030 to replace natural gas, coal and oil in hard-to-abate industries and the transport sector. To accelerate hydrogen projects, the plan includes an additional EUR 200 million in funding.

Fig. 3. European Hydrogen Strategy 2050 targets

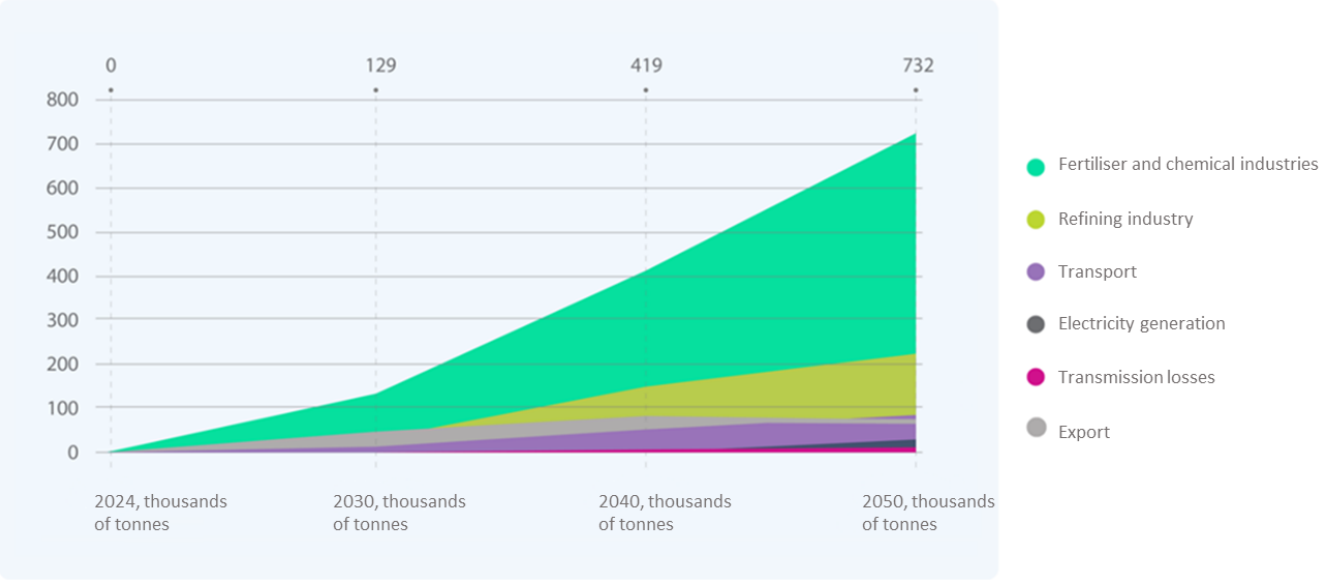



Lithuania has the potential to become an important producer and exporter of hydrogen (and its derivatives) due to the planned large-scale development of RES power generation. In Lithuania, hydrogen can be used to replace fossil fuels in some polluting industrial processes, reducing greenhouse gas emissions and strengthening the future competitiveness of chemical, oil refining, and other polluting industries based on climate-neutral technologies. Hydrogen can also be used as a raw material, fuel, energy carrier and energy storage medium. Hydrogen can be widely used in the industrial, transport and energy sectors. In order to reduce dependence on fossil fuels, hydrogen can be used as a raw material or energy source in processes and sectors where direct electrification is not technically feasible or competitive. In the energy sector, hydrogen production, transport and storage infrastructure can balance and stabilise the energy system and serve as a means of storing surplus renewable energy.

On 26 April 2024, the Guidelines for Hydrogen Development in Lithuania 2024-2050 (the "H2 Guidelines") were approved by Order No 1-81 of 26 April 2010 of the Minister of Energy of the Republic of Lithuania. The H2 Guidelines set out a vision for hydrogen development in Lithuania, defining strategic directions and stages of hydrogen development, the business environment and tasks. The H2 Guidelines document identifies the hydrogen network from Finland to Germany as one of the main hydrogen transport projects, which will run through Lithuania and will enable the export or import of hydrogen from other EU countries. This project will enable Lithuania to benefit from underground hydrogen storage facilities planned in other Member States. Hydrogen blending in the natural gas network is identified in the H2

Guidelines as a transitional measure to stimulate the emergence of a green hydrogen market and to create the first hydrogen transport capacities. In order to exploit the potential of green hydrogen and its derivatives in the Lithuanian economy and export markets, at least one hydrogen valley is planned to be established in the first stage. The number of hydrogen valleys could increase to two later on. According to the H2 Guidelines, the installation of a 1.3 GW electrolysis plant in Lithuania would produce 129,000 tonnes of green hydrogen per year from 2030. Taking into account Lithuania's GHG reduction targets and its international commitments, it is estimated that the demand for green hydrogen in Lithuania could reach 110,000 tonnes per year in 2030. In addition, around 33,000 tonnes could be available for export.

Fig. 4. Projected demand for green hydrogen in Lithuania 2023-2050 in key sectors, thousands of tonnes *(Source: H2 Guidelines)*

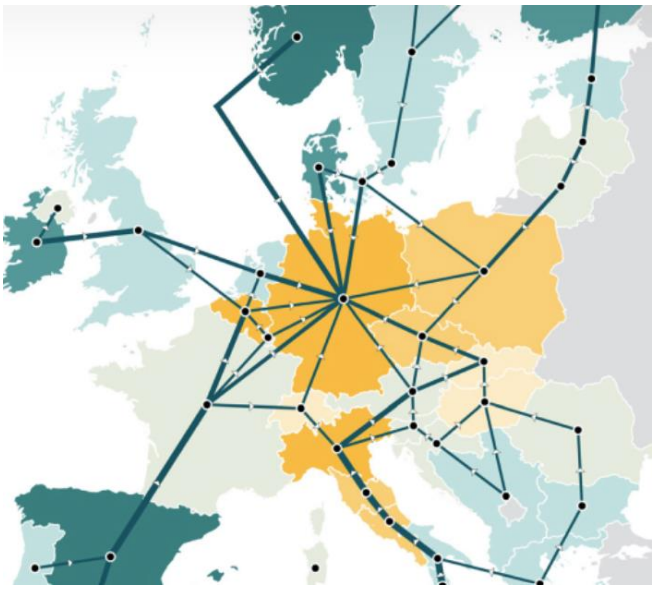



In 2050, Lithuania's demand for green hydrogen is expected to grow to 732,000 tonnes, with exports of around 43,000 tonnes per year. The largest consumers of green hydrogen are expected to be in the fertiliser and chemical industries, as well as in refining and/or the production of green synthetic fuels. Consumption of green hydrogen will also increase in the transport and electricity sectors.

In 2023, EPSO-G, together with other companies of the Group and the consultancy company DNV, prepared a study on the transformation of Lithuania's energy system by 2050. The aim of the study is to simulate scenarios for the possible development of the Lithuanian energy system, taking into account development projects, opportunities, changes in energy consumption and responsible parties. The recommendations of the study are important for the further development of Amber Grid's activities in planning its long-term strategy until 2050. According to the forecasts presented in the Transformation Study, the demand for methane will remain stable until 2030. From 2030 to 2050, the demand for methane will be gradually substituted by hydrogen or hydrogen derivatives. In response to these trends, and in line with the energy transformation towards decarbonisation of the economy and the European Green Deal, Amber Grid started hydrogen transport operations (preparatory stage)

in 2023 and will aim to become the Lithuanian hydrogen grid operator. This will allow for the timely development of new infrastructure, the adaptation of existing gas infrastructure for hydrogen transport and integration into the European green hydrogen network.

The intensive development of renewable energy production and the significant increase in the share of RES in the overall energy balance, as well as the current and future challenges of balancing the electricity grid and integrating it into the electricity transport system, create opportunities for the development of one of the technologies with most potential: Power-to-Gas, green hydrogen produced from renewable electricity. In order to contribute more broadly to the development of hydrogen and Power-to-Gas technologies in the country and the region, the Company participates in the Lithuanian Hydrogen Platform established by the Ministry of Energy and is a member of the European Clean Hydrogen Alliance and the Lithuanian Hydrogen Energy Association.



*Gas for Climate 2050*

From 2021, the Company is participating in the European Hydrogen Backbone initiative, which brings together 31 transmission system operators from across Europe. The aim of the initiative is to create a hydrogen transmission infrastructure in Europe that connects all countries. In 2023, the Company, together with its regional partners (the Baltic and Finnish transmission system operators), completed a technical and feasibility analysis of the adaptation of the gas transmission network to transport methane and hydrogen blends, which assessed the need for investment in the system based on the different hydrogen concentrations.

The adaptation of the natural gas infrastructure to hydrogen transport is expected to take place in several stages. By 2027, a P2G hydrogen blending project in the natural gas network will be implemented in cooperation with the gas distribution system and electricity transmission system operators, through a research programme to assess the technical parameters, economic feasibility, the need for legislative changes to adapt the natural gas infrastructure to transport hydrogen/methane blends, and the potential for adapting P2G technology to provide flexibility to the electricity system. The specific potential size of hydrogen blending and the investment in the natural gas network will be determined after taking into account the results of the planned research, the infrastructure capabilities of neighbouring countries, EU requirements and the results of the economic analysis. In the period up to 2030, the gas transmission and distribution systems will be adapted to transport methane/hydrogen blends at a fixed level.

The Company will focus on the following activities in order to meet the objectives of the European Hydrogen Strategy and the H2 Guidelines:

- Connecting hydrogen producers to the transmission system;

- Adapting a gas transport system to transport a blend of green hydrogen and methane;
- Developing a hydrogen transport system and adapting an existing gas system to transport pure hydrogen;
- Building and developing competences in hydrogen technology.

