

# Future Outlook and Current Situation for Security of Gas Supply in Eastern Baltic Region

Ando Leppiman, Kati Kõrbe Kaare, Ott Koppel

**Abstract**—Growing demand for gas has rekindled a debate on gas security of supply due to supply interruptions, increasing gas prices, cross-border bottlenecks and a growing reliance on imports over longer distances. Security of supply is defined mostly as an infrastructure package to satisfy N-1 criteria. In case of Estonia, Finland, Latvia and Lithuania all the gas infrastructure is built to supply natural gas only from one single supplier, Russia. In 2012 almost 100% of natural gas to the Eastern Baltic Region was supplied by Gazprom. Under such circumstances infrastructure N-1 criteria does not guarantee security of supply. In the Eastern Baltic Region, the assessment of risk of gas supply disruption has been worked out by applying the method of risk scenarios. There are various risks to be tackled in Eastern Baltic States in terms of improving security of supply, such as single supplier risk, physical infrastructure risk, regulatory gap, fair price and competition. The objective of this paper is to evaluate the energy security of the Eastern Baltic Region within the framework of the European Union's policies and to make recommendations on how to better guarantee the energy security of the region.

**Keywords**—Security of supply, supply routes for natural gas, energy balance, diversified supply options, common regulative package.

## I. INTRODUCTION

WHEN the totalitarian system disintegrated, Baltic States, like other Central and Eastern Europe countries that had been controlled by the Soviet Union, received as an “inheritance” a considerable dependency on oil and natural gas imported from Russia [1]. During the past decade, the European Union (EU) has gradually recognized the strategic importance of eliminating Baltic “energy islands” [2].

EU energy policy now aims to couple Baltic natural gas networks with those of their EU allies in pursuit of creation of a single unified energy market in Europe. Cooperation in the framework of Baltic Energy Market Interconnection Plan (BEMIP) between eight Baltic Sea EU Member States is being carried out and a Memorandum of Understanding with an Action Plan was signed on 17 June 2009.

In June 2006, Russian federal law legalized the exclusive right of Gazprom to export natural gas to Europe, and thus thwarted efforts by the EU to bring competition to the Russian gas industry [3]. An understanding of the motivation of the Russian government to support this export monopoly is important if Europe wishes to reduce its dependence on Gazprom. Concurrently, as part of its strategy to diversify its

own energy, the EU has sought competition in the Russian natural gas market. The Russian-Ukraine gas price conflict from 2006 to 2009 clearly demonstrated the vulnerability of Europe to the use of market power by Gazprom in the European gas market [2], [4].

This acceptance of Gazprom's monopolist tactics left much of Europe without diversified supplies of natural gas and therefore, without a genuine market. Instead of enjoying lower prices determined by market forces of supply and demand, Europe accepted Gazprom's insistence on pegging the price of gas to that of oil. This resulted in European consumers paying three to four times more than their counterparts in the USA, where prices are determined by market forces at trading hubs in the world's most liquid natural gas market [2].

Gas supply security makes a constituent part of the national security. Safeguarding of a stable supply of energy for the alliance member states is a strategic task of the NATO. The Russian company Gazprom is main natural gas supplier of all three Baltic States and Finland. The Government of Russia exercises a significant influence on the activities of the largest company in the country at the same time availing of gas supply issues for the achievement of its political goals.

Recently, the issues of supply of energy and resources have become the key axis of the development of relations between the EU and Russia. Taking into account a solid dependence on the Russian gas (25% of the EU consumed gas is supplied from Russia) and application of policy of gas supply discontinuation for transit countries by Gazprom since 2004 (under direct participation of the superiors of the Russian Government) economic and political reasons have become even closer related to gas supply reliability.

