Strategy and efficient mechanisms to improve security and sustainability of the natural gas supply in Baltic States

Edvins Karnitis
University of Latvia, LV-1586 Riga, Raina blvd. 19, E-mail: Edvins.Karnitis@sprk.gov.lv

Abstract: Share of natural gas as an efficient resource in the deficient Baltic primary energy balance is and will be significant (power generation, district heating, households, industry, etc.). Therefore gas supply risks are evaluated and appropriate actions are recommended in the paper to assure reliable availability of affordable and sustainable energy in Baltic. Macro-region's base (including supply and transit countries), risk and cost assessments, timely introduction of non-market measures, high cyber security level of information processing and management systems are components of security strategy. Extension of Incukalns UGS, interlinked pan-Baltic LNG receiving terminal and upgrade of transborder trunk pipelines are recommended as the most efficient tools. Complex realization of all instruments and solidarity of countries are the key issues to implement proposed strategy.

Keywords: energy policy, sustainable energy, gas supply, security of gas supply, gas storage, Estonia, Latvia, Lithuania.

1. Introduction: energy policy and energy balance

It is well-known and even self-evident that energy is not only a sector of economy. EU classification, which includes energy supply in services of general economic interest, clearly shows their significance. Energy always has been a category of basic level of Maslow's hierarchy of human needs, particularly for Baltic (the second coldest EU macro-region after Scandinavia). Nowadays sustainable energy supply is becoming a significant (even the most significant) component of national security of any country. At the same time energy security is not a synonym of energy independence, natural or closed economy is not a today's model.

Therefore increasing regulation of processes in energy sector in interests of society is going on worldwide including EU (e.g., recently approved normative acts EC 2009a, EC 2009b, EC 2009c, EC 2010b).

To achieve adequacy of regulatory activities with current political, economic and social situation, EU energy policy is based on three closely interlinked pillars (fig. 1a), sustainability and security of supply are among them. An indicative feature in the previous years (EC 2008) – understatement of energy costs; competitiveness, of course, includes cost issues, but this was not a primary issue for welfare Western society. At present EU energy policy is updated (EC 2010a) in accordance with current global economic situation. There is pointed that prices for energy products and services should be affordable for all consumers; the policy model is slightly modified to increase significance of energy costs in the energy policy (fig. 1b); such shift relates also to energy security costs.

Fig. 1 here

Policy of Baltic States really all the time was more consistent with the modernized policy model; energy costs have been much more significant for society and business due to economic situation.

An important priority of the updated energy strategy is turning towards much more general accent on low carbon energy (instead of swift development of renewables only) due ongoing economic crisis and necessity to invest in recovery and jobs on one hand and too slow global progress in climate matters (low willingness of US, China, Russia, etc.) on the other hand. According to this objective natural gas as the economically efficient and comfortably usable energy source, as the fuel, which CO_2 emission is only 60% of wood and 51% of coal emission, as a backup for renewables "will continue to play a key role in the EU's energy mix in the coming years" (EC 2010a), thereby balancing affordability and environmental demands.

Share of natural gas in EU primary energy balance currently is significant (power generation, district and local heating, industry, households), nevertheless it is far from dominant position (fig. 2). Proportions in Latvian and Lithuanian balances are quite similar (here and further statistical data of Eurostat are used), in Estonian balance it is much smaller (due to Estonians own oil shale). All energy mixes are quite balanced (Kaderjak P. *et al* 2007); Herfindahl-Hirschman Index for the EU energy balance was 2452, for the Latvian balance – 2683 in 2009. But gas consumption per capita in Baltic States remains significantly lower than in EU – only 44% of EU27 level in Estonia, 58% in Latvia and 70% in Lithuania (2009). One can see that populist expressions like "Baltic is sitting on Russian gas needle" are without any factological basis.

Fig. 2 here

Future expectations on the EU gas market development are very different (instabilities of crisis time), even up to 32% share in energy balance in 2020. Baseline scenario (EC 2010c) shows 7-12% increase till 2020 in Estonia and Latvia, but much more in Lithuania (more than 40% increase) that is related with replacement of nuclear energy, especially in mid-term. Liquefied natural gas (LNG), unconventional and deepwater gas consolidate conventional gas sector. In any case gas sector will be with strategic significance for both EU and Baltic economy and social life.

At the same time EU gas import dependency is high (more than 60%); in any scenario it will increase (up to 85% in 2030). Hence importance and actuality of the security of gas supply (SoS) problem.

Accept of special EU Regulation (EC 2009c) was intensified by recurrent gas crises (2006, 2009) due to disputes between Russia and Ukraine. But it is impossible to solve the problem by activities in consuming countries only, without strong partnership with supply and transit countries. Exactly for this reason

strengthening the external dimension is one more priority of the updated EU energy strategy.

