ALTERNATIVE MARKET DESIGNS FOR THE BALTIC-FINNISH REGIONAL GAS MARKET

August 2020

Executive Summary

The Baltic States and Finland are currently designing the next steps for gas market integration between the four countries according to the Regional Gas Market Coordination Group's (RGMCG) roadmap published in April 2020. This report serves the roadmap in part of "Design of scenarios and analysis for further integration options". The report has been developed in cooperation between the four transmission system operators with focus on qualitative and quantitative comparison between alternative market designs.

The analysis focuses on two alternative market designs, namely, 'Common tariff area' representing a joint tariff area and 'Full market merger' representing a joint balancing area. In 'Common tariff area', the cross-border tariffs between all the four countries are removed, while there still is a formal capacity allocation methodology being applied. In 'Full market merger', there is only a single balancing area between all the four countries meaning that there is a single operator managing and balancing the entire market area and no cross-border capacity allocation.

The results indicate that a full market merger is not economically viable before investments in cross-border transmission capacities in Karksi and Kiemenai in 2024 between Estonia-Latvia and Latvia-Lithuania, respectively. Even after this, full market merger would be more economic than a common tariff area only if a) its implementation project, management and development thereafter is effective, and b) risks for physical congestion in Balticconnector (from Finland to Estonia) are being managed through locational balancing actions, cross-border capacity allocation, and/or provision of restrictedly allocable capacity products.

In contrast to this, a common tariff area between all the four countries would provide an opportunity to realise the majority of the market benefits already in a very short period of time, already before 2024. The transition can be done with minimum changes to the current rules and systems while continuing the work towards harmonisation over time.

In both market models (a common tariff area and full market merger), the countries would first have to establish an agreement on an inter-TSO compensation (ITC) mechanism to remove cross-border tariffs between the countries.

Finally, market integration can be advanced through the harmonisation of market rules and processes and the establishment of common IT platforms regardless of the target model and whether there is agreement on the ITC or not. For this reason, it is advisable to continue the harmonisation and joint service development wherever it leads to further market efficiency, supply security, transparency and non-discrimination, and complies with national legislation and regulation.

Contents

Acronyms and definitions

Term	Definition
BRP	Balance responsible party. A shipper who manages a balancing portfolio.
FCFS	First-come-first-served. A capacity allocation methodology where capacity is allocated to shippers in the order of their capacity booking requests.
GET Baltic	Gas exchange operating in the Baltic States and Finland
ITC	Inter-TSO compensation. A mechanism where TSOs settle transmission service income and costs between each other to financially compensate for the removal of entry and exit tariffs from border points between the TSOs.
LTA	Long-term agreement on the supply of Russian pipeline gas
TSO	Transmission System Operator
VTP	Virtual trading point

1 Introduction

The Baltic States and Finland are currently designing the next steps for gas market integration between the four countries according to the Regional Gas Market Coordination Group's (RGMCG) roadmap published in April 2020[1]. This report serves the roadmap in part of "Design of scenarios and analysis for further integration options". The objective is to evaluate the applicability of and form conclusions on the following market design alternatives referred to in the roadmap:

- Alternative 1. Joint tariff and balancing zone FIN-EST-LAT-LIT 2022
- Alternative 2. Joint tariff and balancing zone FIN-EST-LAT 2022
- Alternative 3. Joint tariff area FIN-EST-LAT-LIT 2022, joint balancing area FIN-EST-LAT 2022 as an intermediary towards joint balancing for FIN-EST-LAT-LIT in 2024 after ELLI project[2] completion
- Alternative 4. Joint tariff area FIN-EST-LAT-LIT 2022, joint balancing area for FIN-EST-LAT-LIT in 2024 after ELLI project completion without Finland joining the balancing area in 2022
- Alternative 5. Possible other identified process of analysis and based on ITC negotiations.

The above scenarios are analysed using the following approach:

1. Two alternative market designs are defined as a basis for the analysis. The first is called 'Common Tariff Area' representing the joint tariff area and the second 'Full market merger' representing a joint balancing zone as referred above.
2. Simplified flow calculations are performed for selected scenarios with the above models. The studied scenarios entail different combinations of entry prices, domestic gas demands, shares of long-term agreements (LTAs) on Russian pipeline gas and transportation capacities as the input (see Annex 1 for details). The purpose of the flow modelling is to study the resulting utilisation rates of the cross-border points between the countries since potential congestion in these points can affect the market design of choice or its implementation schedule.

In this report, we first introduce the concepts of common tariff area and full market merger in more detail. We continue with a discussion on the general objectives for market integration. After this, the results of each flow scenario are presented with discussion on their main findings. The results of all the scenarios are finally summarised to form the overall conclusions and recommendations on the way forward.

2 Alternative market models in brief

The concepts of 'common tariff area' and 'full market merger' and how they are used in this report are described below.

[1] https://ec.europa.eu/info/sites/info/files/energy_climate_change_environment/news/documents/roadmap_on_regional_gas_market_integration.pdf

[2] ELLI project refers to the upcoming investment in additional transportation capacity in Kiemenai cross-border point between Latvia and Lithuania to be commissioned in 12/2023. A similar investment is planned to Karksi cross-border point between Estonia and Latvia before the ELLI project. For clarity, we refer to these investments as 'investments in Karksi and Kiemenai' in the subsequent sections of this report.

2.1 Common tariff area

A common tariff area means that two or more countries agree to set the price of transportation capacity at their cross-border points to zero while still allocating the available transportation capacity to shippers according to a pre-defined procedure (see Figure 1). This allows gas prices to converge between the countries with a positive effect on competition. Furthermore, the commercial gas quantities to be transported between countries remain under control since they cannot exceed the system's physical transportation capacity by definition. In this way, shippers help to maintain each transmission network in balance.

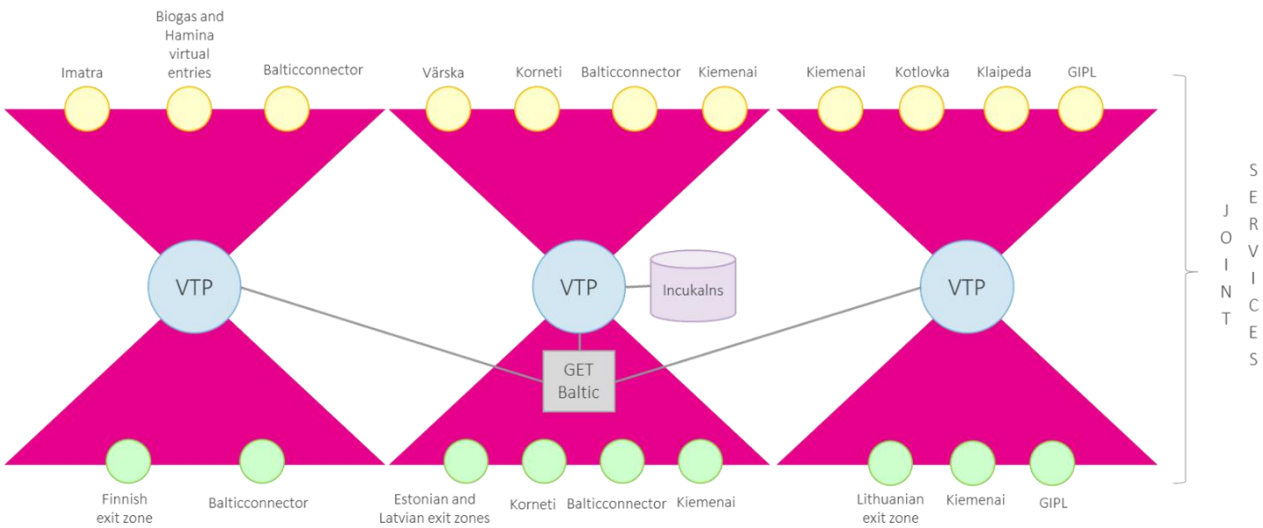


Figure 1. Simplified representation of a common tariff area

As regards capacity allocation in the cross-border points, capacity can be allocated using first-come-first-served (FCFS), pro rata or capacity auctions.