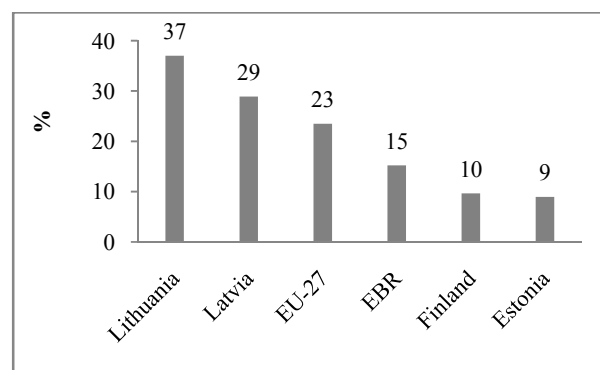


Fig. 1 Share of natural gas in primary energy consumption, 2011 [5]

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The objective of this article is to evaluate the energy security of the Eastern Baltic Region (EBR) within the

framework of EU's policies and to make recommendations on how to better guarantee the energy security of the region.

The Baltic States rely on several types of energy production. During recent recession years, the effects of the global economic downturn has resulted in lower energy consumption than in previous years, but industry experts believe that the pre-crisis demand levels will be restored within the next five years.

The role of gas in these countries is, however, different. While the share of gas in the total energy mix of Lithuania and Latvia is around 30% (2011 37% in Lithuania, 29% in Latvia respectively), in Estonia it is 9%. In Latvia 45% of electricity was generated from gas in 2010 and Latvenergo, the biggest consumer, accounted for 0.6 billion m<sup>3</sup> of consumption (Fig. 1).

## II. PROBLEM FORMULATION

### A. Single Natural Gas Supplier Risk

Since the Baltic States and Finland are receiving gas only from Russia and no other supply option is available there, commercial disputes may arise regarding gas purchase price and other conditions of gas supply agreement (e.g. take-or-pay). For countries that have diverse supply sources by pipeline or liquefied natural gas (LNG) terminals, it is much easier to agree on more favorable commercial conditions. Unbeneficial commercial conditions due to relatively high gas prices in the case of the Baltic States and Finland give competitive advantage to other fuels.

The supply situation in Latvia and the entire EBR differs from the situation in the rest of the EU. Natural gas is stored to Inčukalns gas storage during summer and used during winter to cover main supplies in the region. That makes Latvia and the entire EBR very dependent on the technical integrity of this storage.

Gas supply to Lithuania normally only takes place via a pipeline from Belarus. The country is hence exposed to events in Russia as well as in Belarus. Only small volumes of gas can be supplied from the gas storage in Latvia. Major volumes of gas are supplied in transit to Kaliningrad, which gives a more balanced situation in respect to political and commercial risk for a gas supply disruption from Russia, but not for technical risk or transit risk in Belarus.

Gas supply to Estonia takes place mainly *via* one pipeline. The older pipeline directly from St. Petersburg is not normally used. Gas can be supplied from the gas storage in Latvia.

Gas supply to Finland takes place via two parallel pipelines from Russia. No storage is available and security of supply is mainly achieved by the possibility of dual fuel usage by end-users. The supply situation in Finland is exposed to a situation where the country is located supply wise after large consumption centers like St. Petersburg and from 2011 and 2012 the first and second Nord Stream pipelines.

It is therefore assessed that the security of supply to Finland may be impacted with new supply sources from Shtokman and Siberia on the one hand and new outlets on the other. Furthermore when evaluating security of supply it is important

to keep in mind that security of gas supply and security of energy supply may differ, for example a considerable share of consumers in Finland are able to switch to other fuels in the event of a supply disruption.

Natural gas share has been low in total energy balance in Estonia. On the other hand, Latvia and Lithuania are lacking domestic resources and therefore natural gas supplied from Russia has reached to critical share in their energy balance. In Finland, gas share in total energy balance is still in the acceptable range but substantial increase of natural gas price is one of the drivers of Finnish negative foreign trade balance in recent years, as during the period from 2002 to 2012 Finland energy products import/export balance has dropped from around -2.5 billion Euros to around -7.5 billion Euros. Finland imports 71% from its energy from Russia, prices of energy products are more than doubled during past decade.