2. Baltic: individualities of gas supply

There are very different and mutually unlinked security levels in various EU regions. E.g., 2009 gas crisis affected 18 European countries, some of them significantly, some countries could withdraw gas from their underground gas storages (UGS) or switch to another sources. At the same time Baltic States as well Spain, Portugal, UK, Scandinavia did not feel any problem.
Therefore macro-regional approach to the improvement of SoS is one of the key issues of EU position. This is fully acceptable; the security problem cannot be solved on national level, countries alone cannot develop necessary infrastructure. Security tools are transnational instruments; they are effective if they are based on transnational cooperation and solidarity of neighbour countries. At the same time equal general principles (mainly on political level) should be implemented throughout Europe.
Gas fields are not discovered in the Baltic; in difference with many EU countries there is 100 % supply dependence from only supplier – Russia. Baltic's (incl. Kaliningrad district) peak demand is 40 Mcm/day. Supply of the Baltic is provided by two trunk pipelines (EEGA 2008), their capacity is adequate to current consumption; one is direct pipe, another one – transit pipe via Byelorussia (fig. 3); capacity of each pipe – 30 Mcm/day. There are functioning interconnection pipes Estonia – Latvia (2 Mcm/day) and Latvia – Lithuania (5 Mcm/day), both bidirectional. Two old small pipes (St. Petersburg – Estonia and one more pipe Byelorussia – Lithuania) are not in use, but could be activated. Baltic gas supply system is fully isolated from EU system; this individuality of Baltic is unique on the EU scale.

Fig. 3 here

Isolation of Baltic gas system is linked with several historical causal relationships and consequences:

- Baltic natural gas system from the very beginning (60-ties of 20th century) has been integrated with Russia's system – trunk pipelines, centralised dispatching, supply of Kaliningrad district via Lithuania;
- Eastern Baltic countries (Latvia, Estonia as well Finland) are the only ones that are on the border with Russia; direct gas import without transit routes is a substantial advantage;
- Russia is an owner of the richest gas reserves, it has been a trusty supplier since independency of Baltic States was restored in 1990 in spite of quite complicated interrelations among Russia and Baltic States sometimes; nevertheless the

supply problem would be arisen by sharp increase of domestic market as well development of Eastern export in next years (*ИЭС* 2009);

- development of gas infrastructure in Russia is a crucial issue; new pipeline from Yamal gas fields as well Nord Stream and Shtokman pipelines can have an impact on Baltic supply in future; it depends on real operational capacity of all pipes (Nord Stream will be connected with Yamal trunk pipes);
- technical skills and know-how of Russian specialists is internationally recognized; Baltic gas companies also exploit their knowledge potential;
- *Gazprom* is the shareholder in all Baltic gas companies;
- Incukalns UGS (delivery capacity 24 Mcm/day) is the third supply source and extremely significant security guarantee for the most substantial – winter – period (injection is taking place during summer); usage of UGS is also a real experience of solidarity – not only Latvia, but also Estonia, Lithuania and even Russia exploit capacity of UGS during winter;
- Baltic consumers enjoy the lowest gas prices in EU after Romania (EE – 69%, LT – 72%, LV – 60% of EU27 average price for domestic consumers in 2010S1).

These individualities have to be taken into account during evaluation of risks that could affect gas supply to Baltic's consumers. But one can see the primary problem – only one gas supplier.

Diversification of suppliers and supply routes is a cornerstone of EU policy (Bilgin 2009). In addition to major suppliers (Russia – 33,2% of total EU27 gas import, Norway – 28,8%; Algeria – 14,7% in 2009) there are number of smaller sources. In addition 18% of total gas import was covered by LNG; it was provided by Algeria, Qatar, Nigeria and some other countries. Nowadays EU is searching additional sources of gas supply from Caspian and Middle East countries.

Diversification of gas suppliers, supply sources and supply routes is the strategic task for Baltic gas sector to increase its sustainability and security.

3. Baltic: risk assessment

One can find lot of interpretations of the security of gas supply in political documents and scientific publications. The essence of them would be summarized as "the guarantee that all the gas volumes demanded by non-interruptible customers will be available at a reasonable price" (Luciani 2004).

In any case SoS is a multi-dimensional issue, it includes energy aspects (source security), availability aspects (security of delivery) as well affordability aspects (economic security). More detailed analyses include number of components (see, e.g., Jansen *et al* 2004, Jansen, Seebregts 2010, World Energy Council 2008); the problem is very different sets of aspects, which form the base for assessments:

- European, regional and national issues;
- short-term and long-term aspects;
- evaluation of disruption risks vs economic reasonability, security costs;

- system's risks – centralized vs distributed/networked system;
- stakeholders impact – private (quoted in stock exchange?) and state owned actors;
- unbundling / market measures vs vertical integration / non-market measures.

Disruptions of gas supply far exceed the losses of suppliers and consumers (Umbach 2010). They affect inflation and payment imbalances, unemployment and broadening social programmes. At the same time care on security on national scale should not exclude problems of any household supply security.

It is very popular in Baltic to speak on political risks, on Russian energy policy as supervised by political interests. This approach nowadays really is characteristic for any country (so-called *resource nationalism*); e.g., economics and particularly energy is not separated from politics in Russia, US, China (Linde 2007); not only has any superpower implemented such policy, but even governments of Baltic States.

