Turun yliopisto
University of Turku

Kari Liuhto

A liquefied natural gas terminal boom in the Baltic Sea region?

Electronic Publications of Pan-European Institute 5/2012

ISSN 1795 - 5076

A liquefied natural gas terminal boom in the Baltic Sea region?[1]

Kari Liuhto[2]

5/2012

Electronic Publications of

Pan-European Institute

http://www.tse.utu.fi/pei

[1] I gratefully acknowledge the financial support of the Foundation for Economic Education (Liikesivistysrahasto), the Paulo Foundation (Paulon säätiö), and the Foundation of Turku School of Economics. Their financial support allowed me to take an unpaid leave of absence at the end of 2011, and to conduct research work abroad. The article was completed at the end of September 2012.

[2] Mr. Kari Liuhto is Professor in International Business with a specialisation in the Russian economy. In addition to the professorship, he holds the directorship of the Pan-European Institute, an economic policy research unit of the University of Turku, and the directorship of the Centrum Balticum, Finland's Baltic Sea region think-tank.

Contents

Prologue 1

1 Unconventional gas production and gas supply of the Baltic Sea region 2

2 Existing and planned liquefied natural gas terminals in the region 9

3 A summary 24

Epilogue 28

References 29

Appendices 31

Appendix 1. Estimated gas reserves of the world by gas form 31

Appendix 2. Potential location of unconventional gas reserves in Poland 32

Appendix 3. Natural gas consumption and production in the Baltic Sea region ... 33

Appendix 4. Gas flows in Europe in 2010 34

Graphs, tables and a map

Graph 1 Share of natural gas in primary energy consumption in the EU in 2010..... 5

Graph 2 The development of the global LNG trade 9

Graph 3 Start-ups of LNG receiving terminal in the world.......................................10

Graph 4 LNG receiving terminal capacity in the globe..10

Graph 5 Gas prices in selected markets and European gas prices 11

Table 1 Natural gas supplies in the EU member states of the Baltic Sea region..... 7

Table 2 Some major LNG liquefaction plants and regasification terminals 22

Table 3 The strategic importance of the existing or planned LNG terminals to the gas supply of the BSR 26

Map1 Existing, planned and proposed LNG plants and terminals in northern Europe... 23

Prologue

"Better be despised for too anxious apprehensions,

than ruined by too confident security"

Edmund Burke, Irish/British philosopher and politician, 1729-1797

1 Unconventional gas production and gas supply of the Baltic Sea region

Unconventional gas production is a new phenomenon only if we consider almost 200-year-old things as new. First natural gas well produced gas from shale in New York in 1821. Shale gas became globally recognised approximately ten years ago when the production volumes of shale gas from the Barnett Shale field in the USA increased notably (NETL 2011).

Already in 2010, the USA produced nearly 360 billion cubic meters (bcm) of gas with an unconventional method[3]. Hence, unconventional gas production has compensated the decline in conventional gas production of the USA. As a result, the total gas output of the USA has rapidly grown in a couple of years (IEA 2012)[4].

The unconventional gas production revolution in the USA has set in motion a global chain reaction, which has ignited a liquefied natural gas (LNG[5]) terminal boom in the Baltic Sea region (BSR). The chain reaction is caused by the fact that the USA can reduce its LNG imports, and this reduction forces the LNG exporters of Middle-East and Africa to find alternative consumers in Europe or Asia[6].

In addition to this indirect impact of the US unconventional gas revolution, I would not exclude an option that the USA would start exporting its gas to Europe and Asia[7]. The

[3] Unconventional gas is composed by the same gas molecules as the conventional gas but the method of its exploitation is different. Unconventional reserves can be defined as reserves which are not commercially recoverable at current prices and using conventional technology. Unconventional gas is usually categorised as tight gas, goalbed methane, shale gas or methane hydrates (Centre for Global Energy Studies 2010).

[4] Five years ago the US gas output was some 520 bcm. In 2011, production exceeded 650 bcm. The growth of 130 bcm is equivalent to the EU's gas imports from Russia. At the same period, gas production of Russia, which produces gas only in a conventional manner, has grown at a moderate tempo from 595 bcm to 607 bcm (BP 2012).

[5] LNG is conditioned natural gas that has been cooled to its liquid state at approximately minus 162 degrees of Celcius. LNG is compressed into a liquid form so it can be shipped in pressurised containers. In its liquefied form natural gas takes up 1/600th of the space, making it much easier to ship and store when pipeline transport is not feasible. One million tonne of LNG equals to 1.36 bcm of natural gas (BP 2012).

[6] In 2005, the EIA forecasted that the USA would need to import 70 bcm of LNG in 2010, but due to the unconventional gas revolution, the USA imported only 12 bcm of LNG that year i.e. around 60 bcm of gas was free to flow elsewhere. Most of the liberated LNG found a consumer in Europe and Japan. In 2011, the US LNG imports were just 8 bcm (IGU 2011; IGU 2012).

[7] Already prior to the unconventional gas revolution, the USA piped small amounts of gas to its neighbours, Canada and Mexico, though the USA was still a net importer of gas in its gas relations with its neighbours. In 2010, the US LNG exports amounted to 0.8 bcm, although the USA is still a net importer of LNG (IGU 2011).

US gas exports are motivated by a substantial price difference between the USA and Europe / East Asia, where gas costs more than 5 times that of the USA. Even if the gasification and transport costs are included, the price difference is 2-3 times to the advantage of the US gas producer.

It is extremely difficult to predict the US gas export volume to Europe and Asia since the US Government may wish to restrict the gas sales abroad. The Energy Information Administration (EIA), a unit providing official energy statistics of the USA, estimates the US LNG exports to begin already at the end of this decade though the volumes may be around 10 bcm (IGU 2012). On the other hand, some analysts refer to 40-110 bcm of annual gas exports but their time frame is very blur (Levi 2012; Reuters 2012)[8].

The EU needs to import more natural gas since its own gas production is decreasing due to the depletion of its gas fields[9]. At the same time, the future scenarios indicate that the gas consumption of the EU increases due to a closure of some nuclear power stations and the reduction of the use of environmentally polluting energy sources such as coal[10].

Both the conventional natural gas reserves and gas production in the Baltic Sea region are small on a global scale if we do not include here the region's non-EU members, namely Norway and Russia. The BSR countries, excluding Norway and Russia, possess together less than 500 bcm of conventional natural gas (BP 2012).

On the other hand, Poland and Germany have noteworthy unconventional gas reserves. Poland's unconventional gas reserves amount to 350-800 bcm (UPI 2012). Germany's shale gas reserves (1300 bcm) alone are larger than the total unconventional gas reserves of Poland (Kümple and Messner 2012), but due to environmental regulations and opposition by green parties it might be politically challenging to start unconventional gas production in Germany in the near future (Appendix 1).

---

[8] "*Baringa, a London-based consultancy with a focus on energy, said that between 40 and 80 billion cubic metres (bcm) of liquefied natural gas (LNG) will be exported each year, starting from 2015.These figures are below some estimates that expect U.S. LNG exports to rise above 110 bcm by 2020, but Baringa's Jayesh Parmar and other analysts have said that political pressure could limit export capacities*" (Reuters 2012).

[9] "*The European Union is now importing a major part of its gas demand, 62% in 2010, and forecast to rise to 78% in 2020*" (BEMIP 2012, 3).

[10] Coal satisfies more than a half of Poland's primary energy consumption (BP 2012).

Norway and Russia belong to a completely different category than the rest of the BSR states. Norway's conventional natural gas reserves are approximately 2000 bcm and those of Russia around 45,000 bcm, making Russia's gas reserves the world's largest. Norway's unconventional reserves are probably relatively small, but Russia holds very significant unconventional gas reserves – at least 10,000 bcm.

If one excludes Norway and Russia, the conventional natural gas reserves of the Baltic Sea region would satisfy the gas consumption of the region for a very short period of time, 3-4 years. The unconventional gas reserves of the BSR would last a bit longer (a decade or two), but nevertheless, the region cannot build its economic development on the indigenous gas production for long. Moreover, it is everything but certain when and how much unconventional gas will finally be produced in the BSR (Appendix 2).

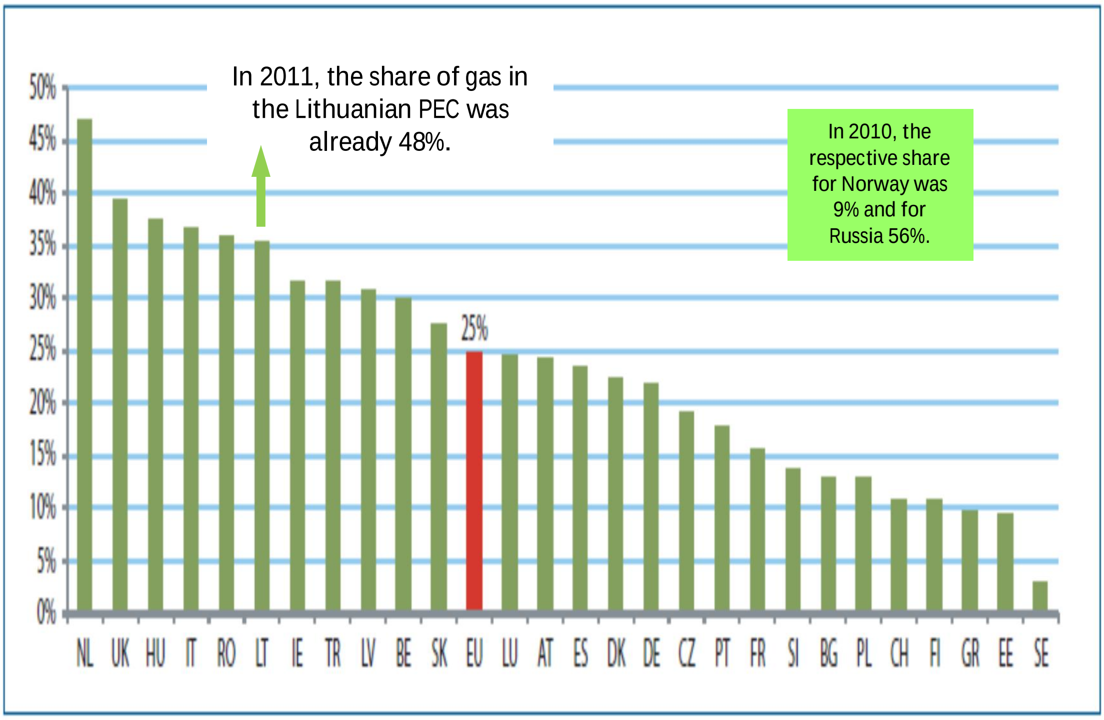
Obviously, Poland will be a frontrunner in the unconventional gas development in the BSR. Poland's Prime Minister Tusk indicated optimistically at the end of 2011 that Poland may start its own shale gas production in 2014[11]. One should keep in mind that the production volumes will be relatively modest in the beginning. By 2035, Poland aims to meet its domestic gas needs completely (Reuters 2011). As Poland uses just 15-17 bcm of gas and I do not expect a major increase in Polish gas consumption, Poland's unconventional gas production plan is not extraordinary ambitious. The Prime Minister's statement reveals that Poland does not have a goal to become a major gas exporter; though it cannot be excluded that Poland would export smaller amounts of gas to BSR countries, the Baltic States in particular, via pipelines. Here, one should remember that LNG shipments within the BSR are not economically feasible vis-a-vis pipeline deliveries due to the short distance between the countries.