In order for competition to develop, there need to be competing gas sources supplying the wholesale market and a number of companies that compete in the end user market. A competitive market will drive desirable behavior from the market participants [6].

Suppliers to consumers will develop innovative products and services tailored to customer requirements to incentivize customer switching and all will aim to maximize the efficiency of their operations by optimizing their business structure. This should lead to benefits for consumers resulting in efficient gas prices linked to supply/demand fundamentals, increased consumer choice, higher quality of service, improved security of supply, better consumer protection and access to innovative products that are tailored to specific consumer needs [6].

It is widely accepted that in order for gas market liberalization to deliver benefits to end consumers it will be necessary for competition in gas supply sources to be established. The most likely form of an alternative supply source to the gas market will be via the delivery of LNG into the market. However, critical to this is whether access to the global LNG market will bring benefits to the gas market as compared to the current situation, whereby gas prices are linked to oil products. Whilst there are clear benefits to improving security of supply through introducing a second source of gas to a market, the potential impact on the price of gas also has to be considered [6].

The development of the global LNG market in recent years has opened up the European gas market, once dependent on indigenous gas and imports through pipelines, to a more international market. Europe now competes with the US and Asia for LNG supplies. The liberalized gas markets of Europe are now supplied by a combination of indigenous supplies and imported gas via both pipelines and LNG [6], [7].

Historically gas import prices from Russia have been subject to the principle known as netback gas price (Fig. 2). The principle bases the gas price in a geographical location on the price of competing fuels at the market center minus the transportation costs of the gas. In recent years Russia has been abandoning the principle of netback pricing and has started applying a "common" gas import price for the entire EU.

However the idea of netback prices still allows us to evaluate the value of the gas at different points in the system, due to varying transportation costs. Any large scale export project, pipeline or LNG terminal, with low transportation costs from

North-West Russia to North-West Europe could thus potentially have an impact on future gas prices in the EBR through gas contract renegotiations.

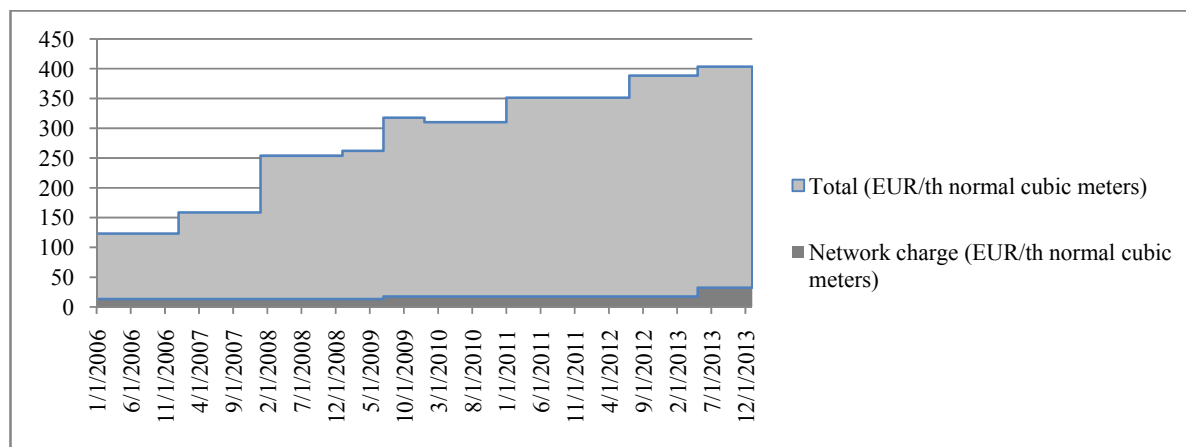


Fig. 2 Price of gas for end consumers: the example of Estonia [8]

Gas prices between the Baltic countries, Finland and the EU gas market are converging, due to a change in pricing regimes. This increases the incentive for investment and makes diversification of gas supplies increasingly economically viable for the Baltic countries and Finland. This increases the economic viability of LNG imports, as well as other pipeline imports, considerably.