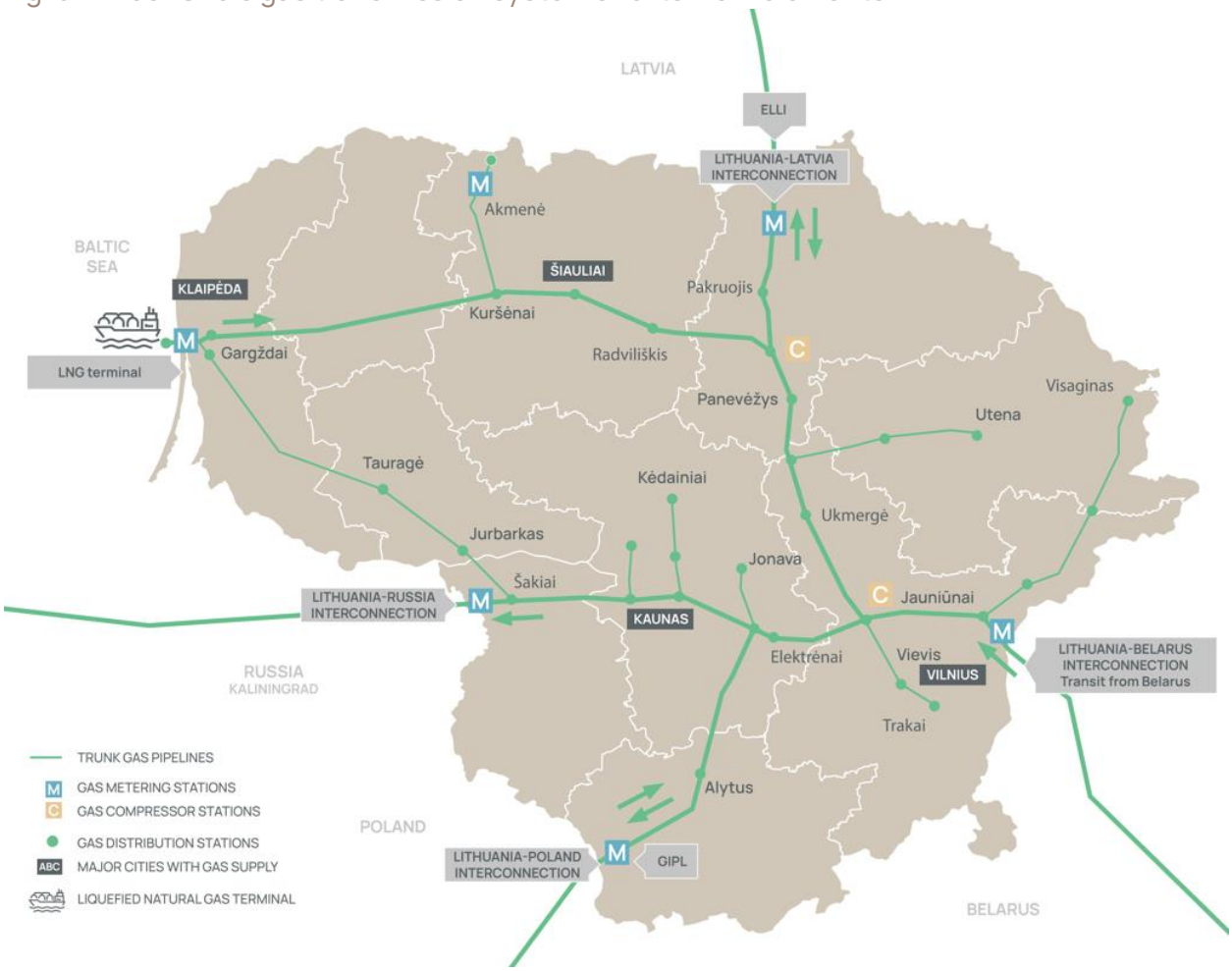
In 2022, Amber Grid, together with the gas transmission system operators of Finland, Estonia, Latvia, Poland and Germany, initiated the Nordic-Baltic Hydrogen Corridor project, which aims to create a green H2 transport corridor between Finland and Germany, linking H2 production, supply and storage centres in Finland, Estonia, Latvia, Lithuania, Poland and Germany. The project is expected to be completed around 2030. In 2023, the European Commission granted the project the status of a project of European interest (project of common interest). A feasibility study for the project was launched at the end of 2023. The objective of the feasibility study is to assess the main business opportunities for the cross-border hydrogen corridor and the main infrastructure parameters and implementation conditions. The deadline for the preparation of the study is June 2024.

## 1.4. Maintenance of the Existing Gas Transmission System, Pollution Reduction Measures, Ensuring Safe Gas Transmission

### 1.4.1. Rehabilitation, Reconstruction and Modernisation

The gas transmission system consists of transmission gas pipelines, gas compressor stations, gas regulation stations ("GRS"), gas metering stations ("GMS"), pipeline corrosion protection equipment, data transmission and communication systems and other assets assigned to the transmission system. The Lithuanian gas transmission system is interconnected with the infrastructure of the LNG terminal in Klaipėda and the gas transmission systems of the Russian Kaliningrad Oblast, Belarus, Poland and Latvia. Gas is supplied to the Lithuanian transmission system via the LNG terminal in Klaipėda and can also be transported via the GIPL pipeline from Poland and the gas pipeline on the Latvian side. As of 2023, biomethane produced in Lithuania is already being transported through the Amber Grid system (Lithuanian Domestic Entry point has been established). In order to provide the transmission service from one third country to another third country, natural gas is supplied through a pipeline coming from Belarus via the Kotlovka GMS and transmitted to Kaliningrad Oblast via the Šakiai GMS.

Fig. 5. Amber Grid's gas transmission system and its main elements




The table below provides information on the main transmission infrastructure investment projects (some of them with the support of EU funds) foreseen in the Company's ten-year network development plan for 2022, which have already been implemented or are currently being successfully implemented.

Table 1. Major investment projects in transmission infrastructure implemented or successfully in progress

| Investment | Status | End Date |
|---|---|---|
| **Gas Interconnection Poland–Lithuania (GIPL) (LT part)** | Finished | 2021 |
| **Latvia-Lithuania Interconnection Enhancement Project (ELLI) (LT part)** | Finished | 2023 |
| **Installation of PIG (pipeline inspection gauge) launchers and receivers and implementation of operational technological control of the gas transmission system (Stage II), implemented between 2018 and 2022.** | In progress | 2024 |
| **Implementation of Operational Technological Control of the Gas Transmission System, 2018-2022 (Stage I)** | Finished | 2022 |
| **Reconstruction of individual sections of the Vilnius-Kaunas gas pipeline, implemented between 2020 and 2023** | In progress | 2024 |
| **Replacement of the valves and connection to the SCADA remote control system, implemented between 2020 and 2023 (Stage II)** | In progress | 2024 |

| | | |
|---|---|---|
| **Modernisation of the Šiauliai GRS and the Telšiai GRS, implemented between 2020 and 2023** | Finished | 2023 |
| **Modernisation of the Grigiškės, Kėdainiai and Vievis GRS, implemented between 2020 and 2023** | Finished | 2023 |
| **Reconstruction of individual sections of the gas pipeline (Stage II), implemented between 2020 and 2023** | Finished | 2023 |
| **Modernisation of gas compressor station control and installation of a data centre, implemented between 2020 and 2023** | Finished | 2023 |
| **Modernisation of the gas purification equipment at the Panevėžys gas compressor station, implemented between 2020 and 2022** | Finished | 2022 |
| **Installation of a pressure control valve on the gas pipeline branches to the Marijampolė GRS, implemented between 2020 and 2023** | Finished | 2023 |
| **Connection of the first biogas production facilities to the gas transmission system planned for 2023-2024** | The first connection has taken place | 2023 |
| **Adaptation of gas transmission pipelines for the transportation of hydrogen and natural gas blends** | Initiated | 2027 |

Between 2024 and 2033, the Company plans significant investments in projects to maintain (rehabilitate) the existing system. Particular attention will be paid to the modernisation and upgrading (retrofitting) of gas compressor stations in order to make them more efficient and to comply with environmental requirements. Further modernisation of the transmission system through the installation of a remote control system (SCADA), rehabilitation of existing pipelines in the line section of the pipeline, relining of individual pipeline sections and replacement of valves are planned. It is planned to upgrade the equipment of worn-out gas regulation stations (GRS) and, in some cases, to completely modernise the GRS. Section 4 of the Plan, "Transmission System Development 2024-2033", describes these investments in more detail.

### 1.4.2. Pollution Reduction


*www.gfa-group.de*

At the end of 2019, the European Commission unveiled the European Green Deal, an ambitious project to help Europe's citizens and businesses benefit from the transition to sustainability and greening. The measures presented alongside an initial plan of key policies include large-scale emission reductions, investment in advanced research and innovation, and preserving Europe's natural environment.

The European Commission agrees that the gas sector and networks can make an effective contribution to the creation and development of a European hydrogen economy.

The aim is to facilitate the integration of renewable and low-carbon gases, in particular hydrogen and biomethane, into the energy system. The plan is to reduce methane emissions by 55% below 1990 levels by 2030 and to achieve climate neutrality in the EU by 2050. With the recent rapid growth in demand for gas produced from renewable energy sources, also known as "green gas", in Europe, this renewable form of energy is making its way to Lithuania. The development of green gas brings Lithuania closer to its goal of reducing its impact on climate change and becoming a green energy country. The Company supports and contributes to the promotion of green energy development in Lithuania in order to meet the country's goals of reducing its impact on climate change and becoming a green energy country.

One of the most significant GHG pollutants for a transmission system operator is methane ($CH_4$), which accounts for more than 90% of the natural gas transported through the Amber Grid system. Methane, according to the Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (2021), has a global warming potential (GWP) 28 times higher over a 100-year period compared to carbon dioxide ($CO_2$), and as much as 80 times higher over a 20-year period. This is why the focus over the next decade will be on reducing methane emissions. In addition to the investments foreseen in this Plan, the Company intends to implement the following measures: the purchase of a second mobile compressor, the purchase of special gas pipeline repair equipment ( stopple) (this equipment will allow repairs to be carried out without interrupting gas transportation in the section being repaired by installing a bypass line, which will reduce gas emissions or allow natural gas to be released from a shorter section), the combustion of natural gas (instead of venting methane, the gas is burned and carbon dioxide emissions have a lower negative environmental impact), the use of stationary and flying equipment (e.g., drones, airships, helicopters, satellites, etc.) for leak detection, the development/deployment of green hydrogen infrastructure.

The increased importance of methane emission reductions between 2024 and 2033 is underlined by the entry into force of the Regulation of the European Parliament and of the Council on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942 in 2024. The Regulation is part of the Fit for 55 package and an important element of the European Green Deal. It is also in line with the European Union's international

commitments under the Global Methane Pledge (GMP) to tackle global methane emissions. The Regulation is targeted at the oil, gas and coal industries and will therefore directly contribute to promoting the reduction of methane (GHG) emissions in Lithuania's natural gas transmission system.

The Regulation introduces new requirements for more accurate and frequent detection and repair of natural gas leaks, the establishment of a Leak Detection and Repair (LDAR) programme, a ban on the periodic controlled release of natural gas into the environment and the periodic burning of natural gas (e.g., in flares), and requirements for annual reporting at an increasing level of detail, using the best available technologies on the market.

Chapter 5 of the Plan, "Measures to Reduce Greenhouse Gas (GHG) Emissions", describes the Company's plans to reduce emissions in more detail.

### 1.4.3. Improvement of the Emergency Resilience of the Gas Transmission System


*www.reuters.com*

The 2024 update of the NEIS includes, among other changes, additional measures to enhance the resilience of the transmission system to improve the protection of facilities and assets important for national security, such as the accumulation of a reserve of equipment and materials necessary for operations, diversification of reserve storage locations and other organisational measures. Such reserves and measures would ensure the rapid restoration of infrastructure and the resumption of essential transmission system operations following technical accidents, natural phenomena or deliberate damage, acts of war.

The composition of the emergency reserve and other measures is defined in the governing documents of energy companies, including Amber Grid, and immediately supplemented or reduced depending on the introduction or lifting of an emergency or crisis situation in a country. The focus will be on threats and dangers that may arise from hybrid warfare tools used by countries hostile to Lithuania, with the additional introduction of measures to ensure infrastructure protection against tools used in conventional warfare.