2.2 Full market merger

Full market merger is used in this report as a synonym for a joint balancing zone between two or more countries (see Figure 2 below)[3]. In a full market merger, the balancing portfolios of balance responsible parties (BRP) cover the entire merged market area and the same imbalance pricing is applied to all. In addition, shippers are assumed to have unlimited transportation capacity within the market area. This means that there is no capacity allocation procedure at the cross-border points between the participating countries. Instead, the TSOs internally schedule the required physical cross-border transportation, while the netted commercial quantities by shippers may well exceed the respective physical cross-border capacities. To enable this, the TSOs utilise their flexible reserves as far as possible (mainly linepack), take locational balancing actions where necessary (i.e., buy or sell gas locally) and settle potential physical imbalances

[3] In earlier communication about the potential full market merger between the Baltic States and Finland, is has been discussed that a full market merger might also entail common rules for gas transmission and a common IT platform for capacity booking. Since this report focuses on balancing, the above transmission related contents have been left outside the scope.

between the transmission networks over time (i.e., use flexibly the operational balancing accounts between adjacent transmission networks). The accrued costs from the above balancing actions are socialised to each network user according to their physical use of the system.

As explained above, locational balancing actions by the TSOs entail a cost. From the market design perspective, it is therefore relevant to assess these costs, their impacts on the market and compare these to that of alternative market designs.

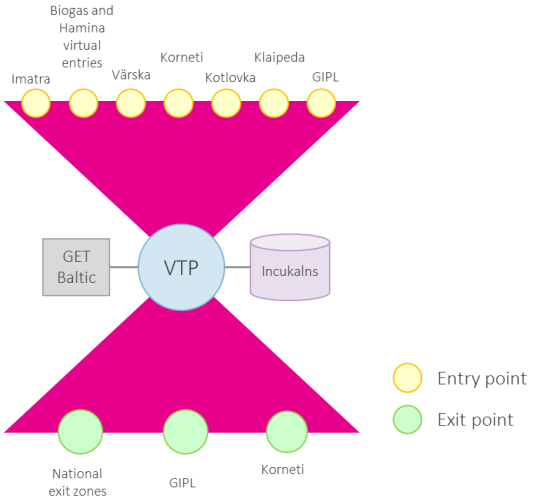


Figure 2. Simplified representation of a full market merger between the Baltic States and Finland

2.3 Stakeholder perspective to the above market designs

The main differences between the above two market models are summarised from the stakeholders' perspective in Table 1.

Table 1. Characteristics of two alternative market designs from different stakeholders' perspective

Common tariff area	Full market merger
End-users	
Shippers have access to end-users in the connected market areas without having to pay for cross-border transportation. Hence a common tariff area enables the formulation of a single price area as far as the cross-border points are not congested. Consequently, a common tariff area increases competition between shippers leading to a reduction in the shippers' margins and thereby lower overall supply prices to end-users. If a cross-border point is congested, market prices between the market areas diverge again – lower market prices occur in the area with the best access to the lowest cost supply. In areas, where there have been low costs before, a single price area may therefore increase the costs to the end-users as a result of their former suppliers now having a competitive access to new clients elsewhere.	A joint balancing zone enables a single price area even when the cross-border points are congested (see the main features of a common tariff area on the left). Some further efficiency gains become transferrable to the end-users thanks to the TSOs centralising their balancing and balance settlement services. However, the TSOs may also have to use locational balancing actions to overcome physical congestion at the former cross-border points. These costs may in certain cases rise high and they are socialised to all network users according to their physical use of the system regardless of which party is responsible for creating the congestion. If the system is severely congested, the gas supply costs to the end-users may increase as a result.
BRPs and shippers	
BRPs are responsible for balancing their portfolios per country. The BRP may be charged for a positive imbalance in one country and a negative in another, while the resulting neutrality charges are distributed to all network users per country. Shippers have access to a larger market but are also faced with increasing competition. The most cost-effective players will win the largest market shares.	In addition to the effects on the left, imbalances are charged only for one portfolio per BRP. Hence there is additional benefit to those shippers who would otherwise have had several portfolios with imbalances to opposite directions in different countries. However, the costs of locational balancing actions (when necessary, see above) are charged from all the network users based on their physical use of the system. This may outweigh the benefits of imbalance netting in part of those shippers who are not responsible for creating the physical imbalances but will still have to participate in the socialised cost. Locational balancing actions may also have indirect implications on the market if the share of the balancing service contracts is large in comparison to the total market size.
TSOs	
Each TSO manages its own balancing zone with overlapping services towards BRPs and shippers. Setting the cross-border tariffs to zero requires agreement from the TSOs and national regulatory authorities and the application of an inter-TSO compensation (ITC) mechanism to settle the income and costs between the TSOs.	In addition to the ITC agreement on the left, TSOs must define common balancing rules, procedures and operations. The cost effectiveness of this depends on how many overlapping functions the TSOs are able to replace, how effectively the market is being managed thereafter, and the potential need for locational balancing actions that result from removing the cross-border transportation constraints from the shippers.

The strengths, weaknesses, opportunities and threats of both models are summarised below (common tariff area in Table 2 and full market merger in Table 3).

Table 2. SWOT analysis of a common tariff area as a market model

Strengths	Weaknesses
• Market prices can fully converge whenever there is no congestion between the countries. • TSOs can fully control commercial cross-border flows so that balancing costs per network can be minimised also when there is congestion. • Market rules and IT systems do not need to be harmonised. Hence there would be minimal costs related to transition-to-target-model. • The model is applicable in a very short time if there is an ITC agreement.	• Market prices diverge between the countries always when there is cross-border congestion. • If market rules, processes and IT systems are not harmonised, shippers will have to continue to adapt to country-specific requirements. • TSOs continue to offer overlapping services on market area management. • The model still requires a capacity allocation method in the cross-border points. • There is no possibility for balance responsible parties to pool their imbalance positions between countries.
Opportunities	**Threats**
• It is possible to harmonise market rules and IT systems as far as this is sensible.	• If there is no ITC agreement, this model is not applicable. • Capacity allocation method in the cross-border points may not function effectively if the methodology is not chosen carefully.

Table 3. SWOT analysis of full market merger as a market model

Strengths	Weaknesses
• Market prices will always be fully converged. • There is no need for formal capacity allocation methodology in the cross-border points. • There is common market area management and the same IT requirements and contracts cover all the four countries. • There is possibility for balance responsible parties to pool their imbalance positions between the countries.	• TSOs must balance each physical network in any case, which may result in high costs of locational balancing due to physical congestion or other mechanisms for managing the risks. This cost is socialised between all network users and not between only those who are responsible for the physical imbalance. • Requires extensive harmonisation of market rules, IT systems and common market area management.
Opportunities	**Threats**
• There might be efficiency gains from common IT systems and market area management if they are designed, developed and managed effectively. • TSOs have a chance to reduce overlapping services.	• If there is no ITC agreement, this model is not applicable. • If there are major differences between national legislations and/or national regulatory authorities have inefficient processes and differing requirements for regulatory approvals, this model might not be efficient or even applicable. • There might be no efficiency gains from common IT systems and market area management if they are not designed, developed and managed effectively.

3 Criteria for successful market design

According to the Baltic and Finnish TSOs, the market design should preferably deliver a combination of the following elements:

- The market design is likely to provide welfare gains compared to the existing design;
- Lower gas supply costs to end-users;
- High tolerance for different risks;
- Effective operation through lean and automated market processes where cost-effective, user-friendly common platforms, etc.;
- Agreements and market rules are compliant with the EU level and national legislation and regulations; and
- Market management is non-discriminatory and transparent towards the stakeholders.

For market development to fulfil these objectives, it should be ensured that:

- Stakeholders' opinions are reviewed, and corrective actions are taken where sensible;
- Decisions are well-grounded;
- Development initiatives are actively identified, and the justified changes planned and implemented on a continuous basis;
- Enough resources are used for planning and implementation;
- The EU regulatory bodies and national NRAs are closely engaged in and consulted along the development process; and
- The deadlines accommodate implementation also in part of the stakeholders.

The above objectives and guidelines are revisited in the conclusions of this report.