However the specific contract, which can be negotiated with the LNG supplier, will to a large extent, determine how competitive LNG exactly will be compared to Russian pipeline imports. Furthermore, the convergence of prices and the potential implementation of new large scale transportation projects, puts added emphasis to the fact that additional gas supplies and integration of these isolated gas markets has to be secured in order not to only increase security of supply and competition, but also in order to ensure a level playing field when gas import contracts are due for renewal.

Interconnection of the Baltic Sea region will open further long term investments and provide a more direct supply. It is also prudent to remember that the overall gas balance in the region is related to the development of the Russian gas system [9].

### B. Security of Supply

The general perception by operators of a potential future disruption leads to panic buying even when supply and demand are apparently in balance. The result is sharp price rises, which directly affect business costs and the purchasing power of private consumers [10]. The instability of energy supplies may also cause serious social disruption.

Today, energy is vital for the functioning of the economy, and any disruption of supply is likely to lead to social demands, and possible social conflict. Lastly, there are many environmental concerns about damage to the ecosystems caused by the energy chain, whether accidentally (oil spills,

nuclear accidents, methane leaks) or as a result of polluting emissions (urban pollution and greenhouse gas emissions) [5].

Security of supply (SOS) is defined mostly as an infrastructure package to satisfy N-1 criteria [11]. But in case of Estonia, Finland, Latvia and Lithuania all the gas infrastructure is built to supply natural gas only from one single supplier, Russia, currently Gazprom. So security of supply should be defined differently in such single supplier set-up, and interruption of physical natural gas as product supply should be taken into account. This has been the main concern of Baltic States and Finland and therefore restrained measures to increase the natural gas demand.

SOS is one of the main objectives of EU energy policy [12]. Energy security is defined as the availability of regular supply of energy at an affordable price. From a European perspective, energy security is most often discussed in terms of SOS, in other words with reference to the avoidance of sudden changes in the physical availability of energy relative to demand [5].

If commercial energy services and electricity are available, income is the main factor that appears to influence a household's choice of fuel. The measures of SOS can be grouped into two categories: dependence, and vulnerability, represented both in physical and economic terms. Physical measures describe the relative level of imports or the prospects for shortages and disruptions. Economic measures describe the cost of imports or the prospects for price shocks [12].

The recent developments in the energy markets have heightened concerns about the feasibility of supply security, usually defined as a continuous availability of energy at affordable prices. EU countries buy more than half of their energy from non-EU sources. Since the demand for energy is growing in the EU, dependence from foreign suppliers will increase over time [12].

In accordance with the Organization for Economic Co-operation and Development (OECD), European countries are

importing more energy products. As a result, external energy dependence for all sectors of the economy is constantly increasing, especially for oil and natural gas. For the future, it is vitally important to be able to implement measures that will allow an orderly and effective response to the threat from energy insecurity [12].

According to the EU Regulation concerning measures to safeguard security of gas supply [13] the N-1 criterion means assessment of the situation in the event of disruption of the single largest gas infrastructure delivery connection. If in the event of interruption it is possible to rearrange deliveries without any supply disruption, the N-1 criterion is met [14].

Based on the calculations in the Joint risk assessment of security of gas supply of Estonia, Latvia and Lithuania 2012 the infrastructure standard N-1 for Estonia was 59.7%, for Latvia - 153.9% and for Lithuania – 27.4%. It means that in the event of a disruption of the single largest gas supply infrastructure only in Latvia the capacity of the remaining infrastructure is able to satisfy total gas demand of the country during a day of exceptionally high gas demand statistically occurring once every twenty years.

Considering all three countries as a whole in the event of a disruption of the single largest gas supply infrastructure - natural gas supply line Minsk–Vilnius, the infrastructure standard N-1 was 129.7% [15].