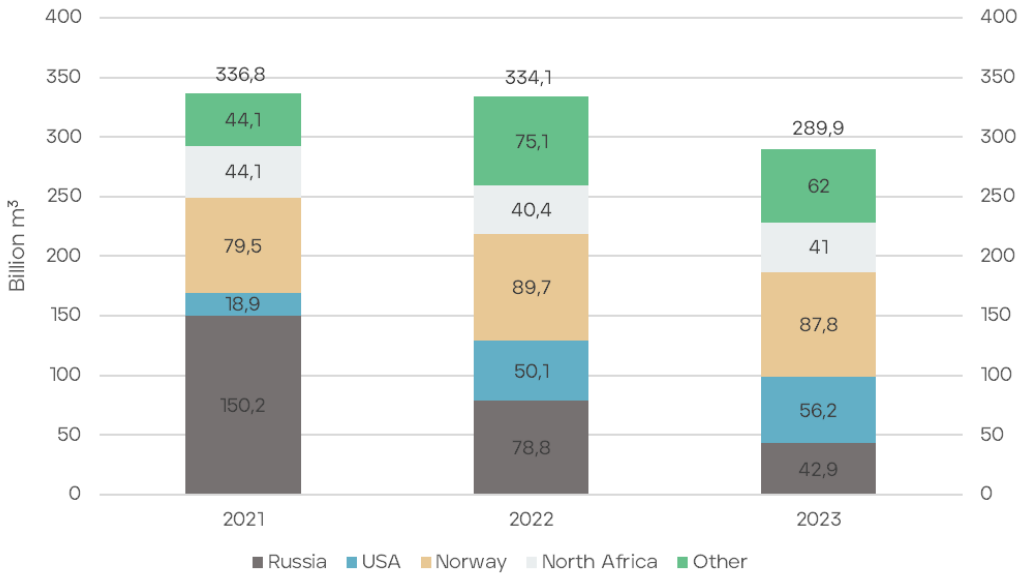
# 2. SOURCES OF SUPPLY OF NATURAL GAS AND THE NEED FOR TRANSMISSION SERVICES

Forecasting gas consumption, cross-border gas flows and consumption capacity is a key factor in planning transmission system development. The gas transport forecasts for the period from 2024 to 2033 have been prepared taking into account the data provided by existing system users on the future gas volumes to be transported as well as assumptions on cross-border gas flows.

## 2.1. Sources of Supply (Entry Flows)

The geopolitical situation in Europe has led to a need to diversify the supply of natural gas, i.e. European countries are seeking to reduce their dependence on natural gas imports from Russia and to increase gas imports from alternative sources. By comparison, in 2021, around 45% (or 150.2 billion m3) of gas imports to EU countries came from Russia, while in 2023 the share of Russian gas has decreased to ~15% (or 42.9 billion m3).

Fig. 6. Countries of origin of gas consumed in EU countries *(Source: Where does the EU's gas come from? - Consilium (europa.eu))*




From April 2022 onwards, in Lithuania there are no imports of gas from Russia for EU use and gas is only transported in transit from Belarus to Kaliningrad Oblast.

Gas is supplied to Lithuanian and EU consumers via the LNG terminal in Klaipėda and, if needed, gas can be transmitted to Lithuania from Latvia via the Kiemėnai GMS, and from Poland via the GIPL interconnection via the Santaka Entry/Exit point. Biomethane produced in Lithuania has been fed into the transmission system since mid-2023.

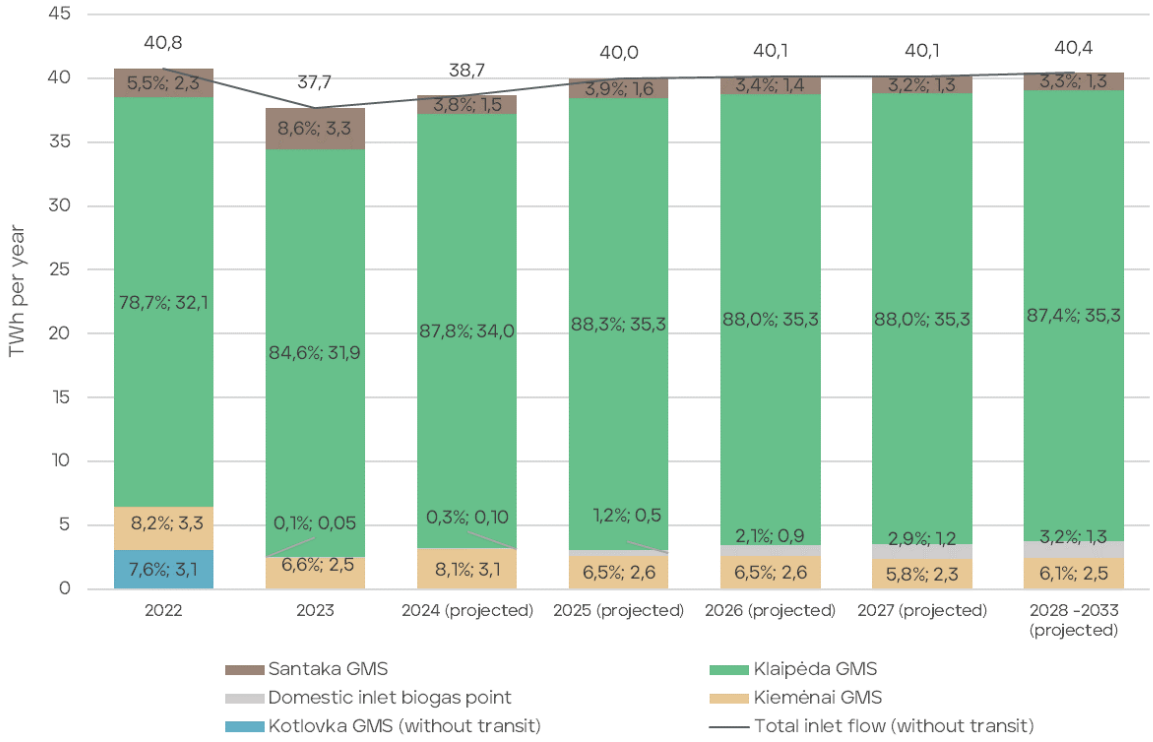
The Klaipėda LNG terminal remains the most important source of gas supply for consumers in Lithuania and the Baltic States. In 2023, 84.6% of the gas (31.9 TWh out of 37.7 TWh fed in quantity) was fed in from the Klaipėda LNG terminal (78.7% of the gas was fed in through the Klaipėda GMS in 2022, 32.1 TWh out of 40.8 TWh fed in quantity). Correspondingly, in 2023, 0%

of gas for EU use was fed in via Kotlovka GMS, 6.6% via the Kiemėnai GMS, 8.6% via the Santaka GMS, and 0.1% of green gas was supplied by a biogas producer.

In 2024, about 87.8% of the gas is expected to be fed in through the Klaipėda GMS, the rest through the Santaka GMS (3.8%), the Kiemėnai GMS (8.1%), and the Lithuanian domestic entry (biogas) point (0.3%).

Both in 2025 and in the future, the distribution of gas volumes by entry point will depend on the competitive and geopolitical situation on the gas market.

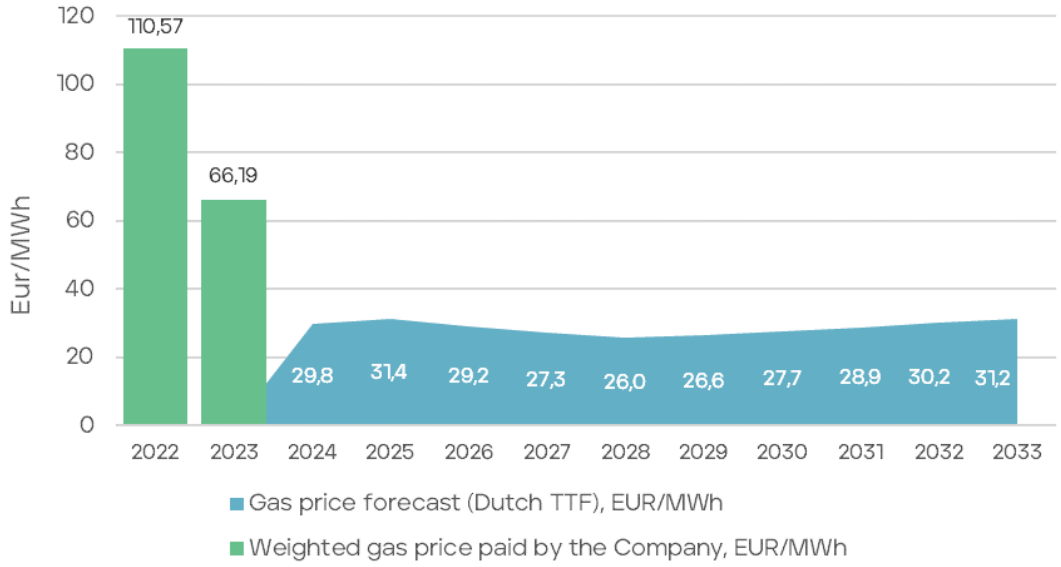
Fig. 7. Sources of natural gas supply (for EU needs) by entry point, 2022-2033, actual and projected flows, % and TWh/year.




The graph below shows the historical level of the natural gas price paid by Amber Grid and the natural gas price forecast. Amber Grid's weighted average gas price was EUR 110.57/MWh in 2022 and EUR 66.19/MWh in 2023. The TTF futures forecasts[1] of 21 February 2024 show that the average gas price in 2024 is expected to be around EUR 26/MWh, with moderate price increases in the future. The forecast takes into account the current stabilisation of the energy resources market.

[1] Source: https://www.cmegroup.com/markets/energy/natural-gas/dutch-ttf-natural-gas-calendar-month.html#venue=globex

Fig. 8. The weighted natural gas price paid by the Company in 2022-2024 (01-02 months) (EUR/MWh) and the natural gas price forecast, Dutch TTF data of 21 February 2024.




In 2023, green gas produced from RES in Lithuania will be fed into the country's gas transmission network. Biomethane is fed into the transmission grid by the newly opened Tube Green biomethane plant in Pasvalys District. More than 47 GWh of biomethane produced and fed into the transmission grid in 2023 has been covered by guarantees of origin. Amber Grid has signed six network connection contracts with biogas producers in Q1 2024. Taking into account the connection conditions currently in force, it is likely that with the gradual emergence of more and more new biomethane producers connecting to the transmission network, the potential of biomethane entry into the transmission grid of more than 2 TWh/year could be reached in the years after 2028.

## 2.2. Gas Demand in Lithuania

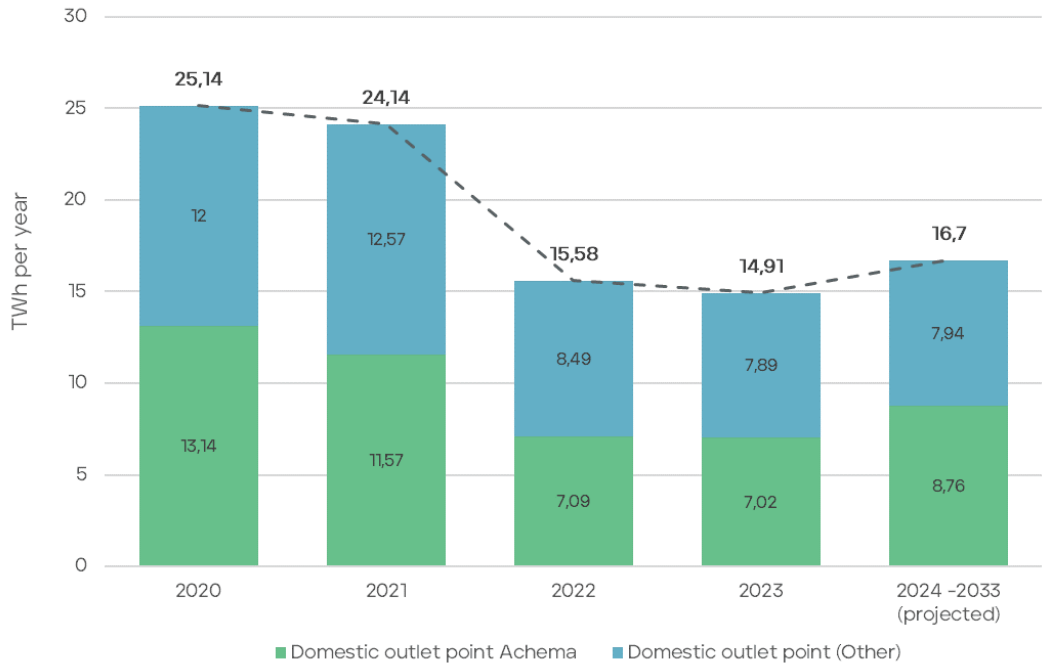
In order to ensure the most accurate planning of gas volumes needed to meet Lithuania's domestic needs, stakeholders—existing and potential transmission system users, supply companies, state authorities, and producers of gas from renewable sources—are consulted. System users were asked to provide volumes and capacities for gas consumption in Lithuania that meet their needs for the next ten years.