4 Flow scenarios

The objectives of the following simplified flow modelling are two-fold. Firstly, we assess the utilisation rates of Balticconnector, Karksi and Kiemenai cross-border points to determine how **sensitive these points are for physical congestion** at selected scenarios of market prices, shares of long-term agreements on Russian pipeline gas and seasonal gas demand. This enables to identify scenarios, where congestion plays a major role, and to determine the subsequent **cost of locational balancing actions** in these cases. Secondly, the capacities will significantly increase in Karksi and Kiemenai cross-border points by 12/2023. We therefore study whether **the timing of these investments should influence the scheduling** of potential changes to the current market model. The above flow scenarios thereby enable the benefits and drawbacks of the alternative market designs to be compared with.

The flows are calculated by minimising the overall gas supply costs to the entire region assuming perfect knowledge by the market parties.

The sensitivity for congestion is studied using three alternative price scenarios for gas at the entry points and GIPL (see Table 4 below). The scenarios assume fixed prices per point for any daily quantities on any day. Hence the prices do not consider that import and export prices may vary according to season or volume. The first price scenario **'FI high, LT low'** represents a market situation where Imatra and Hamina are priced the highest and entries in Lithuania the lowest. The second price scenario **'FI low, LT high'** represents a scenario where Imatra and Hamina are priced the lowest and entries in Lithuania the highest. In the last price scenario **'RU high, alternatives low'** alternative import routes are priced lower than Russian pipeline gas.

Table 4. The prices of gas at entry points and GIPL used in the three price scenarios

Border point	FI high, LT low EUR/MWh	FI low, LT high EUR/MWh	RU high, alternatives low EUR/MWh
Imatra	23.0	19.0	23.0
Hamina	23.5	18.9	22.0
Värska	22.5	20.0	23.1
Luhamaa-Korneti	22.0	20.0	23.0
Kotlovka	21.0	21.0	22.2
GIPL	17.5	21.5	22.0
Klaipeda	17.0	20.0	21.0
Inčukalns	18.0	19.0	21.5

The sensitivity for congestion is studied further at different **shares of long-term agreements (LTAs)** for Russian pipeline gas. To deliver this, the flow rates of Russian pipeline gas are set at minimum to a certain percentage of the national demand. In this report, we have used a range from 0% to 60% of the national demand per country. Furthermore, selected four fixed scenarios are used for the national demands. These are called 'Peak', 'Winter high', 'Winter normal' and 'Summer normal'. The values are based on data in 2019 and the TSOs own views of potential peak values that could realise under extreme conditions. For simplicity, the entry and exit flows to and from Inčukalns gas storage facility have also been pre-fixed as part of the demand scenarios (withdrawal from the storage in wintertime, injection to the storage in summertime).

The applicability of a common tariff area and full market merger is also studied with transmission infrastructure **before and after investments in Karksi and Kiemenai** (see Table 5 below).

Table 5. Transmission capacities of Karksi and Kiemenai before and after investments.

Border point	Max. capacity GWh/d	Min. capacity GWh/d
Before investments		
Karksi (2-way)	73.0	-73.0
Kiemenai (2-way)	67.6	-65.1
After investments		
Karksi (2-way)	105.0	-105.0
Kiemenai (2-way)	130.5	-119.5

The detailed input data for the flow all the above scenarios are presented in Annex 1.

4.1 Flow analysis for a common tariff area

Balticconnector. Before the Karksi and Kiemenai investments, Balticconnector is congested in wintertime in price scenario 'FI high, LT low', while congestion prevails all year around in price scenario 'FI low, LT high' (see Figure 3 below). If gas from Hamina Terminal is more competitive than Russian gas (price scenario 'RU high, alternatives low'), Balticconnector would not be congested at any point.

After the Karksi and Kiemenai investments, some additional gas can be transported from the Baltic States towards Finland:

- In 'FI high, LT low' scenario, this is seen as improved availability of gas to Finland in peak situations, while other numbers remain unaffected by the investments.
- In the 'RU high, alternatives low' scenario, more gas could be transported to Finland all year around.

In the 'FI low, LT high' scenario, there is no change since the direction of the flow is from the North to the South in which case the investments in Karksi and Kiemenai play no role.

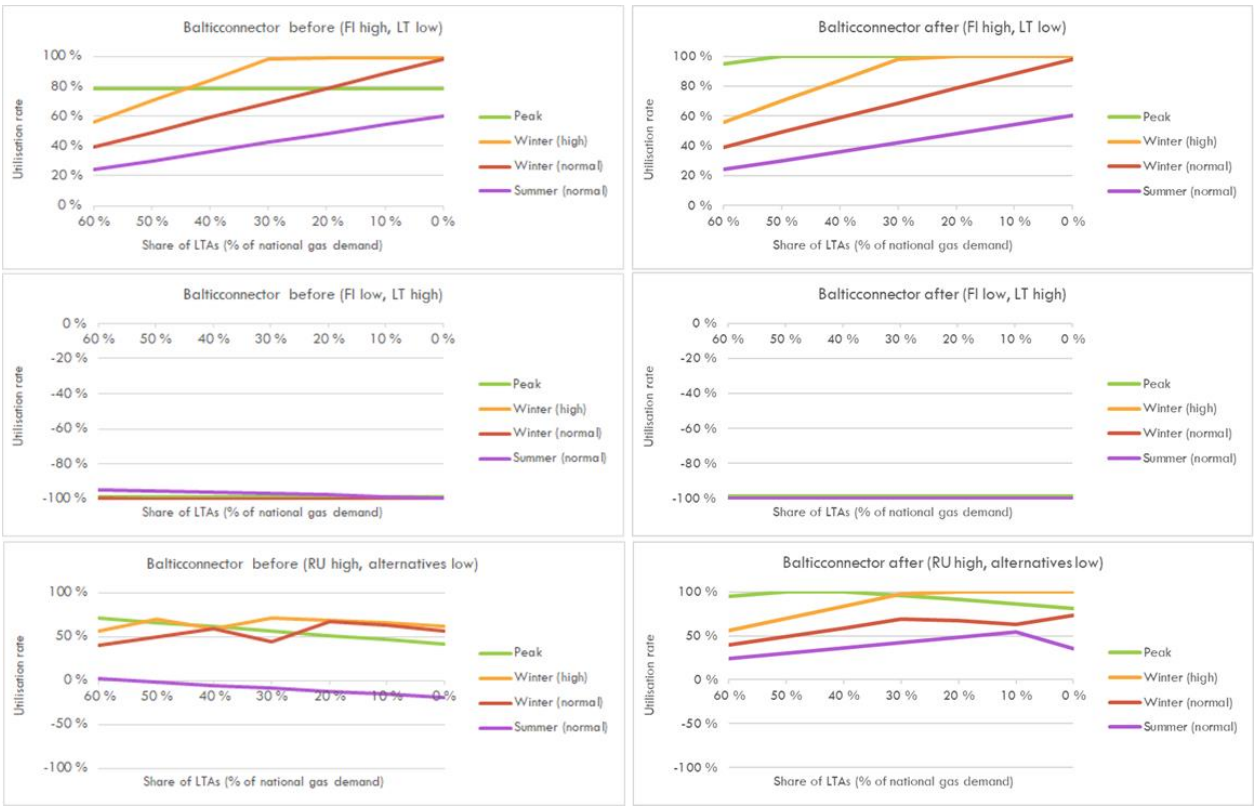


Figure 3. Utilisation rate of Balticconnector in a common tariff area before and after Karksi and Kiemenai investments

Karksi. Investments in Karksi and Kiemenai have a larger effect on the Baltic States than Finland. In all price scenarios, there is no congestion in Karksi with high level of LTAs (> 40%) before and after the investments (see Figure 4 below). With low levels of LTAs, the investments help to reduce the risk for congestion in all price scenarios.

Figure 4. Utilisation rate of Karksi in a common tariff area before and after Karksi and Kiemenai investments

Kiemenai. Kiemenai is heavily congested in both 'FI high, LT low' and 'FI low, LT high' scenarios before the investments in Karksi and Kiemenai (see Figure 5 below). In the case of 'RU high, alternatives low', Kiemenai is congested only in summertime. After the investments, Kiemenai is no longer congested which is a dramatic improvement to the current situation.