The natural gas plays a notable role in the primary energy consumption (PEC) of the Baltic Sea region. Russia, which is a gas intensive economy, meets more than a half of its total energy needs with natural gas, and this stake will not drop significantly in the foreseeable future (Ministry of Energy of the Russian Federation 2010)[12]. Even if also Norway possesses significant gas resources, the country's hydrocarbons are targeted for exports while the country's energy demand is mainly (2/3) satisfied with the

[11] One should be very carefully before declaring that the unconventional gas boom will start in Poland since several test drillings of shale gas have failed (Strzelecki 2012).
[12] Although Russia is the globe's largest producer of natural gas, it is good to remember that Russia also imports significant amount of natural gas (over 30 bcm) from Central Asia and smaller volumes from Azerbaijan (Gazprom 2012).

hydropower. Therefore, the natural gas plays a minor role (less than 10%) in the Norway's PEC (Graph 1).

Graph 1. Share of natural gas in primary energy consumption in the EU in 2010



Source: Eurogas 2011, 5.

Lithuania (LT) is the most gas-addicted country within the BSR, which do not possess major gas reserves. It needs to be noted that the share of gas in the Lithuanian PEC jumped from 30 percent in 2009 to close to 50 percent in 2011 due to the closure of the Lithuanian nuclear power station at the end of 2009 (BP 2011; BP 2012). The respective share in Latvia (LV) is around 30 percent. In Denmark (DK) and Germany (DE) natural gas fuels around a fifth of the economy. A tenth of the energy consumption is met with gas in Poland (PL), Finland (FI) and Estonia (EE). The aforementioned share is clearly the lowest in Sweden (SE) where it covers only a few percent of the country's PEC.

The eastern Baltic Sea region, namely the Baltic States and Finland, meet still at the moment 100 percent of their gas demand with natural gas piped from Russia. Also Sweden used to be completely dependent on a single supplier, Denmark, prior to the opening of the country's first LNG terminal in May 2011. After the opening of the LNG receiving terminal, Sweden imports LNG from Norway.

Despite its gas production, Denmark imports some gas (0.15 bcm i.e. 3% of total consumption) via pipe from Germany. As a whole, however, Denmark is a net gas exporter. Its exports amount to roughly 3.5 bcm. Denmark can be regarded as a regional gas exporter, whereas Norway is a major European actor and Russia a global one. Norway exported 100 bcm and Russia close to 180 bcm of gas in 2010 (Energy Delta Institute 2011).

Poland meets nearly 30 percent of the country's gas needs with the indigenous sources, while the country is 60 percent-dependent on the Russian deliveries. The remaining tenth comes from Germany. In order to diversify its gas imports, Poland plans to build a direct gas pipe from Denmark to Poland, called the Baltic Pipe, and to construct a major LNG terminal in the vicinity of the German border. This gas port could be finalised in 2014, though a delay is possible due to the bankruptcy of one of the main constructors of the terminal. In the first stage, the terminal's capacity may reach the capacity of 2.5-5.0 bcm, and by 2018, the terminal's capacity could be increased to 7.5 bcm. Hence, the terminal could meet nearly half of Poland's needs already in this decade. However, the upgrading of the terminal to reach the nameplate capacity of 7.5 bcm is not fully certain, though still possible.

Germany is 15-percent-self-contained in terms of its gas supply but the country's own production is in a deep decline. Close to 40 percent of gas used in Germany is piped from Russia and around a third from Norway. Germany does not have any LNG terminals, and according to the Global LNG Info (2012), the Wilhelmshaven LNG terminal project has been suspended.

Here, it needs to be mentioned that Germany has decided to shut down all its nuclear power stations, which currently produce a bit less than a tenth of the country's PEC by the year 2022. If Germany would replace the nuclear power solely with natural gas, it should increase its gas imports by 40 bcm. If all of this extra gas would be imported from Russia, it would double Germany's gas imports from Russia and lift Russia's share in Germany's gas imports from 40 percent to over 60 percent (Table 1).

Table 1. Natural gas supplies in the EU member states of the Baltic Sea region
(Terawatt hours, 1 TWh = 0.0923 bcm)

	Indigenous production *	Russia	Norway	Other sources **	Changes in stocks ***	Other balances	Total net supplies
Denmark	85.4	0.0	0.0	-35.1	1.2	-6.8	44.7
Estonia	0.0	6.6	0.0	0.0	0.0	0.0	6.6
Finland	0.0	49.6	0.0	0.0	0.0	0.0	49.6
Germany	123.6	351.2	312.1	113.5	46.5	-13.9	933.0
Latvia	0.0	18.9	0.0	0.0	0.0	0.0	18.9
Lithuania	0.0	46.6	0.0	-14.7	0.1	0.0	32.0
Poland	47.7	101.4	0.0	11.4	3.0	2.6	166.1
Sweden	0.0	0.0	0.0	18.9	0.0	0.0	18.8

* When indigenous production exceeds total net supplies, this indicates that the country is a net exporter of gas.

** Negative figure indicates exports of gas. In the Lithuanian case, this means transit of Russian gas to Kaliningrad and Latvia. Latvia also transits Russian gas to Estonia, and Germany some Nordic gas to Poland, though the above table does not reveal it (see Appendix 4).

*** Negative figure means injection and positive withdrawal.

Source: Eurogas 2011, 8.

Nord Stream 1 and Nord Stream 2 have together a capacity to bring 55 bcm of gas from Russia to Germany. All the gas transported via these Nord Stream pipes does not necessarily end in the German market, since both the Dutch and the French corporation own 9 percent of the Nord Stream company. Gazprom and two German corporations possess together 82 percent of the Nord Stream ownership, which translates to roughly 45-bcm-capacity-ownership in Nord Stream. To put it differently, two Nord Stream pipes could carry enough gas to Germany's needs even if the country would close its nuclear power stations. If Nord Stream 3 and Nord Stream 4 will be built, they are not needed to compensate the gap created by the closure of the nuclear power stations but obviously their aim is to reduce the gas flows transported from Russia via Belarus, Ukraine and Poland to Germany. One may only guess what the end of the gas transit means to these transit countries' relations with Russia.

Many factors justify increasing natural gas imports to the BSR. First, the Kioto Protocol emphasises the role of natural gas since its very clean form of energy compared to other fossil fuels. Second, the indigenous energy production in the region, including nuclear power and gas production, is set to decrease. Third, unconventional gas revolution in the USA have increased available LNG supplies since the USA does not any longer import so much LNG.

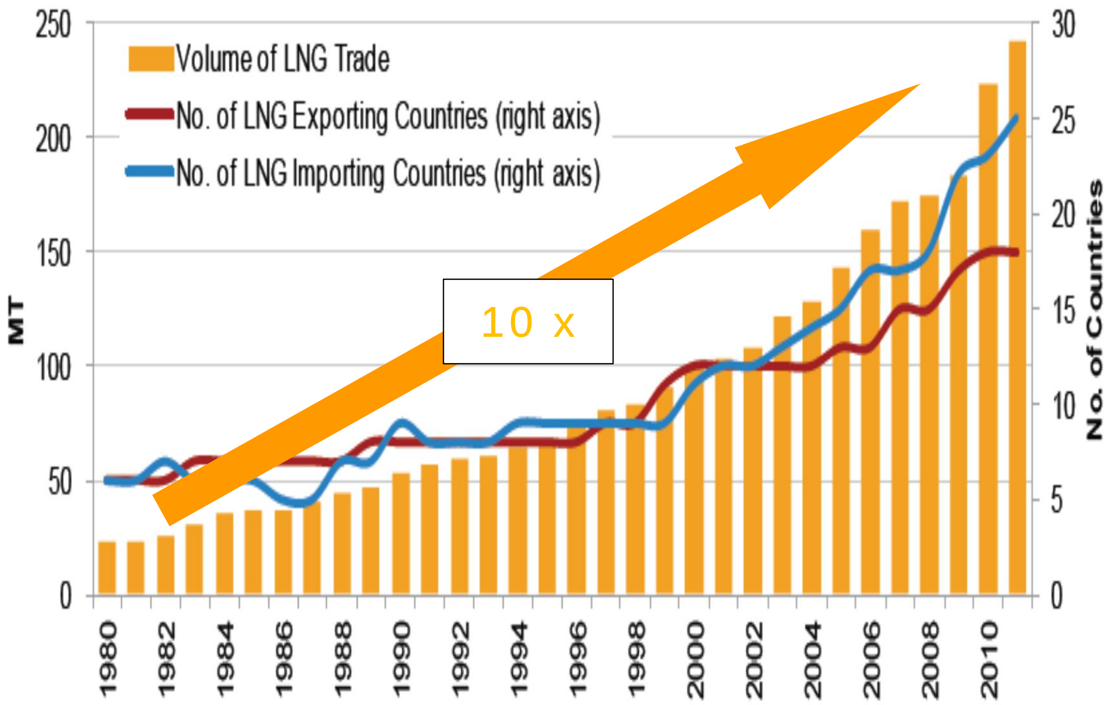
Due to the chain reaction caused by the unconventional gas revolution, the BSR will obviously experience a LNG terminal boom. Hence, the main objective of this article is to describe the existing LNG infrastructure and to analyse the LNG terminal plans and their possible impact on gas supply in the Baltic Sea region.