The declared/estimated consumption capacity of Lithuanian transmission system users for 2024 (the required maximum daily gas volume to meet the maximum gas consumption needs) is 152.0 GWh/day.

In recent years, the volume of gas transmitted through the Company's transmission system to meet the Lithuanian market needs has been decreasing year by year: in 2020-2021, the decrease was insignificant (from 25.1 TWh in 2020 to 24.1 TWh in 2021), and in 2022-2023, the decrease was significant (down to 15.6 TWh in 2022, and to 14.9 TWh in 2023). This significant decrease in gas demand is due to objective reasons, such as the record high gas prices and the EU-wide energy saving measures, which have reduced natural gas consumption not only in Lithuania, but also in Europe as a whole (see Fig. 6). In the short term, gas demand in the country is likely to recover slightly, but the long-term trend in gas demand is downwards.

The largest consumer of natural gas is AB Achema, with gas volumes ranging from 7.0 TWh (2023) to 13.1 TWh (2020) from 2020 to 2023. According to the data provided by the system users, the planned volume of gas to be transmitted to the needs of Lithuanian consumers from 2024 to 2033 will amount to around 16.7 TWh on average, of which the planned gas demand of AB Achema will account for around 52% or 8.76 TWh of the total volume of gas transmitted at the domestic Exit points of Lithuania.

Fig. 9. Structure of gas volumes transported at Lithuania's domestic Exit points, 2020-2033, actual and projected, TWh/year.




The actual demand for long-term transmission system capacity for Lithuanian consumers in the period from 2021 to 2023 has decreased from 82.1 GWh/day (2021) to 20.7 GWh/day (2023), not only due to the overall decrease in gas consumption compared to the pre-war period, but also due to the increasing flexibility of system users, who are using more short-term capacity and a basket of capacities for different periods. In 2024, the projected demand for long-term transmission system capacity for Lithuanian consumers will be 21.8 GWh/day, and in 2025 it will be around 20 GWh/day.

## 2.3. Cross-Border Gas Flows

In recent years, the volume of gas transported to Russia's Kaliningrad Oblast has fluctuated between 23 TWh and 27 TWh, with an average of 24.7 TWh for 2020-2023. In 2020, 24.9 TWh were transported; 26.7 TWh in 2021, 23.4 TWh in 2022 and 23.9 TWh in 2023. In the future, around 26-27 TWh of gas are expected to be transported per year.

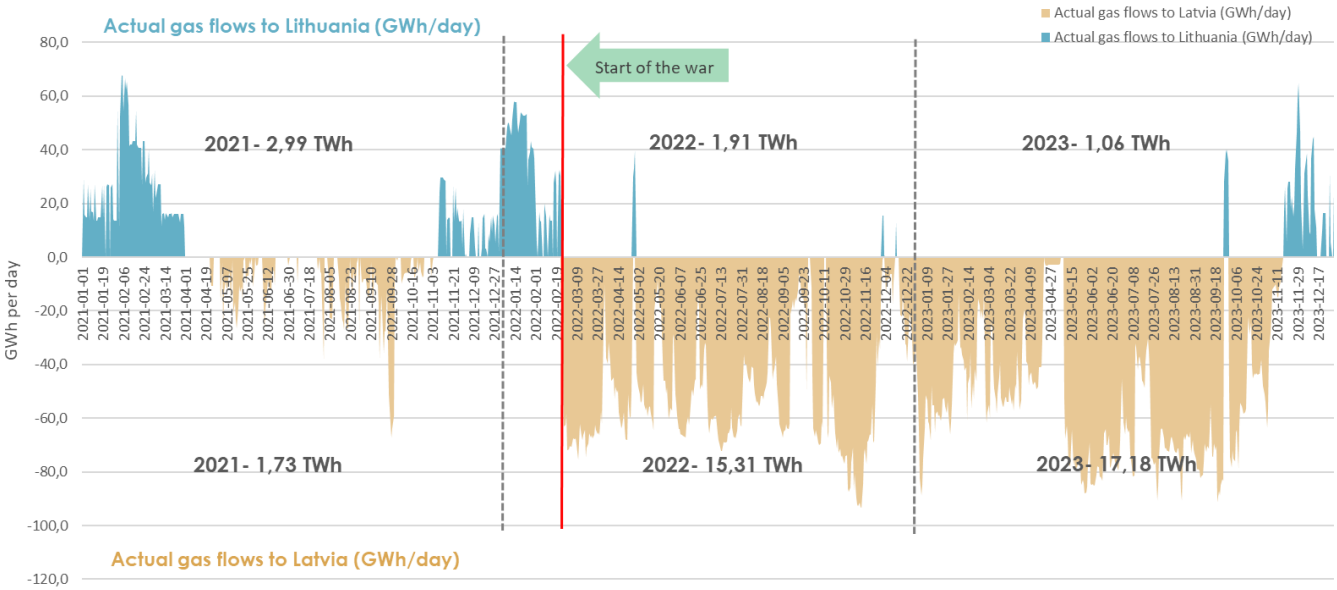
In 2015, using the alternative created by the LNG terminal in Klaipėda, gas supplies to the other Baltic States (and later to Finland) via Lithuania were launched via the Kiemėnai Exit point. The average volume of gas transported between 2020 and 2023 was 2.8 TWh.

From the beginning of 2022, gas flows through the Kiemėnai cross-border interconnection have been also mainly influenced by the geopolitical situation, which is driving EU countries

to minimise their dependence on Russian gas. Fig. 4 shows that at the beginning of the year, as usual in this period, gas flows were moving from Latvia to Lithuania, while after 24 February 2022, when Russia launched a large-scale war against Ukraine, the direction of gas flows reversed, despite the fact that the season for withdrawing the gas from the underground storage facility has not ended. Gas suppliers have sought to fill the Inčukalns underground natural gas storage facility to the maximum. In 2023, 1.06 TWh of gas were transported to Lithuania (1.91 TWh in the same period in 2022) and 17.18 TWh were transported to Latvia (15.31 TWh in 2022).

Looking ahead, the flows through the Kiemėnai point may be most affected by the operation of a new LNG terminal in Finland and/or Estonia. The restoration of the Balticconnector (in April 2024) between Estonia and Finland is likely to reduce the need to import gas via the Klaipėda LNG terminal for the needs of the countries to the north.

Fig. 10. Kiemėnai entry/Exit point flows 2021-2023, GWh/day




Following the completion of the construction of the GIPL gas pipeline connecting Lithuania and Poland in December 2021, an additional Santaka entry/Exit point was added to the gas transmission system. On 1 May 2022, the GIPL gas pipeline became available to gas market participants and commercial gas flows between Lithuania and Poland started. In 2022, 2.3 TWh were delivered in the direction of Lithuania and 6.4 TWh in the direction of Poland. Meanwhile, 3.3 TWh were transported to Lithuania in 2023 and 3.2 TWh to Poland.

From 2025 onwards, the volume of gas transported via the Santaka entry/exit point in the direction of Poland is forecast to reach around 9.3 TWh, with a gradual increase due to the export of green gas. From 2027 onwards, the gas transmission towards Poland is forecast to reach 10.0 TWh/year.

The intensity of additional gas flows transported through the Lithuanian transmission system will depend on the regional natural gas market conditions, the geopolitical situation in Europe, the application of integration measures and the utilisation of regionally important infrastructure (the Inčukalns underground gas storage facility, the Klaipėda LNG terminal), as well as on the operation of the LNG terminal in the Gulf of Finland.

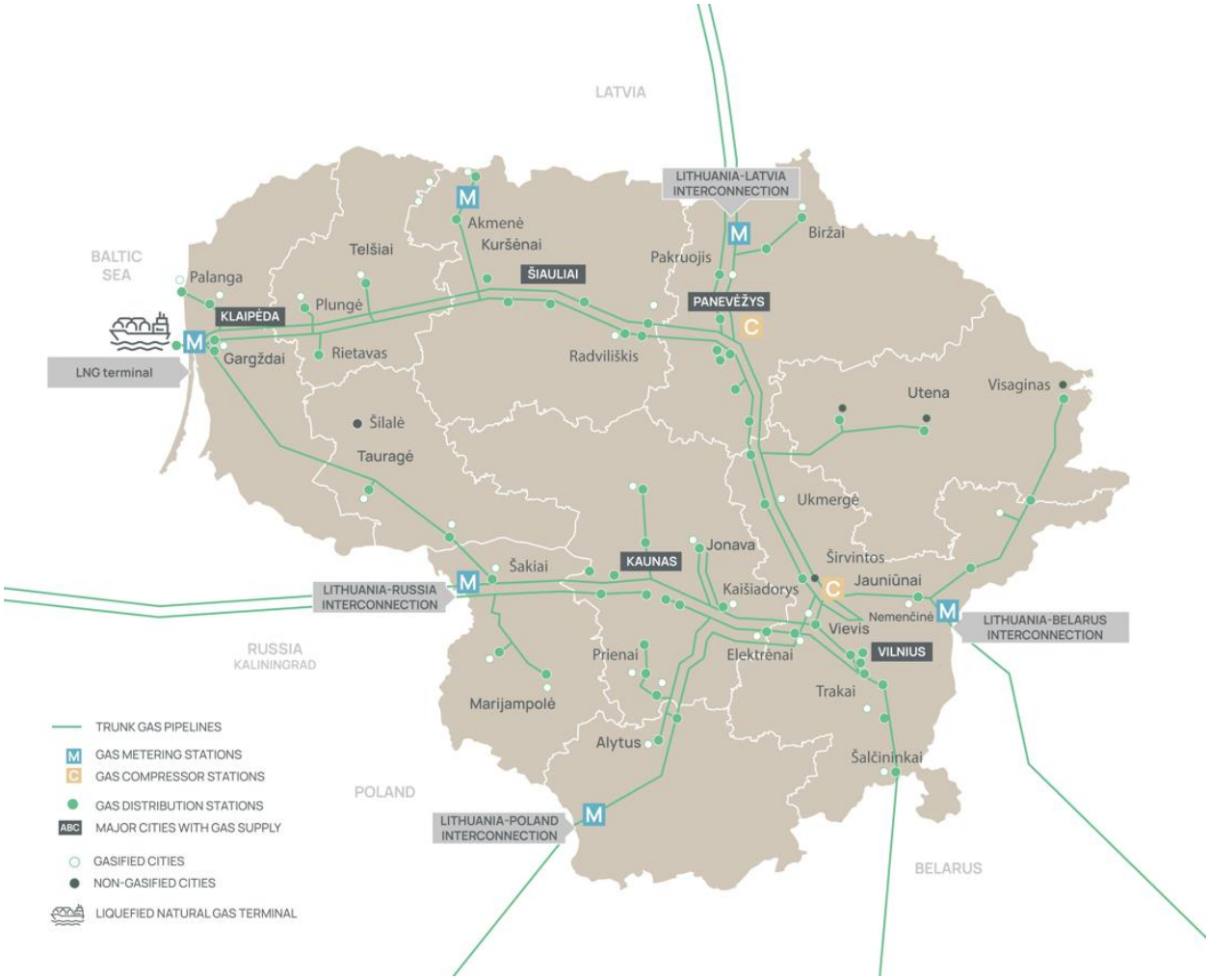
# 3. EXISTING GAS TRANSMISSION SYSTEM

## 3.1. Lithuanian Transmission System

The Lithuanian gas system is interconnected with the gas transmission systems of four countries: Latvia, Belarus, Poland, the gas transmission systems of the Kaliningrad Oblast of Russia, the Klaipėda LNG terminal and the systems of Lithuanian gas distribution operators. The well-developed Lithuanian gas transmission system serves as a regional corridor for gas transmission to the north towards Latvia and to the south towards Poland.

