



NORDIC & BALTIC POWER MARKET

CHALLENGES IN MARKET INTEGRATION

Elforsk report 12:17



Oliver Pearce, Hans-Arild Bredesen

May 2012

ELFORSK

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Preface

The Market Design research programme has been operating for more than 10 years. Over the time the focus has shifted from the national to the Nordic and, in certain cases, to the European level. This emphasis will continue over the next three years, with the European perspective dominating.

In this report written by Oliver Pearce and Hans-Arild Bredesen challenges towards a functioning integrated Baltic and Nordic power market are studied.

The Baltic network is highly integrated into the Russian system - which currently helps the Baltic states to maintain supply adequacy. It is however not consistent with the political decision the Baltic states have taken - to de-synchronise from the Russian network. The European Commission identified establishment of effective interconnection of the Baltic Sea region as a priority area in its Second Strategic Energy Review and integration into EU markets drives a number of requirements in terms of market design for the Baltic Markets. This report provides an overview of the progress that has been made and analyses the challenges remaining in integrating the Baltic Electricity markets into EU markets.

More information about the Market design Research program, finished reports and conference documentation can be found at www.marketdesign.se.

Stockholm, March 2012

Peter Fritz,

Secretary of the Market Design-program

Elforsk AB

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Sammanfattning

Bakgrund

Elforsk har bett Pöyry Management Consulting utreda framstegen som gjorts och utmaningarna som ännu inte lösts för integrationen av de baltiska energimarknaderna med EU:s marknad, som en del av Planen för sammanlänkning på den baltiska energimarknaden (Baltic Energy Market Interconnection Plan - BEMIP). Resultaten redovisas i denna rapport.

Europeiska kommissionen har i sin andra strategiska energiöversyn identifierat den effektiva sammanlänkningskapaciteten av länderna kring Östersjön som ett prioriterat energiprojekt. De två viktigaste målen för BEMIP-planen beträffande energimarknaderna är: (1) att fullständigt integrera de baltiska energimarknaderna med den europeiska och (2) förstärka sammanlänkningskapaciteten till EU:s grannländer.

Allmän situation

Enligt BEMIP-planen kommer sammanlänkningskapaciteten mellan energisystemen i de nordiska och baltiska länderna att utökas med nya kablar till Finland (Estlink II år 2014) och Sverige (NordBalt år 2015). Sammankopplingen av de litauiska och polska överföringsnäten kommer att följas av en ny back-to-back-strömriktarstation och för-stärkning av högspänningsnäten i Polen och Litauen. En elledning med en effekt på 500 MW mellan Litauen och Polen planeras att tas i bruk år 2015 och en annan 500 MW ledning år 2020.

Integrationen med EU-marknaden för med sig en mängd krav på marknadsstrukturen för de baltiska marknaderna. I BEMIP-planen har man kommit överens om att genom-föra en elmarknadsstruktur baserad på den nordiska elmarknadsmodellen. Man har kommit med förslag till en specifik handlingsplan som beskriver vilka praktiska åtgärder som krävs för att skapa den nya marknadsmodellen: Handelsplanen syftar till att undanröja hindren för en fungerande regional elmarknad i Östersjöländerna i enlighet med EU:s bestämmelser för den inre elmarknaden. I handlingsplanen ingår fyra åtgärder och den beräknas vara genomförd senast år 2015.

Vi har gått igenom framstegen som uppnåtts och jämfört dem med huvudåtgärderna i BEMIP-planen. Tabell 1 nedan redovisar ett sammandrag av analysen. Vi kan konstatera att mycket arbete kvarstår fastän framstegen som hittills gjorts inom BEMIP-planen varit goda. Ett annat resultat av analysen är att framstegen inom genomförandet av BEMIP-planen befinner sig på olika nivåer inom de olika baltiska marknaderna beroende på lokala förhållanden. Framstegen i Estland har drivits på av förbindelsekabeln Estlink till Finland och önskan att förbinda sig med Nord Pool Spot (vilket nyligen skett). Samma situation kommer att utgöra drivkraften för behovet av en marknadsreform i Litauen, eftersom landet planerar att förbinda sig med Sverige och Polen inom BEMIP-planen. För tillfället har Lettland inte någon

planerad sammanlänkning med andra EU-länder, och därför kommer landets elförsörjningstrygghet och integration med EU-marknaderna att vara beroende av sammanlänkningen med Estland och Litauen.

Table 1 Genomgång av situationen för BEMIP-processen i juni 2011

Steg 1	Estland	Lettland	Litauen
<i>Integration av den baltiska marknaden</i>	Kvartal 2/2009		
Beslut att inleda integrationen av den baltiska marknaden			
Steg 2	Estland	Lettland	Litauen
<i>Uppfyllande av krav på marknadsöppning</i>	Kvartal 1/2010		
Avskaffande av reglerade tariffer för berättigade kunder (≥35% av volymen)			
Undanröjande av hinder för gränsöverskridande			
Subventionerad RES kan etablera sig på marknaden utan att förlora subventioner			
Separering av verksamheter och roller för TSO			
Grundregler för transparens (regler för Nord Pool Spot)			
Metoder för hantering av överbelastning mellan Estland-Lettland-Litauen			
Marknaderna är öppna för handel			
Steg 3	Estland	Lettland	Litauen
<i>Finjustering av marknadernas funktion</i>	2011-2013		
Gemensam baltisk marknad för påföljande dag		slutet av 2011	
Införande av en intradagsmarknad		2012	2012
Marknadsbaserad hantering av överbelastning, implicit auktion		2012	2012
Transparens enligt ERGEG		Efter inträde i NPS	
Gemensamma reserver och balansregleringsmarknad		Harmoniseringsprocessen pågår	
Harmoniserad avveckling och prissättning av obalanskraft			
Övervakning och uppföljning av gemensamma marknadsregler			
Steg 4	Estland	Lettland	Litauen
<i>Fullständigt fungerande marknadsintegration med den nordiska marknaden</i>	2013-2015		
Fullständigt öppnande av detaljmarknaden	2013	2015	2015
Gemensam energibörs för fysisk handel i Norden och Östersjöområdet	2015	2015	2015
Handelsplats för finansiella instrument (OTC)			planerad
Harmonisering av nätavgifter för producenter			
			

Källa: Pöyry Management Consulting

Utmaningar för att uppnå en fullt integrerad och fungerande energimarknad

Vi har dessutom definierat de största utmaningarna för att kunna uppnå en fullt integrerad och fungerande energimarknad inom de baltiska länderna. Ett sammandrag av resultaten redovisas nedan:

Tillräcklig och trygg försörjning. De baltiska elmarknaderna kommer att behöva nya (marknadsbaserade) investeringar för att kunna trygga elförsörjningen. Om inga nya investeringar görs är prognosen för energibalans i regionen negativ, på grund av att kärnkraftverket i Litauen och andra gamla

verk stängts (t.ex. enheter av det estniska oljeskifferkraftverket). Detta gör att investeringar i ett nytt kärnkraftverk är speciellt önskvärda ur försörjningstrygghetsperspektiv.

Nätverket på den baltiska marknaden är dessutom gammalt och i behov av investeringar. Nätverket är också starkt integrerat med det ryska systemet som för närvarande hjälper de baltiska länderna till en tillräcklig tillgång på el. Ett politiskt mål på sikt i Baltikum är dock att lösgöra sig från det ryska nätverket och ansluta sig till EU:s nätverk. Lösgörandet från det ryska nätverket kommer troligtvis inte att ske förrän efter år 2020.

Ett framgångsrikt genomförande av BEMIP-planen skulle förbättra situationen för försörjningstryggheten men kommer inte nödvändigtvis att garantera nya investeringar från privata bolag. De nuvarande planerna på utbyggnad av kärnkraft och anläggningar som använder förnybara bränslen i de nordiska länderna skulle innebära nödvändiga tilläggsåtgärder, även om BEMIP-programmet blir framgångsrikt, för att säkra investeringar i toppbelastningskraftverk (till exempel en mekanism för kapacitetsbetalningar) för att bevara försörjningstryggheten. Fastän utvärderingen av sådana åtgärder ligger utanför denna rapport kan vi dock påpeka att andra undersökningar som Pöyry gjort har kommit till att samma situation förekommer också i andra liberaliserade och sam-manlänkade europeiska marknader, då nivån för icke reglerbar produktion ökar.

Konkurrens och betalningsberedskap på den baltiska marknaden.

Konkurrensen under BEMIP-programmet måste öka för att sporra marknadsbaserade investeringar. I kapitel 4 använder vi en approach som baserar sig på spelteorin för att undersöka konkurrensens inverkan på de baltiska marknaderna. Denna analys ledde till två huvudsakliga slutsatser: För det första innebär den nuvarande marknadsstrukturen i Baltikum (som är starkt koncentrerad) att den ryska exporten medför en mindre risk för små producenter (såväl genom import som export) än väntat. Fastän detta i allmänhet stämmer har vi inte beaktat fall då handel sker mellan dotterbolag till ett gemensamt moderbolag: ett i Ryssland och det andra i ett eller flera baltiska länder, vilket kunde inverka på slutsatsen. En dylik dynamik måste dock ställas mot BEMIP-programmets politiska syften.

För det andra bör hänsyn tas till såväl lokal konkurrens som marknadsintegration för att den baltiska energimarknaden ska kunna fungera effektivt. Vi fann bevis för att problemen med marknadskoncentration förvärras då de baltiska länderna importerar från Norden och överföringsförbindelserna är överbelastade, eftersom den resterande marknaden, där endast lokala producenter agerar, är liten.

Det kommer också att vara viktigt att privata investerare har tillräckligt förtroende för marknadens likviditet – här förekommer fortfarande brister gällande finansmarknadernas förmåga att garantera likviditet i den baltiska regionen. Ett stegvis tillvägagångssätt för att öppna marknaden, kombinerat med vissa sporrar för producenter att använda spotbörsen och för berättigade kunder att köpa på den öppna marknaden, är därför en viktig del av den fortsatta utvecklingen, vid sidan av ökad regional kapacitet och överföringsförbindelser.

Gränsöverskridande frågor med tredjepartsländer (icke EU-länder).

Den nuvarande avsaknaden av en gemensam marknadsanslutning med tredjepartsländer och bristen på ömsesidighet mellan de baltiska länderna och tredjepartsländer ger anledning till oro bland investerare på grund av den risk som billig import medför. Man är också bekymrad över Kaliningrad, eftersom där råder brist på energi och Ryssland för närvarande levererar elektricitet till exklaven via Vitryssland, Estland och Lettland. Denna fråga borde behandlas på EU-nivå, eftersom den är speciellt viktig för den baltiska marknaden på grund av nivån av överföringskapacitet mellan Baltikum och den ryska marknaden.

Summary

Background

Elforsk has commissioned this report from Pöyry Management Consulting to understand the progress that has been made and the challenges remaining in integrating the Baltic Electricity markets into EU markets as part of the Baltic Energy Market Interconnection Plan (BEMIP).

The European Commission identified establishment of effective interconnection of the Baltic Sea region as a priority area in its Second Strategic Energy Review. The BEMIP has two main objectives relating to electricity markets: (1) full integration of the Baltic electricity market into the European electricity markets and (2) strengthening of the interconnection capacity to the EU neighbouring countries.

General status

According to the BEMIP, interconnection capacity between electricity systems in the Nordic and the Baltic countries will be strengthened with new cables to Finland (Estlink II in 2014) and Sweden (NordBalt in 2015). The interconnection between Lithuanian and Polish transmission grids will be followed by building a new back-to-back converter station and strengthening internal high voltage transmission grids in Poland and Lithuania. The commissioning of 500 MW interconnection between Lithuania and Poland is planned in 2015, and another 500 MW in 2020.

Integration into EU markets drives a number of requirements in terms of market design for the Baltic Markets. In the BEMIP, the Electricity market design has been agreed to be implemented based on the Nordic electricity market model. A specific "Roadmap" that describes practical steps on how to reach the new market model and aims at removing the barriers for a regional electricity market in the Baltic States in conformity with the EU internal electricity market rules has been proposed. The Roadmap consists of four steps and is planned to be implemented by 2015.

We have reviewed progress made against the key BEMIP steps and a summary is presented in Table 2. We find that while good progress has been made with the BEMIP so far, there remains significant work to do. Another notable finding is that progress with the implementation of BEMIP is at different stages in different Baltic markets due to local conditions. In Estonia, progress has been driven by ESTLINK connection to Finland and the desire to connect to the Nord Pool Spot (which has recently happened). The same situation will drive the need for market reform in Lithuania as it plans to connect to Sweden and Poland under the BEMIP. At the moment Latvia has no planned interconnection to other EU markets and hence its security of supply as well as integration into the EU markets will depend on being connected to Estonia and Lithuania.

Table 2 Status review of BEMIP process as of June 2011

Step 1	Estonia	Latvia	Lithuania
<i>Baltic market integration</i>	Q2/2009		
Decision to start Baltic market integration			
Step 2	Estonia	Latvia	Lithuania
<i>Fulfilment of market opening requirement</i>	Q1/2010		
Regulated tariffs removed for eligible customers ($\geq 35\%$ of volume)			
No cross border restrictions			
Subsidized RES can enter the market without losing subsidies			
Unbundling of TSO activities/roles			
Basic transparency rules (Nord Pool Spot rules)			
Congestion management method between Estonia-Latvia-Lithuania			
Markets are open for trade			
Step 3	Estonia	Latvia	Lithuania
<i>Market functioning fine tuning</i>	2011-2013		
Baltic common day ahead market		end 2011	
Introduction of Intra-day market		2012	2012
Market based congestion management, implicit auction		2012	2012
Transparency according to the ERGEG		After NPS introduction	
Common reserves and balancing power market		Harmonization process ongoing	
Harmonized imbalance settlement and imbalance pricing			
Common market monitoring and surveillance rules			
Step 4	Estonia	Latvia	Lithuania
<i>Full functioning market integration with Nordic market</i>	2013-2015		
Full opening of the retail market	2013	2015	2015
Common power exchange for physical trade in Nordic & Baltic	2015	2015	2015
Market place for financial products (OTC)			planned
Network tariff harmonization for generators			

	Achieved
	Somewhat achieved
	Not yet achieved
	To happen by future date (stated if agreed)

Source: Pöyry Management Consulting

Challenges to achieving a fully integrated and functioning power market

We have also defined key challenges to achieve a fully integrated and functioning power market in the Baltic states. These findings are summarised below:

Supply adequacy and security of supply. New (market based) investment will be required in Baltic electricity markets to maintain security of supply. The outlook for power balance in the region, in the absence of new investment, is negative due to closure of the Lithuanian nuclear power plant and other legacy plants (e.g. units of Estonian oil shale plant). This makes investment in a new nuclear plant particularly desirable from a security of supply perspective.

In addition, the network in the Baltic market is old and requires investment. The network is also highly integrated into the Russian system, which currently helps the Baltic states to maintain supply adequacy. However, a long term political goal is for the Baltics to desynchronise from the Russian network and synchronise to the EU network. The timing of desynchronisation from the Russian network is unlikely to take place before 2020.

The successful implementation of the BEMIP will improve the situation towards ensuring security of supply but will not necessarily guarantee new investment from private companies. Current plans for deployment of nuclear and renewables in the Nordic countries could mean that even with successful implementation of the BEMIP programme, additional measures are required to ensure investment in peaking plant (for example a capacity payment mechanism) to maintain security of supply. An evaluation of such measures falls outside the scope of this report but we note that other Pöyry studies have found this situation does occur in other liberalised and interconnected European markets as the level of intermittent generation increases¹.

Competition and liquidity in the Baltic markets. In order to incentivise market based investment, competition will need to increase under BEMIP. In Chapter 4 we use a Game Theory approach to examine the impacts of competition in the Baltic markets. This exercise suggested two main conclusions: firstly, the current market structure in the Baltics (i.e. highly concentrated) means that Russian exports pose less of a risk to small generators (through both imports and exports) than expected. While this finding holds in general, we have not considered the case in which trade takes place between the subsidiaries of a common parent company: one in Russia and the other in one or more of the Baltic states, which could affect the conclusion. However, such dynamics must be set against the political objectives of the BEMIP programme.

Secondly, local competition as well as market integration should be addressed in order make the Baltic power market function efficiently. We found evidence that when Baltic countries are importing from the Nordic area and interconnectors are congested; the problems of market concentration are aggravated as the residual market in which only local producers operate is small in size.

It will also be important for private investors to have enough confidence in market liquidity and there are still some gaps regarding the financial markets ensuring liquidity in the Baltic region. A staged approach to a market opening, combined with certain incentives for producers to use the spot exchange and eligible consumers to source from the open market is therefore an important part of the further development in addition to increased regional capacity and interconnectors.

Cross border issues with 3rd party (non-EU) countries. The current lack of a common market interface with 3rd party countries, and the lack of reciprocity between Baltic States and 3rd party countries is a cause for concern amongst investors because of the risk that cheap imports pose. There are also concerns over Kaliningrad as it has an energy deficit and Russia

¹ The challenges of intermittency in North West European power markets- public summary. Pöyry. March 2011.
<http://www.poyry.com/linked/en/press/NEWSIS.pdf>

currently supplies electricity to the exclave via Belarus, Estonia and Latvia. This issue should be managed at the EU level, it is particularly relevant to the Baltic markets given the level of transfer capacity between the Baltics and Russian market

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**A. APPENDIX 1: COMPETITION IN THE BALTIC ELECTRICITY
MARKET: A GAME THEORETICAL ANALYSIS**

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1 Introduction

In the introduction we give a short historical overview of the Baltic power system to provide context for the background to the Baltic Energy Market Interconnection Plan (BEMIP). We then move onto an overview of the report, briefly describing the objective of each section.

1.1 Background

Historically the Baltic countries were integrated into the Soviet Union. As a result, the Baltic power system is highly integrated to the Russian electricity system in terms of physical connections and system stability (i.e. the systems are synchronous). The transmission interconnections between the Baltic countries and their neighbours Belarus and Russia are also strong.

On 1 May 2004, the Baltic states acceded to the EU. As a result EU objectives for energy markets influence the energy strategy of the Baltic states.

In 2008 the European Commission published the Second Strategy Energy Review. As part of the Review, the Commission identified a set of goals and supporting actions required to deliver the goals. The goals are first, to diversify energy supplies in and to the EU (offshore wind, Mediterranean energy ring, Southern Gas Corridor) and second, to improve interconnection for strengthening the capacity of the market to deliver security of supply. The Commission listed six prioritized infrastructure actions (Figure 1) to deliver the goals. The Baltic Interconnection Plan is one of the two actions in addition to the plan to strengthen the North-South interconnections in Central and Eastern Europe.