2 Existing and planned liquefied natural gas terminals in the region

Natural gas liquefaction dates back to the 19th century when British chemist and physicist Michael Faraday experimented with liquefying different types of gases, including natural gas. The first LNG plant was built in West Virginia in the USA, in 1912 and the operation began in 1917. The first commercial liquefaction plant was built in Cleveland, Ohio in 1941 (Centre for Energy Economics 2012).

In 1980, less than 20 million tonnes of LNG was traded globally, whereas 30 years later the LNG trade exceeded 220 million tonnes per annum i.e. close to 1/10 of the global gas consumption was met with LNG (Graph 2). As a sign of an ongoing LNG boom in the world, LNG trade volumes have doubled during 2006-2010. In 2011, the LNG trade grew by 8 percent and exceeded 240 million tonnes, i.e. over 325 bcm (IGU 2011; BP 2012; IGU 2012).

Graph 2. The development of the global LNG trade

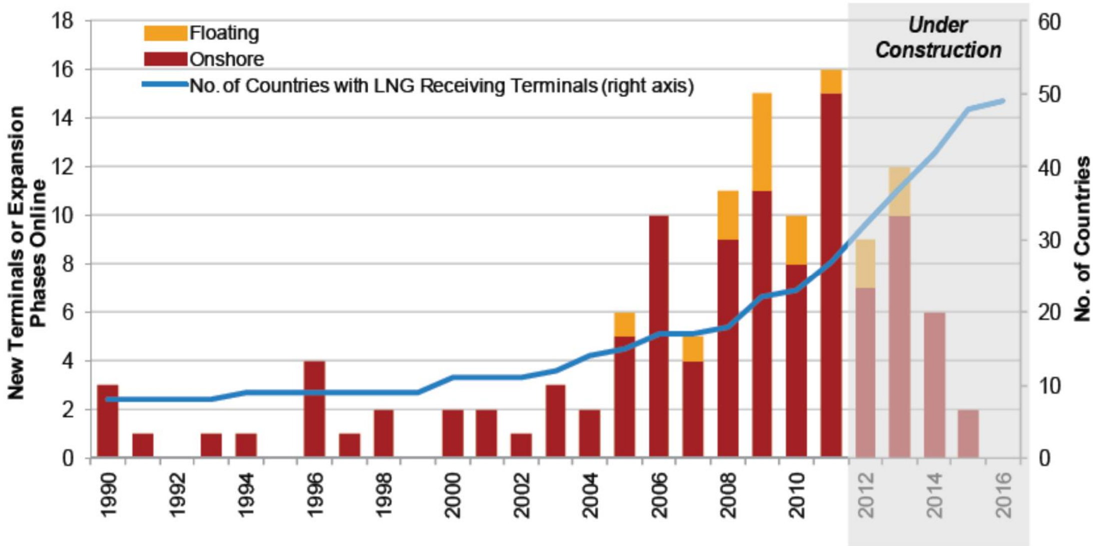


MT = million tonnes

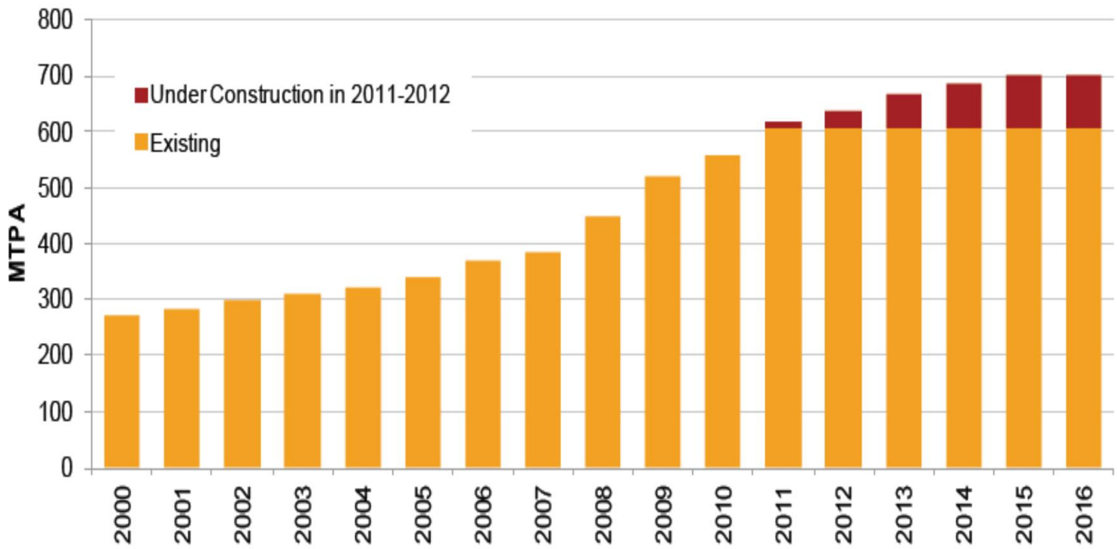
Source: IGU 2012, 7.

There were 89 regasification terminals around the world in 2011. Their total regasification capacity was a bit more than 600 mt per annum i.e. around 820 bcm (Graphs 3 & 4). Out of these 89 terminals, 29 started commercial operations during 2006-2011. Ten of these terminals are offshore facilities. It seems that regasification capacity continues to grow, especially in new markets (IGU 2012).

Graph 3. Start-ups of LNG receiving terminals in the world



Graph 4. LNG receiving terminal capacity in the globe



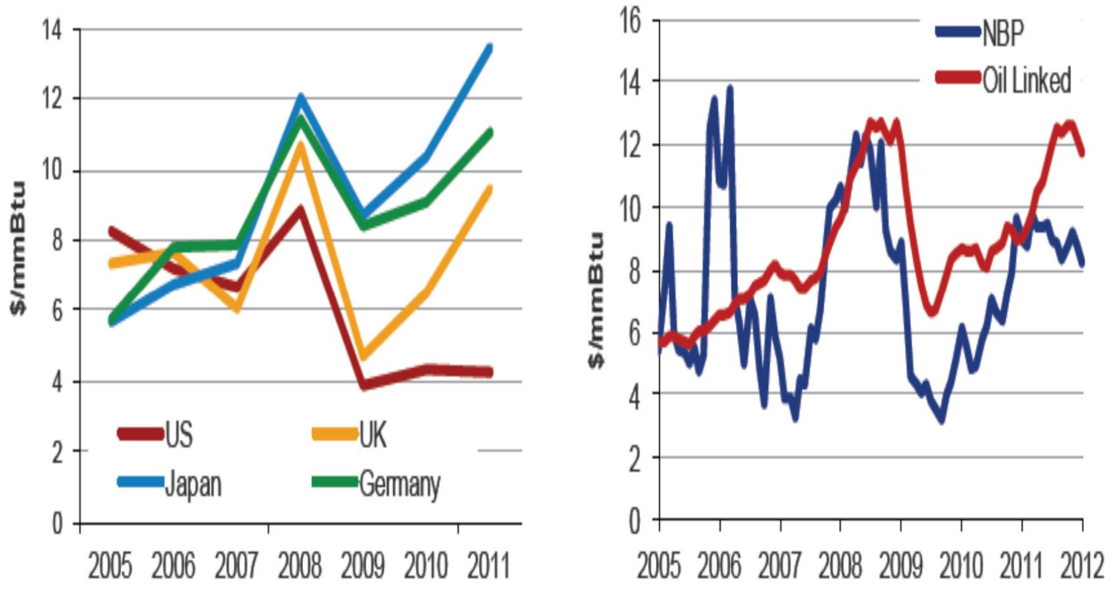
MTPA = million tonnes per annum

Source: IGU 2012, 36.

Prior to 2004-2005, the spot trade accounted a tenth of the total LNG trade. In 2011, this share was more than a quarter, which means than the spot LNG trade covers 2-3 percent of global gas consumption. In other words, the overwhelming majority of gas consumption is still met with long-term agreements – either long-term pipe deliveries or long-term LNG deliveries[13]. I believe that the long-term agreements will dominate the global gas trade for a long time, though the share of spot trading would increase to some extent.

The International Gas Union states as follows (IGU 2012, 6): "*In spite of increased interregional trade, there is still no 'global' gas market. Value continues to be set by micro factors – such as location, contract structure and timing – more than the global balances. Prices even vary within markets, with multiple sources of supply contracted at distinct price levels. This is not expected to change in the near term, especially given the long term nature of many existing contracts*".

Graph 5. Gas prices in selected markets and European gas prices
(oil-linked vs. spot gas[14])



mmBtu = million British termal units

Source: IGU 2012, 50.

[13] Spot trade is defined as any transaction that is not supported by a contract with duration of more than four years (IGU 2012).
[14] In Europe, the most important hub is the National Balance Point (NBP) in the United Kingdom, which is a virtual trading point for Intercontinental Exchange (ICE). It contains both a spot and a futures market (IGU 2012).

Graph 5 shows that during the past 5-6 years, the spot gas has been less expensive than the oil-linked gas prices. The price difference may remain in the favour of spot gas in the near future, since LNG supply have increased due the unconventional gas revolution and the LNG receiving capacity continues to grow at a rapid pace. Although it is not easy to compare the prices of LNG and pipeline gas due to the differences in production, logistics and trade, it is self-evident that increasing gas supply is good for consumers, since it usually pushes gas prices down. Furthermore, LNG may increase security of supply via the diversification of gas suppliers.

At the end of 2011, the global LNG fleet consisted of 360 vessels with a combined capacity of over 50 million cubic meters. The total capacity in 2011 was more than 1.5 times the fleet size five years earlier. At the end of 2011, approximately a tenth of the global LNG fleet was over 30 years old (IGU 2012). Typical LNG carriers have a loading capacity of 145,000-200,000 cubic meters of LNG (Stenkvist 2011).

The LNG represents a quarter of the EU's gas imports (a bit more than 15% of the EU's total gas consumption), whereas the pipelines cover the remaining three quarters of the imports. In 2010, nearly a half of the EU's LNG imports came from Qatar. The share of both Nigeria and Algeria was close to one fifth. In other words, the aforementioned trio takes practically care of the EU's LNG supplies (Eurogas 2011).

All gas arriving from Russia to the EU is piped[15]. The major importers of LNG within the EU are Spain, the United Kingdom, France, Italy, and Belgium. They covered 95 percent of the EU's LNG imports in 2010. None of the BSR countries imported LNG in 2010 (Eurogas 2011).