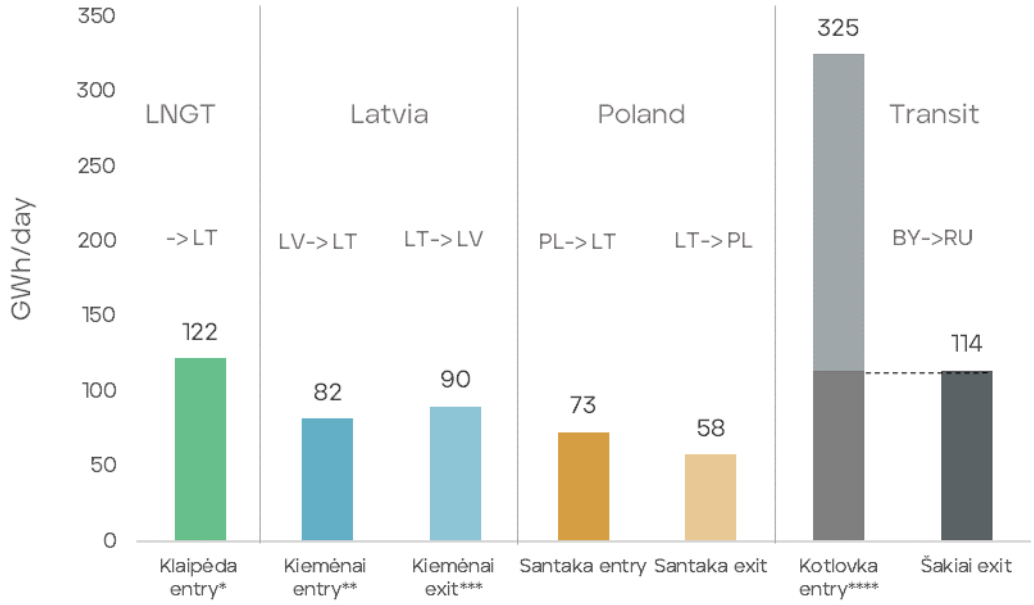
The total length of gas pipelines of the transmission system in the Lithuanian territory is more than 2.28 thousand km. There are 64 GRSs and 4 GMSs to ensure the operation of the transmission system and supply natural gas to the distribution systems. For interconnections with transmission systems of other countries, 3 GMSs owned by the Company are installed in the territory of Lithuania. The Panevėžys and Jauniūnai gas compressor stations help to ensure the necessary gas pressure parameters throughout the transmission system.

Fig. 11. The Lithuanian natural gas transmission system, 2024




The technical capacities of the gas pipeline interconnections with transmission systems in other countries and with the LNG terminal are shown in the graph below.

Fig. 12. Technical capacities of interconnections with transmission systems of other countries and the LNG terminal, GWh/day




Notes:
* - Point of interconnection of the transmission system with the LNG terminal system,
** - Capacity level from November 2023. Transmission system operators may offer technical capacities of up to 130 GWh/day in the Lithuania-Latvia direction and up to 119 GWh/day in the Latvia-Lithuania direction for a limited period of time, after assessing the need for congestion management measures due to the specific operating conditions or circumstances of the transmission system. Specific circumstances may include the Klaipėda LNG terminal's gas entry point and the Santaka gas entry or Exit points being fully utilised, the Panevėžys and Jauniūnai compressor stations operating almost at full capacity at the same time, etc.
*** - Capacity level from November 2022.
**** - Commercially used only for transit from Belarus to Kaliningrad Oblast, i.e. corresponding to the capacity of the Šakiai GMS, up to 114.2 GWh/day.

The existing capacity of the transmission system at interconnection points with Lithuanian distribution systems and directly connected system users is sufficient to meet the needs of Lithuanian consumers. In addition, at the Kiemėnai GMS point, since the beginning of 2022, transmission operators have applied a dynamic technical capacity calculation model, whereby each day, based on the availability of the relevant volumes to be transported through this point, an assessment is made as to whether more technical capacity can be provided. Such a calculation model may be applied in the future to other points where the commercial demand for transmission is close to the technical capacity.

Biomethane has also been fed into the Amber Grid transmission system from 2023. The physical biomethane entry points, which will be commercially available throughout Lithuania, are connected to the Lithuanian domestic entry point. In 2024, the technical capacity of the Lithuanian domestic entry point is about 0.7 GWh/day. Gradually, as biomethane producers connect to the gas transmission system, the capacity of this entry point could reach around 3.2 GWh/day (or 1.17 TWh/year) in 2026, which is equivalent to around 7% of Lithuania's gas demand.

## 3.2. Gas Infrastructure in the Baltic Region

The Company is actively involved in the development of the common gas market in the Eastern Baltic region, aiming to reduce international barriers to the functioning of gas markets, promote competition and liquidity in the gas market, and increase the efficiency of the use of gas infrastructures.

The most important natural gas infrastructure projects in the Baltic region, which were included in the EU's 5th list of projects of common interest, have already been implemented:

- In 2020, the gas pipeline interconnection between Finland and Estonia (Balticconnector) became operational, connecting Finland's transmission system to Estonia's and then to the pan-European natural gas system;
- The Gas Interconnection Poland–Lithuania (GIPL) was built in 2022, connecting Lithuania's transmission system to the European natural gas transmission system and creating wider opportunities for Baltic and Finnish market participants to access diversified sources of gas supply;
- The offshore gas pipeline interconnection between Poland and Denmark (Baltic Pipe) became operational in 2022. This pipeline gives the countries in the Baltic region direct access to natural gas from Norwegian gas fields;
- A strategic gas transmission infrastructure project, the International Latvia-Lithuania Interconnection Enhancement Project (ELLI), was completed in 2023, increasing the capacity of the gas interconnection between Latvia and Lithuania, ensuring security and reliability of gas supply, more efficient use of infrastructure and better integration of the Baltic States' gas markets;
- The Inčukalns underground gas storage facility upgrade project (Latvia) is expected to be completed in 2025.

Fig. 13. Gas infrastructure in the Baltic region (source: ENTSOG), 2024

# 4. TRANSMISSION SYSTEM DEVELOPMENT 2024-2033

## 4.1. Adaptation of the Gas Transmission System for Hydrogen Blending and Transport

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In the energy sector, the development of RES for electricity generation is essential to reduce dependence on fossil fuels. The dependence on hydro-meteorological conditions means that generation facilities that uses renewable energy struggle to ensure the stability of electricity production and complicate the transmission and distribution of electricity. Energy storage technologies that store excess energy and use it during market power shortages are needed to maximise the utilisation of the generated electricity and lessen the technical difficulties related to grid management.

In 2023, the Company, together with its regional partners (the Baltic and Finnish gas transmission system operators), completed feasibility analysis of the technical adaptation for the gas transmission network to transport methane and hydrogen blends, which assessed the need for investment in the system based on different hydrogen concentrations. The adaptation of the natural gas infrastructure to hydrogen transportation is expected to take place in several stages. Together with the operators of the gas distribution and electricity transmission systems, a Power to Gas (P2G) hydrogen blending project in the natural gas network will be implemented by 2027. This will be accomplished through a research programme that evaluates the technical and economic viability of the project as well as the necessity of regulatory changes for the natural gas infrastructure to be modified for the transportation of hydrogen/methane blends. The specific potential size of hydrogen blending and the investment in the natural gas network will be determined after taking into account the results of the planned research, the infrastructure capabilities of neighbouring countries, EU requirements and the results of the economic analysis. In the period up to 2030, the gas transmission and distribution systems will be adapted to transport methane/hydrogen blends at a fixed level.

From 2024 to 2027, AB Amber Grid, together with AB Litgrid, is planning to implement a power to gas project for the testing of mechanisms to ensure the flexibility of the electricity system (Power to Gas project, P2G) and a project for the blending of hydrogen in the gas network.

**Objectives of the Power to Gas project:**

- To prepare for the requirements of future legislation on the adaptation of cross-border gas interconnections to gas-hydrogen blends, for the testing of mechanisms to ensure the flexibility of the electricity system;
- To assess the potential of P2G solutions to provide flexibility and balancing services of the electricity system;

- To acquire the necessary competences to maintain the allowable concentrations of hydrogen and methane blends in the natural gas transmission and distribution system.

**The scope of the P2G project includes:**

- Purchase and installation of equipment for green hydrogen production: an electrolyser, ~1 MW of electric power for ~200 Nm3/h of hydrogen, a storage facility up to 500 kg, up to ~60 bar H2, and a hydrogen and methane gas blending unit;
- Connection of the green hydrogen production facilities to the gas transmission network, with blending, quality monitoring and metering equipment for methane gas and green hydrogen to ensure the quality of the blend at the entry point of hydrogen gas;
- Installation of monitoring equipment to track the changes of the hydrogen/methane gas blend in gas transmission and distribution networks and to study the impact of green hydrogen on gas networks and appurtenance;
- Hydrogen flow control studies: unloading, loading, stopping/starting the hydrogen production facility, while monitoring hydrogen concentrations in the transmission and distribution networks;
- Installation of control, communication and data transmission equipment needed to balance the power system and test the electrolyser's capability to provide frequency control and other services/functions to ensure the flexibility of the electricity system.

The adaptation of the natural gas infrastructure to hydrogen transport will take place in several stages. By 2027, a pilot project on hydrogen blending in the natural gas network will be implemented, with a research programme to assess the technical parameters and economic feasibility of adapting the natural gas infrastructure for hydrogen transportation. The market must also be investigated and the possibility of connecting local hydrogen consumers and producers to the natural gas networks analysed. The technical means to monitor hydrogen concentration in the natural gas network will be installed, chromatographs will be installed to measure the hydrogen concentration and hydrogen separators will be installed if necessary before the hydrogen-sensitive natural gas consumers. The specific scope of the natural gas network investment programme will be determined taking into account the potential hydrogen addition rate, the results of the planned research and tests, the assessment of the infrastructural capabilities of neighbouring countries and EU requirements, and the results of the economic analysis.