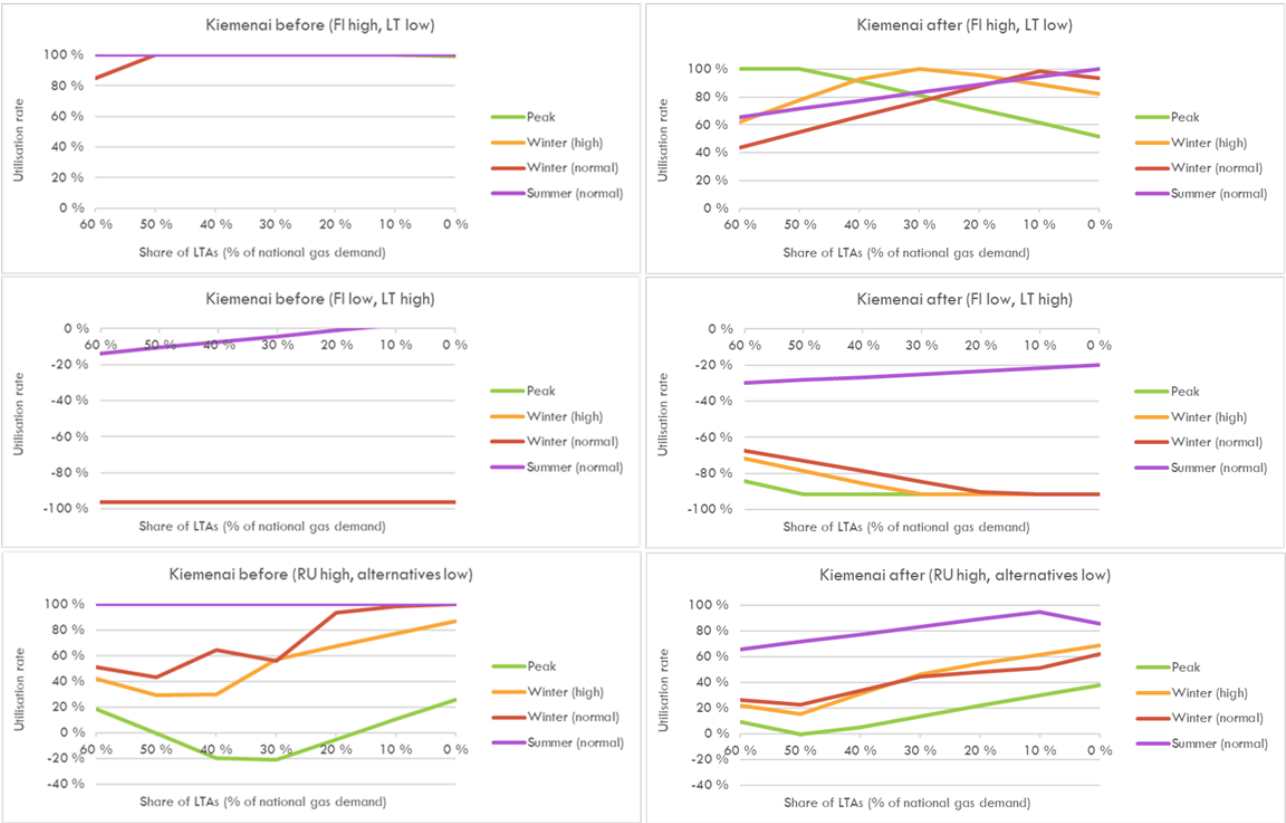


Figure 5. Utilisation rate of Kiemenai cross-border point in a common tariff area before and after Karksi and Kiemenai investments

Conclusions. Investments in Karksi and Kiemenai would significantly improve the availability of low-priced gas in the direction from the South to the North. If Finland would be the lowest cost import route, i.e. gas would flow from the North to the South, Balticconnector would remain heavily congested both before and after. In any case, **it would be beneficial to establish a common tariff area as soon as possible** to enable a single price zone to form as fast as possible even if there are price deviations between the countries at times due to congestion. The cross-border capacities are in any case used at maximum without risk for additional costs due to locational balancing actions. **The welfare benefits for the entire market would just increase after the investments** if Lithuania with its alternative sources of gas continues to be the lowest cost import route to the region[4].

4.2 Flow analysis for a full market merger

Balticconnector. Flow rates to and from Finland remain unchanged by investments in Karksi and Kiemenai. If the shares of long-term agreements on Russian gas are reduced below 30% of the national demand, the need for locational balancing due to Balticconnector is unavoidable in wintertime. Furthermore, if Finland

[4] It should be noted that this study assumes constant prices at entry and exit points before and after. For example, it is not considered how the choice of a market model or investments in transportation capacity would affect the pricing of Russian pipeline gas over the long-term.

becomes the lowest cost import route (see price scenario 'FI low, LT high' below), the physical capacity of Balticconnector could be exceeded by 50…150 % leading to a significant need for locational balancing.

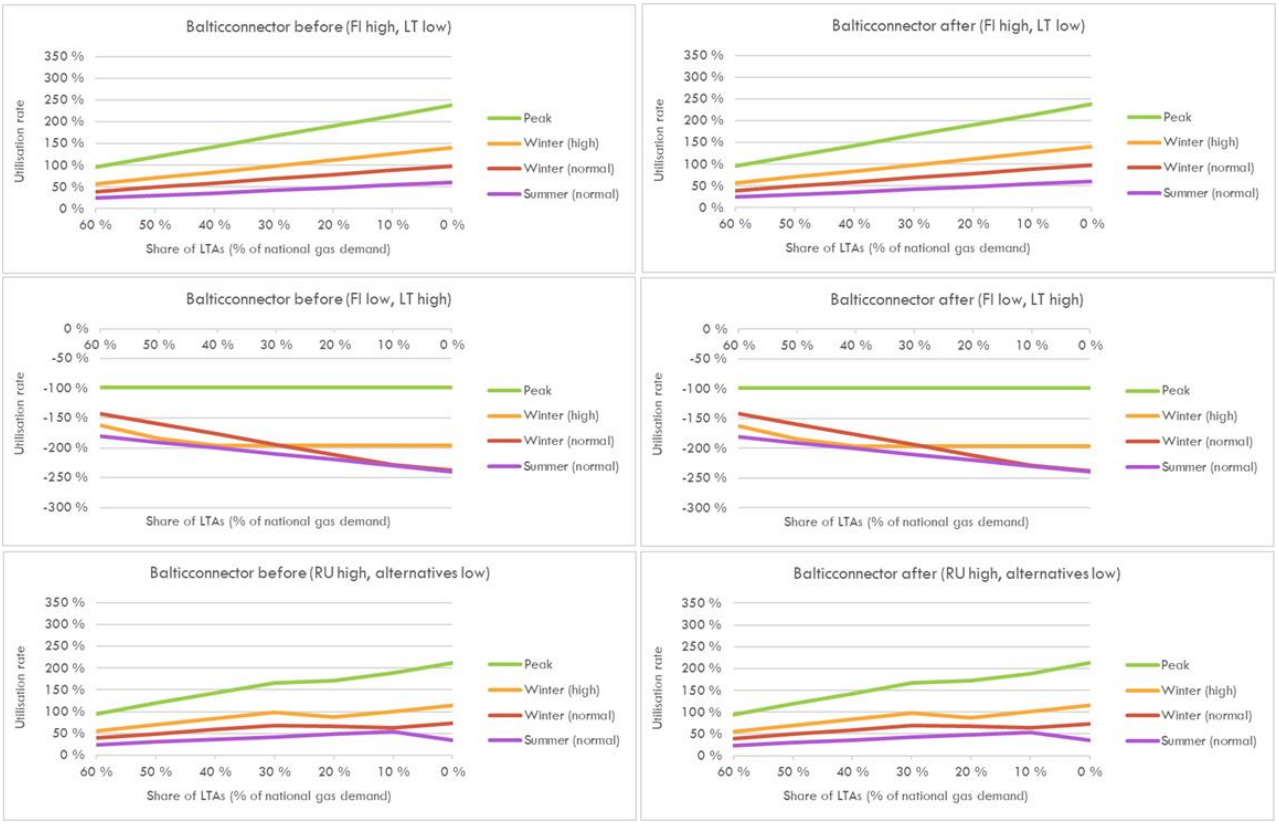


Figure 6. Balticconnector utilisation rates under full market merger before and after Karksi and Kiemenai investments

As discussed above, the price scenario 'FI low, LT high' represents a risk scenario. The associated costs are presented in Figure 7 below[5]. The annual costs of locational balancing strongly depend on the share of long-term agreements on Russian pipeline gas. With a share of 60% of the LTAs, the annual costs would be in the range of 54.5 MEUR/a, whereas with the share of 30% of the LTAs, the annual costs would rise as high as 88.3 MEUR/a. These result in 18.5 and 29.9 TWh of gas per year, respectively, to be sold by the TSOs through locational balancing services in Finland and the same quantity to be bought in the Baltic States. When summarised, these quantities are significant (2 x 18.5 TWh/a equal to 54% and 2 x 29.9 TWh/a equal to 88%, respectively) compared to the overall market size (68.1 TWh in 2019). This would have implications on the market as the shippers contracted by the TSOs would have to be ready to activate significant volumes of gas outside the market. This will inevitably have effect on the availability of gas and capacity in the market.