Stability (lack of investments, political and social instability) in the transit countries is evaluated as very important for the SoS, particularly because typically these countries are not direct partners of gas supply contracts (Hetland, Gochitashvili 2004). Some small supply problems in Baltic also have arisen on transit pipe only; e.g., in 2010 a short (24 hours long) sharp partial reduction (up to 40%) took place in the supply of Lithuania via Byelorussia. Interconnection Lithuania – Latvia was ready for use, but there was no necessity to do it (small consumption because of summer time).

Quantitative criteria, which characterize various security aspects, also are different (see, e.g., Kruyt *et al* 2009). In addition remote authors not always are very familiar with past and current situation in Baltic gas sector. The result is very different and sometimes quite subjective assessments.

Detailed analysis of risks (Ramboll 2009) can be evaluated as the most comprehensive, detailed and well-grounded; in a large measure it was used as the basis for development of BEMIP – Baltic Energy Market Interconnection Plan (EC 2009d). Latvia's security is evaluated as high, quite comparable with Norway first of all due existing Incukalns UGS (fig. 4); also other security components for Latvia are assessed as higher ones. Estonia and Lithuania are assessed as lower security countries, because of weekly diversified supply – only one main supply pipe to each country and too small capacity of pipes from Incukalns (Lithuania's situation is evaluated as better – higher pipe's capacity in comparison with Estonia). In addition the geopolitical risk decreases Lithuania's SoS due transit via Byelorussia. Nevertheless it should be mentioned that partial supply of Estonia from Incukalns during winter is a normal process, but one of short-time problems for Lithuania caused by Byelorussian – Russian relations was operationally solved exactly by gas delivery from Incukalns.

Fig. 4 here

Preliminary calculations of n-1 parameters (EC 2009c) reflect possibilities of gas supply to non-interruptible consumers if there is a failure of the largest supply infrastructure or source. It has been done for Member States according core postulate of the gas security Regulation (EC 2010b); n-1 is significantly above 100% for Latvia (163%) and Estonia (144%), while Lithuania (57% only) is the least secure of the three.
Academic analysts also offer various security evaluations; because of incomprehensible reasons sometimes their approach is too one-sided. E.g., special risky index is developed by combining import dependency risks as well economic importance of the gas (Coq le, Paltseva 2009). Another proposal is based only on the ability of a country to replace all disrupted gas supply by alternative gas and/or alternative fuels (Findlater, Noel 2010); in contradistinction to above described these assessments find a low level of gas supply security in all Baltic States, Latvia is evaluated as the least secure of the three (table 1).

Table 1 here

In general supply risk in Baltic could be evaluated as comparatively low one, although quite different; due several aspects it can and should be further decreased. There are several well-known basic tools to increase SoS, let as analyze them shortly in the Baltic context.

4. Extended UGS system: stability of supply

Underground gas storage is one of the most efficient instruments to increase SoS. It serves a secure gas storage facility near customers (shortened supply chain decreases supply risks, UGS can be used in emergency case) or even equivalent of terminated own gas field for importer countries; the last advantage is extremely important for Baltic (UNECE 2007). Unique, concentrated geological formations in Latvia (porous sandstone with a good collector capacity in an optimal depth 700-800 m that is covered by gas impenetrable carbonate stratum layer) and, possible, in Lithuania (definitely there are no storage possibilities in Estonia and Finland) enables Baltic to expand efficient usage as well further development of UGS.
Currently Incukalns UGS, which is one of the largest storages in Europe (volume of the storage – 4,5 Bcm, active volume – 2,3 Bcm), is already exploited for gas supply during many years; gas is injected in low demand summer period (available and/or cheaper gas) and withdrawn during high demand winter period. Evaluation of gas supply using the local Incukalns UGS shows a radical decrease of the probability of supply disruption (statistical data of the emergency situation have been used) – around 200 times lower in comparison with usage of more than 3000 km long trunk pipeline from gas fields in Russia (Davis *et al* 2009).
Operation of the UGS is an excellent example of existing long-term successful regional solidarity, gas is delivered not only to Latvia's customers, partial winter

season supply is provided to Estonia and NW region of Russia as well occasional delivery to Lithuania (fig. 5). Tariff payment for Incukalns UGS services is approved by National Regulator Authority of Latvia (16 EUR/1000 cm).

Fig. 5 here

The natural question is – can gas storage volume guarantee high SoS in whole Baltic region including Finland and Kaliningrad district? Estimating growth of annual winter volumes that should be delivered from UGS till 2020 (up to 3 Bcm), currently existing peak demand (up to 60 Mcm/day) as well growth of total annual consumption of isolated Baltic region (up to 15 Bcm), one can find that today's capacity is enough only for partial supply (even taking into account planned development of volumes in Russian Nevskoye and Gatchinskoye UGS) and cannot guarantee perfectly secure supply for Baltic.