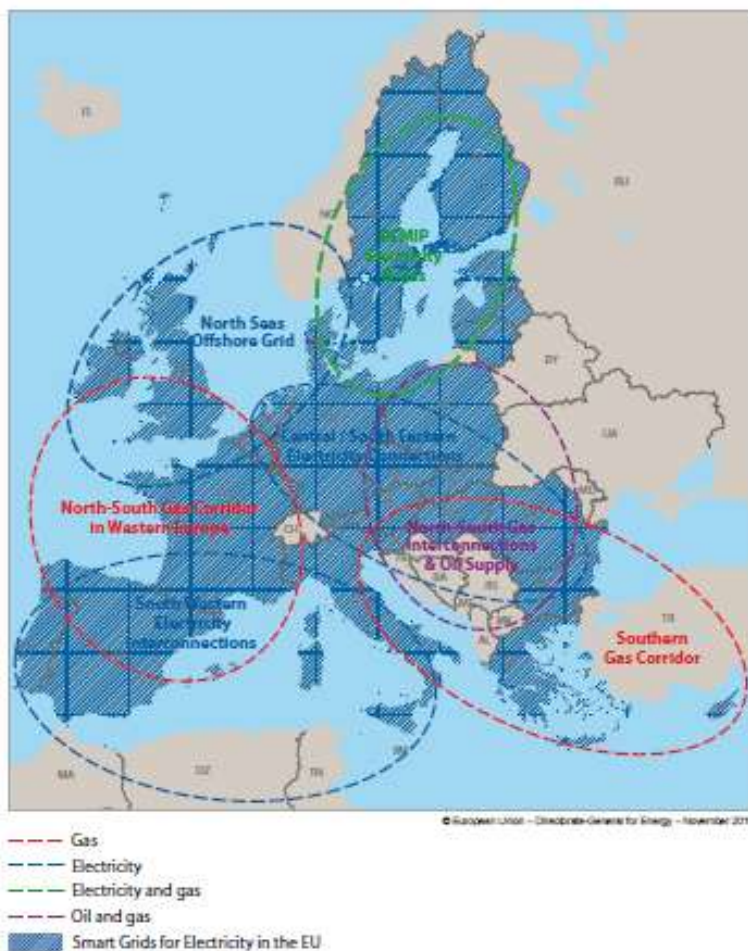
Another longstanding goal is to increase competition in energy markets. This can usually be done by either increasing the number of market players or making the market larger. The Baltic electricity market, as such, is small for competition but there are several plans to strengthen the Baltic market connection into wider EU electricity markets. Currently, the only connection to other European markets is HVDC interconnection from Estonia to Finland with capacity of 350 MW (Estlink I). There are plans to build a second interconnection from Estonia to Finland (Estlink II), a HVDC interconnection from Lithuania to Sweden and a double-circuit connection between Lithuania and Poland.

The Baltic states have taken a political decision to de-synchronise the Baltic network from the Russian power system and to synchronise the Baltic network with the continental power system. A feasibility study regarding the synchronization has been launched and should be finished in 2012.

As members of the EU, the Baltic states are also subject to current environmental policy measures such as emissions trading and the IED. The result of the both these programmes is expected to raise long term electricity prices and ultimately drive the need for new plants i.e. current generation portfolio in the Baltic will need to change.

The situation described above also raises further questions regarding the role of 3rd country imports into the Baltic states, as there is the potential for imports to be below market prices as they do not include environmental costs. Given the historical background of the Baltic markets, this applies especially to imports from Russia (although this is also an EU issue).

Figure 1 Six infrastructure priorities in the Second Strategy Energy Review by DG TREN



Source: EU

1.2 This Report

We have identified three topics which will give Elforsk an understanding of the current situation of Baltic electricity market integration and the challenges that remain. These topics form the chapters of the report:

Chapter 2, provides a detailed overview of the current state of the Baltic power markets and the development trends that will drive the market in the future. Material here includes reviews of the key trends in energy policy and politics; the physical characteristics of the Baltic markets; and a review of the current market structure of the Baltic market.

In Chapter 3 we provide an overview and status of the Baltic energy market interconnection plan (BEMIP). This includes a review of the BEMIP; analysis of achievements in the BEMIP so far; National policies in light of the goals set in BEMIP; and key outstanding issues in the BEMIP.

Chapter 4 identifies the challenges ahead for Baltic market integration based in part of analysis and opinion from our market experts. More specifically, we present material on supply adequacy and security of supply; a view on future competition and liquidity in the Baltic markets based on the application of Game Theory and a following section on the role of financial markets; finally we present material on cross border issues with 3rd party countries.

Finally, Chapter 5 summarises our findings from the previous Chapters.

2 DEVELOPMENT TRENDS IN THE BALTIC POWER MARKET

2.1 Overview

In this Chapter we discuss development trends in the Baltic power market. Topic areas include key trends in energy policy and politics, the physical characteristics of the Baltic electricity system, the market structure in the Baltic countries and an outlook for investment and demand.

The Baltic countries, consisting of, Estonia, Latvia and Lithuania, are going through an extensive restructuring of their energy industries. Market integration, renewable growth and nuclear investments underpin the foreseeable future for the Baltic power system. Privatisation of state-owned assets has started, but a few dominant players are still strong in each of the three countries. There is a medium term commitment in all the countries is to firmly integrate with Nordic power markets physically and regulation wise. In longer term the aim is to become integral member of European electricity and gas systems. Technically the Baltic area remains closely interlinked to Russia far into the future.

2.2 Key trends in energy policy and politics in the Baltic States

2.2.1 Estonia

Estonian national energy strategy is defined in a few documents. Below are reviewed some major energy policy documents.

National Development Plan of the Energy Sector until 2020 (adopted by the Parliament in June 2009). The document defines that the mission of the Estonian energy sector is to ensure continuous, efficient, sustainable energy supply at a justified price and sustainable energy consumption. The use of energy sources shall be diversified by supporting, among others, local energy sources upon the production of energy. By 2020 the share of any energy source in the energy balance shall not exceed 50%.

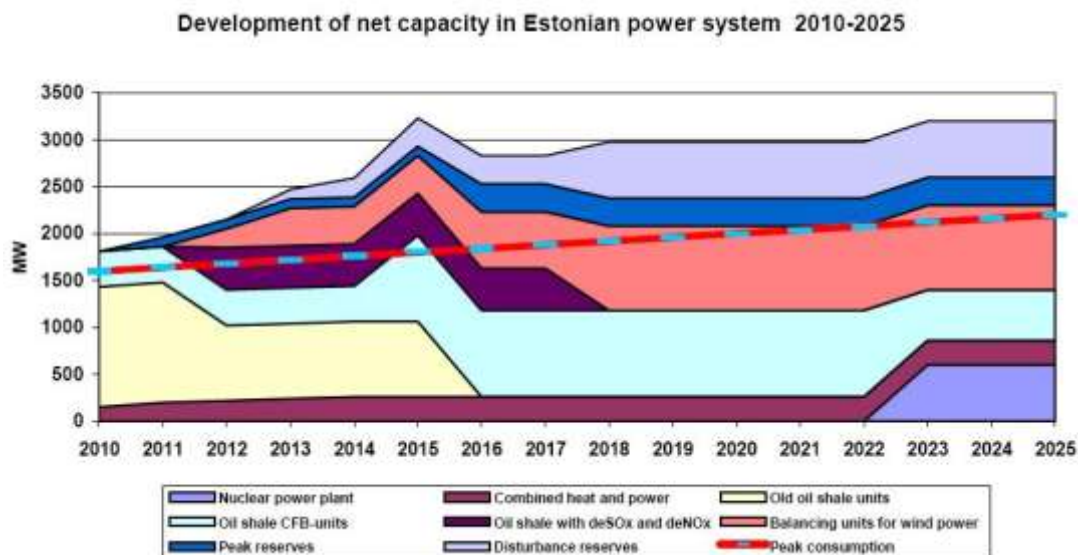
In order to ensure sustainable energy supply and consumption, energy efficiency shall be improved and the share of renewable energy sources and cogeneration shall be increased. Relevant to the development of indigenous and renewable energy resources, by 2025, RES-Energy must be 25% in the primary energy balance (18% in 2005) and by 2020, CHP share of electricity and heat production should be 20% of final energy consumption (10% in 2007).

The Development Plan of the Estonian Electricity Sector until 2018 sets the strategic objectives for the development of the electricity sector within ten years by describing the objectives and the measures for the achievement

thereof with regard to guaranteeing power supply, reduction of the burden on the environment, creation of international energy links, opening of the electricity market and increase of electricity consumption.

The plan presents different supply scenarios. The scenario, which is deemed most likely and useful for Estonia is presented in. It is planned to increase the consumption of electricity produced from renewable energy sources by 2010 to the level of 5.1% and by 2015 to 15%. The share of cogeneration should increase to 20% by 2020. Amongst other things it is considered that beginning from 2016 the Eesti Energia's Narva Power Plants must fulfil the SO₂ and NO_x emission limitation requirements set out by the Large Combustion Plant Directive. At present the existing old blocks do not meet the mentioned requirements. However the emission limitation requirement does not mean an immediate closing down of the blocks as together with the technology developments it may become possible to renovate the blocks in a way that the EU directive requirements will be met.

Figure 2 Capacity scenario for 2010-2025 by Estonian government



Source: The Development Plan of the Estonian Electricity Sector until 2018

In order to implement the Plan the capacity of CHP plants shall be increased up to 300 MW (net capacity during peaks 260 MW), by 2015 to erect the first 300 MW (net capacity 270 MW) and by 2017 the second new fluidized bed oil shale block with the same capacity. In addition in the period of 2012 to 2015 it is necessary to install flue gas desulphurization and denitrification equipment in four of the existing old oil shale blocks (net capacity 4x150 MW) and the capacity of on-shore (land-based) wind turbines shall be increased to 400 MW by 2013. Further increase of the wind mill parks' capacity is practical to do with off-shore located parks.

The National Development Plan for the Use of Oil Shale for 2008–2015 the strategic objective of the plan is to ensure supply of Estonia with oil shale energy and to guarantee the energetic independence of Estonia. In addition, the development plan raises the issues for finding possibilities in the longer

term for gradual reduction of the annual volume of the use of oil shale up to the volume of 15 million tons a year by 2015. The strategic objective set out in the Development Plan for the Use of Oil Shale to increase the efficiency of the use and extraction of oil shale supports the objective of the Development Plan of the Energy Sector to ensure sustainable energy supply and consumption in Estonia. The National Development Plan for the Use of Oil Shale for 2008–2015 was approved by the resolution of the Riigikogu of 21 October 2008.

The Development Plan for Enhancing the Use of Biomass and Bioenergy for 2007–2013: the objective of the plan is to create favourable conditions for the development of the production of domestic biomass and bioenergy in order to decrease the dependence of Estonia on imported resources and fossil fuels and to reduce pressure on the natural environment. The objective of the development plan is to reduce the dependence of Estonia on imported energy resources and to enhance the use of biomass as a raw material for energy which coincides with the objective of the Development Plan of the Energy Sector to guarantee continuous energy supply by diversification of energy sources and more even distribution in the energy balance.

The Energy Conservation Target Programme for 2007– 2013 defines the targets for saving fuel and energy in Estonia for 2007–2013 and establishes the measures required for achieving the targets. The objective of the programme is to ensure more efficient use of fuels and energy in Estonia, which is of significant importance for the achievement of the objectives of the Development Plan of the Energy Sector in the areas of energy conservation and energy efficiency.

On 26th November 2010, the Estonian Government approved National Renewable Energy Action Plan (as required by the EU Renewable Energy directive). The action plan provides a detailed roadmap of how Estonia expects to reach its legally binding 2020 target for the share of renewable energy in their final energy consumption.

The Estonian National Strategy on Sustainable Development – Sustainable Estonia 21, is the most general national strategy document aimed at developing Estonia until the year 2030 and integrating economic factors with the principles of sustainable development. The national strategy is based on the Sustainable Development Act, adopted by the Parliament in 1995, which establishes the principles for the sustainable use of the natural environment and resources.

National Environment Strategy. The National Environment Strategy sets a goal to orientate the energy policy towards the use of RES sources, and reduction in the use of greenhouse gases, and internalisation of external costs of the energy production and consumption in the price of energy.

Renewable energy support scheme was introduced in 2007 by the Electricity Market Act, the latest amendments of the scheme were introduced in 2010. According to the present legislation the producers of the renewable electricity are paid the renewable premium of € 54/MWh. The renewable premium is paid during 12 years.

In summer 2010 the Estonian Competition Authority carried out an analysis of the present renewable premium scheme and concluded that the premium

level provides too high pay-backs to the producers and distorts the market competition. There are no changes yet in the legislation, however the Government has given some indications that the current level of renewable premium shall be reduced.

2.2.2 Latvia

The energy policy for Latvia is set in the Energy Development Guidelines 2007-2016. Latvia energy policy focuses on security of energy supply by encouraging diversification of energy sources and increase self-provision of power generation as well as promotion of renewable and local energy.

In compliance with EU Directives, Latvia promotes utilisation of renewable energy sources in electricity and/or heat generation, CHP based on heat demand, joint power market regulations, energy diversification, reducing greenhouse gas emissions and safety of power supply. The principle of the Latvian electricity market law is that the price of electricity is determined by an agreement between the producers, traders and users.

Tariffs are set and approved by the Regulator "Public Utilities Regulation Commission" only with respect to mandatory procurement of electricity produced by cogeneration or using renewable energy sources. The regulator also sets and approves tariffs for the trade of electricity to captive users (i.e. those customers who have not chosen their own electricity supplier). These tariffs cover the cost of electricity generation and transmission.

One of the key energy objectives is self-sufficiency in primary resources which should be at least 36-37%. Latvia has relatively high dependency on imports, with only 30% of total consumption covered by local sources.

The Latvian National Renewable Energy Action Plan (as required by the EU Renewable Energy directive) was submitted to the EC on 11 October 2010. The action plan provides a detailed roadmap of how Latvia expects to reach its legally binding 2020 target for the share of renewable energy in their final energy consumption. Renewable goals are categorized into RES-electricity, RES-heat and RES-transport. By 2020 RES-electricity (excluding large hydro) is targeted at 9% of total final energy consumption, RES-heat at 29% and RES-transport at 3%. In 2008 RES-electricity was at 6% of total final energy consumption, RES-heat at 24% and RES-transport at 0%. Total renewable goal of 40% by 2020 is challenging due to economic and investment development trends in Latvia. Additional supports are needed to fulfil the ambitious renewable targets.

Latvenergo has forecast electricity generation from renewable sources to be 56% (including large hydro) of Latvia's total end use consumption in 2020, which can be divided into hydropower 37%, biogas 8%, wind and biomass 5% each and solar power 0.02%. The level of electricity generation from renewable sources was 66% in 2010.

The energy policy sets a target for electricity generated in highly efficient CHP using biomass to be 8% by 2016. To fulfil this goal, investments in constructions of new CHP and reconstruction of existing boilers into CHP utilizing renewable sources are supported.

Renewable will play an important role in Latvian climate policy. The aim to reduce greenhouse gas emissions in the energy sector has been included in the energy sector planning documents and legislation. The country is fulfilling its emission reduction obligation despite limited financial resources.

In September 2010 Latvian government decided to subsidise only renewable energy generating companies in the future. The government will no longer subsidise natural gas-fired CHP. In the future only renewable energy producers will have the right to supply energy to Latvenergo for guarantee price. This decision will not impact the plants which received support and supplied energy to Latvenergo before November 31, 2010.

2.2.3 Lithuania

The last National Energy (Energy Independence) Strategy until 2050 was approved on October 6th, 2010, to a large extent guided by increased energy dependency of the country on external suppliers after the closure of Ignalina NPP.

The Strategy defines the main objectives of the Lithuanian state in the energy sector and sets strategic targets and initiatives to be achieved in the fields of electricity, heat, gas, oil, renewable energy and energy efficiency through the years 2020, 2030 and 2050.

By 2050 Lithuania aims to become a carbon-free economy with electricity production from nuclear and renewable energy sources (focus on distributed generation) and centrally supplied heat produced only from renewable energy sources.

By 2020, a major strategic goal is for Lithuania to have sufficient domestic electricity generation capacity to meet domestic electricity demand. The main tools to achieve this are the construction of Visaginas Nuclear Power Plant and generating more electricity from renewables.

In order to achieve greater energy independence, the Lithuanian government plans to create conditions and/or bring forward the following initiatives;

- It is planned to finalize the on-going reorganization of the power sector by 2012 with the power generation, transmission and distribution unbundled on the basis of ownership. Market liberalisation will be completed by 2015 with the abolishment of the regulated tariffs for industrial and household consumers.
- By 2020 Lithuania plans to complete the on-going investments (Lithuanian PP) thermal and hydro pump storage power facilities (Kruonis PSP), commission a 3400 MW nuclear power plant and increase the installed capacity of renewable energy sources to some 880 MW, mainly focusing on biomass and wind power development. By revising the incentive scheme for cogeneration units, it is planned to enlarge the combined heat and power production prioritising facilities run on biomass and Waste to Energy WtE units.
- Within this period, Lithuania targets to increase the share of renewable energy to 20% in electricity production and to about 60% of the centralised district heating. The growth of renewable energy based

centralized district heating may be implemented by unlocking the biomass (wood products and straw) potential and creating the necessary infrastructure throughout the value chain, but also through construction of WtE plants in the vicinity of large urban areas. The annual capacity of the WtE plants is expected to reach some 0,8 TWh heat. The overall target is to increase the share of renewable energy in the final consumption from the current 15% to 23% in 2020.

- The already planned and further investment in power generation fleet development are thought to enable Lithuania to become totally independent in satisfying domestic power demand estimated at up to 17 TWh in 2030 and 22-33TWh in 2050. At the same time, district heating demand is estimated to decrease due to the implementation of the energy efficiency measures on the demand side and gradual switch to electric heating down to 6.5 TWh by 2030 and to 3TWh by 2050 from current 10 TWh.
- Another focus area is the integration of the Lithuanian power system with European energy systems through construction of 700 MW NordBalt (commissioning planned for 2016) and 500 + 500MW LitPol Link (commissioning planned for 2016 and 2020) interconnectors.
- The heat sector will be made more robust through improvements to the natural gas sector and the increase of RES sources in heating. The natural gas sector will be liberalised (unbundling of transmission and supply) and security of supply enhanced through the construction of an LNG terminal at Klaipeda, the construction of an underground storage facility and a gas pipeline to Poland . The share of heat provided by RES is set to reach 36% of heating and cooling under terms of the Renewable Energy Action Plan (NREAP).

The National Strategy for the Development of Renewable Energy Sources (the NREAP for Lithuania) was approved by the Lithuanian government in June 2010.

The development of renewable energy sources in Lithuania is supported through the system of feed-in tariffs and investment incentives. In 2009 Lithuania started preparing a dedicated Law on Renewable Energy to consolidate the legal basis and use of all means of renewable energy, regulate the functions and responsibility of the public institutions, and establish a set of measures aimed to speed up production of renewable energy in electricity, heat and transport sectors. The Law was signed by the President of Lithuania on May 23rd, 2011.