The EU's LNG regasification capacity has more than doubled in the last five years. In 2010, the EU provided a total regasification capacity of 175 bcm per annum with 18 LNG terminals. Here, one should pay attention that the nominal capacity and the real regasification differ quite a lot. The EU's total LNG imports in 2010 were slightly below 80 bcm, though the regasification capacity is twice as much (Eurogas 2011). The difference between the nameplate capacity and real regasification should be taken into

[15] Russia occupied 4% (10.5 mt) of the global LNG exports in 2011. Russia exports LNG from the Sakhalin to the Asian countries. Close to 95% of the Russian LNG exports went to Japan and South-Korea. China's share in the Russian LNG sales was less than 2% in 2011 (IGU 2012). Gazprom also owns some units abroad, which sell LNG, but their LNG deliveries are insignificant when compared to the deliveries of the mother company, Gazprom.

account when assessing the impact of the LNG terminals on the diversification of the gas supply in the Baltic Sea region.

The International Gas Union states "*Over the past years, a large number of countries have proposed to import LNG – but a much smaller number has actually done so. How many countries will be able to overcome the commercial and logistical complexities of developing LNG import capacity?*" (IGU 2012, 34). Guided by the aforementioned statement is good to begin the analysis of the LNG terminal projects around the Baltic Sea country by a country.

<u>Denmark:</u> Denmark pipes all its gas imports (0.15 bcm from Germany), and similarly, all its gas exports are delivered via pipes (3.5 bcm). A half of the Danish gas exports ends in Sweden, a third in Germany, and the remaining stake in the Netherlands. Denmark has neither LNG plant nor LNG terminal, and it has no plans to construct a major unit in the near future (Energy Delta Institute 2011). On the other hand, ships and heavy duty trucks operating over long distances may start to use LNG, and therefore, it has been predicted that LNG demand in Denmark could reach 0.5-0.6 bcm annually. Earlier studies do not indicate when LNG consumption would grow to the aforementioned level (Näslund 2012).

<u>Estonia:</u> The country receives all its gas from Russia via pipe (0.7 bcm). A lesser part comes directly (0.2 bcm) from Russia and the main part (0.5 bcm) via Latvia (Appendix 4). Currently, Estonia does not have any LNG receiving terminals but it has plans to build one or two. Two LNG terminal plans exist; one unit is planned in Paldiski, 50 km west of Tallinn, and one in the port of Tallinn, Muuga.

The nameplate capacity of the Paldiski could go up to 2.5-3.0 bcm. The estimated cost of the Paldiski terminal is € 350-500 million. The project is developed by Balti Gaas, a company owned by Baltic International Trading, Paldiski Arendamise and Sergey Timoshenko. It seems that Balti Gaas is ultimately under control of Russian businessmen. It is impossible to estimate from public sources how closely these Russians are linked with the governmental structures of Russia.

The Tallinn project has been initiated by Elering, a fully state-owned corporation, and the Port of Tallinn. The annual capacity of the terminal may go up to 3.0 bcm and its planned costs are around € 250 million. I assume that ultimate construction costs exceed those mentioned in public. The estimated time of construction is four years from the final investment decision and the location of the terminal will be in Muuga, a part of the Port of Tallinn.

There is also a proposal to build a joint Finnish-Estonian LNG terminal either on the Estonian or on the Finnish soil and to lay a gas pipeline under the Gulf of Finland to connect Estonia and Finland. I regard this proposal as an idea rather than a plan. At the moment, no gas pipeline exists between these countries but such a pipeline, Balticconnector, could be build, provided that a major LNG terminal will be built either on the Estonian or on the Finnish territory – or both.

I assume that there will be only one major LNG terminal in Estonia. I guess that Elering's plan may be more realistic due to security considerations of the Estonian state. Whatever unit will go forward, it is rather certain that the terminal's annual regasification capacity will be much smaller than that indicated in the plans. When analysing the possible size of the LNG terminal, one should remember that Estonia's total gas consumption is just 0.7 bcm. Even if the utilisation rate of the LNG terminals usually does not exceed 50-70 percent, the proposed LNG terminal size is far too big for the Estonian needs alone.

Finland: The first natural gas liquefaction plant in Nordic countries was built in Sköldvik/Kilpilahti, Finland. It is small scale unit that mainly serves the Finnish needs (Näslund 2012). Gasum, a gas distribution company partially-owned by Gazprom, plans to build a major LNG terminal, the Finngulf LNG, in either Inkoo or Porvoo. The nameplate capacity of this LNG terminal could go up to 2.0 bcm. The first stage of the terminal could be in operation already in 2015. It is assumed that the facility will receive its maximum capacity by 2018, and the costs of the project are estimated to be € 200-400 million depending on the final size of the terminal.

Hopefully, Gazprom's partial ownership in Gasum (a quarter) does not slow down the project, since these LNG deliveries may compete with the pipeline deliveries from Gazprom. In this context, one should keep in mind that the main owner of Gasum, Fortum (31%), is strongly committed to the Russian electricity market via its € 3 billion investment in the electricity generation in the Ural Federal District, Russia. Here, it needs to be remembered that natural gas is a major source of energy in Fortum's units in Russia. Together the ownership of Gazprom and Fortum exceeds 50 percent in

Gasum, and hence, Gazprom and Fortum may together stop the Finngulf LNG project if they wish. Therefore, it would be wise to study in detail why Gazprom wishes to build infrastructure which would start to compete with its pipeline deliveries.

In addition to this Finngulf LNG terminal, Finland plans to erect a small LNG unit in South-West Finland. The task of this small scale unit is to bunker LNG-driven ferries and ships. The BSR will most likely witness several LNG fuel stations for ships by the end of the next decade, since the restrictions on sulfur emissions of the ships sailing in the Baltic Sea promotes the LNG-driven vessels. At least the following ports have agreed to promote the development of LNG bunkering infrastructure: Aarhus, Helsingborg, Helsinki, Malmö-Copenhagen, Riga, Stockholm, Tallinn and Turku.

Germany: Depending on a source of information the country consumes some 70-100 bcm of gas annually of which close to 15 percent is produced domestically. Germany is a major net importer of natural gas, though it also exports some 16 bcm of gas. All of gas arriving to Germany is piped. The major external sources are Russia (39%), Norway (33%) and the Netherlands (24%).

Germany does not have any LNG receiving terminals. However, before the Nord Stream consortium received green light to build direct pipes from Vyborg to Greifswald, Germany proposed several LNG receiving terminals, such as Wilhelmshaven 1 (capacity: 10.8 bcm), Wilhelmshaven 2 (5.2 bcm), Rostock (2.5 bcm) and Lüpeck (Energy Delta Institute 2011). All the aforementioned LNG projects seem to be on ice now.

A small scale LNG terminal may appear in Rostock, but its significance to the German gas supply diversification is non-existent[16]. In this context, one needs to mention that the Nord Stream consortium controlled by Gazprom considers building two additional gas pipes from Russia to Germany.

Latvia: Similarly to Estonia, all of Latvia's gas is piped from Russia. 1.4 bcm arrives directly from Russia and 0.2 bcm via Lithuania. Out of this imported gas, 0.5 bcm is re-exported to Estonia (Appendix 4). Latvia plans to build an LNG receiving terminal with

[16] Puka (2012) states that a tenth of the German market benefits indirectly from spot gas trade. Furthermore, the German gas companies, E.On and RWE, have invested in LNG projects abroad.

a nominal capacity of 2.0 bcm in Riga[17]. The proposed nameplate capacity of this terminal is too high to serve Latvian gas consumption alone. As the common Baltic LNG terminal[18] is frozen, the downgrading of the Latvian terminal plan is probable. Despite the possible failure of the common Baltic LNG terminal, I assume that Latvia is committed to build its own LNG terminal.

It will be seen whether the Baltic States will be more cooperative in terms of gas storage. Here, it needs to be underlined that the only storage in the Baltic States with a strategic capacity (2.3 bcm) is located in Inculkalns, Latvia.

Lithuania: Lithuania is a major consumer of natural gas (3.1 bcm in 2010), taking into consideration its populations size. Lithuania receives some 5.1 bcm of gas from Russia via Belarus. Out of this amount Lithuania sends 1.8 bcm to Kaliningrad, the Russian exclave located between Lithuania and Poland, and 0.2 bcm to Latvia (Appendix 4).

Lithuania does not have any other source of gas supply except Russia, and therefore, it vigorously plans to construct an LNG terminal by the end of 2014, but a slight delay is possible. The terminal will be a floating one and could have a start-up capacity of 1.0 bcm that can be extended afterwards to 2.0-3.0 bcm[19]. The terminal will be erected in Klaipeda, which is located approximately 300 km north-west of the Lithuanian capital, Vilnius. The developer of this project is Klaipedos Nafta, a state-controlled oil company, which operates the oil terminal in Klaipeda.

In order to stabilise its external energy supply, Lithuania has a burning need to go forward with the terminal plan, since its dependence on Russian deliveries have substantially increased after the complete closure of the Ignalina nuclear power station at the end of 2009. Therefore, Lithuania has been the fastest among the Baltic States to implement the EU's Third Energy Package. Due to the execution of the package,

[17] Ventspils has also been mentioned as a possible location in earlier plans, but nowadays the Riga proposal has received backing by the authorities and businessmen.

[18] According to the Baltic Times (2012), the EU will fund the LNG terminal only if all Baltic States participate. However, the participation of the members is not certain since the Baltic States have been trying to reach an agreement on having a regional LNG terminal since 2008 (EurActiv 2011). On the other hand, one should not lose faith completely, since the European Commission is currently preparing an analysis on which location would be the most suitable for a common LNG terminal in the Baltic States.

[19] It has also been proposed that the floating unit could move between Klaipeda and Riga, where it would stay during the summer time and supply Latvia's underground storage in Inculkalns, and then, relocate back in Klaipeda in the winter time. It remains to be seen whether such an intelligent form of co-operation will finally be executed or whether it will be blocked by Latvia's wish to have its own national terminal.

Lietuvos Dujos, Lithuania's national gas company, is to be split into two separate firms by 2014; one dealing with gas trade, and the second one with gas transmission. The Lithuanian Government seeks to deprive Gazprom of control over Lithuanian gas grid, so that Gazprom and the LNG terminal will have an equal access to the transmission infrastructure (Hyndle-Hussein 2012).

I assume that the final capacity of the terminal could be less than 2.0-3.0 bcm referred by the public sources. However, the LNG terminal will have a substantial impact on the Lithuanian gas diversification if its annual regasification volumes will go above one billion cubic meters.