There are real possibilities to increase significantly gas storage volume in Baltic:

- extension of Incukalns storage is the major and immediate activity; technical project of extension has been elaborated to increase volume of the storage till 6,2 Bcm, including increase of active volume till 3,2 Bcm; evaluated investments for extension (0,9 Bcm active volume) – 160 MEUR/Bcm (here and further investment figures from Ramboll 2009 and EC 2009d);
- there are at least 11 storage facilities in Latvia with active total volume of up to 50 Bcm. Dobele and Blidene are the most explored (including studies and analysis of storage potential as well number of drilled wells) and perspective UGS, their active volume would be up to 10 Bcm; evaluated investments for Dobele UGS (6 Bcm active volume) – 400 MEUR/Bcm; these developments are not reasonable for Baltic demand only, but it would be real and even best solution for Central and Western European countries (connection with some trunk pipeline is necessary);
- exploration of the geological structure in Syderiai (Lithuania) has been started in order to determine the suitability of Syderiai for the natural gas storage facility (potential active volume up to 0,5 Bcm); evaluated costs are very high – up to 700 MEUR/Bcm, actually taking into account previous options these are unreasonable investments in construction of so small UGS.

5. LNG: real diversification of supply sources

LNG supply is more revolutionary instrument in comparison with UGS: there is provided availability of new gas and new suppliers (Algeria, Nigeria, Qatar, Trinidad & Tobago for EU countries) on the basis of existing natural gas infrastructure (only non-principal technological actions are necessary) and existing market demand. All LNG technologies are developing and costs are decreasing rapidly, global LNG production capacity is growing (current forecast is

130 Bcm/year till 2013). LNG supplies to EU27 have increased by 23% in 2009; it is forecasted (3-6)-fold increase till 2030.
In addition the *Medgaz* gas pipeline Algeria – Spain (currently LNG covers 60% of total Spain gas demand) has come in operation; one can forecast growing LNG supply possibilities for another European regions. If Russia will develop planned Shtokman and Yamal LNG export terminals, there would be extra options. In general LNG sector is more flexible, it has got adjusted to the demand uncertainties, spot proportion is much higher in comparison with natural gas market.
Therefore LNG market is well adjusted to role of diversified supplier when gas shortage is in Baltic and/or to soften supply conditions. Even high level *Gazprom* officials have been admitted freely that in case of development of additional purchasing capacities on 1/3 of *Gazprom* volume's scale (let us repeat, total volume for three Baltic States – 6 Bcm) by means, e. g., by LNG terminal, *Gazprom* will take actions to reduce prices and/or offer other more attractive supply conditions.
Nevertheless there are several specific individualities that will make LNG supply to Baltic more expensive in comparison with Northwest Europe; price premium would be around 8 EUR/1000 cm above UK prices (Ramboll, 2009) because of:

- longer transportation distance;
- Baltic Sea is quite shallow, vessels capacity will be less than 50 000 cm of LNG (30 Mcm of gas); transportation by small vessels are more expensive and reloading (e.g., in Zeebrugge) from typical 145 000 cm ocean vessels is necessary;
- Baltic Sea is colder that originates additional re-gasification costs.

Investments in the LNG terminal (related to 1 Bcm capacity) are reverse to the total capacity of the terminal; terminals, which capacity is less than 2,5 Bcm/year, become economic unprofitable. This is a sign that accordingly to the Baltic region consumption one joint terminal has to be constructed. Unfortunately current plans remain uncoordinated, lot of terminals are recommended even in the BEMIP (Finland, Lithuania, Estonia, Latvia).
Target costs for 2,5 Bcm/year terminal are around 500 MEUR, including storage volume that costs near 200 MEUR; therefore it is unambiguous, that Baltic has to take the opportunity to exploit Incukalns UGS as a storage volume and to interlink terminal with expanded UGS (BEMIP also directly indicates dependency of all potential LNG terminals' projects with expandability of UGS). Because of very much similar conditions in the Eastern coast of the Baltic Sea, for this reason port of Riga becomes the top destination for LNG terminal (onboard re-gasification on ships cannot be evaluated as a perspective option for peak and emergency cases).

6. Network configuration: via Baltic Ring to single mesh network

Sustainability and security of supply very much depends on configuration of the supply system (both transmission and distribution networks). Perfect network configuration should ensure several ways for gas flow to the consumer; thus delivery will not be cut in the case of pipe damage.
Current gas system configuration in Baltic (fig. 3) is a mix of bus-, star- and zipper-style systems (fig. 6), sometimes they are hierarchical ones. Low security level characterizes all these systems; any defect creates an outage for some or even many consumers, network configuration does not provide reserve supply ways. Only in Estonia one can see some kind of imperfect ring transmission system (reverse flows are not technologically feasible).