## 4.2. Transmission System Rehabilitation and Modernisation

### 4.2.1. Optimisation and Modernisation of Compressor Station Capacity

In 2023, taking into account the changing gas flows and the need to ensure efficient management of the gas flows in the transmission system, a feasibility study on the modernisation and upgrade of the compressor stations was carried out and, based on the results of the study, the Company is deciding on the further modernisation and investment needs for the compressor stations.

The **Jauniūnai** Gas Compressor Station (Jauniūnai GCS), built in 2010, is equipped with three compressor units with a total capacity of 34.5 MW. From 2020 to 2023, modernisation of the Jauniūnai GCS control system, installation of an additional fire extinguishing system and a water spillage protection system were carried out.

From May 2022 onwards, when the GIPL pipeline came into operation and gas transport towards Poland became active, it has been observed that the Jauniūnai GCS is operating at only 10-30% load (efficiency). Amber Grid has initiated the modernisation of the Jauniūnai GCS in order to reduce the technological and tax (emission allowance) costs and GHG emissions. It is planned to install a new electric compressor unit with a capacity of up to 5 MW and all the necessary infrastructure at the Jauniūnai GCS by the end of 2026 (or to implement other similar solutions, but in any case, switching to lower capacity and less polluting electrically driven units).

After the implementation of the Jauniūnai GCS power optimisation project, the existing two 11.5 MW gas compressors and a newly installed electrically driven compressor with a capacity of up to 5 MW will be sufficient to ensure the reliability of the station. The further use of one of the existing 11.5 MW units is currently being decided in order to ensure efficient use of the equipment. Possible alternatives are being considered: dismantling and selling the equipment (one compressor), preservation to increase resilience to emergencies, etc.

The **Panevėžys** Gas Compressor Station (Panevėžys GCS), built in 1974, contains seven reciprocating gas compressor units with an installed capacity of 7.7 MW. In 2017, the installation of additional combustion chambers and modernisation of the air supply systems of the Panevėžys compressor station was completed; in 2018, the modernisation works of the automated control and fuel supply system were completed, and gas filters were replaced in 2020-2022. In addition, the investment project "Modernisation of the Control of the Gas Compressor Stations and Installation of a Data Centre" was completed in 2020-2023. These measures have resulted in safer and more efficient operation of the Panevėžys GCS and an 8-10% reduction in gas consumption for engine fuel and air emissions.

The seven compressor units installed in the Panevėžys GCS in 1974 are worn out, obsolete legacy components, with parts needed to repair the equipment no longer being produced. In accordance with Annex II(1) of Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants, emission limit values for nitrogen oxides ($NO_x$) for the gas compressors in Panevėžys will be 250 mg/Nm$^3$ from 1 January 2030, whereas the average values measured for emissions of nitrogen oxides ($No_x$) from the compressors at the Panevėžys GCS will be 3-5 times higher, i.e. the units will not comply with the environmental requirements. Therefore, the units currently operating at the Panevėžys GCS will not be able to operate beyond 2030 and the emission allowance will not be extended. Moreover, the current capacity of the Panevėžys GCS is a limiting factor for the capacity of the gas interconnection with Latvia (up to 90 GWh/day capacity can be achieved with the existing equipment).

For the above reasons, Amber Grid is planning to install three new compressor units, each with a capacity of about 5 MW, to replace the old units by 2028.

After the installation of the new compressor units at the Panevėžys GCS, it is planned to dismantle the old units by 2030.

### 4.2.2. Rehabilitation of the Line Section of Transmission Gas Pipelines

One of the key ways to assess the condition of pipelines is through internal diagnostics of the pipelines, using special control devices to determine the actual technical condition of the pipelines. In order to achieve this objective, the installation of launchers and receivers for intelligent pigging devices, the replacement of line valves, pipe curves and branch assemblies is being completed in the pipelines. Out of the total number of 2288 km of pipelines in operation, 1837 km (80% of all pipelines) can be adapted for internal diagnostics, and 1726 km (75% of all pipelines) have already been adapted and tested.

The aim is to have all suitable pipelines adapted for internal diagnostics by 2025. By 2027, it is planned to install launchers and receivers for pigging devices at the border sections with the Republic of Belarus and Kaliningrad Oblast of the Russian Federation, thus ensuring the independence of diagnostics and the security of data on the technical condition of the gas pipeline, in order to reduce the potential threats and risks to Lithuania's national security.

Over EUR 11 million is expected to be spent on the installation of launchers and receivers for pigging devices over a ten-year period, of which around EUR 7.6 million will be spent over the next five years.

Around EUR 1 million per year is expected to be spent on rehabilitation of gas pipelines, based on the results of internal diagnostics.

The connection of the valves to the remote-control system will continue. It is planned that more than 73% of all main valves will be remotely controlled and the desired level of operational control of the technological management of transmission gas pipelines will be achieved. Around EUR 21 million is planned to be spent on these objectives over the next five years.

There are also planned projects for the reconstruction of individual sections of transmission gas pipelines, which will bring the pipelines up to the requirements of a higher terrain class, i.e. increase their safety. Up to EUR 37 million is foreseen to be used for the re-laying of gas pipeline sections over a period of 5-6 years.

Once the actual technical condition of the pipelines has been determined, a risk and project alternatives analysis is carried out in accordance with the established procedures and the most cost-effective solutions are selected before a decision is taken on the upgrading of the pipeline line section.

Around EUR 5 million is expected to be spent on other rehabilitation/reliability projects of the pipelines.

### 4.2.3. Upgrades to Gas Distribution Stations

The Company currently operates 63 gas regulation stations (GRSs), 4 gas pressure reduction units (PRUs), 1 gas metering and pressure reduction station (GMPRS), and 3 gas metering stations (GMS). The planning of the upgrade of the GRS assesses existing and prospective gas flows and selects the equipment with the optimum capacity in order to make efficient use of the funds allocated for the upgrade.

From 2020 to 2023, the modernisation of the GRSs in Šiauliai, Telšiai, Grigiškės, Kėdainiai and Vievis was successfully completed. These solutions ensure the proper functioning of the gas infrastructure and optimise infrastructure maintenance costs.

In the period up to 2030, it is planned to upgrade (modernise) the GRSs in Elektrėnai, Vilnius and Palanga, for which about EUR 5.2 million is planned. One of the largest projects envisaged is the upgrading of the Elektrėnai GRS (2023-2025) due to the need of AB “Ignitis gamyba” to continue the operation of power units 7 and 8.

Other investments to keep the GRSs and GMSs in good condition (upgrading of pressure control lines, boiler and heating systems, automation and alarm systems, and reliable power supplies (generators)) are expected to amount to around EUR 10 million.

### 4.2.4. Rehabilitation and Modernisation of Other Transmission System Appurtenance and Facilities

Around EUR 13.3 million is planned for the rehabilitation and maintenance of various other transmission system appurtenance and facilities.

The largest part of this investment, around EUR 4.5 million, is planned for the upgrade of the corrosion protection systems and for the upgrade of telemetry system controllers, which are no longer in production, in the GRSs and line section valves: around EUR 4.2 million.

Around EUR 1.1 million is planned for the creation of a reserve of transmission system materials (gas pipes, fittings, shut-off devices) for emergencies (in case of accidents, possible military action), and another EUR 3.5 million for other smaller investments.

The Company also plans to acquire other equipment for use in emergencies (but which would also be used during normal operations if needed) from 2024 to 2033, but it is not part of the transmission system and is therefore not included in the Plan. The value of these investments is around EUR 4 million.

# 5. MEASURES TO REDUCE GREENHOUSE GASES (GHG)

Amber Grid identifies the following greenhouse gas emissions areas when analysing its operations:

**Scope 1:** Direct emissions from the combustion of fuels in stationary and mobile installations, controlled gas discharges and uncontrolled leakages;

**Scope 2:** Indirect emissions from purchased electricity and heat;

**Scope 3:** Indirect emissions from the extraction and transport of fuel in use, business travel, fixed assets, waste generation and disposal, employee travel to/from work, and purchased goods and services.

In 2023, the largest GHG emissions from the Company's operations were from Scope 1 emissions: controlled methane releases, uncontrolled methane leaks, fuel consumption by stationary installations and newly estimated Scope 3 emissions, with the largest emissions from the extraction and transport of fuel in use and costs/investments in fixed assets. First, the Company has chosen to reduce direct Scope 1-2 emissions, which it can most easily affect by changing its energy choices or by adapting GHG reduction measures.

One of the Company's key strategic objectives is to reduce its environmental impact (including Scope 1-2 GHGs) by 2/3 by 2030 compared to 2019 levels. To achieve this goal, a Plan for Reducing Environmental Impacts (including GHG) 2030 has been developed, which includes measures to reduce Scope 1-2 GHGs, their implementation timelines, investments and indicative costs. It is in the period from 2024 to 2033 that the Company is planning to implement projects on the transmission network which, while meeting other strategic objectives, are also in line with the measures set out in the Plan for Reducing Environmental Impacts (including GHG):

- Optimising the capacity of gas compressors, partly by replacing gas compressors with electric ones;
- The Power to Gas project;
- Building green hydrogen infrastructure, hydrogen injection into natural gas, consumption;
- Using electric boilers (or other less polluting equipment) instead of gas boilers for premises and gas heating at gas reduction stations (GRS).

The total investment requirement for the measures included in the Plan is provisionally estimated at around EUR 68.5 million by 2030, as well as additional operational costs.

In addition to the above investments included in the Plan, the Company envisages other measures that are not directly related to the development of the transmission network, but which will require expenditure and labour resources:

- Purchasing special equipment for the reconstruction and repair of gas pipelines;
- Purchasing a mobile compressor with different parameters;
- Aiming to replace as much of energy consumption as possible with green energy (e.g., combustion of biogas with guarantees of origin in compressors);
- Acquiring and using a gas combustion plant during the work;
- Using flying equipment (e.g., drones) to detect gas leaks;
- Replacing vehicles with less polluting ones.

The total investment requirement for all the measures listed above (both included and not included in the Plan) is provisionally estimated at around EUR 78 million by 2030 and will also entail additional operational costs.

In line with the international *Greenhouse Gas Protocol Corporate Standard*, it is estimated that the combination of these measures will lead to a reduction of up to 59% to 76% in GHG emissions compared to 2019. The maximum reduction potential of the measure is indicated here. In practice, GHG reductions may differ significantly from those presented in the Plan as they will depend on the effectiveness of each measure, the extent of its applicability, and the applicability and effectiveness of other related measures.

The expected entry into force in 2024 of the *Regulation of the European Parliament and of the Council on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942* will trigger the implementation and broad adaptation of the measures in the Plan for Reducing Environmental Impacts (including Scope 1 and Scope 2 GHGs) because many of the measures listed are focused on methane emissions.

The Company intends to set new GHG reduction targets for the period 2031-2033, including Scope 3 emissions, which would be consistent with and contribute to the European Union's goal of climate neutrality by 2050. Thus, the objective for the period from 2031 to 2033 will be to fully apply the measures set out in the Plan for Reducing Environmental Impacts by 2030 and to plan and start implementing new measures to reduce and/or neutralise direct and indirect environmental impacts (e.g., sequestration, $CO_2$ uptake, etc).

# 6. HYDROGEN TRANSPORTATION

## 6.1. Hydrogen Production and Consumption

In October 2023, as part of its contribution to the establishment of a sustainable Lithuania, Amber Grid started hydrogen transportation activities (preparatory stage), working on initiatives involving hydrogen-related projects and will seek to become Lithuania's hydrogen infrastructure operator in the future. This will allow for timely integration into the upcoming European green hydrogen transport network.