[5] See Annex 2 for details on the methodology how the costs and quantities have been estimated.

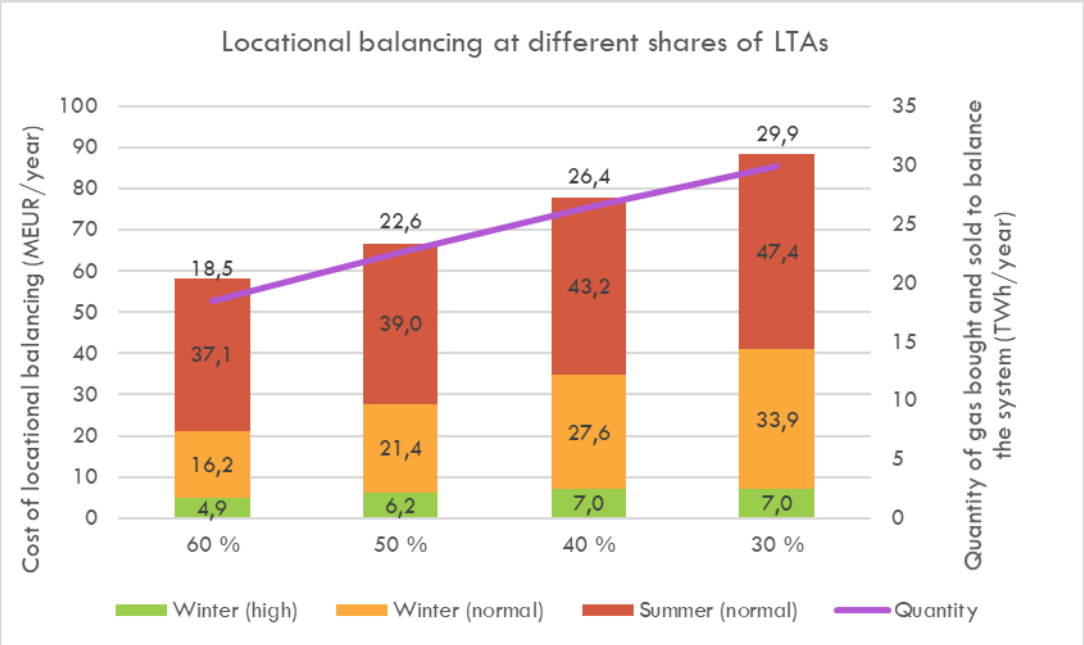


Figure 7. Cost of locational balancing at different shares of long-term agreements on Russian pipeline gas if full market merger is carried out in price scenario 'FI low, LT high' before Karksi and Kiemenai investments. The same costs apply after Karksi and Kiemenai investments since the congested point is Balticconnector.

Karksi. Karksi and Kiemenai investments reduce some risk for congestion in Karksi (see Figure 8). If imports from Finland would be the lowest cost import route to the Baltic States, Balticconnector still remains as the primary reason for having to use locational balancing actions in the Baltic States. This means that managing the congestion in Balticconnector with locational balancing actions would eliminate any physical congestion in Karksi at the same time.

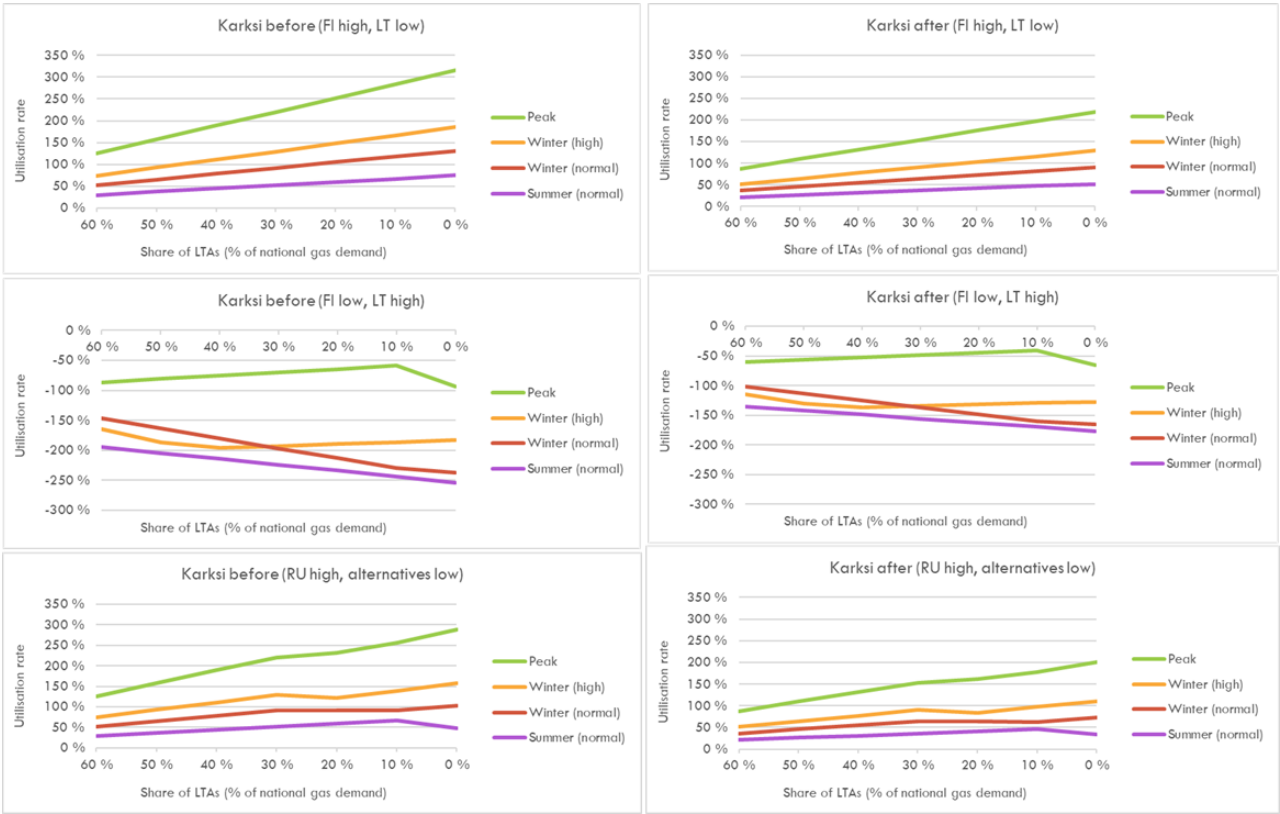


Figure 8. Utilisation rate of Karksi cross-border points under full market merger

Kiemenai. Karksi and Kiemenai investments significantly reduce the risk for congestion in Kiemenai (see Figure 9 below). The most importantly, this happens with all the three price scenarios.