Fig. 6 here

Baltic trunk pipeline ring are the first substantial step in order to increase supply security, although it will be incomplete one; reverse gas flows will be feasible to integrate all income gas flows.
Several projects have been included in the BEMIP to increase cross-border capacity and thus to form Eastern segment of the *Baltic Ring* and to increase security on macro-regional scale; these recommendations are fully acceptable. Already started upgrade of Lithuania – Latvia trunk pipe as well following upgrade of Latvia – Estonia trunk pipe are substantial and cost-efficient activities. Next steps would be trunk pipes Finland – Estonia (*Balticconnector* project, cost – 120 MEUR) and Poland – Lithuania (*Amber* project, cost – 300 MEUR). Significance of the last project for Baltic States will sharply increase if the test drilling for shale gas near Gdansk will be successful (1000 Bcm capacity of the shale gas field in Poland has been prognosticated).
Meshnetworks form the most secure and sustainable supply system; they already have become the basic ones for electronic communications sector, this is also a trend for step by step development of electricity infrastructure. Huge investments are necessary to implement this principle in gas infrastructure. Careful risk assessment and cost-benefit analysis should be made to evaluate purposefulness of conversion of any system's segment in meshnetwork; it relates to local distribution networks also.
Synchronous increase of security on national/internal level in general is as much important for consumers as macro-regional security. Duplicated access to Incukalns UGS, connection of the LNG terminal, feasibility of reverse flows in distribution network are substantial issues for any consumer.

7. Implementation: complexity of actions

Complex and comprehensive implementation of mentioned infrastructure instruments will be a key topic in order to ensure efficiency, sustainability and security of gas sector. All tools are closely interlinked and interdependable – LNG

terminal & UGS, LNG terminal & pipelines, UGS and reverse flows, cross-border and national developments, etc.

Yet more, coordinated electricity and gas supply systems (see, e.g., BEMIP projects), networked power supply that is an advanced basis for CHP generation (the most efficient generation technology for comparatively cold Baltic) should become the mainstream for development of energy infrastructure in order to modernize energy sector (e.g., Weisser 2007).

There are several issues which have to be taken into account for successive implementation, some of them ask for modernized political and normative environment.

Risk assessment is an extremely substantial kick-off individual activity for any country and/or macro-region to be prepared for crisis situations; it should contain not only qualitative and quantitative evaluation of risk factors exactly for this country/region, but also their probability. 100% security of technological system cannot be achieved in principle, real security level from consumer's position will be individual and in close compliance with economic situation and possibilities. Following contingency and emergency planning that contains all measures and necessary investments also is individual, it is coming out from both risk assessment and financial situation. Established in Regulation (EC 2010b) top-down n-1 principle, which is binding for all Member States, is a contradictious in terms with logic bottom-up (based on risk assessment) approach.

Investments are serious precondition for SoS, amount of necessary funding is directly linked with chosen degree of the reasonable security level. Energy policy and energy security really become a one of top issues in national security policy, but it not always is in line with business interests of energy companies. (Umbach 2010). Accent on development of market and competition is resulting in low business interest and responsibility for the SoS; hereof necessity for adequate financing model that includes public investments also. Good will and activities of gas supply companies is of crucial importance, public participation will increase also motivation of private investments.

There is finding on huge investment gap (EC 2010d) and necessity to finance partly security infrastructure projects from EU and national public funds. Unfortunately connection between strategic projects and investment sources on EU and national levels are weakly defined. One of the possibilities, which has to be discussed, is matching financing of SoS projects from the budget of national security

Consumers are the most vulnerable stakeholders in the gas market. One of the basic tasks for the regulation is to ensure general affordability of gas prices. Statistics shows that low income households (1st quintile) substantially limit gas usage, expending for it larger share of their comparatively less budget (fig. 7).

Fig. 7 here

EU normative acts have determined special protection rules for low income and remote customers: „The shared values of the Union in respect of services of general economic interest … include in particular … a high level of quality, safety and affordability … and the promotion of universal access." (EU 2007). "Member States … shall, in particular, ensure that there are adequate safeguards to protect vulnerable customers… They shall take appropriate measures to protect final customers in remote areas who are connected to the gas system." (EC 2009a).

The universal service principle is regarded as a real instrument for the availability of various services throughout the country for any individual. Introduction of this instrument in gas sector should be considered as a component of security programme.

All security measures are directed mostly to protection of non-interruptible customers, security level of customers will become different. Unanswered question is – are tariffs should be different too?

Growing volatility and unpredictability of gas prices in last years has initialized discussions on optimum payment system – on spot or long-term contract basis; the major reason – since middle of 2008 spot prices are lower.

But nobody knows how long and how much they will be lower. Analysing situation in the past, one can find alternating situations, e.g., in 2005-2006 and 2007-2008 spot prices were higher. In addition large and sudden price spices are typical for spot market; it is not an issue for contract prices. Also forecasts of spot prices even for 2011 are highly uncertain (within 100 – 500 USD/1000 cm).

Existing long-term contracts (Estonia and Lithuania – till 2015, Latvia – till 2030) are additional substantial aspects of SoS for Baltic; they increase reliance on sustainability of gas supply. Therefore contract basis should not be changed. Another topic is achievement of more balanced and better structured contracts, advanced shift from oil linkage to gas-to-gas (LNG and unconventional gas) competition.