Hydrogen produced from renewable electricity and its products—synthetic gases and fuels—will be a key element of decarbonisation in the industrial, transport and energy sectors. This will lead to significant reductions in the use of fossil fuels and environmental pollution. Hydrogen and its derivatives are expected to be used in fertiliser production, refining of petroleum products, metals industry, transport, flexible power generation and other areas. Long-term storage of renewable solar and wind energy as well as electrical system balancing will depend on hydrogen, which is created by splitting water into hydrogen and oxygen molecules using renewable power.

In the industrial sector, hydrogen plays a significant part in creation of many compounds, metalworking, petroleum product refinement, and manufacturing processes. Hydrogen is used as a raw material for the production of ammonia, methanol, hydrogen peroxide, solvents, plastics, polyester and nylon. Hydrogen is also often mixed with argon and used to weld metals. The industrial sector is one of the most promising sectors to start using green hydrogen.

The projected demand for hydrogen in the fertiliser and chemical sectors in 2030 is 2.7 TWh. Up to 41% of the ammonia needed for fertiliser production will be produced from green hydrogen. In addition to the fertiliser industry, green hydrogen could potentially be used in other industrial processes requiring high and stable temperatures (production of glass, cement, etc.) and replace natural gas. The involvement of other Lithuanian companies outside the industrial category in green hydrogen value chains should also be encouraged. The goal should be to develop new capacity for hydrogen production, transportation, and storage as well as to investigate new opportunities for the switch from fossil fuels to green hydrogen.

An initial stakeholder survey was carried out in March 2024, which was followed by targeted meetings with selected major existing H2 production/consumption facilities and facility developers in order to develop the green hydrogen transportation network in Lithuania, including pipelines between future green hydrogen producers and consumers with other countries together with connections to other countries.

Fifteen potential hydrogen market participants who identified their plans to develop green hydrogen projects in Lithuania from 2028 participated in the survey and attended the targeted meetings. 15 potential H2 production facilities and 7 H2 utilisation facilities were identified, some of which intend to use the H2 produced in Lithuania as an energy carrier to decarbonise their operations and/or to produce synthetic fuels. The rest of the H2 produced in Lithuania would be exported to other countries.

The results of the H2 stakeholder survey and interviews show that the total amount of H2 production considered by developers in Lithuania in 2030 will be 300 kt H2/year (10 TWh H2)

and H2 demand in Lithuania is expected to reach 200 kt H2/year (7 TWh H2). From 2040, the total amount of H2 production considered by developers in Lithuania will increase to 755 kt H2/year (25 TWh H2) and the expected demand for H2 will reach 252 kt H2/year (8.4 TWh H2).

The results of the survey helped to identify the first potential geographic locations for the production and consumption of green H2, the need for capacity, and the timeframes in which the need for H2 transport could arise in Lithuania. The survey and other available information will be used to assess both the feasibility of transport infrastructure for green H2 and the options for alternative transport methods such as gas carriers (gas carriers provide flexibility to transport H2 to remote locations where building a pipeline infrastructure is unreasonable).

As many companies are currently in the process of assessing sites for hydrogen production and have identified in the survey of several potential geographic locations that they are evaluating, the calculations based on the survey data above only reflect a projected vision of the market development, which is subject to change over the short term. Changes in plans may arise not only due to adjustments in the strategies of H2 developers, but also due to technological, legal, or market demand changes that affect the overall development of the H2 market in Lithuania.

## 6.2. Tasks for Hydrogen Infrastructure Development

In line with the H2 Guidelines, the tasks for 2030 to create a green hydrogen ecosystem and infrastructure in Lithuania are as follows:

1. To start preparatory actions for the construction of the hydrogen network from Finland to Germany via Lithuania and, once completed, to start construction of the hydrogen network;
2. To assess the need and feasibility of adapting the natural gas network to transport hydrogen and of new hydrogen networks;
3. To prepare a feasibility study on harnessing the potential of offshore wind energy in the Baltic Sea through hydrogen production infrastructure;
4. To ensure the safety and certification of the production, use, storage and transport of hydrogen and its derivatives, the development of hydrogen market integration, export, import and storage activities, and the development of international transport corridors for hydrogen and access to hydrogen storage facilities in other EU countries;
5. To increase hydrogen storage options;
6. To ensure that new electrolysis capacity is built with short-term storage capacity and can operate flexibly depending on the electricity market situation;
7. To analyse the long-term storage of hydrogen in Lithuania, assessing the potential for its conversion into other products, and to assess the potential for geological storage of hydrogen;
8. To assess the prospects for long-term hydrogen storage in other EU countries;
9. The technical solutions for integrating the Klaipėda liquefied natural gas terminal infrastructure into the hydrogen value chain are to be assessed. The adaptability of the existing infrastructure of the Klaipėda liquefied natural gas terminal for the transport of hydrogen and its derivatives and the need for new infrastructure will be assessed.

The demand for green hydrogen for export in 2030 will also depend on the progress of the development and adaptation of hydrogen transportation infrastructure. In the absence of the

necessary infrastructure, some or all of the green hydrogen could be converted into other products for export.

In 2030, it is projected that 6.51 TWh of electricity will be needed to produce 4.26 TWh of green hydrogen. The highest electricity demand is projected for hydrogen production in fertiliser and refining areas. The demand in other areas will be negligible and will not have a major impact on the electricity transmission and distribution networks. One of the main measures to exploit the potential of green hydrogen and its derivatives in the Lithuanian economy and export markets is the creation of green hydrogen valleys.

Green hydrogen valleys will aim to develop production capacity, integrated projects in the industry, transport and energy sectors, production of green hydrogen value chain components (such as electrolysers), create a favourable investment environment and take advantage of Lithuania's geographic location and system interconnections.

In order to assess the opportunities and benefits of hydrogen storage, it is necessary to investigate the feasibility of geological storage of hydrogen and the above-ground storage of ammonia and methanol, and to assess the feasibility of geological storage of hydrogen on a regional scale, i.e. what access to geological storage of hydrogen in other countries in the region could be.

In addition, the potential of synthetic methane as a long-term hydrogen storage option needs to be explored. The production of synthetic methane from green hydrogen would allow storage to balance seasonal fluctuations in natural gas demand and maintain the existing natural gas infrastructure. According to the analyses carried out, ammonia can also play an important role in Lithuania's hydrogen development, so its storage potential needs to be properly assessed.

## 6.3. Creation of a National Hydrogen Network

Due to the high uncertainty in the development of the H2 market due to the immature H2 market in Lithuania, the planned national hydrogen transportation network is in the visioning stage. Based on the interim results of the ongoing study on the development of an international H2 transmission system, the data of the companies identified in the survey, the Energy Transformation in Lithuania Study, the objectives set out in the draft National Energy Independence Strategy, the guidelines for the development of the hydrogen sector in Lithuania in 2023-2030, the requests for connection of electrolysis plants to the 330 kV network received by AB Litgrid, etc., we see a need for the development of a national hydrogen transportation network in Lithuania.

Lithuania can become a significant green hydrogen producer, given the planned large-scale development of RES, the domestic industry that will require large quantities of green hydrogen, and the geographically favourable circumstances to establish import and export routes with other EU countries. Changes in the development of the H2 market are expected already in the next decade, when H2 production capacity will exceed Lithuania's needs. H2 production is expected to reach 10 TWh from 2030 and 24-26 TWh from 2040. A third of the H2 produced will be consumed domestically, the rest will be transported to other countries, primarily Poland and Germany, where the demand for hydrogen is expected to be the highest and the supply limited.

Table 2. Overall forecast of the potential development of the green H2 market, which led to the development of the national H2 transmission network map:

| | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Total H2 production in Lithuania, TWh** | 10 | 24-26 | 25-32 |
| thereof North-Western Lithuania | *4* | *19-20* | *19-25* |
| thereof Central Lithuania | *6* | *6* | *6* |
| **Total H2 demand in Lithuania, TWh** | 5-7 | 12-18 | 17-27 |
| thereof North-Western Lithuania | *4* | *5-6* | *5-12* |
| thereof Central Lithuania | *1-3* | *7-12* | *12-16* |
| **Supply of H2 produced in LT to the Amber Grid network, TWh** | 7 | 16 | 16-21 |
| **Retrieval of H2 produced in LT from the Amber Grid network to meet Lithuania's needs, TWh** | 1-3 | 4-8 | 8-17 |
| **Potential H2 exports, TWh** | 3-5 | 8-13 | 4-8 |
| **H2 entry flows from Latvia, TWh** | 12-20 | 38-67 | 50-96 |
| **H2 exit flows to Poland, TWh** | 17-24 | 50-76 | 57-101 |

The smooth development of hydrogen requires close inter-institutional cooperation, so the electricity transmission operator AB Litgrid was consulted to assess the capacity of the electrolysis plants as accurately as possible. This consultation was necessary to assess the potential electricity supply capacity required for hydrogen production and thus ensure an optimal hydrogen production process in line with the H2 transport system development scenarios under consideration in a highly uncertain market.

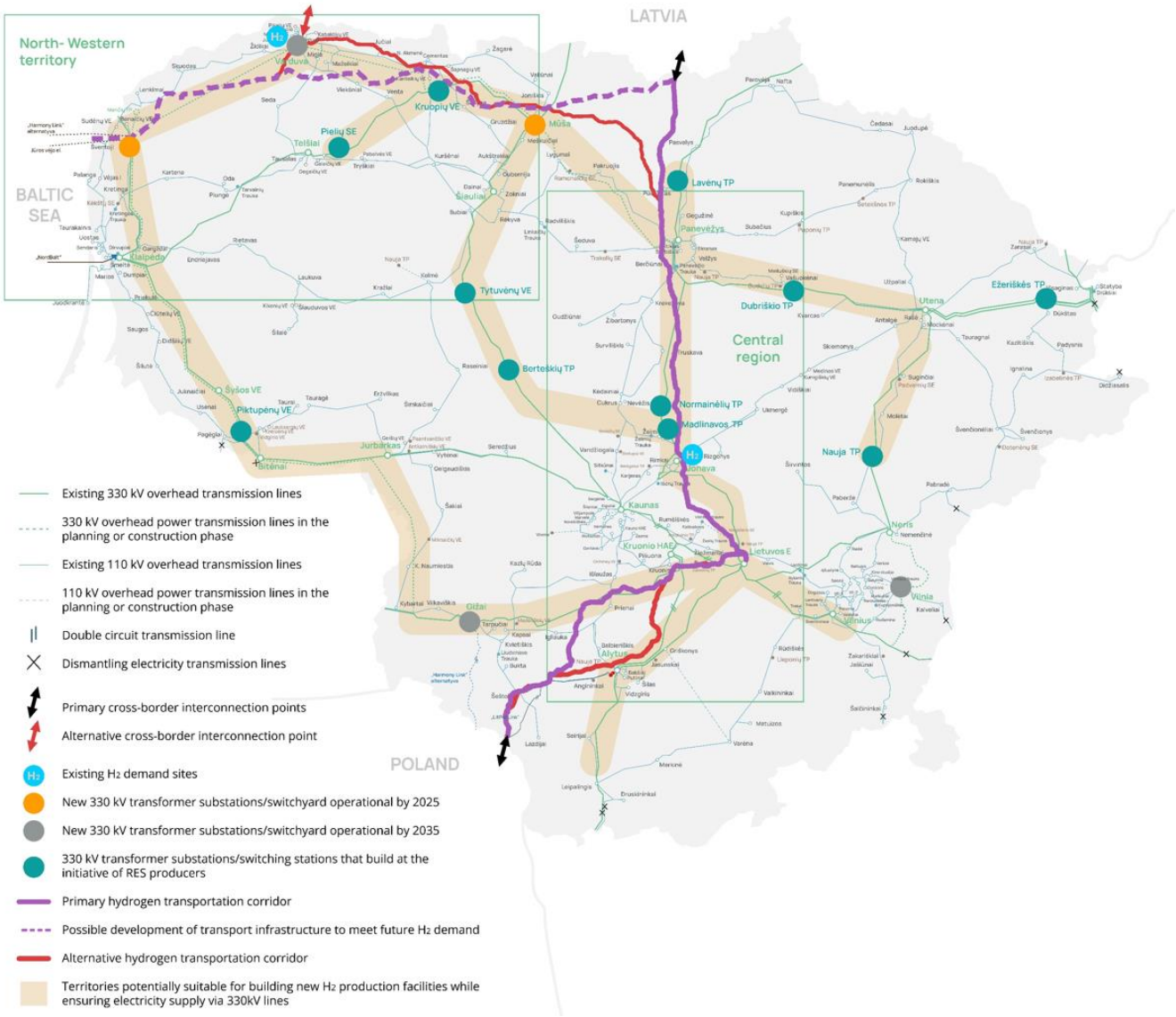
Figure 14 below shows the H2 transport network according to the geographical locations of H2 production/consumption considered by the developers. It is not yet known whether hydrogen will be transported via pipelines or whether other alternative transport methods will be chosen for the entire H2 transport infrastructure shown. One of the alternative methods used in other countries is gas carriers (trucks), which allow efficient delivery/reception of hydrogen to/from remote areas where building pipelines are not reasonable.