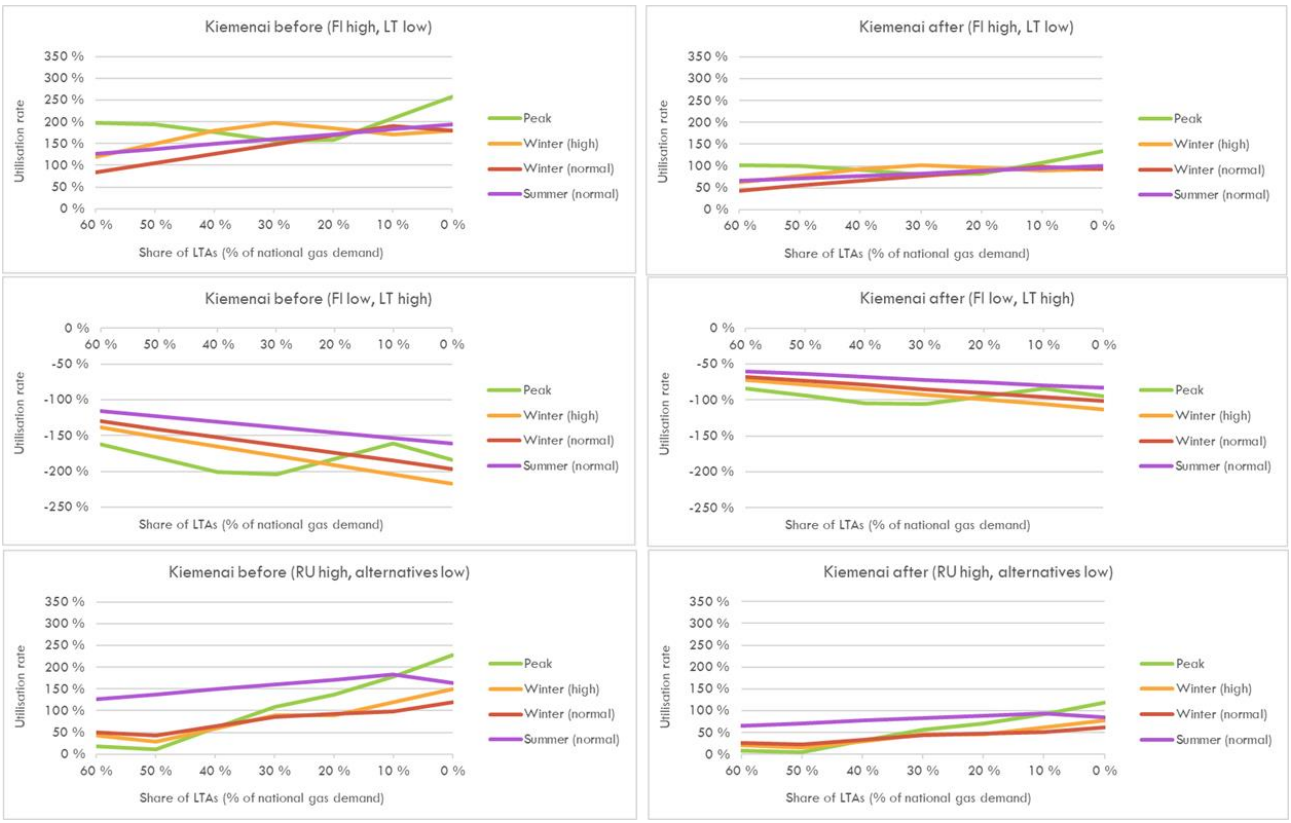


Figure 9. Utilisation rate of Kiemenai cross-border point in full market merger

As indicated above, Kiemenai would be severely congested in the price scenario 'FI high, LT low' before Karksi and Kiemenai investments. The costs of locational balancing related to this are dependent on the share of long-term agreements as visualised in Figure 10 below. The annual cost of locational balancing would be 11.7 MEUR per year at 60% but would increase to 45.5 MEUR per year at 30% share of LTAs.

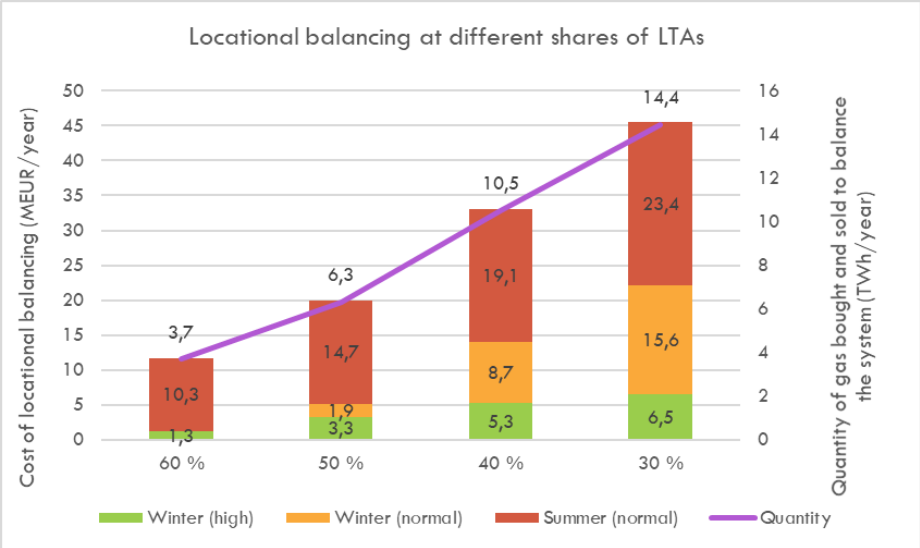


Figure 10. Annual costs of locational balancing at different shares of long-term agreements on Russian pipeline gas if full market merger is carried out before Karksi and Kiemenai investments in price scenario 'FI high, LT low'. These costs can be avoided after the Karksi and Kiemenai investments.

A full market merger would not be financially viable in price scenario 'FI high, LT low' before investments in Karksi and Kiemenai as demonstrated in Figure 11. This is because the direct costs of locational balancing outweigh the benefit of full market merger in comparison to a common tariff area. It should also be noted that this calculation still ignores the indirect effects of locational balancing actions on the market such as increased volatility of short-term market prices, higher risk margins in bilateral contracts and reduced availability of transportation capacity to the market.

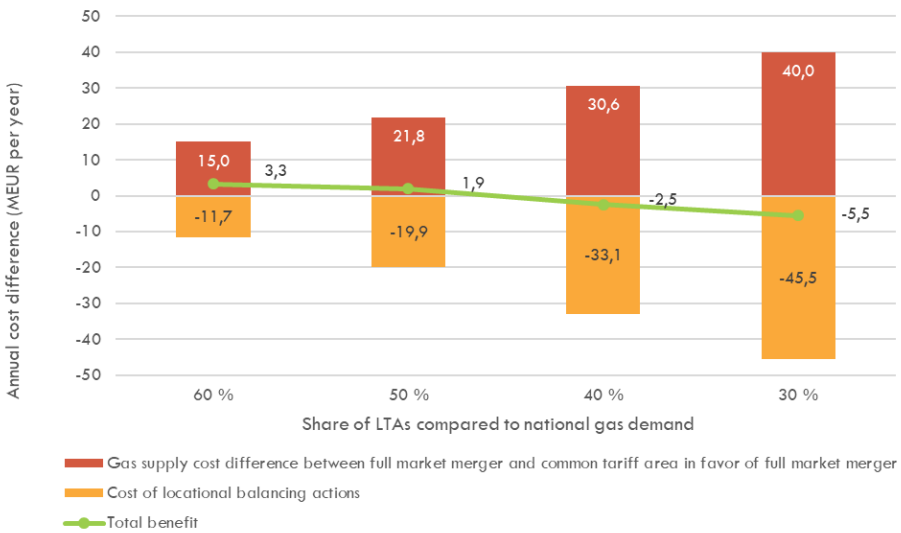


Figure 11. Impact of locational balancing actions on the benefit of full market merger before Karksi and Kiemenai investments under price scenario 'FI high, LT low'

After Karksi and Kiemenai investments, the price scenario 'FI high, LT low' will lead to equal results regardless of the market model at shares of LTAs above 30%. If the shares of LTAs fall below 30%, there would be a need for locational balancing with minor costs in the full market merger in wintertime. The benefit of full market merger would still outweigh these costs. This implies that a full market merger could be more beneficial for the market than a common tariff zone provided that the full market merger is carried out using effective market processes, cost-efficient IT solutions and effective cooperation between the TSOs and NRAs for the market management.