Theoretically competitive environment provides lower gas prices; it would be achievable in stable periods (see, e.g., Kalashnikov, Kalashnykova 2008); at the same time it is mentioned that "each player maximizes his profit under certain capacities constrains". Market practice shows that even small supply reduction causes the sharp increase of price. In emergency situation (e.g., if significant reduction of supply takes place) constrain of competitors decreases or even disappears completely, in reality it means flashes of prices.

Traditionally in *force majeure* and even pre-emergency situations market is not evaluated as preferable tactics. Also Regulation (EC 2009b) envisages non-market based measures as the last resort in emergency situations that clearly accepts their higher efficiency in comparison with everyday market based measures. Market as crisis manager is a dream. Preemptive introduction of non-market measures in alert or even early warning situation would prevent this groundless increase. In addition proposed typical EC huge bureaucracy has to be revised: even in emergency case 10 days are necessary for decision making procedures.

An actual and politically sensitive theme is unbundling and third party access issues related to gas infrastructure. Similar tactic is already carried out during few years in electricity networks, this experience has to be taken into account.
It is the demand of updated EU gas legislation (EC 2009a, EC 2009b) in order to facilitate entry of new suppliers in gas market. Derogation of corresponding articles has been approved for Estonia, Finland and Latvia because of isolated gas supply infrastructure; there is no legal pressure on these countries to unbundle networks. Lithuania has not asked for derogation (reasons are not completely clear).
Owners of infrastructure are not very interested to invest in both transmission and distribution capacity reserve because they are not in direct service contacts with consumers; even more, sometimes it would be more profitable to ensure less than 100% peak demand (not speaking on security demands) in order to cut down investments. The result is inadequate and ageing European electricity infrastructure (lot of blackouts in last years). Integrated company is more interested in security and sustainability of supply.
The same relates to third party access; it also is not an end in itself, it should be a tool to improve quality and security of supply as well affordability of prices. If vertical integration is an encouraging factor for stability and sustainability of oil markets (Hafner 2010), why it would not be acceptable for so similar gas markets (see also concerns in Ming-zhi 2009).
It is sense to evaluate introduction of mentioned open market instruments when real competition possibilities will exist (e. g., LNG terminal will be constructed or interconnection with European gas system created). While it is impossible to import gas from outside *Gazprom* – there is no practical sense to do it.
Shareholder's interest of *E.ON* and *Gazprom* is a closely related issue. Well-balanced composition of shareholders (gas supplier and experienced manager of Western style gas business) in combination with high-skilled regulation is an advantage of Baltic countries (sustainable supply and the lowest gas prices throughout EU in the non-competitive environment). We can add close cooperation factor of shareholders in European scale projects. Long term review of processes in *Latvijas gaze* shows radical increase of efficiency of company and reliable gas supply. Of course, both shareholders already are very dissatisfied with political decision on currently premature unbundling activities in Lithuania and Estonia that will decrease value of assets. It will lower neither the supply risks, nor the gas price.
Gas networks similarly electricity networks due electronic information processing and management gradually become more *intelligent* – management of flows, dispatching, process efficiency, etc. Security and reliability of information systems in a full measure determines security of gas supply; high level of cyber security of gas information system is on the same importance level. Physical harms of infrastructure are low-probability events, but to attack networked information system is comfortable in comparison with damaging pipes und storages; cyber

attacks are being highlighted as some of the greatest security threats for infrastructure.
Intelligent energy grids are vulnerable to cyber attack; potential offensive would be not only terrorist, but also political or economic, even tough in nature. E. g., it was reported in April 2009 that foreign spies had infiltrated the US electrical grid and installed software, which could be used to disrupt the system.
Cyber security issues around critical infrastructure are now a top international priority; they should be included in the programme of gas supply security.

8. Solidarity and partnership of countries

Solidarity, partnership and conformity of countries in policy, actions, investments is one of strategic pillars to implement recommended strategy and instruments, to ensure efficient, sustainable and secure gas supply (EC 2010a). The security problem cannot be solved on national level; security of supply really is a macro-regional problem, all above described security tools (interconnection of pipeline systems, diversification of supply, LNG terminals, UGS) are transnational instruments. On the other hand global, even European scale is not purposeful for identical tools and measures due to very different situations.
Macro-regional priority of the security policy (EC 2010b) is the only way to achieve an energy-efficient and energy-secure Europe, to the full it relates to Baltic. Notwithstanding of accumulated solidarity practice related to exploitation of Incukalns UGS, some reasonable doubts remain on the capability of the Baltic States to cooperate in energy sector; there are several unsuccessful cases, e.g., liquidation of common dispatch centre *DC Baltija*, long-term stochastic activities related to *Visagina Nuclear Power Station* project. Evaluation of current sectoral policy and shift to more balanced cooperation and competition of Baltic States is necessary to achieve reliable gas supply.
At the same time macro-regional principle that is established as legally binding by the Regulation (EC 2010b) is too narrow. Internal market very depends on external supply, let us remember 60% import in EU current natural gas balance. Both 2006 and 2009 gas crises clearly showed that EU alone cannot solve the problem. Strategy (EC 2010a) shows the right way – harmonized external energy policy, consolidation of gas supply, transit and consuming countries (joining Russia and Byelorussia to Baltic macro-region). Expansion of macro-regions and solidarity (centralized dispatching, coordinated and solitaire investments, etc.) will ensure more reliable supply (see also Roze 2007).
Recently approved EU Regulation EC 2010b provides a political and normative base only for EU Member States; long-term discussions with Russia were not very successful (e.g., on Energy Charter and its Transit Protocol). To incorporate third countries a conjunctive political environment is necessary; exactly political contacts between EU, Russia and Ukraine was the primary step in order to solve crises.