AB Amber Grid and AB Litgrid experts, in the process of cooperation in the development of hydrogen networks, have foreseen that it would be desirable to connect the H2 production facilities to the planned new 330 kV transformer substations (TS) that will be built in Lithuania as a result of the connection of the RES power plants. As the new RES TSs are mostly built in undeveloped areas away from residential areas and cities, there will usually be sufficient vacant undeveloped land in the vicinity suitable for the construction of a new plant, and the new 330 kV TSs will also provide for additional connection possibilities as the connection of a new consumer to an existing 330 kV TS built a long time ago has always been complicated or even impossible because the existing old 330 kV TSs are mostly located close to cities or have not been planned for expansion. In addition, H2 production facilities should be considered in areas close to the international hydrogen transport network, if the aim is to export H2. Such a strategic solution would optimise logistics costs, reduce transport complexities and increase the overall efficiency of exports, ensuring a faster and safer supply of hydrogen to international markets. However, in the absence of such opportunities, Amber Grid will seek to secure the necessary interconnections to the international hydrogen transport network by developing sections of the national network to effectively integrate Lithuania's hydrogen

production potential with the wider European energy market needs and strengthening the country's position as an important transit zone in the hydrogen supply chain.

In the future, the possibility of transporting H2 via the Baltic Sea using offshore pipelines could be considered. This would allow efficient and safe connection of hydrogen production centres to international markets, reducing logistics costs.

Fig. 14. Preliminary route of the national H2 transmission network, to be refined during the planning process.



## 6.4. The Nordic-Baltic Hydrogen Corridor, a Project of Common Interest for the European Union

On 29 November 2023, the European Commission approved the first list of projects of common interest (PCIs), which includes projects fully in line with the European Green Deal. These key cross-border energy infrastructure projects will help the EU meet its ambitious energy and climate goals. They will be subject to simplified permit granting and regulatory procedures and will be eligible for EU financial support from the Connecting Europe Facility (CEF).

*www.rigzone.com*

The Nordic-Baltic Hydrogen Corridor (NBH2C) project, in which the Company is involved, is also included in this list. In the Baltic region pure hydrogen network development initiative aims to create interconnections between countries where the supply of pure hydrogen resources is expected to be high (Finland, Lithuania) due to the huge renewable energy potential, capacity development and availability, with European countries (Germany, Poland) which will be able to import hydrogen from other European or neighbouring countries to meet the demand for hydrogen.

In the Baltic region the pure hydrogen transport project aims to develop a green hydrogen transport corridor between Finland and Germany, connecting hydrogen production, consumption and storage centres in Finland, Estonia, Latvia, Lithuania, Poland and Germany, contributing to:

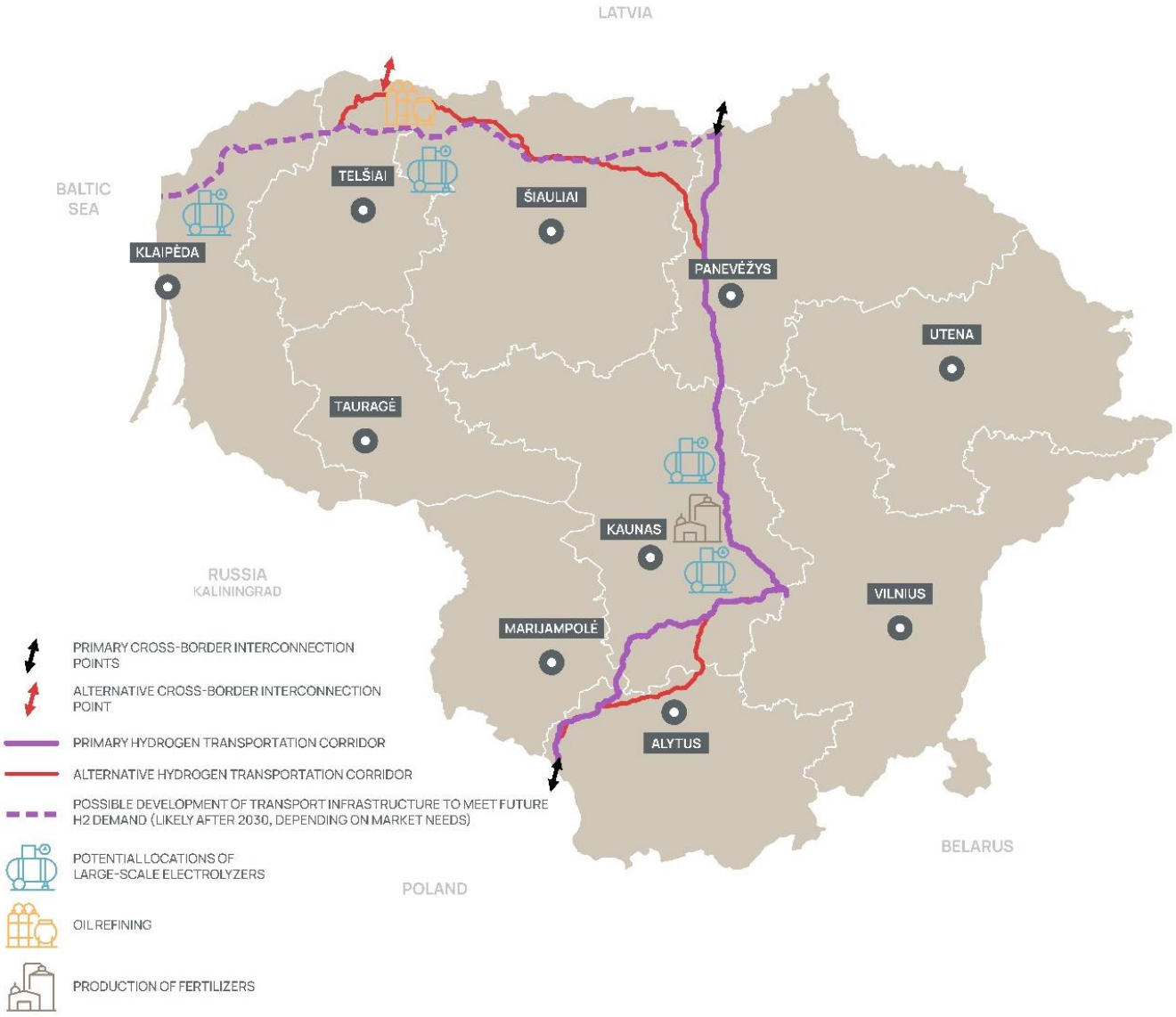
- Decarbonising the national, regional and European energy system;
- Creating and developing a competitive and liquid European hydrogen market;
- Cross-border regional cooperation.

Fig. 15. The Nordic-Baltic Hydrogen Corridor project.


The part of the Nordic-Baltic Hydrogen Corridor project to be implemented in Lithuania is planned to be developed by Amber Grid, not only as a natural gas transmission system operator, but also as a future hydrogen infrastructure operator. Lithuania, like Estonia and Latvia, is exempted by the *Directive of the European Parliament and of the Council on Common Rules for the Internal Markets in Renewable and Natural Gases and in Hydrogen* from unbundling the activities as a hydrogen transmission network operator until 31 December 2030.

The NBH2C or the Nordic-Baltic Hydrogen Corridor pre-feasibility study analyses the feasibility of the hydrogen transport infrastructure location (route) and its alternatives, taking into account geological, hydrological, environmental, protected area and related constraints, the technical parameters of the infrastructure, the cost assessment, and the availability of financing sources. The route analysis is accompanied by hydraulic modelling of hydrogen flows under different scenarios of hydrogen demand and supply. The project is expected to be completed by 2030.

Fig. 16. Part of the Nordic-Baltic Hydrogen Corridor project in the territory of Lithuania (illustrative route, real route not yet formed)



## ANNEX. 1

### Planned Investments (EUR million)

| No | Name | By 2024* | 2024 | 2025 | 2026 | 2027 | 2028 | 2029-2033* | Total planned investments | Including: Donations, third-party funding** | GHG reduction measure | Energy transformation | System security/reliability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | **Adaptation of the transmission system for the transport of hydrogen and gas blends, including the Power to Gas project** | | **0.12** | **5.08** | **9.50** | | | | **14.70** | | **X** | **X** | |
| 2. | **Transmission System Rehabilitation and Modernisation** | **1.28** | **7.49** | **20.75** | **51.29** | **27.29** | **28.15** | **62.42** | **198.67** | **2.19** | | | |
| 2.1. | Optimisation and modernisation of compressor station capacity, including major investments: | | **0.42** | **11.34** | **15.62** | **9.04** | **16.08** | **7.90** | **60.40** | | X | | X |
| 2.2. | Rehabilitation of the line section of gas transmission pipelines, including: | **1.28** | **4.79** | **5.71** | **32.07** | **13.77** | **9.92** | **42.36** | **109.90** | **2.19** | | | X |
| 2.3. | Upgrades to Gas Distribution Stations | | **1.32** | **2.15** | **1.51** | **2.45** | **0.33** | **7.32** | **15.08** | | | | X |
| 2.4. | Rehabilitation and modernisation of other transmission system appurtenance and facilities, including: | | **0.96** | **1.55** | **2.09** | **2.03** | **1.82** | **4.84** | **13.29** | | | | X |
| | **Total investment** | **1.28** | **7.80** | **25.86** | **60.79** | **27.29** | **28.15** | **62.42** | **213.37** | **2.19** | | | |

* The share of funds of continuing projects invested before 2024.