Norway: According to Energy Delta Institute (2011), Norway produced some 106 bcm of gas in 2010. Around 6 cm is consumed domestically and the rest is exported. Five main importers of Norwegian gas are Germany (27%), France (12%), the Netherlands (10%), Belgium (7%) and Italy (6%). The overwhelming majority of Norwegian gas is exported via pipelines to the European gas network, and through this network to final consumers. The International Gas Union (IGU 2012) indicates that the Norwegian LNG exports amounted to less than 5 bcm in 2010, and the main recipients of the Norwegian LNG were Spain (38%), the UK (20%) and the USA (15%).

Norway has one major LNG plant, Snøhvit with the capacity of 6 bcm. Statoil Hydro, a Norwegian state-owned hydrocarbon producer, is the main owner of the field. Besides Snøhvit, there are two middle-sized plants with the combined capacity of 0.6 bcm. Risavika is owned by Skangass and Kollsnes by Gasnor. In addition to the aforementioned three plants, Norway has two small-scale plants; one in Karmöy and one in Tjeldbergodden.

Besides LNG plant, Norway has also erected LNG receiving terminals. The country possesses over 40 LNG receiving terminal designed for the domestic gas distribution. The majority of them are owned by Gasnor and Skangass (Stenkvist 2011)[20].

[20] Until recently, RD Shell used to be a minority owner (4%) of Gasnor. However, Gasnor has agreed to sell all its shares to RD Shell. The transaction will be concluded by the end of 2012. In turn, Lyse owns Skangass. Correspondingly, Lyse is owned by 16 municipalities in the Southern Rogaland district of Norway.

Most of Norway's LNG exporting capacity is in use, and therefore, one should not be overoptimistic about Norway's capacity to send major amounts of LNG to other parts of the BSR if Norway does not increase its LNG exporting capacity.

Poland: Gas plays a much smaller role (less than 15%) in the country's PEC than generally believed. Poland does not use more than 15-17 bcm of gas out of which 11 bcm is imported. Nearly 90 percent of imports originate from Russia, whereas the remaining 10 percent comes from Germany (Energy Delta Institute 2011).

At least until the mid-2014, all Poland's gas will be imported via the pipes, but thereafter, a significant amount of gas (2.5-5.0 bcm) could be received by the Swinoujscie LNG terminal, called Gazoport, located in South-West Poland. Probably, Qatar will most likely be the long-term supplier of LNG to the Polish terminal. Despite the progress of the project (a quarter of the project has been completed by the summer of 2012), one cannot exclude a considerable delay due to the bankruptcy of some building companies involved in the LNG project. In fact, the project was already late by four months in the summer of 2012.

The project may cost approximately € 1 billion. The terminal is controlled by Polskie LNG, a subsidiary of Gaz-System. Gaz-System is a completely state-owned firm. The terminal may receive vessels of about 70,000 DWT, transporting some 145,000 cubic meters of LNG. In addition to this LNG terminal, a direct gas pipe from Denmark to Poland has been proposed. This pipeline would further diversify Poland's gas supply.

Russia: Russia is a major exporter of gas in the globe. Energy Delta Institute (2011) refers to that the country's exports reached nearly 180 bcm in 2010. The overwhelming majority of Russian gas (over 50%) ends in the EU. Other major recipients of Russian gas are Ukraine (21%), Belarus (12%) and Turkey (10%). According to the International Gas Union (IGU 2012), Russia's LNG exports amounted to 14 bcm out of the total exports of 180 bcm in 2010 i.e. over 90 percent of the Russian gas exports are tied to the pipes.

Russia's two major LNG plants with the nameplate capacity of 14 bcm are located in the Sakhalin Islands. In 2010, more than a half of the Russian LNG (59%) was sold to Japan and 32 percent to South Korea. The share of China was only 3 percent, reflecting that China is not ready to pay sufficient price for gas yet. Russia did not sell any of its LNG produced in Russia to Europe.

In addition to two Sakhalin units, the Yamal LNG plant has been planned. This plant could be in operation in 2018 with the annual capacity of 20 bcm. The project may get the final investment decision at the end of 2012 but only few would be surprised if the project would be postponed in a similar manner as the Shtokman field. It is possible in principle that the Yamal LNG plant controlled by privately-run Novatek could serve the needs of the LNG receiving terminals of the BSR[21]. However, the Russian Government may not tolerate that privately-owned Novatek would start to compete with the pipeline deliveries of state-owned Gazprom. On the other hand, the BSR governments may wish to diversify the country where gas comes from, not only the company which sells gas i.e. this would put Novatek in an unfavourable position in the future LNG competition in the BSR.

The Shtokman LNG plant with the planned capacity of 10 bcm has been postponed indefinitely, and it may remain idle for a very long time despite public statements indicating fast return of the project.

The Baltic LNG plant, which was to be placed in the Russian part of the Gulf of Finland, was canceled by Gazprom in 2008. In March 2012, the majority of this project (80%) was sold to Sibur, a subsidiary of Novatek. The original size of the project was 6.8-9.8 bcm with a budget of around € 3 billion, but under the prevailing circumstances, the proposal to build a plant with a nominal capacity of 2.0 bcm sounds more realistic. The location of the Baltic LNG plant will be in Primorsk, the Leningrad region, close to the Finnish-Russian border. It has been estimated that the project can be completed within 2-3 years after the final investment decision. I believe that the Baltic LNG terminal will not become operational prior to 2018. In addition to the aforementioned Primorsk unit, Sibur aims at starting export deliveries of liquefied petroleum gas (LPG) from Ust-Luga, a port close to the Estonian-Russian border, in 2013. A delay of implementing this project could happen.

[21] Russia may aim to meet the gas needs of some Asian countries from the Yamal LNG plant via the North-East Passage. On the other hand, one should also keep in mind that China does not pay a sufficient price for gas at the moment, and secondly, the passage is truly operational only during a few months of the year.

Even if Gazprom has earlier rejected the Baltic LNG project, it has recently expressed a plan to build a small scale plant in Kaliningrad. Furthermore, Gazprom has proposed the construction of a major LNG plant in Vyborg. However, it is too early to comment how realistic these projects are, but it seems evident that Gazprom has once again become interested in LNG projects (Stenkvist 2011).

<u>Sweden:</u> Sweden consumes a small amount of gas (1.3-1.7 bcm) compared to its size. For instance, Finland, with a population a half that of Sweden, consumes almost three times more gas than its western neighbour. All gas deliveries to Sweden were conducted via pipeline from Denmark prior to opening of the LNG terminal in 2011. Due to the low level of gas consumption, it may seem surprising that Sweden was the first country in the Baltic Sea region to construct a major LNG terminal, but obviously Sweden has been motivated by opportunities created by gas bunkering business.

Sweden opened the Brunnsviksholme LNG terminal in Nynäshamn in May 2011. The nominal capacity of the Brunnsviksholme LNG terminal is 0.4-0.5 bcm. This LNG terminal will be supplied by a Norwegian Skangass LNG plant in Stavanger. The Brunnsviksholme terminal is owned by the industrial gas company AGA which is a part of the Linde group.

In addition to this terminal close to Stockholm, Sweden plans to open another facility with a capacity of 0.5 bcm in Gothenburg in 2013-2015. I guess that Norway will be the main supplier of the Gothenburg facility. If also the second terminal comes on stream, Sweden could in principle meet a lion's share of its gas consumption with LNG. On the other hand, I believe that Sweden's gas consumption may grow considerably from what it is at the moment.

Besides these two aforementioned major terminals, Sweden has proposed several small scale terminals. As an example, one can name the terminal plans in Helsingborg, Malmo, Stockholm and Sundsvall.

As the aforementioned description reveals, nearly 10 major LNG terminal plans exist in the BSR (Table 2). When assessing the impact of these LNG terminals on the diversification of gas imports, one needs to take into consideration the following facts. First, the capacity of LNG terminals, which will be in operation at the end of this decade, will be close to 10 bcm. Here, it is good to remind that the gas consumption of the BSR, excluding Denmark, Norway and Russia, is 100-130 bcm depending on a source of information. However, Germany's massive gas consumption combined with its lack of interest in building LNG terminals makes this overall analysis biased. For smaller BSR countries these LNG terminals could be extremely strategic investment in order to diversify gas imports.

On the basis of these figures, one may safely conclude that the LNG does not replace pipeline gas in the foreseeable future in the BSR. Secondly, Russia's role as a gas supplier to the BSR countries, excluding Denmark, Norway and Sweden, will remain substantial. Even if one should not overstate the impact of the LNG terminals on the gas import diversification, they nevertheless, bring the needed diversification in certain BSR countries and more importantly, they introduce competition, which is rarely bad for consumers' gas bill.

Table 2. Some major LNG liquefaction plants and regasification terminals in the Baltic Sea[22]