The United Nations regional branch UN Economic Commission for Europe (UNECE) would become a right institution to manage this job; this corresponds to the major action line of UNECE – promotion of pan-European economic integration, policy advice and assistance to governments, cooperation with other players and key stakeholders, notably the business community; UNECE already has become a venue for:

- dialog;
- common position development;
- coordinated policy and activities;
- monitoring trends;
- developing legally-binding international agreements and instruments;
- assistance in implementation.

UNECE is very qualified for this kind of work, because it unites all countries and sustainable energy supply is on the top of its activities (see, e.g., UNECE 2010). UNECE has power to launch wide spectrum of activities (including diplomatic ones) that is principally necessary for successful implementation of the recommendations. UN has also some experience, exactly it has started global activities related to Internet security according to resolution of the World Information Society Summit 2003-2005; this experience has to be exploited.

National Regulatory Authorities have to become the basis of experts delegated to the working groups; these experts have a long-term experience to reconcile interests of gas suppliers with interests of consumers and national interests of the country. At the same time participation of and cooperation with gas providing companies is absolutely necessary. United expertise, experience and capacity will help to find optimum cooperation between countries, as well optimum unified instruments on macro-regional level. Strong cooperation with councils of European energy regulators will be very useful. Especially it relates to ERRA (that unites non-EU countries too) as well to new-established EU regulatory group ACER. It will become possible also to eliminate inconsistency of regulatory environment in various EU as well non-EU countries.

Conclusions

Current gradual shift in EU energy policy is favourable for Baltic States, more pragmatic approach to energy costs, strengthening cooperation with supply countries, huge investments in infrastructure are actual issues for Baltic. Role and significance of stable, secure and sustainable natural gas supply is accented in the modernized strategy and accompanied normative documents.

Careful and comprehensive risk assessment shows quite high, but different security level in Baltic States; nevertheless security level has to be improved further. Latvia enjoys the best situation of the three, mainly due existing Incukalns UGS. Other countries also exploit capacity of this UGS; Baltic already has accumulated significant solidarity practice.

Both smart energy policy and associated advanced comprehensive instruments is the only way to ensure more secure and sustainable gas supply for affordable prices. Complex implementation of economically efficient infrastructure instruments, updating normative environment, strong partnership with supply and transit partners, their involvement in common activities is a right strategic way. Projects and measures for increase of SoS in Baltic are planned and first steps for their implementation already has been started.

Macro-regional principle is an advantageous one for small Baltic States. Comparison of potential infrastructure developments shows, that the most efficient option is the pan-Baltic LNG terminal that is interlinked with expanded UGS (Findlater *et al* 2010). Of course, upgrade of cross-border pipes is necessary. Security tax on gas would be around 5% (fig. 8). Any national-scale LNG project will be more expensive, especially those in Estonia and Lithuania. Figures show that actually Latvia is not interested to invest in Baltic pipe, because this option is more expensive in comparison even with national LNG terminal.

Fig. 8 here

Baltic trading hub, which is based on Baltic LNG terminal and Incukalns UGS, could be gradually developed in the future.

Pan-Baltic political and economic cooperation, efficient partnership of gas companies is the cornerstone for success, some existing bottlenecks for Baltic cooperation has to be overcome. But UNECE as political venue for all European countries would be very catalytic for achievement of progress, much more because of UN plans to declare year 2012 as "The Year of Energy Access".

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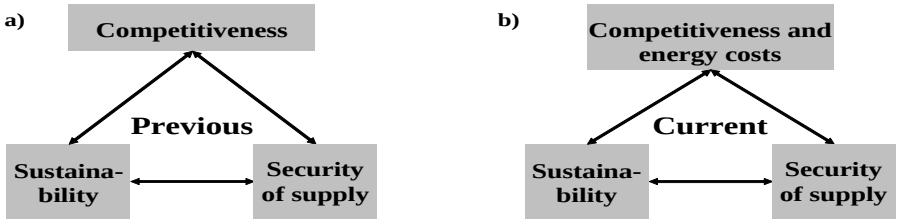

Fig. 1. Models of energy policy.