2.3 Physical characteristics of the Baltic electricity system

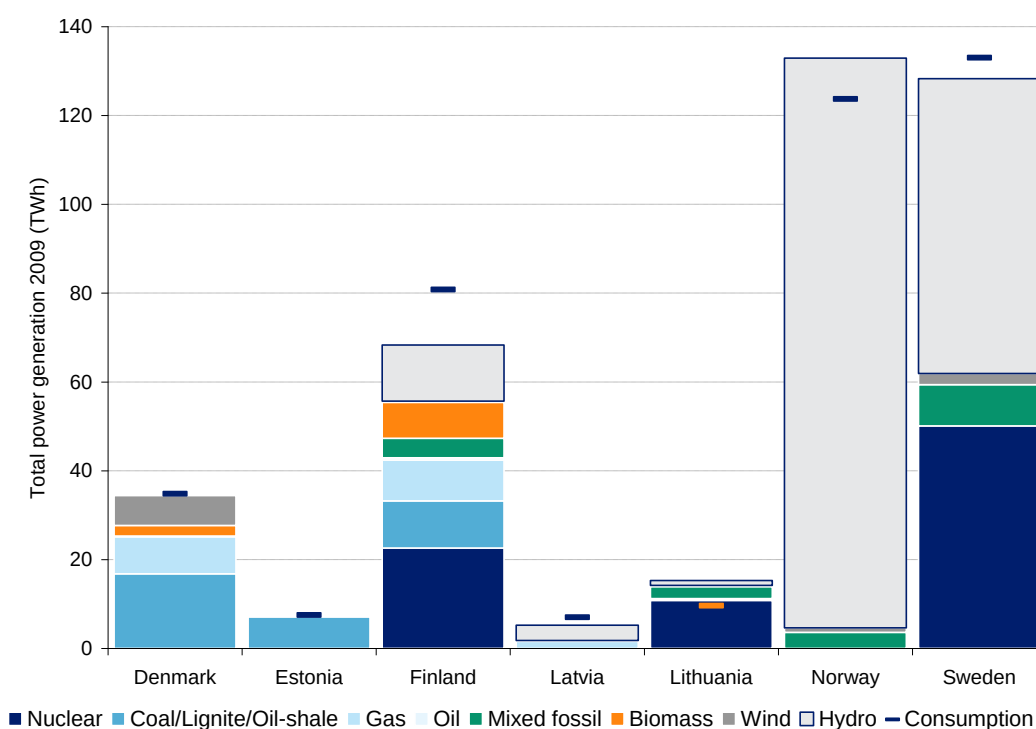
2.3.1 Generation capacity and demand for electricity

Until the end of 2009 Ignalina nuclear power plant in Lithuania provided base load to the whole Baltic region. This is reflected in Lithuania's net export of 2.9 TWh in 2009. Latvia is dependent on power imports from neighbouring countries as its domestic capacity is not sufficient to meet the demand. More than half of Latvia's annual production is from run-of-river power plants

in river-Daugava. Hydrological situation thus have an important effect on Latvia's import dependency. Oil-shale fired power production in 2 power plants with total of 13 units in Estonia represents more than 90% of total consumption. Estonia also exports to Latvia and Finland annually more than 1TWh each.

Following Figure 3 illustrates the total power generation and consumption in Baltic and selected Nordic countries in 2009. The statistics for 2010 were not available. For Sweden biomass is included in mixed fossil production.

Figure 3 Power generation by fuel and consumption in selected Nordic and Baltic countries in 2009 (TWh)

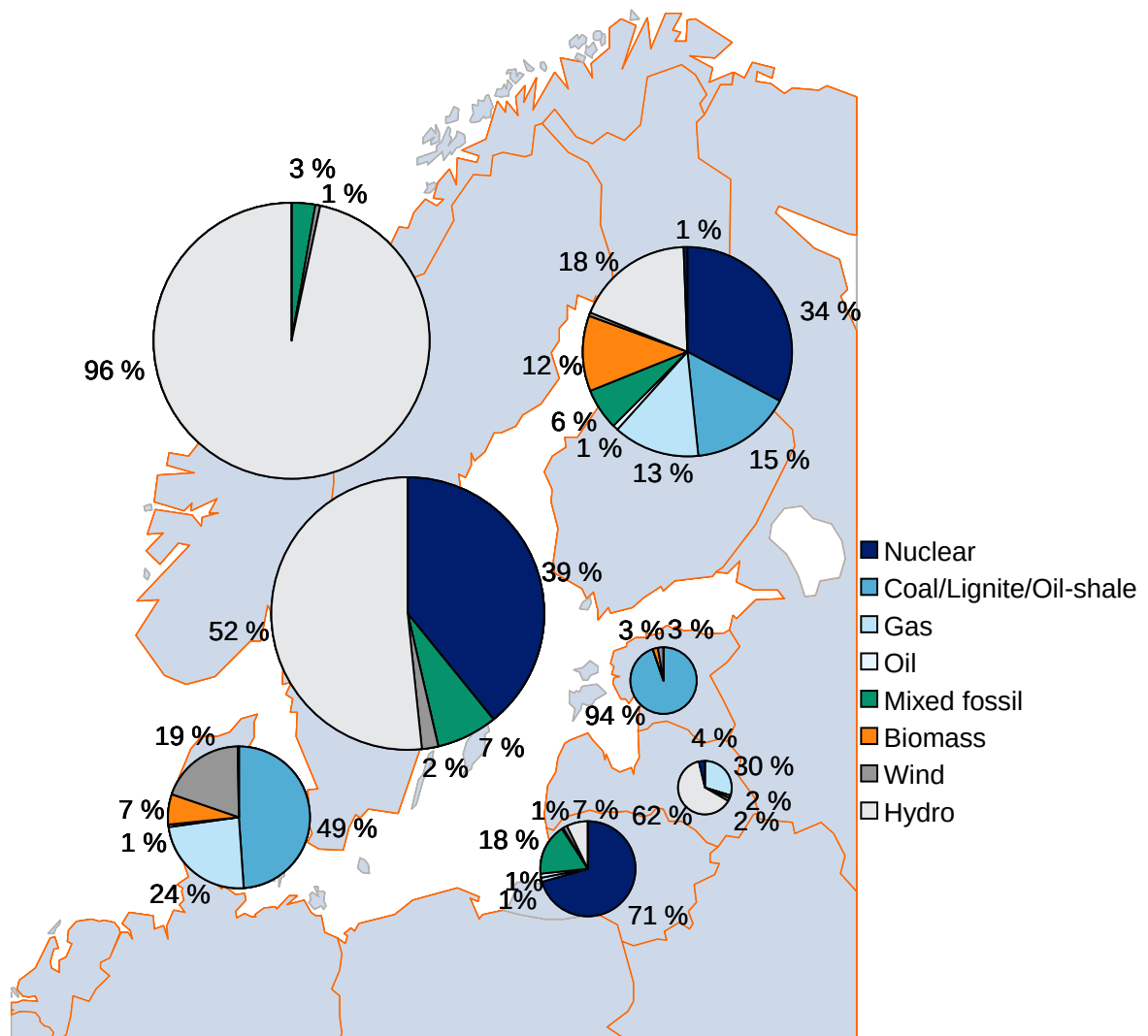


Source: ENTSO-E System adequacy retrospect 2009, Pöyry Management Consulting

Finland and Latvia are distinctively the only countries which are dependent on power import. Power balance in Norway and to some extent in Sweden depends largely on the hydrological situations. Electricity deficit in Sweden in 2009 was due to nuclear outages. In 2008 nuclear generation was 11 TWh higher in comparison to 2009 which contributed to Sweden's net surplus of 2 TWh in 2008. In 2010 electricity generation in Lithuania dropped significantly (66%) from the previous year due to the close down of Ignalina nuclear power plant from 14 TWh in 2009 to 5 TWh in 2010. As a result Lithuania has become also net importer of electricity. Total electricity consumption decreased significantly from 2008 to 2009 in all the countries due to economic recession.

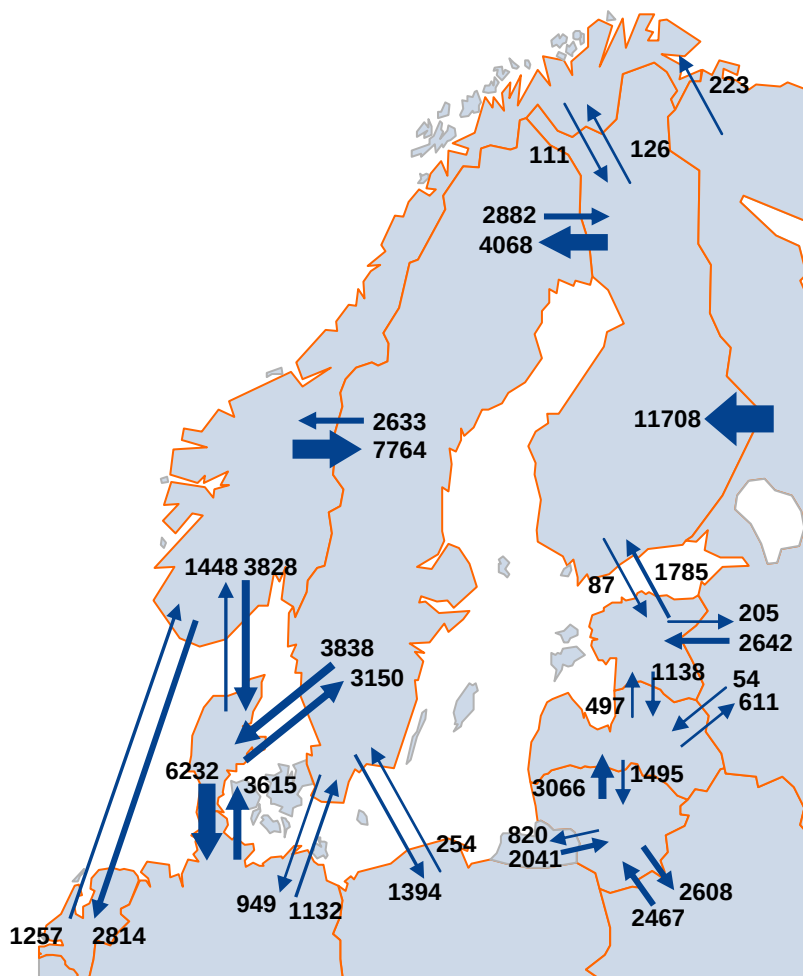
Figure 4 visualises the total generation by fuels in each of the countries. The size of the bubble is relative to power generated.

Figure 4 Power generation in the Baltic Sea area in 2009 (total 393 TWh)



Source: ENTSO-E System adequacy retrospect 2009, Pöyry Management Consulting

The differing power balances between the countries are highlighted in the resulting power flows in the region as illustrated in Figure 5. Close to 12 TWh of electricity was imported from Russia to Finland in 2009. The trade pattern resulting from different diurnal and seasonal price variation in the Nordics and in Central-West Europe is seen in extensive power trade to both directions in all the interconnectors between the two market areas. Electricity is exported from Nordic market during peak load hours and imported during off-peak hours.

Figure 5 Physical power flows 2009 in the Baltic Sea region, GWh

Source: ENTSO-E Statistical Yearbook 2009

2.3.2 Outlook to investments in generation capacity and power balance

Estonia

Estonia relies heavily on power production from local oil-shale firing. Total oil-shale fired capacity will inevitably decrease as existing units in Narva and Balti power plants will need to go through extensive refurbishment in order to comply with IE-Directive. Until 2012 free allocation of carbon credits will ensure oil-shale capacities competitiveness, but there after Narva and Balti power plants position in regional merit order will largely depend on carbon prices. There are two known nuclear projects in very early phase in Estonia. There is relatively strong political commitment to develop nuclear capabilities. Another possibility is for Estonia to take joint ownership in the NPP being developed in Lithuania. In fact, a decision on participation should be made in the next year or so.

Besides biomass utilisation in co-generation wind power represents the most feasible potential for renewable deployment in Estonia.

Eesti Energia is planning to build the new power plant with two 300 MW capacity units next to the existing plants in Narva. The first unit shall be in operation starting from late 2015. The decision on investments in the second power unit development will be made in 2012. In March 2011 the European Commission opened an in-depth investigation under EU state aid rules about the project's planned state support scheme of up to €1.5 billion spread over 20 years. Thus the implementation of the project is not still clear yet.

We have assumed:

- two new block in Narva power plant, 275 MW each (2015 and 2020);
- 140 MW of growth in CHP by 2020;
- 180 MW of new wind capacity; and
- at least 150 MW of TSO-owned balancing power ².

Latvia

The hydro power capacity in Latvia is expected to grow only marginally through upgrading existing turbines. Latvenergo has completed an upgrade of the first 400 MW CHP unit in 2008. Furthermore, there are four known plans for new thermal power plants apart from the Visaginas Nuclear Power Plant project in Lithuania:

- a new coal condensing plant of 200-400 MW in Kurzeme is expected to be in operation by 2020. The project has been approved by the Latvian Cabinet of Ministers after long discussion in Latvia. Three potential construction sites in Liepaja and one in Ventspils were considered;
- construction of the second 400 MW unit in Riga CHP2; and
- biomass cogeneration (120 MW) in 5 cities.

Wind power capacity is expected to grow significantly slower than in other Baltic states due to the complex support system e.g. cap of load hours in the power generation and insufficient transmission and distribution grids in some areas. In 2010, AST received applications for wind power connection to the national grid with total capacity of 697 MW (operation from 2010-2012).

Lithuania

Lithuanian power plant (LPP) will be gradually phased out in the coming 10-15 years. LPP's capacity will decrease to 1200 MW after 2012 when the new CCGT(s) become(s) operational. The remaining capacity will likely be kept operational until the planned commissioning of Visaginas NPP. The future investment in Lithuania power generation is expected to be concentrated on the new nuclear power plant and RES based generation.

² This is actually tertiary reserve and not available to the commercial power market.

Figure 6 Electricity system of Lithuania 2011

Source: Litgrid

Visaginas NPP (also Ignalina II NPP) is a nuclear power project brought forward by Lithuanian government and aimed to ensure the energy independency and security of electricity supply, as well as to develop the electricity export potential of the country after the closure and decommissioning of Ignalina NPP. The site is located in the near proximity to Ignalina NPP, on Lake Druksiai in the Visaginas Municipality of North Eastern Lithuania, close to the border with Belarus.

The initial plan was to build a 3200-3400MW plant entering in operation with two units in 2016 and 2021. In 2009 the revised construction plan was published for one unit with the construction start in 2012 and commissioning in 2018, with possible further capacity increase to 3400MW. The terms of

construction and commissioning were furthermore reviewed by shifting the start of construction to 2013-2014. By the end of 2010 all potential investors had withdrawn from the tender-based selection process, including KEPCO. Further negotiations with the potential investors and technology providers were carried out and in Summer 2011 GE-Hitachi Nuclear Energy were chosen as strategic investor in the plant. A contract with the strategic investor is expected to be signed by the end of 2011. The project viability will be primarily guided by the possibility to attract the relevant know-how and financing. Another nuclear power project is now being developed in the Baltic region by Russia.

Other investments in the Lithuanian electricity generation are to a large extent targeted to maintain the already existing generation capacities.

Lietuvos Elektrine is undertaking an investment project to substitute the existing units 3 and 4 of total 300MW with a new 450MW CCGT unit, which is planned to be commissioned in 2013.

The following investment projects are now under consideration:

- Kaunas PP – up to 350MW (initially 2012, estimated 2013-2014);
- Klaipėda waste incineration CHP – 50MW thermal; 17MW electrical (2012-2013; building permit obtained in 2011);
- Mažeikiai CHP - 48 MW (2013);
- Lithuanian PP – additional 400 MW (2015); and
- Panevėžys CHP - 33 MW (2015).

According to Lietuvos Energija estimations, the timely commissioning of these units would provide for the appropriate level of the system security and energy independency. There is a number of renewable, mainly wind power, projects already in the pipeline for over 250MW. A waste incineration facility is under consideration by Reenergy (ICOR) in Vilnius as well as the Klaipėda project (Fortum) mentioned above.

2.3.3 Power balance in the Baltic countries

Table 3 shows the power balance for Baltic countries based on EU statistics and Pöyry Management Consulting projections as noted in Section 2.3.2.

In 2009 the Baltic countries were overall in a state of surplus. However, the situation was different at the state level: Estonai and Latvia ran at zero or had an energy deficit. On the other hand, Lithuania had a significant surplus and hence exported to the rest of the region. This was because the Ignalina NPP in Lithuania was providing baseload energy for the region. However, at the end of 2009 (31 December) the Ignalina NPP closed. This has put downward pressure on Lithuanian production and as a result the power balance of the entire Baltic region has turned negative i.e. they are now net importers of electricity. Our analysis for the future shows demand continuing to rise and supply failing to keep up which results in the Baltic markets being net importers.

Table 3 Historical and future expected power balance in Baltic markets (TWh)

		2009	2015	2020
Estonia	Demand	8	9	10
	Production	8	7	11
	Surplus/Deficit	0	-2	1
Latvia	Demand	7	9	10
	Production	6	8	7
	Surplus/Deficit	-1	-1	-3
Lithuania	Demand	9	12	15
	Production	15	8	8
	Surplus/Deficit	+6	-4	-7

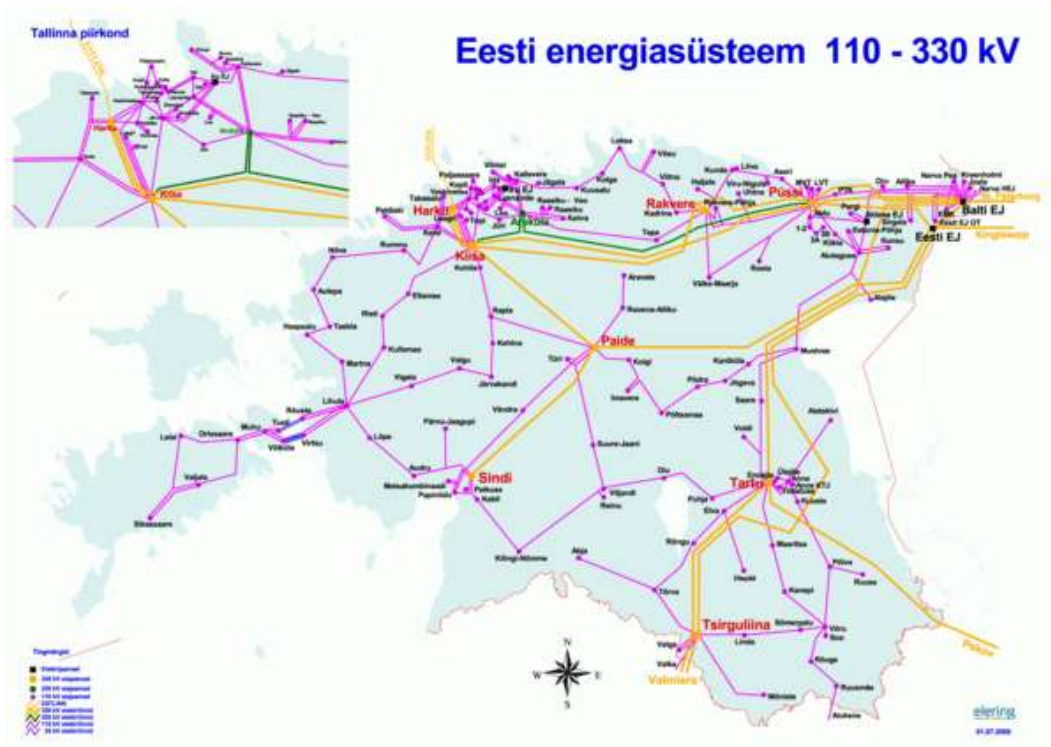
Source: EU statistics, Pöyry Management Consulting

2.3.4 Transmission networks

Estonia

Current transmission networks status

The Estonian electricity system has been built up as a part of the north-west common power system of the former Soviet Union. Currently the Estonian electricity system works among the united synchronised system of the CIS and Baltic countries IPS/UPS and is connected through alternating current (AC) lines with Latvia and Russia, as well as with Finland through a direct current (DC) line. Transfer capacity of the AC lines between Belarus, Russia, Estonia, Latvia and Lithuania is high, which assumes close cooperation between TSOs in the planning and management of the common synchronised parallel operation. The 110-330 kV connections of the Estonian power system are presented in the following figure.