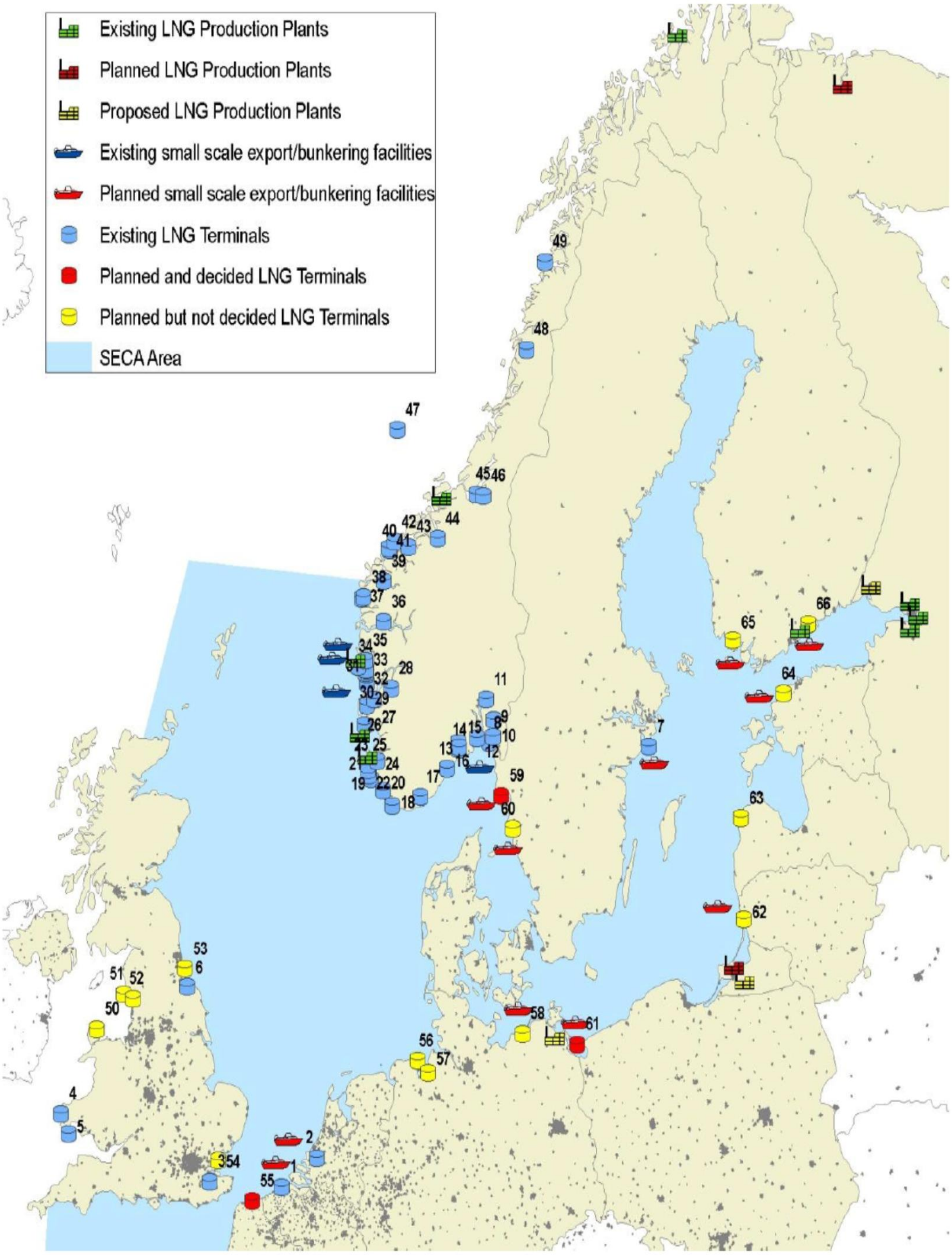
	Name & location	Annual capacity (bcm)	Status
Denmark	No existing LNG plants or terminals – no information about plans to build a major LNG unit		
Estonia	Paldiski LNG terminal (50 km west of Tallinn)	2.5-3.0	Planned (in operation 2015)
	Muuga LNG terminal (Tallinn)	3.0	Planned (in operation 2016-2017)
Finland	Porvoo / Inkoo LNG term. (50 km of / 60 km of Helsinki)	Up to 2.0	Planned (in operation 2015-2018)
Germany[23]	Wilhelmshaven LNG term. (1&2)	16.0	Suspended
Latvia	Riga LNG terminal	2.0	Planned
Lithuania	Klaipeda LNG terminal (300 km north-west of Vilnius)	1.0-3.0	Planned (in operation 2014-2015)
Norway	Snøhvit LNG plant (connect to the Melkoya Island with a 160-km-submarine pipe)	5.8	On stream since 2007
	Risavika LNG plant (close to Stavanger)	0.4	On stream since 2011
	Kollsnes LNG plant (1 & 2)	0.2	On stream since 2003
Poland	Swinoujscie LNG terminal (close to Szczecin)	2.5-5.0 with upgrading potential to 7.5 by 2020	Under construction (in operation 2014-2015)
Russia	Baltic LNG plant (Primorsk 100 km north-west of St. Petersburg	2.0 (downsized from original plan of 6.8-9.8. bcm)	Cancelled by Gazprom in 2008, acquired by Sibur (Novatek) in March
Sweden	Brunnsviksholme LNG term. (Nynäshamn)	0.4-0.5	On stream since 2011 (onshore)
	Gothenburg LNG terminal	0.5	Planned (in operation 2013-2015)

Sources: Compiled by the author

[22] Liquefaction plant indicates a possibility to export LNG and regasification terminal readiness to import LNG. The information presented in the table is gathered from various public sources. Information is rather contradictory, and hence, the table may contain errors. Moreover, the situation develops rather quickly, and hence, the data needs constant updating. This table was completed in September 2012.

[23] The Global LNG Info (2012) mentioned only the Wilhemshaven LNG terminal plan in its list. According to the Global LNG Info, the project has been suspended. In fact, this project has stalled already in the autumn of 2008, but the revitalisation of this project is possible depending on the development of the LNG prices. The Global LNG Info did not mention anything about Germany's earlier LNG terminal plans i.e. Lübeck and Rostock proposals.

Map 1. Existing, planned and proposed LNG plants and terminals in northern Europe



Source: Stenkvist 2011.

3 A summary

One can summarise the findings of this study as follows:

- ***Denmark*** has no intentions to build a major LNG plant or terminal in the foreseeable future. However, I would not exclude the possibility of the construction of small scale LNG plants, since annual consumption of LNG in Denmark may exceed 0.5 bcm.

- ***Estonia*** will host only one major LNG terminal. I believe that the project proposed by the Estonian state will go forward. Most probably, the size of this terminal will be smaller than indicated in the plans. I guess that the nameplate capacity of the Estonian LNG facility will be close to 1.0 bcm if it will be implemented on the national basis. I estimate that the LNG unit will be operational by the end of this decade.

- Gasum's plan to construct a major LNG receiving terminal in ***Finland*** seems realistic as long as Gazprom does not start to slow down the project from within the firm. Here it needs to be underlined that Gazprom owns a quarter of Gasum and may influence decision-making of Gasum's main owner (Fortum) via its gas supplies to the company's electricity generation units in the Urals. Gazprom/the Russian Government may consider that there is a conflict of interests between the proposed LNG terminal and Gazprom's gas pipe deliveries to Finland. As there is no clear understanding of Gazprom's real motives, it is impossible to predict the final size and timetable of this unit despite detailed plans. Should the terminal reach the proposed 2.0-bcm-capacity, then it could have a major impact on diversifying Finnish gas imports. In addition to this major terminal, Finland will build a small scale unit to bunker LNG ferries and ships in South-West Finland.

- ***Germany*** may prefer to build additional pipes from Russia rather than construct LNG receiving terminals. Even if Germany would decide to build a small scale LNG terminal in Rostock, it does not have a major impact on the gas diversification of the country, since the terminal would meet less than 2-3 percent of Germany's total gas consumption.

- I would not be surprised if ***Latvia***'s LNG project would slightly be postponed from the original plan. Furthermore, the downgrading of the project seems inevitable as the common Baltic project does not seem to materialise.

- ***Lithuania*** has progressed most among the Baltic States with its LNG receiving terminal. It has declared to open the first LNG terminal in the Baltics already at the end of 2014, though most probably the terminal will be babtised during 2015 due to a slight delay.

- ***Norway***'s LNG exporting capacity is nearly in full utilisation at the moment. Therefore, it is not self-evident that Norway will be the main supplier of the LNG terminals in the BSR, unless Norway constructs new LNG plant or expand the existing ones.

- ***Poland*** tries to open its LNG terminal in 2014, though a delay up to 1-2 years is possible, since one of the main constructing companies involved has gone bankrupt. It cannot be excluded that the terminal's capacity would go with time to 7.5 bcm, but I assume that 2.5-5.0 bcm seems at the moment more realistic.

- ***Russia:*** Sibur, a subsidiary of Novatek, plans to build a plant with a nominal capacity of 2.0 bcm. The location of the Baltic LNG plant will be in Primorsk, the Leningrad region, close to the Finnish-Russian border. It can be estimated that this terminal could be operational by 2018. This project will proceed if the Russian Government considers that Novatek would not start to compete with the pipeline deliveries of Gazprom. In other words, this would mean that Sibur's main clientele would be outside the BSR. In addition to this plant, Sibur plans to erect a liquefied petroleum gas unit in Ust-Luga, a port close to the Estonian-Russian border, in 2013.

- ***Sweden*** opened the first LNG receiving terminal in the BSR in May 2011. Sweden may well proceed with another LNG unit in Gothenburg in 2013-2015. These two terminals with the combined capacity of 1.0 bcm can cover a major part of Sweden's gas consumption (1.3-1.7 bcm). On the other hand, I assume that gas consumption in Sweden will substantially increase, since the country uses little gas compared to its size. Besides these major LNG receiving terminals, there are plans to build at least five small scale LNG terminals. I assume that not all of these small scale units will see daylight.

To sum up, it is more than likely that the BSR will not witness all the LNG terminal plans in their planned capacity[24]. Second, the postponement of some of these projects is evident. Third, it is important to remember than the nameplate capacity of the terminals is much higher than the actual regasification volumes. On the other hand, for some BSR countries these LNG terminals might prove to be extremely strategic investments, even if their realized capacity would be smaller than the planned one (Table 3).

Table 3. The strategic importance of the existing or planned LNG terminals to the gas supply of the BSR (excluding major gas producers in the region i.e. Denmark, Norway and Russia)

	Maximum capacity of planned LNG terminals (bcm)	Gas consumption of the country (bcm)	Ratio*
Estonia	6.0	0.7	8.57
Finland	2.0	3.6	0.55
Germany**	0.0	72.5	0.00
Latvia	2.0	1.2	1.67
Lithuania	3.0	3.4	0.88
Poland	7.5	15.4	0.49
Sweden	1.0	1.3	0.77
Total	21.5	98.1	0.22
Total to be realised by 2020 (author's guess)	less than 10	98.1	less than 0.10

* Ratio value of 1.00 means that the country could meet the nation's all gas consumption with LNG. Here one needs to stress that the planned nameplate capacity is much higher than the regasification volumes of the realised LNG terminals.

** Suspended terminal plans have not been included here.

See: Table 2 and Appendix 3

[24] For instance, the total gas consumption of the Baltic States is around 5 bcm, whereas the proposed LNG terminal capacity is over 10 bcm.

All in all, one can safely conclude that the LNG terminals of the eastern BSR will not replace Gazprom's deliveries but rather allow the BSR countries to diversify a proportion of their gas supply. On the other hand, these LNG terminals will introduce long waited competition which has a positive (lowering) impact on the price paid by the final consumers. And moreover, the LNG terminals will improve the security of gas supply, though the eastern BSR in particular cannot build its gas supply on the LNG deliveries alone. And finally, Gazprom's ongoing battle with the European Commission may lead to unexpected consequences already in this winter or by the next winter at the latest (BBC 2012; Russia Today 2012).