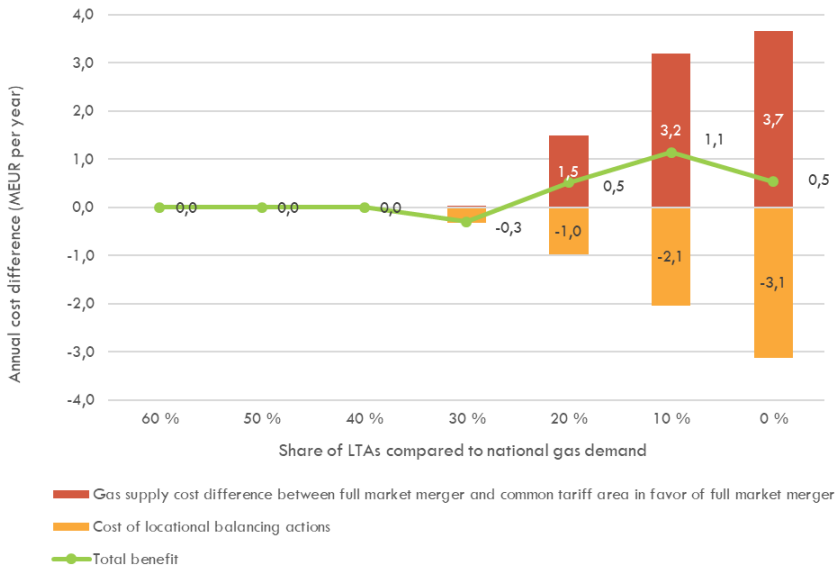


Figure 12. Impact of locational balancing on the benefit of full market merger after Karksi and Kiemenai investments in price scenario 'FI high, LT low'

As discussed earlier in this report, the 'FI low, LT high' represents a risk scenario. This is illustrated in Figure 13, where the benefits of full market merger are cancelled out by the costs of locational balancing. This demonstrates how sensitive the results are for the price differences between the countries. The need for locational balancing actions should therefore be considered as a factor that requires active risk management regardless of the timing of the Karksi and Kiemenai investments.

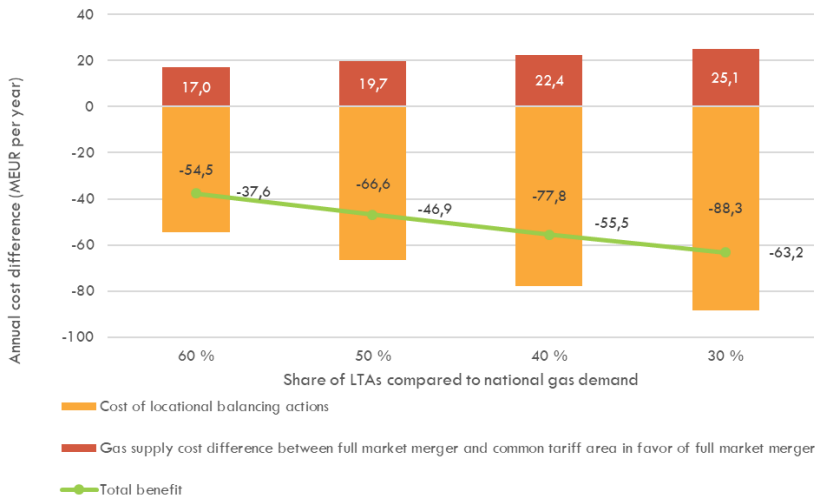


Figure 13. Impact of locational balancing actions on the benefit of full market merger before Karksi and Kiemenai investments under price scenario 'FI low, LT high'.

The results of a potential full market merger only between Finland, Estonia and Latvia before Karksi and Kiemenai investments are presented in Annex 3. The results leave the conclusions unaffected.

5 Conclusions and recommendations

In the price scenario 'FI high, LT low', there would be no need for locational balancing after Karksi and Kiemenai investments if the share of LTAs remains above 30% per country throughout the year. For this reason, **a full market merger could be beneficial for the region only after the Karksi and Kiemenai investments whereas a common tariff area is recommended as soon as possible**. Both models require an inter-TSO compensation agreement to be concluded between all the four countries. In addition, **a full market merger should be implemented and operated very effectively for its benefits to outperform that of a common tariff area.** This is because both models will lead to the same gas supply costs due to no congestion. Consequently, a full market merger is more sensible than a common tariff area only if it can be shown that the development project is efficient, market processes are lean, there are clear savings from IT and personnel costs, and the market development and management are more effective than in a common tariff area. This requires time for the design and implementation of the full market merger according to the objectives and design factors presented in Section 3 of this report. Timewise, it would already be a challenge to achieve full market merger between the four countries by the end of 2023.

In the price scenario 'FI low, LT high', the high costs of locational balancing cannot easily be avoided in the case of a full market merger. **It is therefore imperative that the NRAs and market participants are publicly made aware of this issue** so that the consequences of this risk are properly acknowledged before a decision is made on potential full market merger. Furthermore, **the NRAs and market participants should be made aware of the potentially large share of locational balancing service contracts in relation to the total market size** which is likely to impact the overall functioning of the gas market. This is due to balancing service providers being prepared to transport significant quantities of gas either in or out of the system on a short notice, which leads to a) sudden and significant changes to the availability of gas to the short-term market, b) higher risk margins applied to all gas supply contracts and c) a large share of import and export capacities not being available to the market. Acknowledging this will help the market participants not only to

understand the associated risks but also to minimise the probability for these with their own behaviour in advance.

From a risk management perspective, it should be noted that in the case of a full market merger, risks for physical congestion and the related locational balancing actions **can effectively be controlled by taking capacity allocation procedures back into use** in Balticconnector, Karksi and/or Kiemenai if necessary. This concerns especially Balticconnector in the direction of gas flows from Finland to the Baltic States, whereas the risk for congestion in the Karksi and Kiemenai points will effectively end in 2024. Other methods how to control the flows could include, e.g., the introduction of capacity products with restricted allocability. This means that TSOs would restrict the availability of freely allocable capacity to quantities for which the cross-border transportation can be guaranteed. The drawback of this is that it could discriminate between importers based on their specific import route even though the cross-border points between the Baltic States and Finland are two-directional and there might be several import routes to one country. For this reason, it may be more convenient to control the availability of capacity directly in the respective cross-border points rather than in specific entries. Consequently, **the appropriate risk management measures and their application should be designed in detail** to ensure the welfare gains and non-discrimination. The NRAs and market participants should also be made aware of the possible back-up plans if there are challenges with locational balancing.

In this report, we have not assessed the financial costs and benefits of the harmonised market processes and IT systems supporting them. Such an assessment would require **a comparative study between a) the harmonisation of only balancing rules and the related processes and b) harmonisation of both balancing and transmission rules and processes at the same time with alternative IT set-ups.** The costs and benefits of the alternative IT set-ups should be estimated since each country may have a different starting point for this from the stakeholders' and TSO perspectives. The further harmonisation of market rules, processes and common IT platforms or interfaces may be beneficial even without a full market merger or common tariff area.

Finally, there is a trade-off between using resources and time for further analyses and directly selecting one target design for implementation. For this reason, **the stakeholders should be given a chance to express their opinion on the alternative market designs with their implications laid out** while the final decision should be made at the NRA level.

5.1 Limitations due to the modelling method

In our analysis, the modelling considers cross-border capacities and the country of location of each entry and exit point, while other characteristics of the physical network are ignored. Hence the actual day-to-day operation is likely to be more restricted than what is presented in this report. In addition, the **impacts of planned or unplanned capacity restrictions due to maintenance or failures have not been considered**.

The calculated flows reflect a single day per each demand scenario. For simplicity, these daily results are multiplied by a selected number of days to represent longer-term averages. More flow scenarios could be calculated to refine the results (up to full 365 days per year).

Gas prices are set constant for each entry and exit point throughout the year even though the prices typically are lower in summertime than in wintertime. The financial results thereby reflect the effect of price

differences rather than absolute prices. We have not investigated how sensitive the financial results are to changes in the absolute or relative gas prices.

In reality, the portfolios of each shipper consist of multiple fixed and flexible gas contracts with different prices that may be fixed or indexed to certain gas hubs/exchanges or other energy commodities. In addition, the market participants manage uncertainty over the prices and quantities by using a selected risk management strategy. In contrast to this, the optimisation algorithm used in this report assumes perfect knowledge of the prices and demand and minimises the supply costs in favour of the overall welfare in the four countries together. In this respect, the optimisation model represents an ideal case whereas the real market behaviour is not as efficient.

From the above limitations it follows that, if there is a need to study the sensitivities further, the cost-benefit analysis should be continued using a commercial gas market model. This would enable the use of market price forecasts as input and modelling the market evolution over time under more detailed assumptions.