Figure 7 Estonian transmission network

Source: Elering

In Estonia there is one undertaking providing transmission network service named Elering AS, who is at the same time also the system operator, the TSO. The length of transmission lines (110-330 kV) that belong to the TSO is 5200 km.

Elering AS had its inception in the 1998 from a decision of Eesti Energia AS to merge five regional electricity networks and forming from them two structural units – Elering (the TSO) and Jaotusvõrk (the distribution network). Elering started operating electrical devices at a voltage of 110–330 kV (including 110 kV transformers).

Beginning from 1 July 2010 the Electricity Market Act sets out the requirement that the transmission network undertaking cannot at the same time be also a distribution network undertaking, nor belong to the same group with an undertaking who is acting in the fields of activity related to production or sale of electricity. In Estonia the TSO (Elering AS) is separated by ownership from all other electricity production and sale undertakings since 27 January 2010. 100% of its shares belong to the Estonian state.

Future transmission networks plan

Whilst so far the Estonian TSO has primarily been dealing with network reconstruction works then in the next years the emphasis is put on investments that improve security of supply and interconnections with neighbouring countries. Most important projects are the second HVDC connection between Estonia and Finland - Estlink 2 and two quick-start

reserve power plants with capacities of 100 and 150 MW, which shall be commissioned in 2013 and 2016 respectively.

According to an assessment by Elering the condition of the national 110-330 kV electricity network is satisfactory. The available transmission capacity is sufficient to supply domestic electricity consumers at peak loads and fulfilling the security of supply requirements at the same time.

The Estonian domestic power flows move mainly in Narva-Tallinn and Narva-Tartu direction, where the majority of consumption centres are located. In the Narva-Tartu direction the transfer capacity is sufficient. These lines are basically used for the export to Latvia, Lithuania and for the transit from Russia to Latvia, Lithuania and Kaliningrad. The main Estonian load areas are Tallinn and Harju County (surrounding Tallinn). In order to secure reliable transmission in the Narva-Tallinn direction new 330 kV lines and substations are planned to Tallinn, Harju County and also Pärnu according to the approved investment plan of the TSO.

In accordance with the Estonian 110-330 kV electricity network development plan, the new transmission lines would stronger link with each other the southern and northern 330 kV networks and ensure higher security in supplying Tallinn and Pärnu regions. At the same time the new lines would create better possibilities for connecting of wind mills to the network and facilitate possible construction of a new, the third 330 kV transfer line between Estonia and Latvia (Sindi-Riga). A necessity for this line will increase even more after implementation of the Estlink 2 interconnection because of higher power flows in the direction of Püssi-Harku(Kiisa)-Sindi-Latvia.

Latvia

Current transmission networks status

Founded in 2005, Augstsprieguma tīkls AS is the Transmission System Operator and the company provides transmission network services in Latvia. The company is a subsidiary of Latvenergo AS.

Augstsprieguma tīkls AS transmit the electricity through high voltage networks (330 kV, 110 kV transmission lines), substations and distribution points located in the territory of Latvia and other equipment pursuant to the license E12001 issued by the Public Utilities Commission. Augstsprieguma tīkls AS has the following assets:

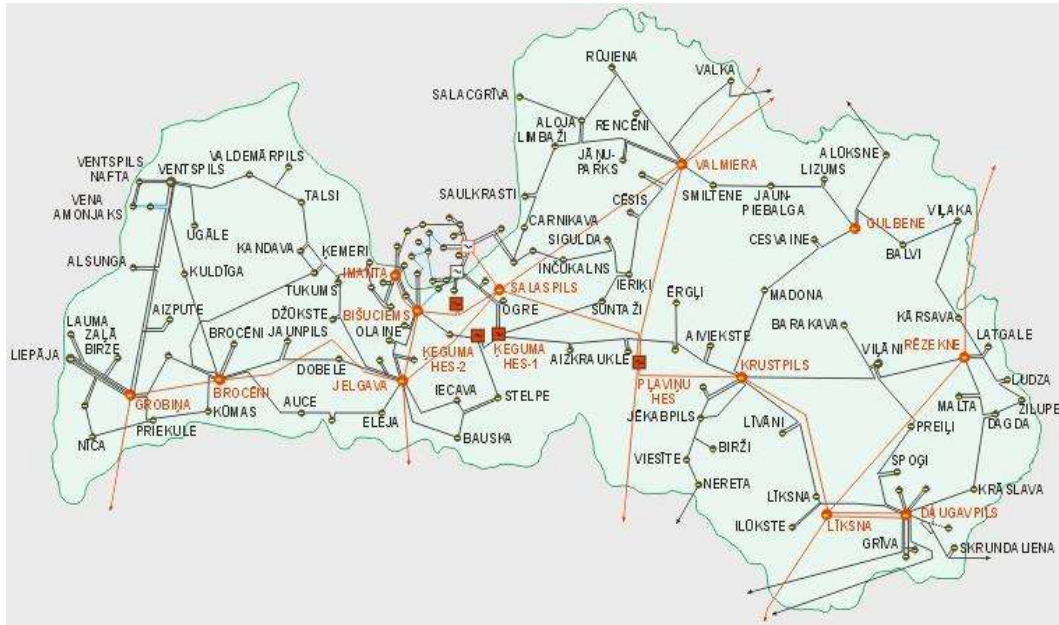
- 330 kV: 15 substations and electricity transmission lines of 1249 km; and
- 110 kV: 117 substations and electricity transmission lines of 3428 km.

In order to ensure improved operation of the 330/110 kV substations and distribution points, the substations have been divided into 13 substation groups according to their geographical location: Salaspils, Krustpils, Daugavpils, Viskaji (Jelgava), Brocēni, Grobiņa, Valmiera, Gulbene, Rēzekne, Sloka, Ventpils, Rīga – Right Bank and Left Bank with one master substation in each group.

Augstsprieguma tīkls AS is in charge of a transmission network receiving electricity from hydroelectric and thermal power stations of Latvia, as well as Lithuania, Estonia and Russia and transferring it further to the distribution

network companies. Latvian transmission network have two interconnections with Estonia, one 330kV with Russia (in BRELL ring) and four 330kV lines with Lithuania (two lines in BRELL ring and two lines in load feed).

Figure 8 Transmission networks in Latvia (330 kV, 110 kV)



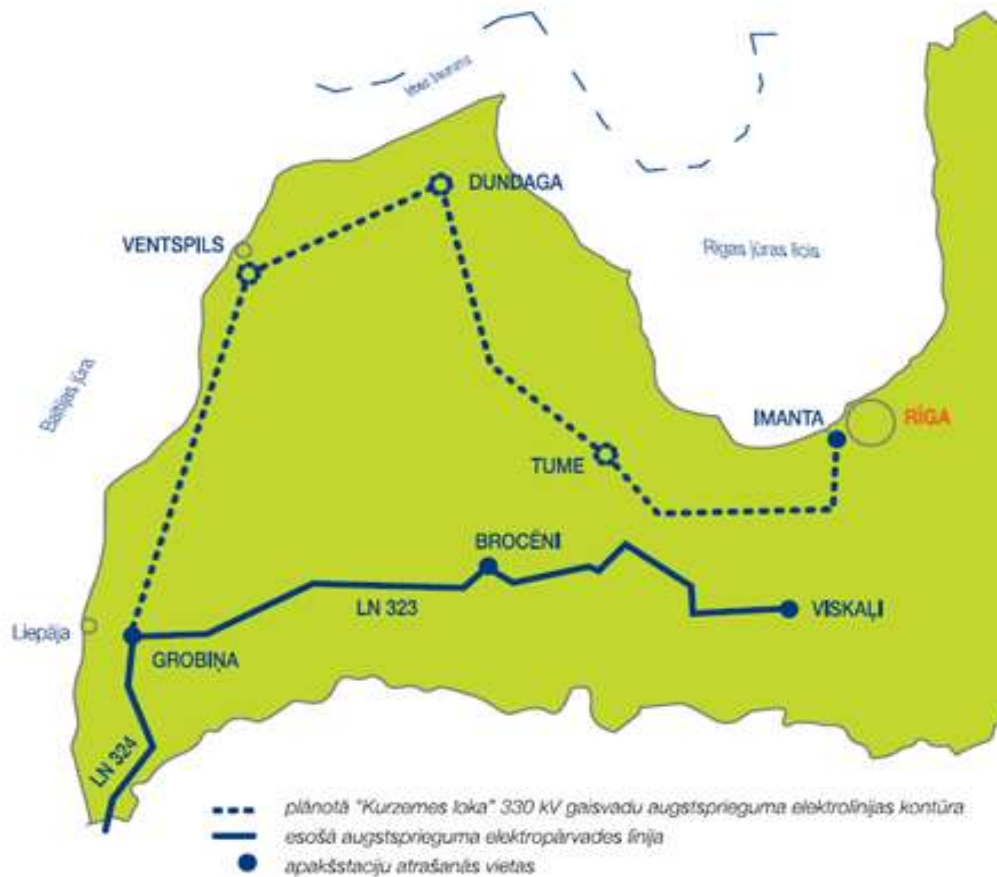
Source: Augstsprieguma tīkls AS 2011

After Ignalina NPP closure, Valmiera 330 kV substation becomes important transit substation in the interconnected Baltic transmission system. The development of Latvian transmission grid is mainly related with Kurzeme Ring (330 kV) project and connecting new capacity units to transmission grid in the western part of Latvia. Kurzeme Ring constitutes a part of the larger NordBalt project, which includes the interconnection installation Latvia – Estonia – Sweden with an objective to improve power supply reliability in the Baltics and transit possibilities with other European Union Member States.

The present 110 kV transmission network does not ensure sufficient electricity supply reliability to the customers in Kurzeme region which has the greatest wind power potential in Latvia. The existing 110 kV transmission network in Kurzeme permits only the connection of limited capacities to wind power plants (up to 220 MW). However, the Latvian transmission system operator has received up to 697 MW wind power plant applications in Kurzeme both on land and offshore.

Another planned reconstruction is the 330 kV substation in Grobiņa which will be expanded and its safety enhanced. Grobiņa substation is an important electricity supply facility for Liepāja region and Latvia.

The new interconnections will improve the regular electricity supply reliability level in the Baltic region not only when operating under the regular conditions but also in emergency situations and repair modes.

Figure 9 Kurzeme Ring in Latvia

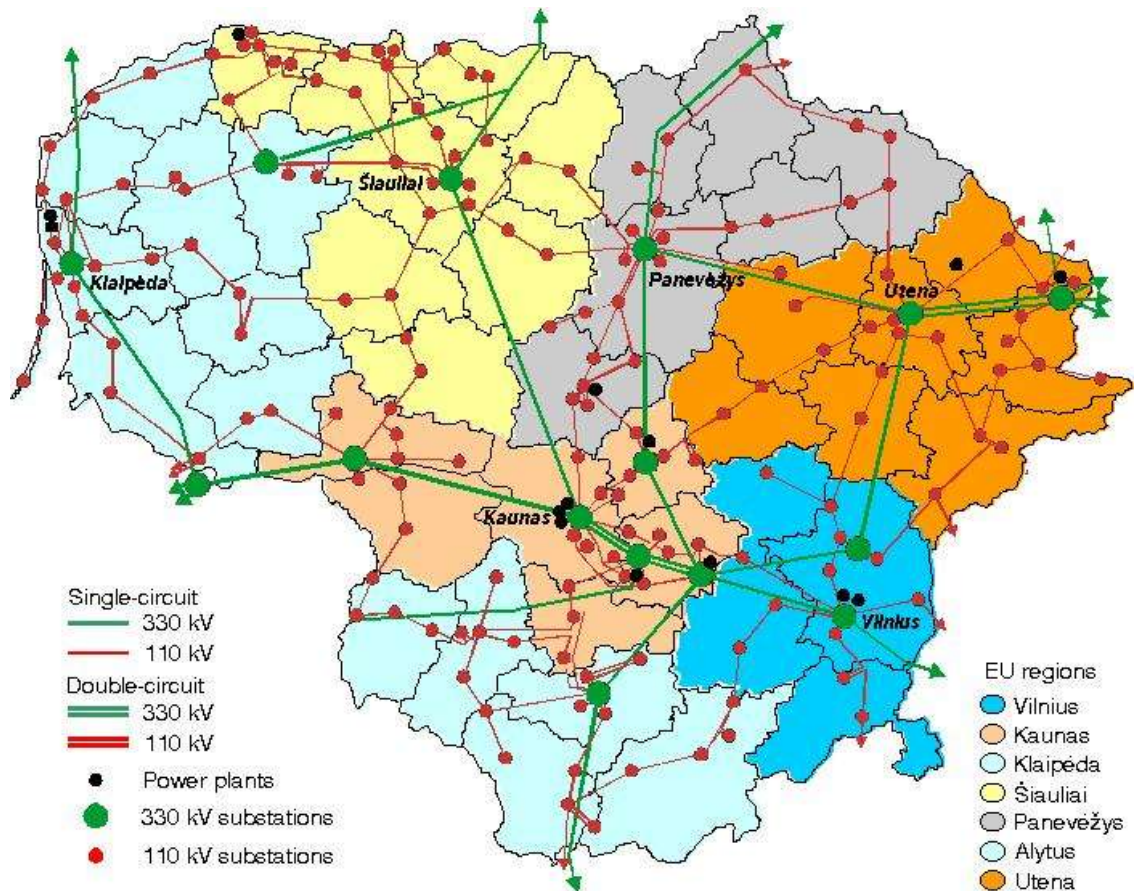
Source: Latvenergo

Lithuania

Current transmission networks status

Lithuanian transmission system is interconnected by four lines with Latvia, four 330kV and one 750kV line with Belarus and three 330kV lines (connected through the substation in Sovetsk) with Russian Kaliningrad region.

Lithuania has a quite well developed 110 -330kV transmission network with the length of transmission lines corresponding to 6630 km. The network has sufficient throughout capacity and no overloads have been observed in the previous years. However, the bulk of power transmission facilities were built more than 25–30 years ago, where the operational service time has reached or exceeded the design service time. The old transmission facilities form one of the major concerns for the system reliability in the future and a number of refurbishment, replacement and new facilities construction are taking place. The transmission network of Lithuania is presented in Figure 10.

Figure 10 Transmission network in Lithuania

Source: Global Energy Network Institute

Kaunas HPP and Kruonis PSP are used for ensuring capacity balances and regulation of regimes in the transmission system. The main role of Kruonis PSP is to provide a spinning reserve, regulate the load curve of the power system and prevent the accidents. During capacity surplus the plant operates in pump mode. In case of capacity deficit in the system, the units of Kruonis PSP are automatically launched into operation. The plant serves an important tool for regulating voltage levels in the 330 kV network. Kaunas HPP is the only power plant in the Lithuania capable of solely starting operation after a complete blackout of the power system. It is the most important generation source in the case of a black start or a scheme separation. The plant is connected to the 110kV network.

Following to the ownership unbundling requirement of all transmission operations from electricity production and sale, Litgrid Turtas AB was established on November 16th, 2010, as a spin-off from Lietuvos Energija AB, to take over the power transmission system assets and become a 100% shareholder of Litgrid AB, who performed the TSO functions. The companies were merged by Litgrid Turtas AB taking over the assets, rights and liabilities of Litgrid AB as of March 1st, 2011; and Litgrid Turtas AB renamed to Litgrid

AB. 97,5% of the company's shares belong to the state-owned energy holding Visagino Atominė Elektrinė.

Future transmission networks plan

The national transmission system strengthening is one of the strategic priorities of Lithuanian power system development. The ageing transmission fleet, growing demand in the country and planned integration into the ENTSO-E system require investments in the network refurbishment and enhancement.

One of the weak points of the national grid is the Western part of the country. The Western part of Lithuania has been in part supplied through the transmission systems of Russia and Latvia. Furthermore, Western regions host and have the major potential for the wind power development. The need for transmission system development in this area is also conditioned by the planned NordBalt interconnector project.

To strengthen the national grid and provide for a major independence in energy supply, a new 330 kV switchyard in Bitėnai was constructed on the border with Russia in 2010. Before, the transmission lines from Bitėnai stretched through Kaliningrad region to Western Lithuania. The project enabled the power transmission from the Eastern regions of Lithuania to Klaipėda entirely through the national territory.

Other major planned and progressing grid projects, inter alia, include:

- New 330kV lines Klaipėda–Telšiai (2013) and Panevėžys–Mūša, including new 330kV switchyard on the line Šiauliai–Jelgava (in Joniškis area), which would allow to reduce the transit through Latvian energy system, but also prepare the system for Visaginas NPP and synchronous operation with European Continental Network.
- Reconstruction of 330/110/10 kV Šiauliai TS (2013), Panevėžys TS (2014) and Klaipėda TS (2014).

The plans for development of the 110kV transmission system are to a larger extent guided by the major cities development and construction of industrial facilities. New 110kV substations are also being installed to connect wind power plants to the transmission network.

Due to exclave position of Kaliningrad region of Russia, Lithuania has been ensuring the electricity transit from Russia via Belarus and Estonia. The Kaliningrad region has been long characterised by the energy deficit requiring electricity import of over 1,2 TWh per annum, initially implemented from Ignalina NPP. With the commissioning of the second unit of 450MW on the gas-fired Kaliningrad CHP-2 in December 2010, the region is expected to be able to meet the internal demand by own generation when the plant reaches full capacity.

2.3.5 Interconnections to the EU market

Estlink

On November 2010, Finnish Ministry of Employment and the Economy granted Fingrid Oyj, Finland's electricity transmission system operator, a

licence to build a new 650 megawatt power transmission cable between Finland and Estonia. The Estlink 2 interconnection will be built as a joint project of the two countries' national grid companies, and will be located between Porvoo in Finland, and north-eastern Estonia. The intention is to take this new submarine cable into use at the end of 2013. The cost estimate for the cable is 320 million euro. The European Commission granted the project a 100 million euro support from the European Energy Programme for Recovery. Fingrid has taken the final investment decision in September 2010.

NordBalt

The EU Commission decided on August 2010, to co-finance the NordBalt electricity interconnection between Sweden and the Baltic States. The EU is contributing EUR 131 million to the link itself, which is being built by the Transmission System Operators Svenska Kraftnät in Sweden and Lietuvos Energija in Lithuania. The estimated costs of the co-financed parts are approximately EUR 552 million. Additionally, reinforcements in the Swedish and Lithuanian grids are financed separately on each side. EU is also contributing further EUR 44 million of EU funds in co-financing grid reinforcements in Latvia, being a part of the general NordBalt project. The 450 km cable will have a 700 megawatt capacity and should be complete by 2015.

LitPol

LitPol is a HV interconnection project between Lithuania and Poland. The link will consist of 400kV overhead double-circuit transmission line between Alytus (Lithuania), where the transformer substation will be reconstructed and expanded by a back-to-back converter station, and Elk (Poland). The expected capacity of the interconnection is 500-1000MW and length – 154km (approx. 50km in Lithuania and 100km in Poland).