On 7 November 2012 Estonian transmission system operator EG Võrguteenus presented, that in accordance with the latest calculations N-1 criteria for Estonia is fulfilled due to the increased pressure after the reconstruction works in Russia in the pipeline St. Petersburg–Narva. As previously the pressure in that pipeline was 20-22 bar, then after reconstruction works the pressure have been increased to 28-29 bar and due to that 3 million m<sup>3</sup> gas can be imported per day through this connection as well [16].

So the newly calculated N-1 criterion for Estonia is therefore (1):

$$N - 1[\%] = \frac{14+0+0-7}{6,7} \times 100 = 104\% \quad (1)$$

Although infrastructure standard N-1 calculations show that in the event of the largest capacity disruption the capacity of the remaining infrastructure should be able to satisfy total gas demand, response scenarios demonstrate that there will be gas shortage in the region due to internal cross-border bottlenecks. The main bottlenecks in the system are the capacity of meter stations on the borders as well as the Inčukalns underground gas storage facility (UGS) send-out capacity in the spring [14].

### C. Risks Assessment

In Baltic States, the assessment of risk of gas supply disruption has been worked out by applying the method of risk scenarios. Three types of scenarios were drawn up [15]:

- risk causality scenarios;
- risk impact scenarios;
- response scenarios.

Each of the risk scenarios has its own function in the description and evaluation of the risk of gas supply disruption.

Risk causality scenarios serve to describe the possible ways of errors that lead to a gas supply disruption. These scenarios also feature safety barriers designed to interrupt the development of errors by preventing them to cause the unwelcome basic event. Based on the risk causality scenario, it is possible to calculate the overall probability of the unwelcome event as well as to describe the impact of each identified error on the overall probability of the event.

The task of a risk impact scenario is to describe the variety, scope, gravity and area of influence of potential consequences of the unwelcome event if it occurs. The risk assessment features a description of the reasons of gas disruption and the impact of their consequences in each of the Baltic States, breaking down into three levels - local, national and regional scale.

Response scenarios, for their part, reveal the capability of the system to react properly in the cases of a variety of unwelcome events.

The matrix of Baltic gas supply disruption risk provides a summary of all results of the Baltic States gas supply risk assessment (Table I). In the case of a gas supply disruption, the Baltic States' gas supply companies practically do not suffer direct losses as, depending on the direction of the supply disruption, changes are made in the operation of the Baltic States' gas supply systems. While gas supply issues are being solved, the continuity of gas supply in the Baltic States will be ensured by the gas reserves accumulated at the Inčukalns UGS.

The calculation of losses in the event of gas disruption should be linked to gas consumer groups. Households using gas for cooking only are practically unaffected by a brief gas disruption. Major heat supply companies should have a backup fuel, which would enable them to keep operating during gas supply disruptions. The highest losses would be those of medium production and heat supply companies without a backup fuel.

The amount of losses for this group will be determined by the costs of unrecoverable materials incurred by interrupted operation. Gas supply accidents may harm the nature and threaten human lives. There will be more harm to the nature if the accident occurs in ecologically sensitive environment or in a restricted area.

## III. SOLUTIONS

### A. TEN-E Priorities and Proposed Actions for EBR

According to the TEN-E Guidelines [13] the Community shall promote the interconnection, interoperability and development of trans-European energy networks and access to such networks in accordance with Community law in force with the aim of:

- a) encouraging the effective operation and development of the internal market in general and of the internal energy market in particular, while encouraging the rational production, transportation, distribution and use of energy resources, so as to reduce the cost of energy to the consumer and contribute to the diversification of energy

- source;
- b) facilitating the development and reducing the isolation of the less-favored and island regions of the Community, thereby helping to strengthen economic and social cohesion;
- c) reinforcing the security of energy supply, for example by strengthening relations with third countries in the energy sector in the mutual interest of all parties concerned, in

- particular in the framework of the Energy Charter Treaty and cooperation agreements concluded by the Community;
- d) contributing to sustainable development and protection of the environment, inter alia by involving renewable energies and reducing environmental risks associated with the transportation and transmission of energy.