5.2 Revisit to design alternatives in the RGMCG Roadmap

As a revisit to the introduction of this report, the alternative market designs referred in the original RGMCG Roadmap are linked with the cases covered in this report in Table 6 below.

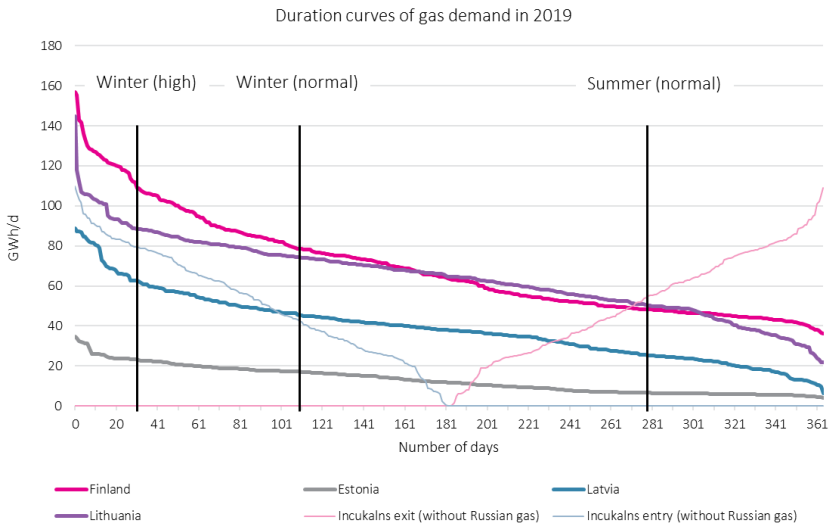
Table 6. Alternative market designs in the RGMCG Roadmap vs. cases covered in this report

RGMCG Roadmap	In this report	Main findings
Alternative 1. Joint tariff and balancing zone FIN-EST-LAT-LIT 2022	Full market merger before Karksi and Kiemenai investments	Not cost-effective
Alternative 2. Joint tariff and balancing zone FIN-EST-LAT 2022	Full market merger between Finland, Estonia and Latvia before Karksi and Kiemenai investments (see Annex 3)	Not cost-effective at least before Karksi and Kiemenai investments
Alternative 3. Joint tariff area FIN-EST-LAT-LIT 2022, joint balancing area FIN-EST-LAT 2022 as an intermediary towards joint balancing for FIN-EST-LAT-LIT in 2024 after ELLI project completion	The case above plus full market merger after Karksi and Kiemenai investments	Not cost-effective
Alternative 4. Joint tariff area FIN-EST-LAT-LIT 2022, joint balancing area for FIN-EST-LAT-LIT in 2024 after ELLI project completion without Finland joining the balancing area in 2022	Common tariff area before and full market merger after Karksi and Kiemenai investments	Cost-effective if the full market merger is implemented, operated and managed more effectively than a common tariff area (since both models result in the same supply costs to the region)
Alternative 5. Possible other identified process of analysis and based on ITC negotiations	Common tariff area before and after Karksi and Kiemenai investments	Cost-effective if full market merger would not be implemented, operated and managed more effectively than a common tariff area (since both result in the same supply costs to the region)

Annex 1. Input data to flow scenarios

National demand and Inčukalns entry and exit

Input values for national gas demand and entry from and exit to Inčukalns gas storage facility are based on data in 2019 as shown below.



	Day*	Demand in Finland	Demand in Estonia	Demand in Latvia	Demand in Lithuania	Inčukalns exit	Inčukalns entry
Peak		190	40	104	129	0	160
Winter (high)	30	112.0	23.4	67.2	88.9	0	81.3
Winter (normal)	110	78.6	17.2	47.3	74.3	0	42.3
Summer (normal)	280	48.2	6.5	21.4	50.3	55.2	0.0

* Number of day in duration curve

Prices of gas at entry points and GIPL exit point

Prices of gas at entry points and GIPL exit point are shown below.

Border point	FI high, LT low EUR/MWh	FI low, LT high EUR/MWh	RU high, alternatives low EUR/MWh	Other EUR/MWh
Imatra	23.0	19	23.0	23.0
Hamina	23.5	18.9	22.0	23.0
Värska	22.5	20	23.1	23.0
Luhamaa-Korneti	22.0	20	23.0	23.0
Kotlovka	21.0	21	22.2	23.0
GIPL	17.5	21.5	22.0	22.0
Klaipeda	17.0	20	21.0	21.0
Inčukalns	18.0	19	21.5	21.5

Transmission capacities

Technical capacities used for the system entry and exit points are shown below in the situation after Karksi and Kiemenai investments. Positive values in the 2-way cross border points mean capacity from the South to the North and vice versa. For example, in Kiemenai the maximum capacity of 130.5 GWh/d means maximum capacity from Lithuania to Latvia and -119.5 GWh/d means maximum capacity of 119.5 GWh/d from Latvia to Lithuania.

Border point	Max. capacity GWh/d	Min. capacity GWh/d
Imatra entry	249.0	23.6
Hamina entry	20.0	0.0
Balticconnector (2-way)	80.0	-80.0
Värska entry	29.3	5.2
Karksi (2-way) before investments	73	-73
Karksi (2-way) after investments	105.0	-105.0
Luhamaa-Korneti	178.5	14.2
Kiemenai (2-way) before investments	67.6	-65.1
Kiemenai (2-way) after investments	130.5	-119.5
Kotlovka entry	211.2	22.3
GIPL entry	73.7	0.0
GIPL exit	58.3	0.0
Klaipeda entry	122.4	0.0

Annex 2. Methodology to assess the annual cost of locational balancing actions

Phase 1. Annual quantity of locational balancing actions

The annual quantities of locational balancing actions are determined according to the following steps:

1. The flow calculation results of the selected price scenario are used as input for the calculation. The results entail there most likely demand scenarios (Winter high, Winter normal and Summer normal) at different levels of LTAs.

2. The cross-border point, that indicates the most severe congestion according to the results of Step 1, is selected as the congestion point that determines the need for locational balancing actions on both sides of the congested point. For example, this is Balticconnector in price scenario 'FI low, LT high' while it is Kiemenai in price scenario 'FI high, LT low'.

3. The required quantities of locational balancing actions are then calculated for each demand scenario by deducing the technical capacity of the congested point from the respective commercial flows calculated in Step 1. The technical capacity is considered in the same direction as the commercial flows. At this point the results are in unit GWh/d per demand scenario.

4. If the resulting quantity is positive, this quantity of gas needs to be sold via locational balancing action in the southside of the congested point and bought in the northside. If the resulting quantity is negative, the respective quantity of gas needs to be bought via locational balancing actions in the southside of the congested point and sold in the northside.

5. The estimated quantities per demand scenario in Step 3 are multiplied by different numbers of days and summarised to represent the annual quantities as follows:

    - Quantity calculated for 'Winter high' is multiplied by 31 days,
    - Quantity calculated for 'Winter normal' is multiplied by 152 days, and
    - Quantity calculated for 'Summer normal' is multiplied by 182 days.

Phase 2. Price of locational balancing actions

The price of locational balancing actions is assumed to be +/-5% compared to the price of gas in the nearest entry point of Russian pipeline gas in the selected price scenario. This means that the costs for TSOs to buy gas is 5% higher and the revenue from selling the gas is 5% lower than the price of Russian pipeline gas (EUR/MWh) at the physically closest entry point of Russian gas in the price scenario.

Phase 3. Annual cost of locational balancing actions

The annual quantities are finally multiplied with the price difference between the sell and buy prices determined in Phase 2. All the results are calculated at different shares of LTAs. This is done to highlight the sensitivity of the locational balancing costs to the shares of the LTAs.

Annex 3. FIN-EST-LAT in a full market merger and LIT in a common tariff area in 2022

If Finland, Estonia and Latvia established in a full market merger and Lithuania were to join a common tariff area before Karksi and Kiemenai investments, this would lead to a lower need for locational balancing than a full market merger between all the four countries. The scenario 'FI low, LT high' continues to be a risk scenario. According to scenario 'FI high, LT low', the full merger of three countries before Karksi and Kiemenai investments provides no additional benefit in comparison to that of a common tariff area at shares of LTAs higher than 30%.