The project will require the reconstruction and enhancement of the transmission system on both sides, i.e. in North-East Poland (networks between towns of Ostrołęka, Olsztyn and Białystok) and Southern Lithuania (reconstruction old transmission devices and construction of new transmission line between Alytus and Kruonis Pumped Storage Plant).

The estimated project cost is EUR 237 mln. Works in Lithuania are partly financed with the Ignalina International Decommissioning Support Fund (IIDSF), which is administrated by EBRD. The construction of the electricity line may be also supported by the EU Trans-European Energy Network (TEN-E) funds. In its turn, the works in Poland are planned to be financed from the Infrastructure and Environment Operational Programme from the EU regional funds for Republic of Poland.

The project is planned to be commissioned in 2015-2016 with the capacity of 500MW which will be enhanced to 1000MW by 2020. The timing of LitPol-interconnector between Lithuania and Poland is assumed to depend on the progress of Visaginas nuclear power plant.

2.4 Market structure in the Baltic countries as of Jan 2011

2.4.1 Brief history

Historically there has been one vertically integrated state-owned energy utility in each Baltic country: Eesti Energia, Latvenergo and Lietuvos Energija. Upon implementing the 3rd energy package, these utilities have been unbundled. The states have, however, the ownership of all major generation assets.

The implementation of the 3rd Energy Package directives in the Baltic States starts with the acknowledgment of the future status of the national transmission system operator (TSO). The Lithuania's and Estonia's choice is the first alternative - full ownership unbundling, each undertaking which owns a transmission system acts as a transmission system operator. In Latvia, the first draft concept on TSO unbundling in line with the Electricity directive was presented to the Cabinet of Ministers in June 2010, but the final decision still has to be taken.

The Baltic electricity market is moving towards the removal of regulated end-user tariffs for customers. In August, 2010 Latvia reached 35% and Lithuania 29% of electricity sold for market price, i. e. bilateral agreements or electricity purchase in power exchange; in Estonia, due to decrease of electricity demand, the actual market opening is 28%. In Lithuania there is the approved plan for the gradual abolishment of the regulated end-user prices: as of 2013 those will be applied only to households. In Estonia the market will be fully opened as of 2013 including households.

The Baltic Member States present different structures and mechanisms of electricity markets as well as a different degree of market opening:

- In Estonia electricity market was dominated by a single state owned vertically integrated company (Eesti Energia), which has 97% of the production capacity and 88% of the retail market share and controls the whole transmission networks. In the beginning of 2010 Transmission system operator, newly named Elering, was unbundled from Eesti Energia. Starting from January 2009 35% of the market was opened; only by the year 2013 the opening of the electricity will be completed.
- In Latvia the power market is completely open as from 1st July 2007 in compliance with the directive 2003/54/EC. There are no restrictions for any electricity trading company to enter the market and to offer electricity at a lower price. Electricity consumers can freely change their electricity supplier. There are also no restrictions or tariffs for electricity import and export. In May 2008 regulated tariffs for customers that do not have rights to receive universal service in accordance with the electricity directive were removed (53% of the customers). In 2009, 6% of the customers that are in the free electricity market switched their electricity supplier.
- In Lithuania since 1st July 2007 all consumers have got the status of eligibility (100% of market opening in compliance with the directive 2003/54/EC). Up to now around 13% of customers have exploited their right of eligibility. Regulated electricity price is lower than

electricity price under market conditions. (Source: EC Report: Assessment of the electric markets in the Baltic region, 2009).

2.4.2 Wholesale markets in Estonia

In April 2010 the power exchange of Nordic countries Nord Pool Spot (NPS) extended to Estonia by creating the NPS Estonia (originally named as NPS Estlink) price area with day-ahead trading (Elspot) in the power exchange. In October 2010 Elbas was also opened. The new area connects Estonia to the Nordic power market, offering Baltic participants a liquid market and a trustworthy reference price. Elspot electricity in 2010 accounted almost for 32 per cent of the electricity consumption in Estonia.

As of May 2011 there were 17 market participants in the NPS Estonia price area, including traders from Latvia and Lithuania. The total volume of sales of NPS Estonia in 2010 was 5.2 TWh, the average price was 46.29 EUR/MWh. On 25 July 2010 cumulative volume of NPS Estonia reached 1 TWh. In 2010 the average daily volume has increased from 4.5 GWh in April to 14 GWh in August.

Market players

Generators

In Estonia the state owned company Eesti Energia AS is the largest electricity producer. Eesti Energia owns over 95% of the country's power generation and about 90% of the distribution market. It serves approximately 470,000 residential customers and 26,000 business customers.

Eesti Energia, first established in 1939, is a 100% state-owned energy company. Since 2009, Enefit brand has been used in international markets.

The main products and services of the company include:

- electricity and heat generation;
- sales of electricity, network services, heat and shale oil;
- energy related services, comprising electrical works, energy audits and thermal performance reviews, energy labels issuance, providing Kõu internet; and
- export of oil shale processing know-how and technology.

Other biggest generators are Tartu CHP and Pärnu CHP (started in December 2010), which both belong to Fortum and Tallinna Elektri jaam (Vao CHP) of Tallinna Küte AS owned by Dalkia.

Industrial consumers

Estonia does not have large power intensive industries. Energy consumption is largest in the sector of non-metallic mineral products followed by wood industry, pulp and paper and food industry.

Other market participants

In April 2010 the power exchange of Nordic countries Nord Pool Spot (NPS) extended to Estonia by creating the NPS Estonia price area with day-ahead trading in the power exchange. While in 2009 the Estonian electricity market

could be considered as national one where the largest producer had a 90% market share, from the beginning of 2010 the Estonian market participants are acting also in the markets of Finland and other Baltic states.

2.4.3 Wholesale markets in Latvia

Established in 2007, Latvian electricity market ABC is performed by Latvenergo AS. However, due to technical and economic reasons, some functions remain regulated even after the electricity market is opened. Competition takes place in electricity production and electricity trade whereas the functions related to network infrastructure or system services remain monopolistic and unregulated. The Public Utilities Commission is in charge of setting network tariff and default supply tariff.

The Latvian electricity market ABC trades the following products:

- fixed price electricity (long term contract ranging from 1-3 years);
- variable price electricity (price depends on market situation, electricity costs fluctuate either once a month or every half a year); and
- seasonal price (electricity price depending on the season for a fixed period of time for entities with seasonal businesses).

In general, electricity can be traded by power producers, distribution system operators and electricity traders (18 companies). In 2009, 64% of electricity was sold at regulated tariff and the remaining 36% was sold at fixed contract prices. The shares of variable and seasonal price are marginal.

Latvian electricity wholesale market is currently integrated with Estonian and Lithuanian wholesale power markets as each country has one dominant market player and their local markets are too small. There are no limitations for cross border trades between the Baltic States except the limit set by the transmission link. Latvia has been actively involved in international trading by selling surplus and buying additional electricity with Estonia, Lithuania, Russia and Finland.

Due to the vertically integrated structured of Latvenergo, the Latvian government objected to the initiative on ownership unbundling in the electricity and natural gas sectors during the discussion of the Third Energy Package. It is not likely that the Latvian legislator will opt for full ownership unbundling or for the independent system operator model but more to apply the less stringent independent transmission system operator model (European Energy Review 2010).

In the future Nord Pool Spot is ready to establish new price areas as soon as legal and other preconditions will be implemented. Currently in Latvia, a six month notice period is needed to connect to the existing price area.

The Nord Pool Spot may leave Latvia outside the common electricity market of the Baltic Sea Region in 2011. The reason relates to the country's wavering with full separation of energy generation and retail from management and transmission (Dienas Bizness 02/2011). Latvenergo plans to sell its AST, the transmission system operator, but the company's assets including transmission systems will remain in Latvenergo's property.

Market players

Generators

Latvenergo AS is a 100% state-owned energy utility whose core business is the generation and sale of electricity and thermal energy. Through its subsidiaries Augstsprieguma tīkls AS and Sadales tīkls AS, the company also carries electricity transmission and distribution businesses, respectively. In addition the company provides information technology and telecommunication services.

With the generation capacity of 2356 MW Latvenergo represents around 95% of the total Latvian capacity and generates 90% of total electricity produced in Latvia. In 2009 the company generated 4871 GWh of electricity and 2678 GWh of heat. Latvenergo's main power plants are two CHP power plants in Riga and three hydro-power units on the river Daugava. Plavinas hydro power plant with its ten hydroelectric plants is the largest hydropower plant in the Baltic States and the second largest in the European Union in terms of installed capacity. All power plants were built during the Soviet times and Latvenergo is currently implementing a large investment programme in replacing the CHP power plants with new CCGT units.

In addition, Latvenergo AS owns 51% in Liepājas enerģija SIA which generates and supplies thermal energy in the city of Liepāja. The heating and electrical capacities of Liepāja TEC are 311 MW_{th} and 12 MW_{el} respectively. The total thermal capacity of Liepājas enerģija SIA is 427 MW_{th}, and generates 75% of the heat supplied to the central heating system of Liepāja.

Industrial consumers

The industrial sector ranks third largest sector that consumes electricity in Latvia after the households and other sectors. The electricity consumption of industrial sector was 1.5 TWh in 2009 or 25% of total electricity consumed in Latvia. Key industries are fine chemicals and pharmaceuticals, electronics and electrical engineering industry. JSC Liepājas metālurģija is the only metallurgical company in the Baltic States that consumes 3.6 PJ of electricity use in the steel sector.

Other market participants

Latvenergo represents the biggest electricity generation company and therefore other independent electricity generators are too small to offer big energy volume for large customers. Key trading partners are Baltenergo trade, Enerģijas realizācijas centrs UAB, Inter RAO, Lietuvos Enerģija, Nord Pool, Eesti Energia, Fortis Energy and Latvernergo Kaubandus.

2.4.4 Wholesale markets in Lithuania

The wholesale electricity trade in Lithuania is carried out through the power exchange and direct bilateral agreements concluded between the electricity producers and suppliers. Before 2010 electricity auctions took place on the supply side. From January 1, 2010, the power exchange based on the Nord Pool Spot (NPS) platform started operating in Lithuania. The power exchange is run by BALTPOOL UAB (established in 2009) whereas Nord Pool Spot AS provides spot trade volumes and prices calculation services to BALTPOOL UAB.

In 2010 the Lithuanian power exchange operated autonomously. The price area of NPS Estonia allows Lithuanian (and also Latvian) market participants to trade there on the condition that a trade guarantee agreement is concluded between the TSOs of the respective countries and Estonia.

The Lithuanian power exchange is organized based on the principles of Nord Pool Spot and provides daily physical electricity trading for the next day's 24 period CET time (the day-ahead market). The prices are formed by the marginal cost principle. The trading is organized anonymously. Only licensed participants, such as electricity producers, suppliers, transmission or distribution systems operators, importers/exporters, are allowed to participate in the power exchange. Consumers are not treated as the direct market participants and cannot buy electricity from the power exchange.

In 2010 the number of registered participants corresponded to 26, including 20 actively trading. Local electricity may be traded both through bilateral contracts and power exchange. All imported and exported electricity is traded at the power exchange to enable optimization of the power flows between Lithuania and neighbouring energy systems and ensure that the traded volumes are within the intersystem transmission capacity limits. In case the total cross border bids exceed the available transmission capacity defined by the TSO, the Market Operator exercises the right to reject or limit the most expensive import and least priced export bids within the amount exceeding the cross border trade capacity. At the moment, BALTPOOL comprises only the day-ahead market, with future plans of introducing long term products and derivatives.

In 2010, about 71% of the electricity demand in Lithuania was bought on the power exchange. Over 8 TWh were traded at the power exchange to generate a monetary turnover of LTL 1.32 million (approximately EUR 382 million).

Electricity imports constituted some 62% of the total consumption amounting to 9,2TWh in 2010. The electricity price formation in Lithuania has been to a certain extent influenced by Inter RAO Lietuva, whose share in the electricity sales at the power exchange corresponded to 40%. According to Inter RAO UES, the company exported over 5 TWh to Lithuania in 2010.

Market players

Generation

Following to the closure of Ignalina NPP, the Lithuanian power market is dominated by a single state-owned electricity producer – Lithuanian Power Plant. Other major producers include Vilnius CHP, Kaunas CHP, Mazeikai CHP, Kaunas HPP and Kruonis PSPP, as detailed below:

- Lietuvos Elektrine AB is an energy company based in Elektrenai. It is involved in the generation, supply and distribution of electricity and thermal energy. The Company operates 4x150 MW and 4x300 MW unit gas fired condensing plant, which forms about 65% of the total installed capacity in the country at present. 95.54% shares of Lietuvos Elektrine AB belong to Lietuvos Energija AB.
- Vilniaus Energija UAB is the owner Vilnius CHP is a gas fired CHP of 355 MW net capacity. The plant supplies about 713 GWh electricity to the grid and 2 600 GWh heat to the DH system of the city of Vilnius.

The company also owns and operates the DH network. Vilniaus Energija UAB is owned by the municipality of Vilnius. In 2002 the company was leased to French Dalkia for a 15-year period, who took over the responsibility for operation and improvement of various plants and systems.

- Kauno Termofikacine Elektrine is a subsidiary of Gazprom. The company operates Kaunas CHP (161MW net) and supplies electricity and heat to Kaunas, which is the second largest city in Lithuania. Kaunas CHP generates approximately 613GWh electricity and 1.5 TWh heat annually and satisfies about 95% of Kaunas heat demand. A new facility of some 350 MW is under consideration.
- ORLEN Lietuva owns and runs Mažeikiai Refinery and Mažeikiai CHP. The power plant is of 148 MW net capacity and is run on oil products. The company holds the license of the independent power supplier. The electricity produced by the power plant is used to satisfy the needs of the refinery and is also transmitted to the grid.
- Lietuvos Energija AB owns Kaunas Hydro Power Plant (HPP) of 50 MW net capacity and Kruonis Pumped Storage Plant (PSP) of 760 MW net capacity, which are used for ensuring capacity balances and regulation of regimes in Lithuanian power system. The company performs electric energy production and supply, electric energy import and export and electricity sales activities. 97,5% of the company's shares belong to Visagino Atomine Elektrine UAB.

In 2010, Inter RAO Lietuva and Lietuvos Energija together with Lietuvos Elektrine covered 80% of the electricity sales on the power exchange, constituting around 40% each. The share of Vilniaus Energija was almost 7%, followed by Kauno Termofikacine Elektrine with 3,4%.

Industrial consumers

Lithuania doesn't have many large industrial consumers. One of the biggest electricity consumers is ORLEN Lietuva with an annual demand of around 0.6TWh, which corresponds to approximately 7% of total electricity demand in the country. ORLEN Lietuva owns and operates Mažeikiai Refinery and has its own generation capacity - Mažeikiai CHP.

Energy suppliers

By the end of 2010 55 companies held the licenses of Independent Electricity Suppliers (IES) where some 30% actually implemented activities of the IES. Those also include a number of international companies (e.g., the Lithuanian subsidiary of Eesti Energia -Enefit, Latvenargo Prekyba, Apliq Energija Lietuva, Baltic Partners and other).

Inter RAO Lietuva, affiliated with Russian power export-import monopoly Inter RAO UES, has a strong position in Lithuania able to provide to the market up to 7TWh at prices lower than those of the local producers. The company, inter alia, acts as a independent electricity supplier. At the end of 2010 Inter RAO Lietuva renewed the contract for electricity supplies to one of the biggest industrial consumers – ORLEN Lietuva.

2.4.5 Transmission capacity allocation

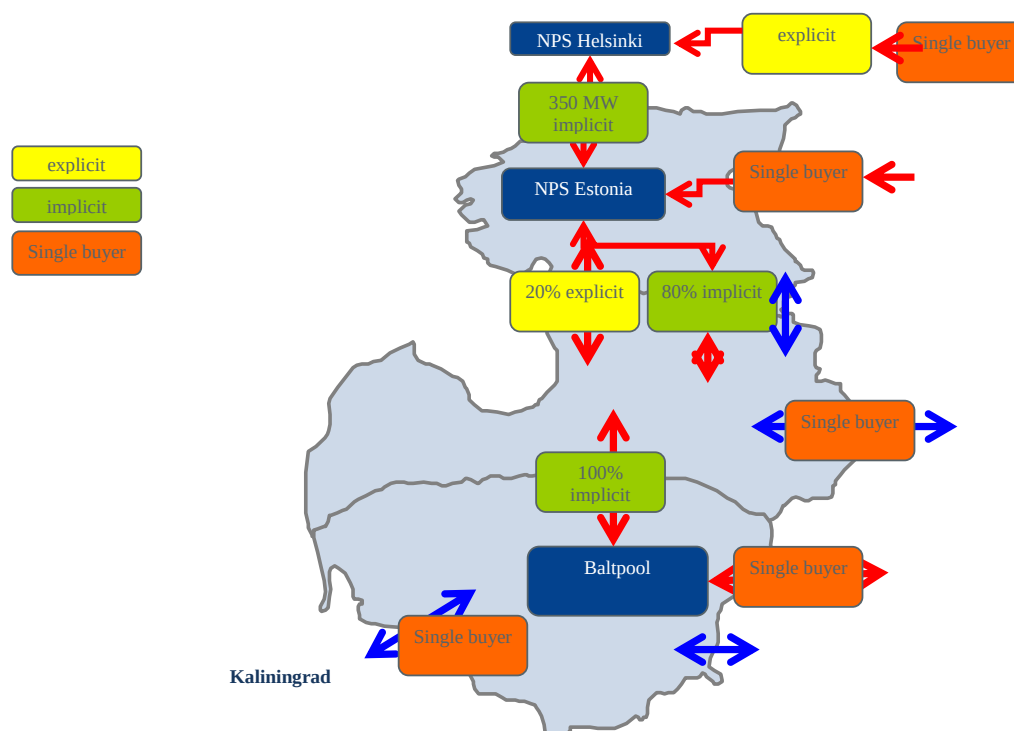
The Baltic TSOs started negotiations on the implementation of a cross-border transmission capacity allocation market based mechanism between the Baltic power States.

The Baltic TSOs Elering, Litgrid and Augstsprieguma Tīkls signed a Memorandum, which sets out general methodologies for capacity allocations and congestion management. It was trilaterally agreed that for inter-country transmission capacity allocations the principle of implicit auctions will be applied, which provides best possibilities for producers and sellers for trading, as well as the lowest prices for consumers in the region.

For supplies resulting from the trade between Estonia and Latvia in the NPS Estonia price area for the period 1 April 2010 until 31 December 2011 the transmission capacity is ensured using a power optimisation mechanism, where at least 80% of the total transmission capacity is allocated through the NPS trading platform. The rest of capacity is allocated through week based explicit auctions, where the transmission capacity bought in advance can be used in the two-days-ahead (D-2) planning phase for trading upon bilateral purchase-sales contracts.

Figure 11 presents the transmission capacity allocation methods utilised in the Baltic electricity market as of 1.1.2010.