TABLE I  
MATRIX OF BALTIC GAS SUPPLY DISRUPTION RISK [15]

Probability	Negligible risk	Substantial risk	Medium risk	High risk	Very high risk
Very high Once a year and more often	Repairs of gas supply infrastructure				
High Once in 1-15 years		Accident on a gas pipeline branch-off to any gas regulation station (GRS) in the Baltic States. Gas transmission pipeline (GTP) accident in the territory of Estonia	Technical accident on GTP Izborsk-Pskov. GTP accident in the territory of Lithuania	Suspended gas supply from Belarus to Lithuania. GTP accident in the territory of Latvia	
Medium Once in 16-50 year		Accident at any GRS in the Baltic States		Inčukalns underground gas storage facility (UGS) fails to supply the required gas volume	Gas supply from Russia to the Baltic States is suspended
Low Once in 51-100 years		Accident at any technological gas equipment of Inčukalns UGS		Technical accident on GTP Kotlovka-Minsk	Accident on GTP section Riga-Iecava
Very low Once in more than 100 years				Large-scale accidents at Inčukalns UGS	Simultaneous technical accidents on GTP Izborsk-Pskov and Kotlovka-Minsk

Political and strategic actions on intergovernmental level as well as legislation and regulatory actions in the EBR ensure the effective operation and development of internal gas market.

The EU gas market directive cannot be fully functioning before all member states are connected to the integrated system. To facilitate the development and reducing the isolation the Baltic Region has been identified as the first of six major sets of infrastructure projects. The integration of the Baltic States into EU energy networks is seen as one of the main objectives that will contribute to the stability and economic growth of the EBR. This view is also shared by the Council which clearly endorsed this in its conclusions of the European council of October 2008[17].

In order for competition to develop, there need to be competing gas sources supplying the wholesale market and a number of companies that compete in the end user market [17]. A competitive market will drive desirable behavior from the market participants. Security of supply is relatively low in most of the countries in the EBR due to lack of inter-connection and only one main supplier. Furthermore only a few countries have access to underground gas storage and no countries have so far access to any LNG facilities.

One of the aims of the LNG terminal is to supply the shipping sector with LNG as propulsion. It has in earlier studies [18]been shown that this is a cheap and clean way of living up to the Sulphur Emission Control Areas (SECA) requirements.

The access to more competitive gas supplies also provides the power sector with a relevant alternative to more polluting fuels such as oil shale. The share of natural gas in the power

mix in Estonia is only currently below 5% and will only marginally increase until 2030. In comparison, oil and solid fuels is approximately 95% of current power generation. There is a significant potential in changing the fuel source to gas in terms of lower emissions. Oil shale has an emission of 106 kg/GJ and is one of the highest among the primary fuel sources. For comparison gas has an emission of 57 kg/GJ. The saving alone in CO<sub>2</sub> by converting to gas will be at least 540 kg/MWh produced electricity [9].

In addition it will also provide support for further growth in the production of renewable energy such as wind and biomass. Estonia is ahead of their 2015 target for energy from renewable sources. Gas will provide a flexible back-up source of energy for further expansion of renewable energy.

### B. Regulatory Package

Whilst the EU aims to achieve a single energy market, the EBR has remained energy islands regarding the natural gas market. All these countries depend on only one gas supplier and have no pipeline connections with the rest of the Europe.

Also there is no interconnector between Finland and Baltics but the size of separate markets remains unattractive for alternative suppliers and infrastructure developers. Additionally, the incentive to develop new transmission infrastructure is not clearly in place in markets dominated by single supplier controlled vertically integrated gas companies.

Creating an integrated EBR gas market will allow to attract alternative suppliers and thus create competition between suppliers and fair price for consumers. It will also:

- enhance the energy security of the region;
- contribute to the diversification of energy sources;

- enable the energy market to operate efficiently;
- enhance rational production, transportation, distribution and use of energy resources;
- strengthen the economic and social cohesion;
- contribute to sustainable development and protection of the environment [19].