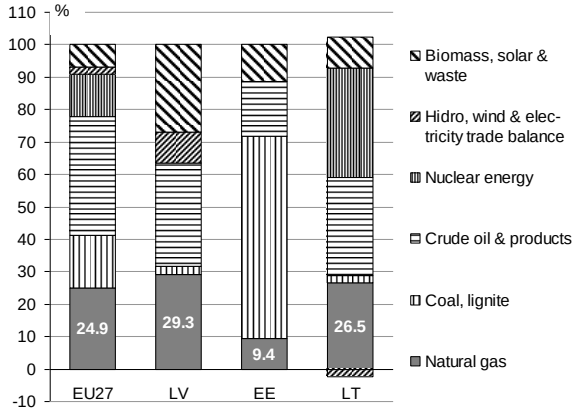

Fig. 2. Energy balance (2009); source – Eurostat

Fig. 3. Baltic gas supply grid; source – BEMIP

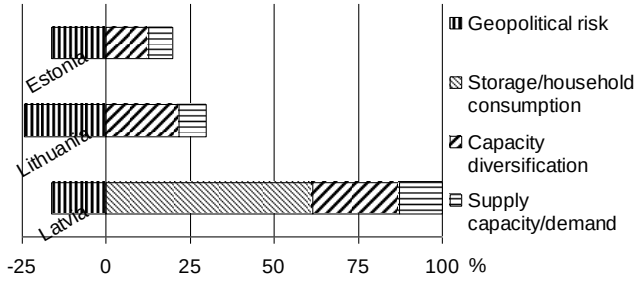

Fig. 4. Ramboll SoS index; source – Ramboll Oil & Gas

Table 1. Comparison of results of risk assessments of Baltic States

	Evaluated security level		
Source	*The best*	*The medial*	*The worst*
Ramboll	Latvia	Estonia	Lithuania
n-1	Latvia	Estonia	Lithuania
Coq le	Estonia	Lithuania	Latvia
Findlater	Estonia	Lithuania	Latvia

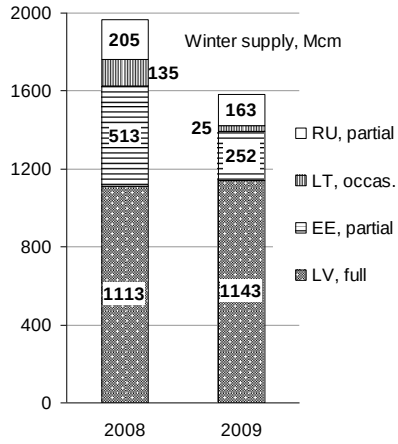

Fig. 5. Delivery of gas from Incukalns UGS; source – Latvijas Gaze

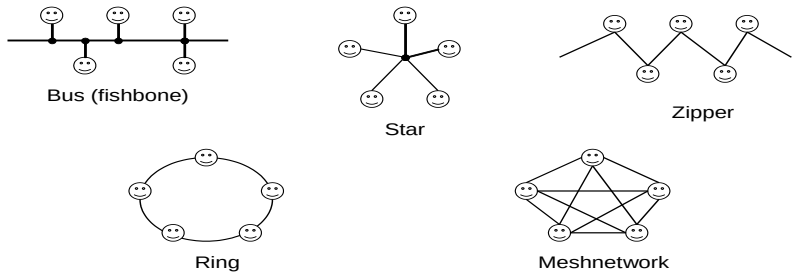

Fig. 6. Types of networks

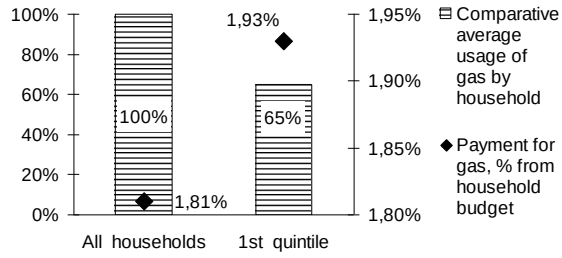

Fig. 7. Households' spending for gas supply (Latvia, 2009); source – CSB Latvia

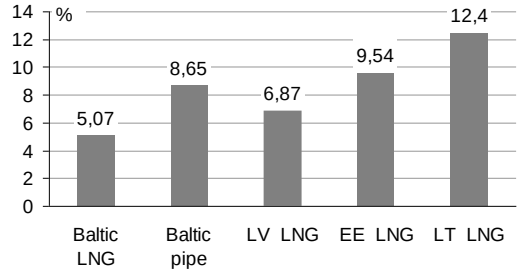

Fig. 8. Security tax on gas (%): options; source – Ramboll Oil & Gas

Biographical note

E. Karnitis, Prof. (since 1998), Dr. Sc. eng. (since 1992), major field of interests – information analysis, processing and systems.

Leading Researcher, University of Latvia (since 1999); Commissioner, Public Utilities Commission of Latvia (since 2001). Member, Advisory Board of Riga Technical University (since 2002). Member, UNECE Committee on Sustainable Energy (since 2010); Expert, Subcommission of National Development of the Saeima (Parliament) of Latvia (since 2007).

Worked as Adviser to the Prime Minister (1999-2000) and to the Minister of Economy of Latvia (2000-2001). Active in elaboration of national strategic programmes. As a local researcher has participated in EU multicountry analytic projects. Author of more than 190 scientific and technical publications.