Figure 11 Structure of Baltic Electricity Market (as of 1.1.2010)



Source: Eesti Energia

3 BALTIC ENERGY MARKET INTERCONNECTION PLAN (BEMIP) – STATUS REVIEW

The Baltic Energy Market Interconnection Plan (BEMIP) has two main objectives relating to electricity markets: (1) full integration of the Baltic electricity market into the European electricity markets and (2) strengthening of the interconnection capacity to the EU neighbouring countries. These objectives serve in pursuing of one of the three EU energy policy goals, namely security of supply. As a main objective of the creation of a fully functioning and integrated energy market supported by the necessary infrastructures in order to strengthen energy security in the Baltic Sea Region. According to the BEMIP the interconnection capacity between electricity systems in the Nordic and the Baltic countries will be strengthened with new cables to Finland (Estlink II in 2014) and Sweden (NordBalt in 2015). The interconnection between Lithuanian and Polish transmission grids will be followed by building a new back-to-back converter station and strengthening internal high voltage transmission grids in Poland and Lithuania. The commissioning of 500 MW interconnection is planned in 2015, and another 500 MW in 2020. This is planned to be implemented within three years. In addition, cross border transmission capacity allocation principles will be harmonized.

In the BEMIP the Electricity market design has been agreed to be implemented based on the Nordic electricity market model. A specific "Roadmap" that describes practical steps on how to reach the new market model and aims at removing the barriers for a regional electricity market in the Baltic States in conformity with the EU internal electricity market rules has been proposed. The Roadmap consists of four steps and it's planned to be implemented by 2015. Each step contains concrete actions to be executed, covering for example, removal of regulated tariffs, separation of TSO activities and roles, removal of cross-border restrictions, establishment of market based congestion management as well as common reserves and balancing power market, full opening of the retail market and establishment of common power exchange for physical trade in Nordic and Baltic area. Progressing on these market design aspects represents a crucial element for the integration of the electricity systems of the three Baltic States into the Nordic electricity market system. The fact that the Baltic countries are physically integrated to the Russian and Belarus synchronous electricity systems is a special characteristic that entails special challenges; particularly when considering the difference in scale between the Russian and the Baltic electricity systems.

The Baltic power exchange will first cover only the day-ahead market and, thereafter, on the basis of the acquired experience and feedback from the day-ahead market, further markets will be introduced in the power exchange, namely the intraday market based on continuous negotiation (Elbas) and the financial markets (e.g. futures).

3.1 Baltic energy market interconnection plan

The BEMIP roadmap towards an integrated power market consists of a stepwise process accompanying the progressive development of the power market in the Baltic area up to its full integration with Nord Pool market. The following main steps have been identified and already agreed on:

- As Step 1, the decision to start Baltic market integration was made in summer 2009.
- Step 2 - Fulfilment of market opening requirements (Q1 2010):
 - Eligible customers buy power from market. Regulated tariffs have been removed for eligible customers (at least 35% of electricity consumption in each of the Baltic countries);
 - Cross border restrictions (license, tariff) have been removed;
 - Subsidized renewable energy can enter the market without losing subsidies;
 - Separation of TSO activities/roles (clearly separating trading, import/export activities from the core activities of TSO);
 - Basic transparency rules (Nord Pool Spot rules);
 - Congestion management method between Estonia-Latvia-Lithuania and a common position towards Russian and Belarus TSO's;
 - Estonia, Latvia, Lithuania and Finland have a common ITC treatment of the perimeter countries;
 - Estonian, Latvian and Lithuanian markets are open for trade and participation to both power exchanges mentioned below;
 - Nord Pool Spot introduces price area Estlink; and
 - Update of Lithuanian day-ahead power exchange according to the Nord Pool Spot model, as a temporary solution.
- Step 3 –Market functioning fine tuning (1-3 years):
 - Baltic common day ahead market (based on Nord Pool Spot trading platform);
 - Stepwise introduction of Intra-day market;
 - Market based congestion management, implicit auction between Baltic countries managed by NPS;
 - Estonia, Latvia, Lithuania and Finland have a common position and trading principles towards non EEA third countries;
 - Transparency according to the ERGEG's North European Electricity Regional Initiative;
 - Common reserves and balancing power market;
 - Harmonized imbalance settlement and imbalance pricing;
 - Common market monitoring and surveillance rules; and

- Development of financial markets (OTC).
- Step 4 – Fully functioning market integrated with Nordic market (3-5 years):
 - Full opening of the retail market;
 - Common power exchange for physical trade in Nordic and Baltic area;
 - Market place for financial products; and
 - Network tariff harmonization for generators.

All Prime Ministers of the Baltic States signed a Joint Statement on September 24, 2010. The Prime Ministers agreed to continue work, according to the BEMIP objectives and time-lines, on the creation of a fully functioning electricity market in the Baltic States and its integration within the Nord Pool Spot Price Area during 2011.

3.2 Analysis of BEMIP achievements so far

In this section we present an analysis and commentary of the achievements so far in the BEMIP.

The current status in BEMIP process is mapped in Table 4. The process started in 2008 when the President of European Commission, José Manuel Barroso launched a working group to evaluate the development needs in the Baltic electricity and gas markets and Baltic electricity market integration to the rest of EU markets. The group's plan for the development of the Baltic electricity market was adopted on 17 June 2009 when eight Baltic region states signed a Memorandum of Understanding regarding the BEMIP. As already mentioned the action plan described in the BEMIP aims to develop interconnection between Baltic states, Finland, Sweden and Poland and to integrate the Baltic power market with the Nordic power market.

One recent significant step forward is the decision by EMV (the Finnish market regulator) to approve the incorporation of the ESTLINK connection into the Finnish market (and hence Nord Pool) and create an associated price area.

The left hand column in Table 4 breaks each step of the BEMIP into its constituent elements. The three columns to the right show the status of the constituent elements for each Baltic state.

Table 4 Status review of BEMIP process as June 2011

Step 1	Estonia	Latvia	Lithuania
<i>Baltic market integration</i>	Q2/2009		
Decision to start Baltic market integration			
Step 2	Estonia	Latvia	Lithuania
<i>Fulfilment of market opening requirement</i>	Q1/2010		
Regulated tariffs removed for eligible customers (≥35% of volume)			
No cross border restrictions			
Subsidized RES can enter the market without losing subsidies			
Unbundling of TSO activities/roles			
Basic transparency rules (Nord Pool Spot rules)			
Congestion management method between Estonia-Latvia-Lithuania			
Markets are open for trade			
Step 3	Estonia	Latvia	Lithuania
<i>Market functioning fine tuning</i>	2011-2013		
Baltic common day ahead market		end 2011	
Introduction of Intra-day market		2012	2012
Market based congestion management, implicit auction		2012	2012
Transparency according to the ERGEG		After NPS introduction	
Common reserves and balancing power market		Harmonization process ongoing	
Harmonized imbalance settlement and imbalance pricing			
Common market monitoring and surveillance rules			
Step 4	Estonia	Latvia	Lithuania
<i>Full functioning market integration with Nordic market</i>	2013-2015		
Full opening of the retail market	2013	2015	2015
Common power exchange for physical trade in Nordic & Baltic	2015	2015	2015
Market place for financial products (OTC)			planned
Network tariff harmonization for generators			

	Achieved
	Somewhat achieved
	Not yet achieved
	To happen by future date (stated if agreed)

Source: Pöyry Management Consulting

The objective of Step 2 of the BEMIP is to provide the building blocks for integration into the Nordic market. Four of the elements that constitute Step 2 of the BEMIP plan have nearly been entirely met. There remain another four elements to meet.

The first element is the removal of regulated tariffs for eligible customers. As this transition was envisaged to be a gradual process, a target of 35% of electricity sales without a tariff was set. In August 2010 Latvia reached the 35% target. The first milestone in the transition was May 2008, when regulated tariffs for customers that did not have rights to receive universal service in accordance with the electricity directive were removed: this equated to 53% of the customers. As a result in 2009 64% of electricity was sold at regulated prices. The electricity price for captive customers in Latvia is regulated by the Latvian Public Utilities Commission (PUC). In Lithuania,

from January 2010 regulated tariffs have not been applicable to customers representing 35% of demand (mainly large customers). It is planned that from January 2013 regulated tariffs will only be applicable to retail customers and by 2015 regulated tariffs will be phased out entirely. In Estonia, the transition to an open market for consumers began before 2009 when customers with demand over 40GWh (12% of demand) were exempt from regulated tariffs. From January 2009 customers with demand over 2GWh were eligible (35% of demand). However, only since April 2010 has it been obligatory for eligible customers to buy electricity that is not on a regulated tariff. Estonia has a goal of 100% end user market opening by 2013.

The second element, removal of cross border trade limitations, has been achieved as there are no limitations for cross border trades between the Baltic States except those imposed by transmission constraints.

The Baltic markets have also made good progress on allowing subsidised RES to enter the market without losing its subsidy. In Estonia, when an electricity producer sells electricity on the free market and exports it to the electricity grid, the transmission grid operator pays a bonus on top of the selling price. In Lithuania renewable electricity generation is promoted through a price regulation based on minimum prices. Operators of renewable generation are entitled to payment against the grid operator for electricity fed into the grid. The total amount of electricity eligible for promotion through the price regulation is limited by statutory law and depends on the source of energy used. In Latvia the NPS rules states that the RES scheme should not limit trading possibilities. There are obligations on the public supplier to purchase electricity in CHP or from renewable sources but Electricity from renewable sources is not given priority to grid access. Amended laws are currently before parliament to rectify the situation (June 2011).

The fourth element is unbundling of TSO activities/roles. Both Lithuania and Estonia have decided to opt for full ownership unbundling, with each undertaking to form TSO covering the network they own. In the beginning of 2010 Estonia named Elering the TSO and this was unbundled from Eesti Energia (still 100% state-owned). In Lithuania following to the ownership unbundling requirement of all transmission operations from electricity production and sale, Litgrid Turtas AB was established on Nov 2010, as a spin-off from Lietuvos Energija AB, to take over the power transmission system assets and become a 100% shareholder of Litgrid AB, who performed the TSO functions. The companies were merged by Litgrid Turtas AB taking over the assets, rights and liabilities of Litgrid AB as of March 1st, 2011; and Litgrid Turtas AB renamed to Litgrid AB. The entity is 97,5% state-owned.

In Latvia, the first draft concept on TSO unbundling in line with the Electricity directive was presented to the Cabinet of Ministers in June 2010, but the final decision still has to be taken. Founded in 2005, Augstsprieguma tīkls AS is the TSO in Latvia and is 100% state-owned.

The fifth element concerns the adoption of basic transparency rules (i.e. those of the Nord Pool spot). In general all of the Baltic TSOs have adopted transparency rules in accordance with EU regulation. Estonia has adopted Nord Pool Spot AS transparency rules and from January 1, 2010, the power exchange based on the Nord Pool Spot (NPS) platform started operating in Lithuania. The power exchange is run by BALTPOOL UAB (established in 2009)

whereas Nord Pool Spot AS provides spot trade volumes and prices calculation services to BALTPool UAB. In addition, Latvia provides urgent market messages to Nord Pool Spot.

The sixth element, which has not yet been achieved, is for the three states to come to an agreement on congestion management methods. In June 2011 Congestion management step 2 (Estonia- Latvia-Lithuania) was under discussion (EC). A memorandum of understanding on the capacity allocation mechanism between the Baltic states was signed by TSOs in 2010. Estonia will be forced to limit the current implicit allocation of EST-LAT cross border capacities if Latvia and Lithuania will not join NPS.

The final element of the second phase is to implement markets that are open for trade. This has happened in Estonia and Lithuania but not Latvia. In April 2010 power exchange of Nordic countries Nord Pool Spot (NPS) extended to Estonia by creating the NPS Estonia (originally named as NPS Estlink) price area with day-ahead trading (Elspot) in the power exchange. The Latvian electricity market ABC, established in 2007 is under the control of Latvenergo AS. However, due to technical and economic reasons, some functions (network) remain regulated even after the electricity market is opened. The Latvian government does not recognise power exchanges as legal entities and operates under a tax regime different than that governing Nord Pool Spot.

The objective of Step 3 of the BEMIP is to take the Baltic market region and fine tune it so it is in an appropriate stage of evolution for full integration into the Nordic market. Estonia has introduced major elements of step 3 with Latvia and Lithuania following.

The first element of step 3 is for the Baltic markets to join a common day ahead market. In April 2010 the power exchange of Nordic countries Nord Pool Spot (NPS) was extended to Estonia by creating the NPS Estonia (originally named as NPS Estlink) price area with day-ahead trading (Elspot) in the power exchange. In January 2010 Baltpool was granted a licence to act as the electricity market operator in Lithuania. Baltpool organises the wholesale power exchange in cooperation with Nord Pool Spot. Latvia: has plans to join to the Nord Pool Spot but legal changes related to the role of the power exchange in Latvia need to be finalised and the role and rules of the Latvian ISO need to be accepted by the EC according to the 3rd package. A provisional target for this is the end of 2011 or beginning of 2012

The second element is the introduction of an intra-day market. So far Estonia has introduced this system with Latvia and Lithuania looking to introduce this in 2012, once the day-ahead market has been well established. Nord Pool Spot, the Estonian transmission system operator Elering and the Finnish system operator Fingrid are finalised their preparations for Estonia to join the intraday market (Elbas) in October 2010.

Market based congestion management has been introduced in Estonia but amendments to Latvian and Lithuanian laws are required for these to be implemented in the respective markets; NPS is foreseen in 2012 in both cases.

Transparency according to ERGEG has been somewhat achieved in Estonia, but in all countries it will be achieved after the introduction of the NPS. Of the remaining actions no public date has been set for their completion, but there

is evidence that these are being considered in the regular meetings of the Baltic Market mini forum.

Step 4 means integrating the Baltic states market fully into the Nordic market. Most of the goals in this stage have either not been set a deadline or the deadline is more far in the future. There are, however, a couple of points to note. The first, regarding a fully functioning market integrated with the Nordic market is that Lithuania Baltpool has close cooperation with NASDAQ OMX. The second is that all of the Baltic states plan to have a fully open retail market by 2015 (Estonia plans for 2013). All of the states have set 2015 as the target date for which to implement a common power exchange for physical trade in Nordic and Baltic markets. Finally Lithuania has set an objective to integrate the settlement of forward contracts (no date available).

3.3 National policies in the light of goals set in BEMIP

In general all Baltic countries are in favour of BEMIP and the governments have set their action plans to achieve the goal according to the schedule set by EU. Estonia is relatively on the schedule with its BEMIP process plan while Lithuania is trying to catch up with its plan. Latvia is relatively lagging behind in implementing its plan compared with Estonia and Lithuania.

3.4 Key outstanding issues in BEMIP

There are four main outstanding issues in BEMIP development. These are the establishment of a Latvian pricing area; ensuring security of supply in the Baltic countries; agreement of common principles and creating the necessary preconditions for the establishment of a financial market.

- Establishment of Latvian price area – only after that progress is possible in creating common principles in congestion management (implicit CM in all borders) and creating a common Baltic balancing and regulating power market. The Latvian solution for TSO unbundling is different from Estonian and Lithuanian solutions, as Latvia is proceeding with ISO (Independent System Operator) solution. This means that the ownership of transmission system assets and technical and commercial transmission system operations are separated. The details of the Latvian solution are still to be determined and the solution is to be approved by the Commission.
- Ensuring security of supply in the Baltic countries means securing peak-load and reserve capacity supply adequacy and, if necessary, demand side response in disturbance situations and competitiveness of Baltic producers in integrated power markets.
- Agree common principles for trading and interconnection capacity allocation towards third countries.
- Create preconditions for establishment of financial market – first OTC trading/brokers, then financial market place.

The latter three issues are discussed in Chapter 4 of this report.

4 CHALLENGES ON THE ROAD TO A FUNCTIONING INTEGRATED POWER MARKET

In this Chapter we examine the main challenges on the road to a functioning and integrated power market in the Baltics. These challenges can be grouped into the following categories:

- Supply adequacy and security of supply to 2016;
- Competition and liquidity in the future Baltic markets; and
- Cross border issues.

4.1 Supply adequacy and security of supply until 2016

4.1.1 The role of electricity imports and new capacity

The Baltic countries will have to go through a serious refurbishing of the electricity generation capacity in order to maintain adequate capacity and to comply with EU-legislation. From system security and energy independency point of view it is highly desirable to proceed with Visaginas nuclear project or equivalent low-emitting base load project. The key challenge for the Baltic markets will be to create a market environment in which investment is forthcoming.

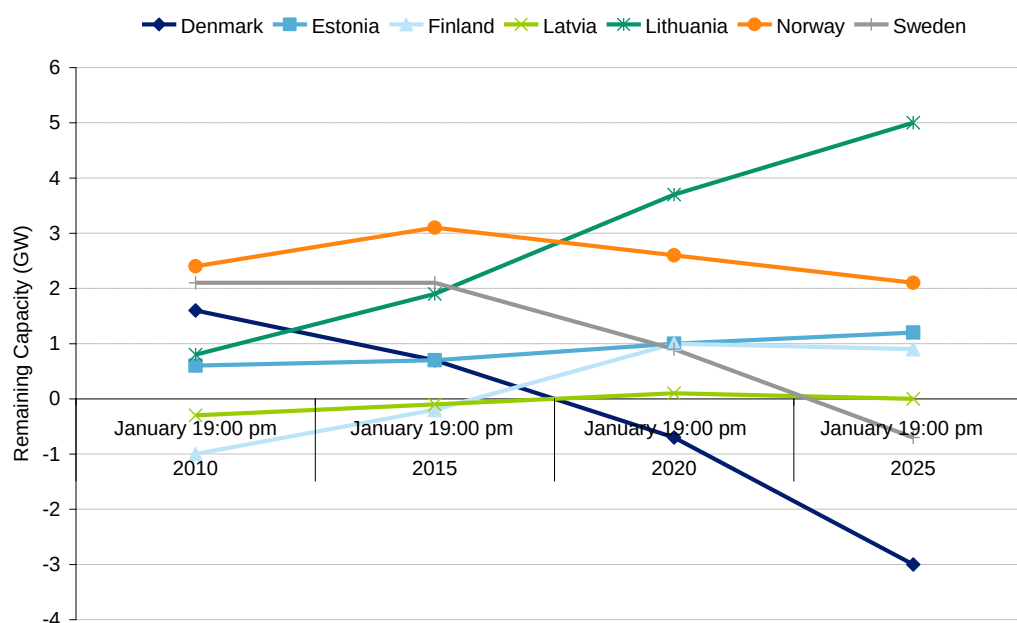
As long as the Baltic system is synchronized with Russia stability of the power system is generally not seen as an issue due the size and interconnection capacity from the Russian system to the Baltic markets. The Estonian TSO, Elering, is also preparing for additional wind capacity by investing in fast reserve plant. In the first instance gas combustion engines with a combined capacity of 250 MW have been procured. The first phase will be 100MW capacity and are scheduled to be completed by 2013 and potentially another phase of 150MW by 2014. The reason for this investment is that the contract under which Elering currently procure balancing services (from Latvernergo) will run out in 2013 and Elering deemed renewal of the contract with Latvernergo to be too costly. There are also plans for creating preconditions for the Baltic electricity system independence from non-EU countries. The Baltic countries are supported by EU Commission in reaching this goal. In light of the previous point, the decision by Elering to procure its own balancing capacity makes some sense.

ENTSO-E's projection of capacity adequacy relies on forecasts provided by national bodies. The resulting remaining capacity assessments are thus slightly biased in following Figure 12.