The negative impacts will potentially derive from changes in environment, but can be diminished by adhering to environmental requirements.

All four EBR countries have somewhat different setups and preconditions in terms of regulation and legal framework e.g. Estonia and Lithuania have started the unbundling process, and Latvia has specific conditions regarding its storage. Network tariffs and prices are regulated in all four countries. Even though all four markets are regulated the methodologies which are applied in the various countries, may differ from country to country.

This means that prices and tariffs differ from country to country and thus the economic viability of projects may also change depending on what regulation applies. This may create an obstacle in regards to implementation of cross-border investments, because some investments may be profitable under one set of regulation and not under another. Thus it is vital that rules and legislation are as uniform in all the countries in order to create the appropriate investment climate and in order to ensure the creation of a functioning gas market in the region.

Clear market and infrastructure regulations are preconditions for developing new infrastructure. In EU the harmonization of network codes, including capacity management rules, gas transmission tariffs, entry-exit regimes etc. is a continuing process. For EBR, as a minimum the same rules should apply for Baltic States and Finland.

Financial regulation necessary for developing new natural gas infrastructure investments in East Baltic region should involve the following components (but not only): principles of participation and cost-sharing, harmonized conditions for transparent and non-discriminatory third party access (TPA) to transmission infrastructure, regulation of tariffs, joint natural gas entry/exit model (EEM), capacity management rules, conditions and schedule for creating a regional balancing area.

The prerequisite for the development of regulatory framework is the market analysis with the focus on market and financing issues. Analyses could establish the foundations for integrated natural gas market and could include the following aspects:

- identifying the beneficiaries and benefits of new natural gas infrastructures by member states and consumer groups based on BEMIP's list of projects of common interest;
- estimating the costs of new natural gas infrastructures and their allocation schemes between the member states;
- proposal for signing an Inter-Governmental Agreement on financing and management models for different types of infrastructure (pipelines, regional LNG terminal, underground storage) including financing regulations.

### C. Infrastructure Package

On 14 October 2013, the European Commission has adopted a list of 248 key energy infrastructure projects. These projects have been selected by twelve regional groups established by the new guidelines for trans-European energy infrastructure.

They may also have access to financial support from the Connecting Europe Facility, under which a 5.85 billion Euros budget has been allocated to trans-European energy infrastructure for the period 2014-2020[20].

Amongst others following infrastructure package has been proposed under the BEMIP cooperation by Estonia, Finland, Latvia and Lithuania.

*Enhancement of Latvia-Lithuania Interconnection.* Current capacity (bidirectional) is 5 million m<sup>3</sup> per day, and two upgrades are possible: one would increase the daily capacity to 6 million m<sup>3</sup> per day, while the other one would bring it to 12 million m<sup>3</sup> per day.

*Gas Interconnection Poland-Lithuania (GIPL)* is a 562 km pipeline (211 km in the territory of Lithuania and 351 km in the territory of Poland) with a capacity of 2.3 billion m<sup>3</sup> per year (expandable to 4.5 billion m<sup>3</sup> per year) connecting Warsaw to Vilnius.

*Modernization and Expansion of Inčukalns UGS.* The whole Baltic network is designed to exploit the asset at its best. Hence, with a working gas of 2.3 billion m<sup>3</sup> per year, the gas from Russia is injected during the summer season and is withdrawn during winter season at an average of 24 million m<sup>3</sup> per day. With further investments the working storage capacity could be increased to up to 3.2 billion m<sup>3</sup> per year.

*Finland-Estonia Interconnector (Baltic Connector)* project is a single pipeline linking Inkoo (Finland) to Estonia, with a capacity of billion m<sup>3</sup> per year. Baltic-connector would secure gas provision in case of disruption of gas supply from Russia. It would support Finland in the diversification of the supply sources, in reaching Inčukalns and in gaining access to the European gas network in case other projects (such GIPL or LNG terminal) would be implemented.