Epilogue

”I look to the future because

that’s where I’m going to spend the rest of my life”.

George Burns, US actor and comedian, 1896-1996

References

Baltic Times (2012) EU to fund LNG terminal only if all the Baltic States participate, http://www.baltictimes.com/news/articles/31577/

BBC (2012) Gazprom faces EU anti-competition probe, http://www.bbc.co.uk/news/business-19482312

BP (2011) Statistical Review of World Energy 2011, British Petroleum, www.bp.com

BP (2012) Statistical Review of World Energy 2012, British Petroleum, www.bp.com

BEMIP (2012) Gas Regional Investment Plan 2012-2021, http://www.gie.eu/memberarea/purtext_entsog_GRIP.asp?wa=plus_GRIP

Centre for Energy Economics (2012) http://www.beg.utexas.edu/energyecon/ lng/LNG_introduction_06.php

Centre for Global Energy Studies (2010) What is unconventional gas ?, http://www.cges.co.uk/resources/articles/2010/07/21/what-is-unconventional-gas

Energy Delta Institute (2011) http://www.energydelta.org/

EurActiv (2011) Baltic countries ask EU to solve LNG terminal row, http://www.euractiv.com/energy/baltic-countries-ask-eu-solve-ln-news-508935

Eurogas (2011) Eurogas Statistical Report 2011, http://www.eurogas.org/figures_statistics.aspx

Gazprom (2012) Annual Report 2011, www.gazprom.com

Global LNG Info (2012) World’s LNG Liquefaction Plants and Regasification Terminals As of June 2012. http://www.globallnginfo.com/ World%20LNG%20Plants%20&%20Terminals.pdf

Hyndle-Hussein Joanna (2012) Lithuania's parliament adopts a law to build an LNG terminal near Klaipeda, CE Weekly 20.6.2012, Centre for Eastern Studies, Warsaw http://www.osw.waw.pl/en/publikacje/ceweekly/2012-06-20/lithuanias-parliament-adopts-a-law-to-build-lng-terminal-near-klaiped

IEA (2012) Golden Rules for a Golden Age of Gas, International Energy Agency. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/WEO2012_GoldenRulesReport.pdf

IGU (2011) World LNG Report 2010, International Gas Union, http://www.igu.org/igu-publications/IGU%20World%20LNG%20Report%202010.pdf

IGU (2012) World LNG Report 2011, International Gas Union, http://www.igu.org/igu-publications/LNG%20Report%202011.pdf

Kümpel Hans-Joachim and Messner Jürgen (2012) Future Gas Supply from the German Perspective; Domestic Production and Import, St. Petersburg International Gas Forum, St. Petersburg, 4-6 June 2012.

Liuhto Kari – ed. (2009) The EU-Russia gas connection: Pipes, politics and problems, Pan-European Institute, http://www.tse.fi/FI/yksikot/erillislaitokset/pei/ Documents/Julkaisut/Liuhto%200809%20web.pdf

Liuhto Kari (2010) Energy in Russia’s Foreign Policy, Pan-European Institute, http://www.tse.fi/FI/yksikot/erillislaitokset/pei/Documents/Julkaisut/Liuhto_final.pdf

McClay Sebastien and Ortmans Laurent (2011) Physical gas flows across Europe and security and diversity of gas supply in 2010, Department of Energy & Climate Change, http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-trends/articles/3928-physical-gas-flows-europe-2010.pdf

Levi Michael (2012) A Strategy for U.S. Natural Gas Exports, Brookings Institute, http://www.brookings.edu/research/papers/2012/06/13-exports-levi

Ministry of Energy of the Russian Federation (2010) Energy strategy of Russia, http://www.energystrategy.ru/projects/docs/ES-2030_(Eng).pdf

NETL (2011) Shale Gas: Applying Technology to Solve America's Energy Challenges, National Energy Technology Laboratory, http://www.netl.doe.gov/technologies/oil-gas/publications/brochures/Shale_Gas_March_2011.pdf

Näslund Michael (2012) LNG – Status in Denmark, http://www.dgc.eu/publications/pdf/lng_status.pdf

Puka Lidia (2012) Adding Fuel to Gas Market Changes: Liquefied Natural Gas Development in the EU, http://www.pism.pl/publications/bulletin/no-82-415

Reuters (2011) Poland may start shale gas production in 2014: PM, http://www.reuters.com/article/2011/09/18/us-poland-shale-idUSTRE78H0Y120110918

Reuters (2012) US likely to gap gas exports – analysts, http://in.reuters.com/article/2012/06/08/usa-lng-exports-idINL5E8H678C20120608

Rozmarynowska Monika, Nawigacyjny Wydzial and Katedra Systemow Transportowych (2011) LNG supply in the Baltic Sea region, Port Technology International, pp. 121-126, http://www.porttechnology.org/images/uploads/technical_papers/PT50-22.pdf

Russia Today (2012) Gazprom: EU using political pressure to angle for fuel prices, http://rt.com/news/gazprom-eurocomission-prices-conflict-875/

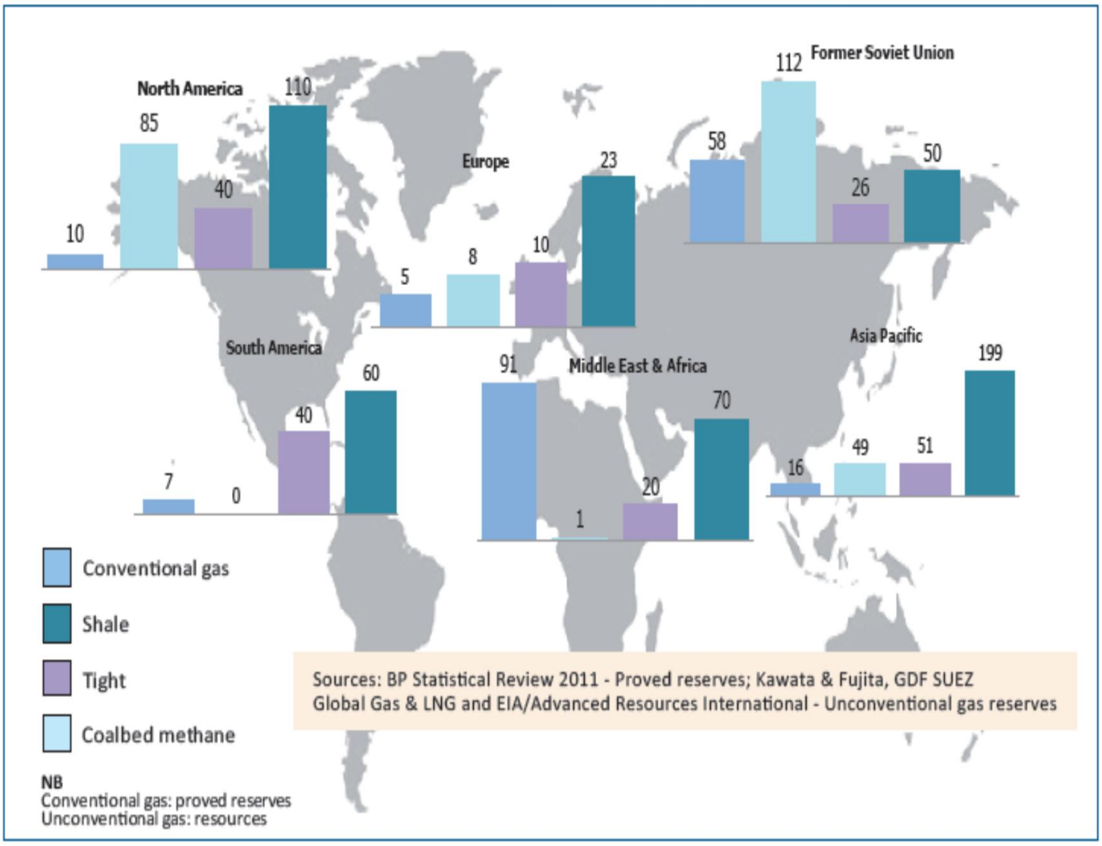
Stenkvist Maria (2011) North European LNG Infrastructure Project, http://www.dma.dk/themes/LNGinfrastructureproject/Documents/Documents/LNG_draft_FR_20111121_app_E.pdf

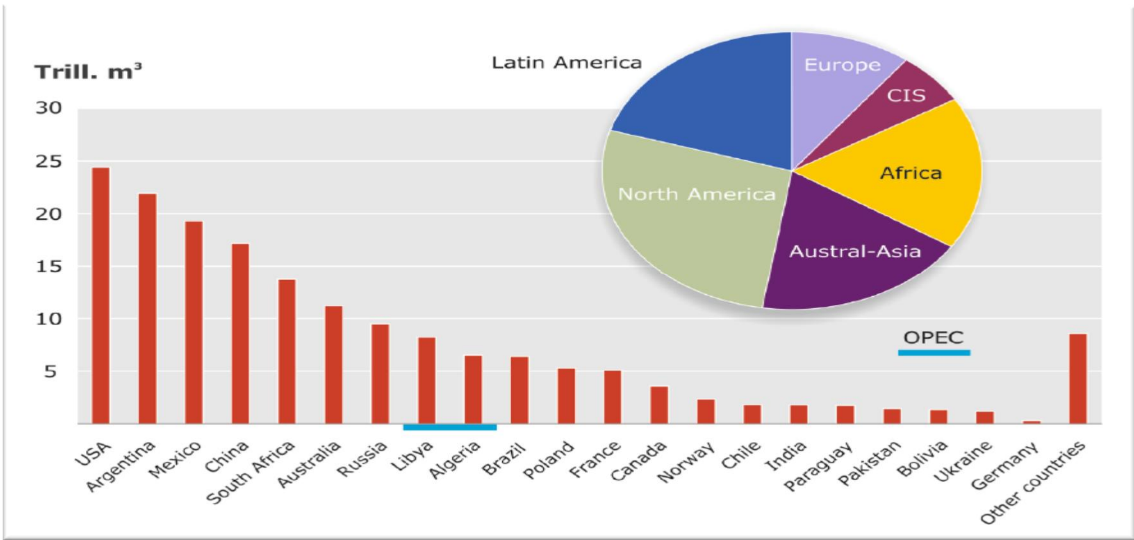
Strezelecki Marek (2012) Shale Boom in Europe Fades as Polish Wells Come Up Empty, http://www.bloomberg.com/news/2012-03-26/shale-boom-in-europe-fades-as-polish-wells-come-up-empty-energy.html

UPI (2012) Lower Poland shale gas reserves estimated, 23.3.2012, http://www.upi.com/Business_News/Energy-Resources/2012/03/23/Lower-Poland-shale-gas-reserves-estimated/UPI-90051332498600/

Appendices

Appendix 1. Estimated gas reserves of the world by gas form (-000 bcm)





Note: Poland's shale gas reserves were downgraded from 5,500 bcm to 350-800 bcm in 2012.