The data shows capacity adequacy rises in the Baltic states and Finland, stays positive (but decreases) in Norway and falls in Sweden and Denmark. The

decrease in capacity adequacy in Denmark and Sweden is due to the roll out of wind, which is considered to be non-usable by ENTSO-E and the retirement of thermal plants in these markets. While this is the absolute trend in Denmark, in Sweden reserve capacity is expected to increase to 2016 on the basis of higher nuclear availability and the conversion of fossil plants to biomass. Capacity adequacy decreases post 2015 due to the decommissioning of thermal plant. If the expected efficiency improvements in Swedish nuclear units are undertaken, the remaining capacity for Sweden would be some 0.5 GW higher than in Figure 12. Before the seventh nuclear unit in Finland is operational remaining capacity will stay negative in Finland.

In Lithuania, the trend is the result of a new 900MW CCGT, expected between 2013 and 2018, and a new NPP in 2018 to 2020. There are also two new interconnectors with Sweden and Poland. Lithuania's strong reliability margin is based on ENTSO-E's fairly optimistic views on new investments in conventional and nuclear capacity. Likely investments by 2020 would result in remaining capacity settling just above 1 GW. In Latvia, the trend is the result of the commissioning of a 400MW gas steam unit, and a new 400MW unit in the west of Latvia. Estonia benefits from new disturbance reserve (Wartsila gas engines) and additional 650MW connection with Finland. Additional new shale oil plant, new CHP and a share of the new nuclear plant are also included in the ENTSO-E scenario.

Figure 12 Remaining capacity in ENTSO-E Best Estimate scenario ³

Source: ENTSO-E System Adequacy Forecast 2010 – 2025: Best Estimate scenario

The Baltic market is at this point technically interconnected to Russia and Belarus. The target of the Baltic countries is however to reach independency in energy – meaning that the Baltic electricity system could be operated independently from the Russian system. To achieve this, investment is needed in transmission system and generation, and a strengthening of the interconnection capacity to the Nordic and Central European network.

A key element for a future expansion of the regional market development will be the increase of interconnection capacity for the integrated market. This can be achieved in two different ways; (1) allocation more (all) interconnection capacity on the existing interconnections to the market; and (2) build new interconnection capacity. In Table 5 the current plans for this are listed. This will ensure a bigger liquidity pool that will form the basis for the price.

The trading principles with other EU countries are defined in the 3rd package. A key issue for having a transparent and trusted price will be to agree on the trading regime towards the non-EU countries, i.e. Russia and Belarus. The

³ Best Estimate scenario takes into account the commissioning of new power plants considered as certain and the shutdown of power plants expected during the study period as well as future power plants whose commissioning can be considered as reasonably credible according to the information available to the TSOs.

Remaining Capacity = (Reliable Available Capacity – Load). When Remaining Capacity is positive, it means that some spare generating capacity is likely to be available on the power system under normal conditions. (ENTSO-E Report System Adequacy Forecast 2010 – 2025)

trading on these borders and how the import/export to these countries is managed will be crucial for the market development.

Besides Russia and Belarus, the Baltic countries have only quite recently had the possibility to trade electricity from other countries or markets. This has been the case since 2007, when the Estlink 1 cable between Estonia and Finland became operational. As part of the BEMIP, interconnection capacity with the Nordic countries will be further increased through Estlink 2 and NordBalt. In addition, the Baltics will also be connected to Poland through LitPol. Compared to today's import capacity of 350 MW through Estlink 1, these interconnector plans will increase the interconnector capacity to EU or EU-related countries to a total of 2200 MW (excluding the option of 500 MW more through LitPol). This implies an increase of over 400% with respect to today's capacity of Estlink 1. Compared to the current peak consumption in the Baltics of 4741 MW measured in 2010, this means that 46 % of current peak consumption could be covered through electricity imports from EU or EU-related countries. With respect to net installed capacity in 2010 of 9339 MW, the import capacity relates to 23 %.

The planned expansion consists of three different projects in addition to the existing Estlink 1. The projects are divided between the different countries with different capacities as shown in Table 5.

The planned expansion of interconnector capacity through the BEMIP is substantial and will impact on the available supply. The role of electricity imports on supply adequacy and security of supply may however be three-fold;

1. The possibility to import electricity may increase security of supply if it leads to diversification of supply, i.e. having more available resources with different sources and/or location, and a balanced portfolio of available total supply resources.
2. Or it may represent a negative impact if the opposite is the case.
3. The possibility to export electricity at higher may increase profitability of Baltic power plants meaning plants incentivising capacity to remain available

Table 5 Details of planned Baltic interconnection

Name	Interconnected areas	Capacity (MW)	Planned (MW)	Option (MW)
EstLink 1	Estonia and Finland	350		
Estlink 2	Estonia and Finland		650	
NordBalt	Lithuania and Sweden		700	
Litopol	Lithuania and Poland		500	500
	Total	350	1850	500

The risks related to electricity imports can be related to market issues or technical aspects. With respect to market issues, such risks may be related to export policies of the interconnected market places (for example the historical export restriction practice of Sweden towards Denmark) or different market framework and/or competition situation in the exporting country's market ⁴.

It should also be noted that new interconnection projects will need to be financed and there is currently some discussion surrounding the impact of the proposal for Financial Transmission Rights (FTRs) on the investment behaviour of TSOs. Some parties believe that incentives for TSOs to invest in new capacity may be reduced due to the auctioning of transmission capacity using FTRs ⁵.

With respect to technical issues it may be related to outages and vulnerability related to such outages, if a major portion of the supply in the country is served by import and there is not sufficient reserve capacity in the internal market.

We will now analyse how the above applies to the case of the Baltics, with the planned increases in interconnector capacity through BEMIP and the existing capacity of Estlink 1. The only country which is not directly involved in any of the interconnector projects is Latvia. The total interconnector capacity provided through the current Estlink 1 and the planned projects of Estlink 2, NordBalt and LitPol, will be quite equally divided between Estonia and Lithuania. The amount of interconnectors and division of the total capacity between Estonia and Lithuania, contributes to diversification of supply and at least decreases the technically related risk of outages. More system-related risks may still apply in the case of severe situations in the system operation, if this would require export restrictions from either Sweden or Finland. With regards to the market related issues, the majority of these projects are then related to the Nordic countries, which are known for having a well-functioning day-ahead market (Nord Pool Spot). The market-related risks should therefore be low. Latvia may be in a vulnerable situation depending on the strength of the interconnections it has with Estonia and Lithuania, and the functioning of the current market arrangements and future common market place⁶.

In total, it is therefore reasonable to expect that the planned increase of import capacity will have a positive effect on the supply adequacy and security of supply in the Baltics. However, it should be noted that interconnection cannot be relied upon as a silver bullet as the direction of

⁴ Svenska Kraftnät used to restrict the export capacity on interconnectors from Sweden to neighbour countries to handle internal congestion in the Swedish central grid. This practice was complained to the European Commission by the Danish Energy Association, and as a response to this Svenska Kraftnät changed their methodology to handle internal congestion by introducing price areas (to be implemented November 1st 2011).

⁵ See "FTRs in the Nordic Market. Pros and cons compared to the present system with CfDs". Björn Hagman and Jørgen Bjørndalen. Elforsk rapport. April 2011.

⁶ A part of the NordBalt project is the Kurzeme Ring, which aims to strengthen the grid in Latvia.

flows is dependent on what happens in both markets. Indeed, in some situations increased interconnection can exacerbate supply problems and therefore cannot completely guarantee security of supply hence the need for a substantial domestic capacity margin.

As a result, investment in new generation capacity will still be required in the Baltic markets in the coming years and this in turn will depend on the evolution of competition, market liquidity and cross border issues.

4.2 Competition and liquidity in future Baltic electricity markets

4.2.1 Market equilibria in the Baltic countries – Cournot model of the competition

The structure in the Baltic electricity system (market) as it stands today is highly concentrated. There are three major producers, one in each country, representing a significant share of the total market. Furthermore the power imports from Russia originate from a single supplier, Inter RAO. In the context of this study we have created a simplified game theoretical model (Cournot-model) to illustrate the changes in market equilibrium when changing the trade situation with Russia and with the Nordic Countries.

We have taken a simplified approach in this exercise, and none of the results should be interpreted as predictions of market outcomes. The aim of this exercise is to show drivers and directions of potential changes in market equilibria under different assumptions of cross-border trade. The game theoretical analysis can be found in whole in the Annex of this report.

4.2.1.1 The assumptions

We have assumed that the generation capacity in the Baltic area consists of 1000 MW of small independent generators and 3 large producers whose generation capacity and marginal costs are respectively 1200MW, 2000MW, and 1600MW (40€/MWh, 45€/MWh and 50€/MWh). The unlimited import capacity from Russia is assumed at 4600 MW and the underlying marginal cost for electricity imports at 30€/MWh.

In the game theoretical framework we have tested a different set of residual demand levels and demand parameters to illustrate oligopolistic market equilibria for the residual market. In this setup it can be interpreted that the fringe of small generators cover the first 1000 MW of demand while the 3 generators and Russian exporter compete for the remaining market.

The trade capacity between the Baltic and the Nordic areas has been assumed to be 1700 MW and the market in the Nordic area has been assumed perfectly competitive.

4.2.1.2 Market equilibrium in isolated Baltic market with unlimited import capacity from Russia

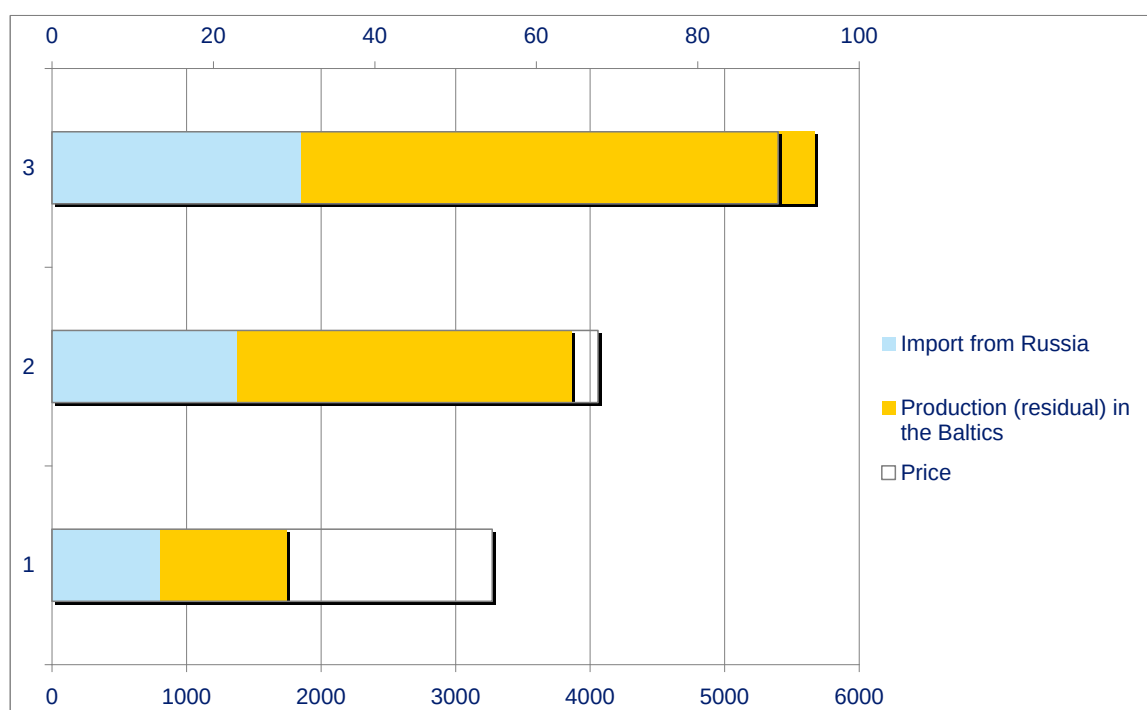
A noteworthy result of the game theoretical analysis is that although there is a potential for 4600 MW of electricity export from Russia, even in peak load situation a profit-maximizing strategy for a monopoly exporter is to export

only 2000 MW, as can be seen in the figure below. The three local producers generate the rest of the electricity.

Under the assumptions and methodology adopted in this chapter the results show that high market concentration in the Baltic area actually “protects” the producers from predatory exporting from a third country. If the modelled market consisted of more producers, the profit maximising strategy for an exporter would be to export more.

The implication of this finding is that the more the Baltic market becomes competitive the more there is need to limit export from third countries from local generators’ perspective.

Figure 13 Cournot-equilibrium in different demand levels (MW / €/MWh)



Source: Cournot analysis

4.2.1.3 Effects of limiting the Russian import capacity from 4600MW to 1000 MW

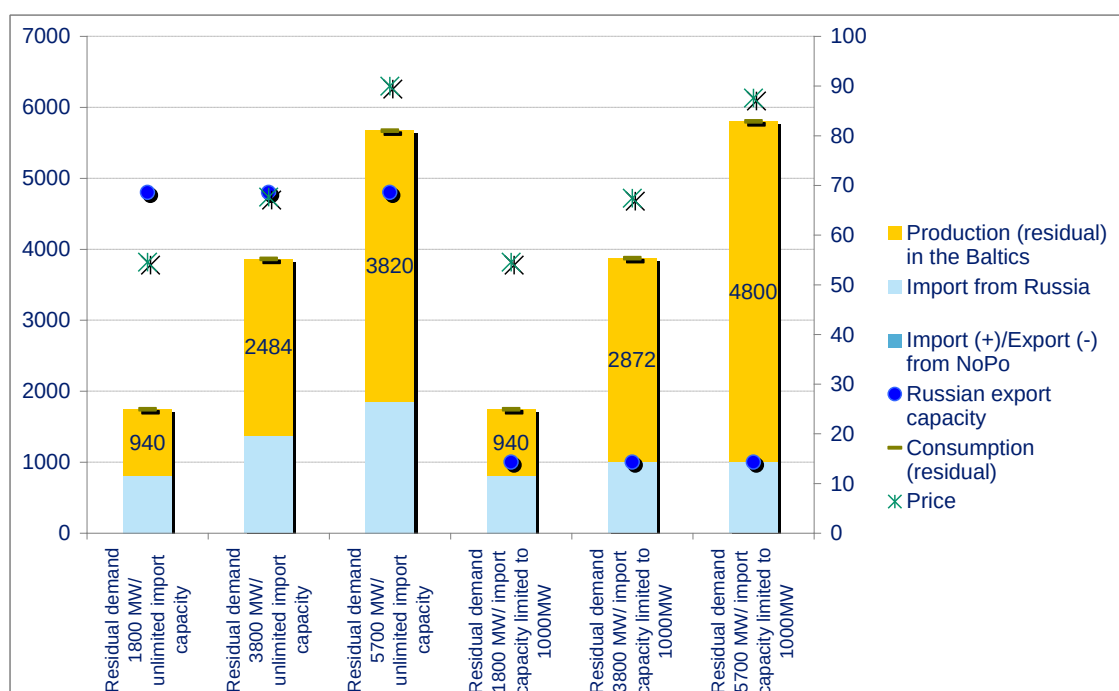
In the low demand case the limitation of Russian interconnector capacity to 1000MW has no effect on the outcome, as in both cases the export volume is 805 MW. In mid demand case the effect on production in the Baltic area is 400MW and in peak demand already 1000MW.

The higher the demand the more the import limitations effect the price. Here it should be noted that the equilibrium prices should only be understood as indicators of the market concentration. In the mid demand case price decreases by 0.4% and in peak demand case by 2.6%. Reduction of import capacity resulting in decreasing prices indicates that even though if the cost of imported electricity was significantly below production costs in the Baltic area,

its effect on price can be contradictory. When only considering the negative effects of market concentration it can be said that a dominant low-cost supplier has a negative effect if its potential market share was not reduced.

The reason is that in this Cournot model, when production of one firm is restricted, all the other firms increase their production, trying to benefit from the situation as much as they can. As a consequence the price falls because supply increases more than Russia's production is restricted. It should be noted that this means the equilibrium profits of Baltic firms could easily be higher when Russia's production is restricted even if price falls as Baltic firms sell more.

Figure 14 The effects of limiting Russian import capacity on market equilibrium



Source: Cournot analysis

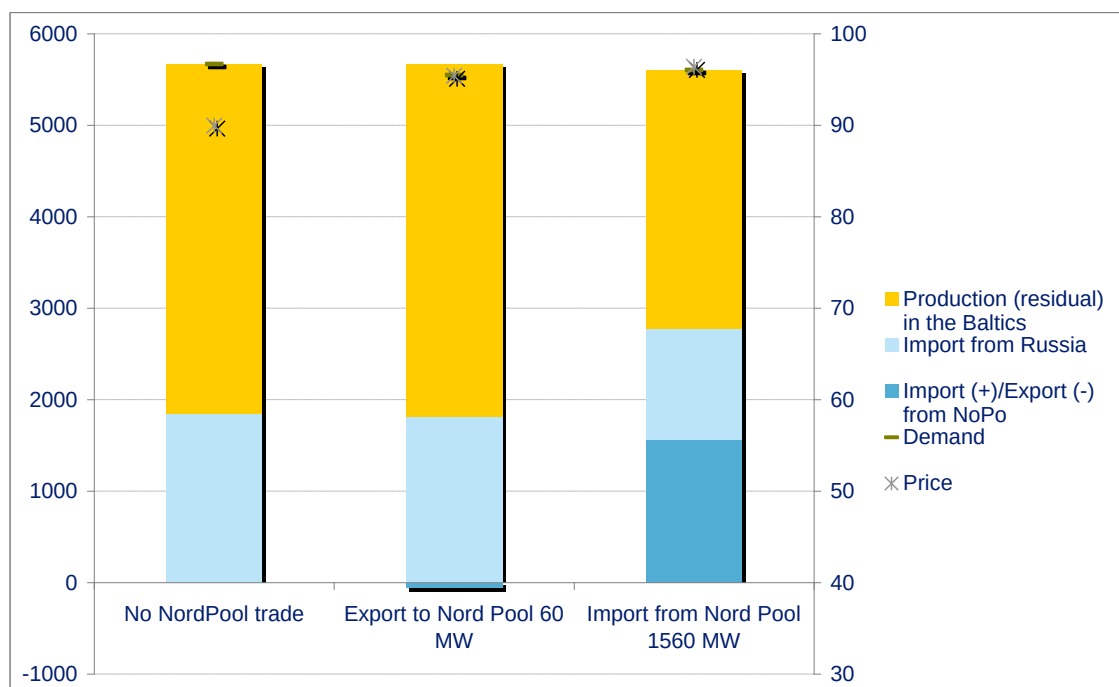
4.2.1.4 The effects of trade with Nord Pool on market equilibrium in the Baltic area

As can be seen in the figure below, the relative adaptation of behaviour is stronger for the imports from Russia than for the Baltic producers when the import from Nord Pool is increased.

The assumptions of perfect competition in the Nordic countries mean that the Nordic producers do not change their behaviour according to the market situation in the Baltic area. This explains the counter intuitive results of increasing prices when imports from the Nordic area are increased (see the Annex for more details). This observation implies that although in normal market situations the prices in the Nordic and Baltic areas will converge when interconnector capacity is increased, the problems arising from the market concentration within the Baltic area persist in the residual market when the cables are congested. Market integration does not alone guarantee more

competition while it certainly reduces the number of hours during which the market concentration can cause difficulties.