*Enhancement of Latvia-Estonia Interconnections.* Current capacity is 7 million m<sup>3</sup> per day, which would be boosted up to 10 million m<sup>3</sup> per day, besides having installed a reverse flow.

*New Regional LNG Terminal.* Different port locations might be eligible for the realization of the LNG terminal: Muuga and Paldiski in Estonia, Riga in Latvia, Inkoo in Finland. Each location proved to consider the major technical issues potentially impacting the terminal effectiveness. According to the analysis by Booz & Company [21] the LNG terminal in Estonia and Finland would grant maximum benefits. The key economic differences lie in the costs of connection from the terminal to the grid, but no agreement has been reached. Attracting a large consensus around a specific project appears to be challenging from a technical, political and economic perspective.

The fact that economics of scale exist for LNG terminal investments, indicates that it is economically optimal not to invest in many smaller LNG terminals but instead only to

invest in one "large" terminal in the EBR. A joint assessment of the required investments shows that Estonia (in particular Paldiski port in case of Baltic connector landing there) is the location that helps minimizing additional investments to connect the terminal to the main transmission system and to equalize benefits of supply diversification and supply security [21].

In accordance with the analysis by Booz & Company the FinGulf LNG Terminal in Finland would bring the same benefit to the region than a LNG terminal located in Estonia. Furthermore, a LNG terminal in Finland has the advantage to be closer to the center of biggest gas consumption in the region, namely Finland. However this consumption is fully covered with supplies from Gazprom and therefore it is unrealistic to expect the real need for LNG in Finland before the maturity of existing take-or-pay contract on 2025 [21].

#### IV. CONCLUSION

There are various risks to be tackled in EBR in terms of improving security of supply, such as single supplier risk, physical infrastructure risk, regulatory gap, fair price and competition.

The EBR is dependent on Russia for gas supplies and this is a major cause of concern of the governments. E.g. Gazprom has significant influence over the gas market; being the sole importer of gas, a major shareholder in the gas transmission system and the largest supplier of gas. The single supplier is free to impose prices and take decisions without the consent of key stakeholders. The single supplier does not have the appropriate incentive to develop sufficient supplies to ensure that there is no interruption of supplies when compared to its other supply obligations to Europe.

Developing a common natural gas market will strengthen economic and social cohesion by reducing the isolation of the less-favored regions of the EU. Increasing competition in the market might reduce gas prices for industry and consumers as well as end the potential threat of continuously increasing gas prices due to monopolistic market and substitution of energy sources. In order for competition to develop, there need to be competing gas sources supplying the wholesale market and a number of companies that compete in the end user market. A competitive market will drive desirable behavior from the market participants.

Opening of the gas market to new companies with the entry-exit model, which eases the introduction of the gas companies and gas dealers to the East-Baltic area independent from the TPA, which will be in parallel to the entry-exit model. Interconnection to Poland as an "energy bridge" creates an access to alternative natural gas market and suppliers as well as brings gas from Poland further to the East Baltic Sea area.

If LNG terminal is considered, the terminal will be probably utilized at 50% of its capacity and Russian contracts might be utilized at minimum quantity intake. The remaining LNG capacity could provide flexibility for peak shaving. The overall importance of gas storages in Inčukalns in order to provide flexibility and to optimize gas systems is of utmost

importance.

A joint implementation of Intrabaltic connections, Baltic connector and GIPL would help the area to achieve some degree of supply diversification (about 33% of "diversified" gas, mainly in Latvia and Lithuania), but the security of supply in Lithuania would only marginally improve. Improving interconnection between the Baltic States may also improve the security of supply position but only if the single supplier risk is also addressed.

So whilst the Estonian regulator has identified the Baltic connector interconnection with Finland as an important part of the solution to this issue, this would only be effective if other developments remove the single supplier risk. To expand supply options and achieve security of supply, an LNG terminal of 4 billion m<sup>3</sup> per year can be considered. This could help to diversify further the Baltic supply mix (circa 60% of Russian gas, 20% LNG, 20% gas imported from European network).

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