Sources: Eurogas 2011, 12; Kümpel Hans-Joachim and Messner 2012, 12.

Appendix 2. Potential location of unconventional gas reserves in Poland

Source: BIMEP 2012, 39.

Appendix 3. Natural gas consumption and production in the Baltic Sea region

Natural gas consumption[25]

Billion cubic metres	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011
Denmark	-	-	-	0.6	2.0	3.6	4.9	5.0	5.0	4.2
Finland	-	0.7	0.9	0.9	2.5	3.2	3.7	4.0	3.9	3.6
Germany	15.0	43.7	57.4	54.6	59.9	74.4	79.5	86.2	83.3	72.5
Lithuania	n/a	n/a	n/a	4.2	5.6	2.3	2.7	3.3	3.1	3.4
Norway	-	-	0.8	1.2	2.1	2.9	4.0	4.5	4.1	4.0
Poland	5.8	7.7	9.7	9.9	9.9	10.0	11.1	13.6	15.5	15.4
Russia	n/a	n/a	n/a	350.4	407.6	366.5	354.0	400.3	414.1	424.6
Sweden	-	-	-	0.1	0.7	0.8	0.7	0.8	1.6	1.3

Natural gas production

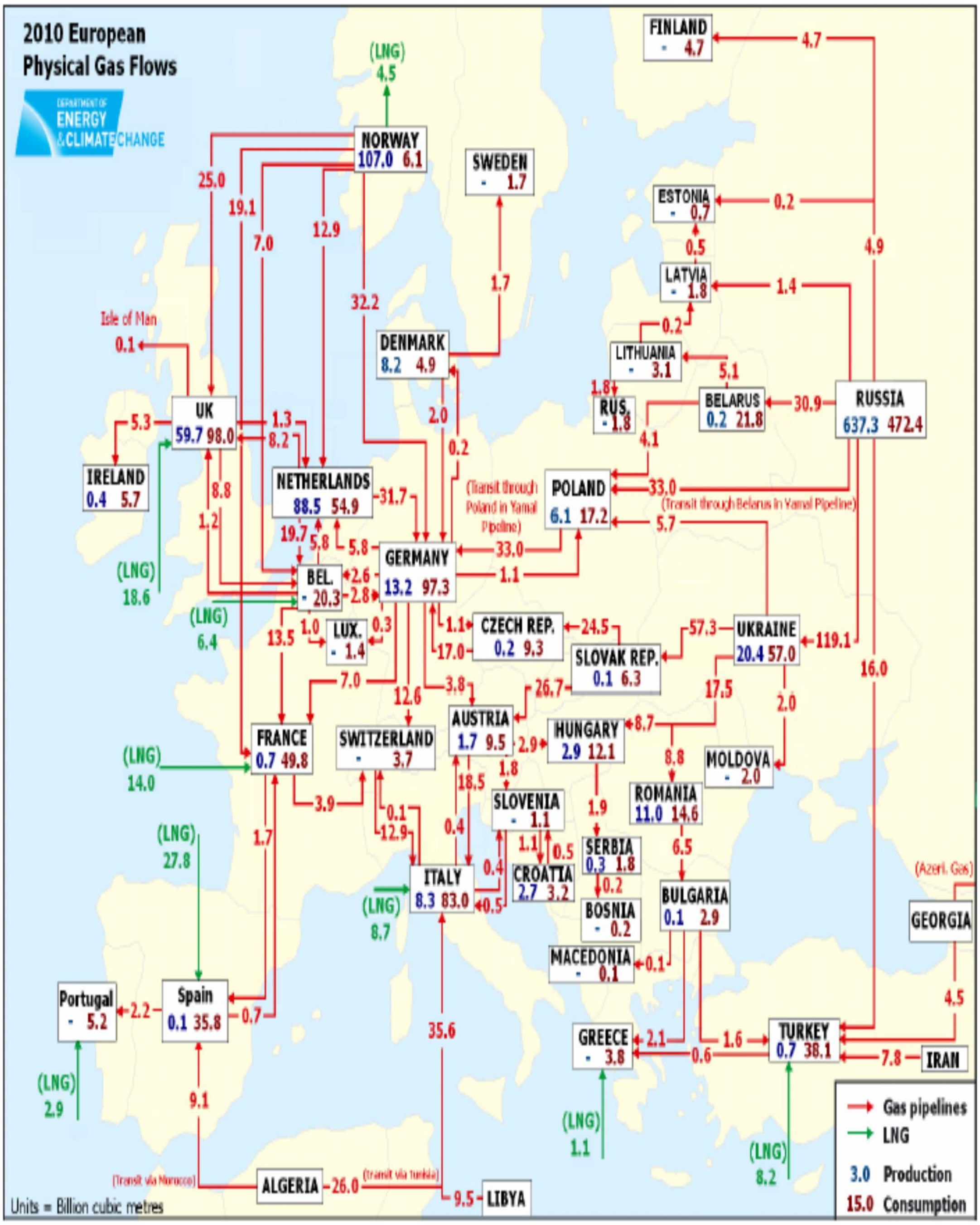
Billion cubic metres	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011
Denmark	-	-	-	1.1	3.1	5.3	8.2	10.4	8.2	7.1
Germany	11.0	17.7	18.5	17.4	15.9	16.1	16.9	15.8	10.6	10.0
Norway	-	-	25.1	26.2	25.5	27.8	49.7	85.0	106.4	101.4
Poland	4.9	5.4	5.0	4.6	2.6	3.5	3.7	4.3	4.1	4.3
Russia	n/a	n/a	n/a	418.1	590.0	532.6	528.5	580.1	588.9	607.0

The British Petroleum does not offer figures for Estonia and Latvia. Their natural gas consumption was, according to Gazprom, 0.7 bcm and 1.2 bcm respectively (Gazprom 2012). The Baltic States, Finland and Sweden do not produce any gas.

Source: BP Statistical Review of World Energy 2012, 22-23.

[25] Other sources give somewhat different figures. For instance, the gas consumption of Germany was around 97.3 bcm and Finland 4.7 in 2010 (Energy Delta Institute 2011).

Appendix 4. Gas flows in Europe in 2010



Source: *McClay and Ortmans, 2011, 112.*

Electronic publications of the Pan-European Institute in 2010-2012

Freely available at http://www.tse.utu.fi/pei

2012

4/2012
Mäkinen, Hanna (ed.)
Selected articles on modernisation and innovation in Russia

3/2012
Mäkinen, Hanna
Innovations in the Baltic Sea region

2/2012
Tsachevsky, Venelin
Five years of Bulgaria's membership into the European Union – the slow absorption of EU funds slackens Bulgaria's europeanization

1/2012
Tamulyte, Julija
The determinants of capital structure in the Baltic States and Russia

2011

6/2011
Hanson, Philip
Risks in Russia – is the environment changing?

5/2011
Liuhto, Kari
The Inauguration Address on the Occasion of Receiving the Honorary Doctorate at the Saint Petersburg State University of Economics and Finance

4/2011
Valdaytsev, S. – Sergeyev, A.
Technological innovations in Russia

3/2011
Agibalov, S. – Kokorin, A.
Copenhagen Agreement – A new paradigm for the climate change solution

2/2011
Laaksonen, Eini (ed.)
Baltic Rim Economies Expert Articles 2010

1/2011
Tsachevsky, Venelin
Bulgaria, the Balkans and the Pan-European infrastructure projects

2010

21/2010
Prazdnichnykh, Alexey – Liuhto, Kari
Can Russian companies innovate? – Views of some 250 Russian CEOs

20/2010
Mäkinen, Hanna
Energy efficiency – a new energy resource for Russia?

19/2010
Christie, Edward Hunter
The Russian gas price reform and its impact on Russian gas consumption

18/2010
Shadrina, Elena
Russia's foreign energy policy: norms, ideas and driving dynamics

17/2010
Christie, Edward Hunter
EU natural gas demand: uncertainty, dependence and bargaining power

16/2010
Tsachevsky, Venelin
Bulgaria's EU membership: the adaptation to the new status is not over

15/2010
Panibratov, Andrei
Russian multinationals: entry strategies and post-entry operations

14/2010
Laaksonen, Eini
Political risks of foreign direct investment in the Russian gas industry – The Shtokman gas field project in the Arctic Ocean

13/2010
Shashnov, Serguei – Prihodko, Serguei
Selection of priorities for innovation development of the region: Russian experience

12/2010
Prihodko, Serguei
Обследование инвестиционной активности предприятий в период экономического роста в России (2001-2005 гг.)

11/2010
Vahtra, Peeter
The Rusnano Corporation and internationalisation of Russia's nanotech industry
10/2010

Liuhto, Kari
Energy in Russia’s foreign policy

9/2010
Mäkinen, Hanna
The future of natural gas as the European Union’s energy source – risks and possibilities

8/2010
Zashev, Peter – Dezhina, Irina
Internationalisation of Russian small innovation companies: motives and limitations

7/2010
Kuznetsov, Alexey
Industrial and geographical diversification of Russian foreign direct investments

6/2010
Bogomolov, Oleg
Global economic crisis: lessons for the world and Russia

5/2010
Vahtra, Peeter
A dawn for outward R&D investments from Russia?

4/2010
Luukkanen, Arto
”…Miksi Neuvostoliitto laahaa teknologisesti USA:ta jäljessä?” – Tutkimuksen, kehityksen ja modernisaatioprosessien merkitys nyky-Venäjällä

3/2010
Hägerström, Markus
Arvio Venäjän valtionyhtiöiden toiminnasta

2/2010
Zasimova, Liudmila
Public policy and access to new drugs: evidence from Russian pharmaceutical market

1/2010
Heikkilä, Marika
Suomalaisinvestointien poliittis-hallinnolliset riskit Venäjällä, Ukrainassa ja Valko-Venäjällä

pan-european institute

www.tse.utu.fi/pei