Figure 15 The effects of the trade with Nord Pool area: production and prices



Source: Cournot analysis

4.2.1.5 Concluding comments

Although the interconnectors to Russia are very strong in comparison to the total size of the Baltic market, it is evident that in current market structure export potential from Russia to the Baltic area represents smaller risk to the local generators than has been suspected. One caveat to add to this finding is that we have made the assumption that the importer and Baltic market players are independent. While this is generally true, there has been a recent example of Eon using imports from its Russian subsidiary to cover a shortfall in Baltic generation⁷. On the other hand it is the market concentration in the Baltic countries that explain this finding in the Cournot-model. At the same time limiting imports from Russia do not greatly affect the price in our model, which implies that the import limitations do not as such imply higher electricity prices in the Baltic countries.

Market integration with the Nord Pool increases competition in the Baltic area. In this game theoretical framework we found evidence that when Baltic countries are importing from the Nordic area and the interconnectors are congested, the problems of market concentration are aggravated, as the residual market in which only local producers operate is small in size. This implies that besides market integration, also competition locally should be addressed in order make the Baltic power market function efficiently.

⁷ <http://elering.ee/the-baltic-electricity-shortage-increased-in-july/>

4.2.2 Role of financial markets

Well functioning financial markets are an important means by which risks associated with the physical electricity market can be managed. Therefore the development of financial markets in which electricity can be traded is an important challenge in the evolution of Baltic electricity markets. In this section we review standard financial instruments associated with the electricity market, investigate the current state of financial markets related to electricity trading in the Baltics and identify areas for future development.

As power markets become more tightly integrated, physical trading strategies become more difficult to carry out. A high level of trade activity in traditional physical contracts would require rather complex monitoring of a large number of contracts across different transmission system operator areas and interconnections. Financial contracts are entered into without regard to technical conditions, such as grid congestion, access to capacity, and/or other technical restrictions.

The system price, the price for energy delivered on the following day, is set by the spot exchange. The Baltic region can e.g. be one price area in NPS or three, one for each country. Every hour of the day a price is set based on the offers/ bids from generators, distributors and large consumers (e.g. in the industry). In the financial market, the same buyers and sellers conclude forward contracts for electrical energy. The forward contract is a measure to hedge against price changes, which also provides a measure of predictability for consumers. Below is a list of factors that influence on the price determination in the spot market and in the financial market for electrical energy:

- Weather and temperature conditions;
- Transmission capacity;
- Generating capacity;
- Currency movements;
- Prices for input factors in generation of electrical energy;
- Prices for emission allowances; and
- Power consumption over time.

Risks associated with changes in physical market prices can be managed through the financial (forward) market for electricity. A buyer or seller of power can reduce the risk of future price changes by selling or buying the cost of future electricity to/from other players with the ability and willingness to accept this price risk. Players can thereby change their risk exposure as required, and are able to hedge the price of future output or consumption.

Price hedging based on financial contracts at power exchanges or in the bilateral market, combined with physical procurement at national or regional spot markets approximates a hedge. A key tool in risk management, this method of hedging, has largely replaced traditional bilateral trade in physical-delivery contracts.

All financial power contracts are cash-settled. They have been designed to satisfy the needs of various participants:

- Producers, retailers and end-users using the products as risk management tools; and
- Traders who profit from volatility in the power market, and contribute to high liquidity and trade activity.

Using the exchange/marketplace allows players to secure the greatest possible transparency around pricing, and reduce the risk of incorrect price formation in the future. The alternative is to do this bilaterally with limited information about the overall position.

4.2.2.1 Products

At present the contract types traded in a financial power market are mainly power derivatives. The derivatives differ from different exchanges/marketplaces and can be peak and/or base load futures, forwards, options, and Contracts for Difference (CfD). The reference price for these contracts is the system price of the physical power market. The maximum trading time horizon can differ from one to six years. There is no physical delivery of financial market power contracts. Cash settlement is made throughout the trading and/or the delivery period, starting at the due date of each contract (depending on whether the product is a future or forward).

Future contracts for trading

Settlement of futures contracts involves both a daily mark-to-market settlement and a final spot reference cash settlement, after the contract reaches its expiry date. Mark-to-market settlement covers profit or loss from day-to-day changes in the daily closing price of each contract.

Final settlement, which begins at delivery, covers the difference between the final closing price of the futures contract and the system price in the delivery period. Throughout the final settlement period, which starts on the expiry date, the member is credited/debited an amount equal to the difference between the spot market price and the futures contracts final closing price.

Forward contracts for trading

Year contracts are normally cascaded (split) into quarters. Quarter contracts are cascaded into months. There is normally no settlement during the trading period prior to the expiry date for forward products. The mark-to-market amount is accumulated (but not realized) throughout the trading period as a daily loss/ profit, and realized in the delivery period. Throughout the delivery period, starting at the expiry date, cash is required in the members' pledged / non-pledged cash accounts, and settlement throughout the delivery period is carried out in the same way as for futures. The non-pledged cash account must be supported by a bank guarantee.

Option contracts

An option is a right to buy or sell an underlying contract at a predetermined price at a predefined date in the future. Options, combined with forwards and futures, offer valuable strategies for managing the risk associated with power trading. Option contracts to buy are termed call options, and option contracts to sell are termed put options. Thus, the holder of a call has the right to buy the underlying contract, and the holder of a put has the right to sell.

Contracts for differences (CfDs) for differences

The reference price for forward and futures contracts is the system price. Actual physical delivery purchase costs are determined by actual area prices (like in the Nordic area with 11 different price areas for the time being). An area price differs from the system price when there are constraints in the transmission grid; contract for differences (CfDs) then allow members on the exchange to hedge against area price risk.

A perfect hedge using forward or futures instruments is possible in situations when there is no transmission grid congestion in the market area, that is, area prices are equal to the system price. In reality the difference between area prices and system prices are hedged using a contract for difference along with a futures instrument.

4.2.2.2 Clearing

Another important component of a financial market is the clearing business, which means that a clearing house enters into contracts as a counterpart and thereby accepts responsibility for their future settlement. The most important function of the clearing process is to provide members with a quick and effective settlement process after carrying out the trade. At the same time, it reduces the financial risk for exchange members. NPS have a well-functioning clearing solution.

4.2.2.3 Developments of the Markets

The markets thus seem to prefer short-term futures close to due date and the nearest quarter and year forwards. The main reason for this preference seems to be the different margin calls for futures and forward contracts and the high liquidity. Financial settlement of futures includes normally daily mark-to-market settlement, which requires a large amount of cash in pledged/non-pledged cash accounts, especially for the long period contracts at the far end of the time horizon. Financial settlement of forwards involves normally no daily mark-to-market settlement, only daily margin call, and thus requires posting cash collateral only during the delivery period, starting at the contract's due date.

Market projections indicate that trade in financial contracts will predominate in the developing European market. The reference prices will be spot prices and indexes based on spot prices and OTC prices. Financial contracts are entered into without regard to technical conditions, such as grid congestion, access to capacity, and other technical restrictions. Price hedging based on financial contracts at power exchanges or in the bilateral market, combined with physical procurement at national or regional spot markets approximates a hedge. A key tool in risk management, this method of hedging has largely replaced traditional bilateral trade in physical-delivery contracts. As power markets become more tightly integrated, physical trading strategies become more difficult to carry out. A high level of trade activity in traditional physical contracts would require rather complex monitoring of a large number of contracts across different transmission system operator areas and of interconnections.

4.2.2.4 Market surveillance

In order for any market to prosper and grow one needs to have confidence in the pricing mechanisms, in the transparency of price relevant information and in the integrity of the market. Market surveillance has an important role in establishing and maintaining this confidence and integrity by having a strong and visible presence in the market.

Market surveillance continuously monitors the market conduct of trading participants, and investigates possible breaches of the trading rules or applicable laws. Essentially market surveillance is looking for any matters related to the market participants' business in the markets that are likely to have a substantial impact on the prices. All information acquired in investigations and cases handled by market surveillance have to be treated as strictly confidential.

4.2.2.5 Challenges remaining for financial markets in the Baltics

Independent of the market model some prerequisites have to be fulfilled before establishing a financial market in the Baltic area. Some important prerequisites will be:

- Wholesale reference price, transparency and liquidity;
- Competition in generation;
- No (or few) cross border restrictions;
- Effective market opening, i.e. equal market access to potential market participants;
- Independent regulators;
- Effective TSO unbundling;
- Reduced market power (through unbundling or a larger regional market);
- Opening of the retail market;
- Demand side participation/management; and
- Market based allocation of cross-border capacities.

As described above, and shown in Table 4, the Baltic energy market interconnection plan include more or less all of these prerequisites. Some are fulfilled in accordance with the plan – some are planned to be implemented by 2012 and the rest – including a common power exchange for physical trades in the Nordic and Baltic area and a market place for financial products – should be in place by 2015.

The three Baltic markets are rather small physical wholesale markets, and the degree of competition in the market is generally low in the different markets with one dominant generator in each jurisdiction (e.g. Eesti Energia AS have a share of 90 % of the power generation in Estonia). A reasonable level of competition is therefore dependent on the following:

- Successful regional integration in one common market place with sufficient interconnection capacity between the areas for to establish a trustworthy reference price, and thereby increase the liquidity and

reduce market power. With sufficient interconnection capacity between the areas, it will also be possible to establish the whole Baltic region as one single price area in NPS if desired.

- “Boost” the liquidity from bilateral contracts to the spot exchange. The volume in NPS Estonia was 32 per cent of the electricity consumption in Estonia in 2010 and there is a potential for moving more of this to the exchange.
- Increase the capacity of supply. One way of doing this is to increase the level of interconnectors - both Estlink 2 and NordBalt should be in operation by 2015. These interconnectors would both increase the liquidity and reduce the market power of the dominant producers.
- Introduce imbalance cost/balance responsibility. Competitive energy markets require that the responsibility for upholding balance is allocated to the TSOs. A prerequisite for new generators and end use customers to participate in the wholesale market is to have a system for balance responsibility in each area. This means that all generation and eligible customers are exposed to the concept of hourly electricity balances. For each hour the balance responsible party balances forecasted demand plus sold electricity with planned generation and bought electricity (planning phase). Both bilateral trade and electricity sold on the spot market are included. Afterwards, in the imbalance settlement phase, the actual demand and generation is controlled in the balance settlement. By introduction of balance responsibility and an imbalance price, there will be a “punishment” for the difference between planned and settled result. This will give the balance responsible parties incentives to trade themselves in balance at the spot and intraday markets.
- Promote cross border balancing via a common merit order of balancing bids. Cross border balancing has been employed for some time in the Nordic market, covering tertiary reserve. The balancing mechanisms of the different Nordic markets have been harmonised over a number of years and the TSOs cooperate in the balancing system and maintain a common merit order list of offered resources for tertiary response through the Nordic Operational Information System.
- Strengthen market surveillance from market operators and competition authorities to ensure the transparent and fair price setting.

As shown above, there are still some gaps existing in the Baltic region, confirming that the transition to an open wholesale market with a financial market place needs still future development. A staged approach to a market opening, combined with certain incentives for producers to use the spot exchange and eligible consumers to source from the open market is therefore an important part of the further development in addition to increased regional capacity and interconnectors.

4.3 Cross-border issues with 3rd countries

In this section we assess cross-border issues with 3rd countries. This issue is particularly relevant due to the integration of the Baltic markets into the

Russian electricity system on the one hand and the desire to integrate them into the Nord Pool market on the other hand.

Current interconnection capacity into the Baltic markets from Russia is 4600MW which is significant in relation to the market size. This raises issues for rules governing trading and other commercial arrangements between 3rd party countries and the Baltics from a technical and commercial point of view.

4.3.1 Status today and development trends with Russia

All the Baltic countries are synchronized with the Russian and Belorussian electricity systems. These countries are thus interdependent on system balancing. Commercial trade is however regulated. Estonia, Latvia and Lithuania are currently seeking a sustainable approach on how to regulate and limit electricity imports from non-EU countries. The Baltic countries will likely aim to reduce the electricity imports from non-EU countries to as low level as possible in the sake of preventing "carbon leakage".

Finland currently imports base load electricity from Russia. In the political and public debate regarding new nuclear capacity in Finland it was argued that one new unit is needed in order to decrease electricity imports from Russia. Also, in 2006 an application for an underwater interconnector with an import capacity of 1000 MW from Russia to Finland was rejected, as it was seen as negative to the security of supply of Finland. At the same time, there are discussions of transforming Finnish-Russian interconnection partially into two-directional, which is assumed to happen after 2020 at earliest.

On another side, Norway is showing an interest in increasing electricity exchange with Russia. There are current plans of a new back-to-back station on the borders between Norway and Russia providing an exchange capacity of 300 MW. As part of the internal strengthening of the Norwegian power grid between north and south, there is plan for a line to be constructed up to the border with Russia. There are however some concern related to environmental and safety issues, in particular the import of nuclear power from older Russian nuclear plants.

A more general point applying for anyone with interest in (or dependency on) importing power from Russia is also the future internal power situation and balance in Russia. There are several plans for investments in supply capacity in Russia, however they have been politically decided, and whether they will represent the needed investments for the future therefore represent a risk. Also, industrial growth in Russia is at least expected in some areas.

4.3.2 Reciprocity considerations

The possibility to establish trade on fair terms and under reciprocal conditions is an important issue. For the Baltic countries, with an historical dependency on electricity imports from Russia, this is of particular importance, and also with respect to the future strategy of increased independence. There are issues in the relation between the Baltics and Russia which raise questions about the reciprocity of the electricity (and energy in a broader context) trade, and which are cause of concern to the Baltic countries.

To be able to trade on fair terms with a transparent and legitimate price is the point of concern. The following issues in particular may impede the potential of fair trade:

- Regulated gas prices in the Russian electricity supply sector;
- No mechanism for pricing of carbon like the ETS in the Russian electricity supply sector;
- Different gate closure and calculation times preventing day-ahead market coupling (not necessarily preventing intra-day coupling); and
- Electricity market design in Russia provides no transparent single price for electricity.

The first two aspects directly affect the competitive balance between the two countries. The unfair competition introduced at least by the first aspect is a challenge to the Baltic States' development of own electricity supply. With respects to pricing of carbon, it might be somewhat more uncertain whether this is a relevant issue, as Russia at least are fulfilling their commitments with respect to Kyoto.

The electricity market design in Russia is based on nodal-pricing and a separate capacity market, which makes it difficult to calculate a correct price for exchange of electricity⁸.

To seek better terms of trade or a possibility to protect the internal market are then two alternative or mutual strategies for the Baltic countries to respond to the current situation. We will now on a high level discuss the possibilities for this through the EU-Russia Energy Dialogue or through the WTO in case of Russian membership in the organisation.

Russia is a major energy partner of the whole European Union, and the so-called Energy Dialogue between Russia and the EU is one of the key issues in the bilateral relations between the two parties. The overall objective of the energy partnership is to enhance the energy security of the European continent by binding Russia and the EU into a closer relationship in which all issues of mutual concern in the energy sector can be addressed. At the same time, it is to ensure that the policies of opening and integrating energy markets are pursued. Russia is welcomed as an energy partner to the EU subject to conditions of reciprocity in market principles, mechanisms and opportunities, as well as equivalent environmental standards. Both the EU and Russia recognise the importance of working together towards a strategic EU Russia energy partnership.

As EU-members, the Energy Dialogue also applies to the Baltic countries and is a tool for the Baltic States in their relation towards Russia. Due to the smaller markets that the Baltics represents, the leverage of negotiating through a larger entity is important (the Baltic States alone have little bargaining power). It may however be argued that the interest of the Baltics may be different in some aspects from the rest of the EU, and there is not necessarily internal agreement in the EU on what should be the energy policy

⁸ For more information about this, we refer to the Elforsk financed study on the Russian electricity market currently being undertaken by the Lappeenranta University of Technology in Finland.

of EU towards Russia. It is also a question of whether the EU is a sufficiently strong tool when it relates to foreign policy, historically having a focus on internal EU policies⁹.

Russia is also in the process of negotiating a possible membership in WTO. The WTO is a forum for international cooperation on trade-related policies. The WTO is governed in particular by five principles which set the framework for trade policies: Non-discrimination, reciprocity, enforceable commitments, transparency and safety valves. Reciprocity refers to the exchange of equal or identical advantages or privileges. The framework provided by WTO should provide terms which should improve the terms of trade or tools to remedy potential discrepancies. The WTO among other provides for the possibility to restrict trade based on unfair competition. A relevant measure is countervailing duties on imports that have been subsidized.

4.3.3 Status today and development trends with Nord Pool markets

Recently the Finnish Energy Market Authority, or EMA, accepted ESTLINK 1 into the Nordic electricity market. The process that was followed can serve as a valuable template for other connections from Baltic markets to the Nord Pool.

The Energy Market Authority approved the rules and mechanisms regarding auction, use of capacity. Estlink shareholders needed to change the capacity purchase agreement (CPA) in order to open the Estlink connection for implicit auction. This allowed the creation of the Estlink price area by enabling the lease of Estlink capacities to TSOs

The EMA noted that in the case of conflict between the CPA and shareholders agreement, the latter supersedes the former.

This statement was accepted on the basis that the Shareholders' Agreement must not prejudice the condition set in this decision whereby the above-mentioned measures to integrate the Estonian and Nordic power markets need to be enabled.

The Capacity Purchase Agreement enables the transfer of the transmission capacity either fully or in part for use by Finnish and Estonian transmission network operators as well as implicit auction in the "Estlink" price area of Nord Pool Spot. The Energy Market Authority finds that this section enables the basic structure of the market model between Estonia and the Nordic countries and, at a later stage, the Baltic States and Nordic countries in accordance with the roadmap presented in the BEMIP.

This requires that:

- The day-ahead market is based on implicit auction on the Nord Pool Spot trading platform;
- The intra-day market is based on the Nordic Elbas market model according to which transmission capacities available once the day-

⁹ A SPES policy paper by Arunas Molis from February 2011 provides interesting analysis on this subject; "Rethinking EU-Russia energy relations: What do the Baltic States want?"

ahead market is closed are offered for trading on the intra-day market; and

- The balancing power market is based on the Nordic market model according to which transmission capacities available once the markets (day-ahead and intra-day) are closed can be used to meet the needs of the balancing power market.

If the above interpretation is not possible, the rules and mechanisms currently being adopted must be changed. Should the Applicant make any amendments to the Shareholders' Agreement, the amended Shareholders' Agreement must be submitted to the Energy Market Authority for approval.

4.3.4 Other European long-term market coupling solutions

The development of long-term market coupling solutions is a key issues in the BEMIP, as it aims to integrate the Baltic market into the European electricity market (among other implying the need for strengthened physical interconnection). Market coupling has in general also been an important issue for other EU-countries, in the interest of increased security of supply and increased competition among other. The EU has also through the 3rd package clearly put a goal for a pan-European power market based on price market coupling between countries/regions.

An example of a market coupling process is the KONTEK cable, a DC interconnector between East-Denmark and Germany with a capacity of 600 MW (550 MW offered to the market in both directions). It came into operation in 1995 and is now operated by the Danish TSO Energinet.dk and the German TSO 50 Hertz. At the time of establishment a larger part of the capacity on the cable was reserved to parties with priority access contracts. First in 2002, explicit auctioning of capacity that was not used by the parties with priority access was opened for. Then in 2005, Nord Pool Spot implemented implicit auctioning on the KONTEK cable by opening a price area in Germany. In 2008, the former solution of Nord Pool Spot was replaced by a joint venture between EEX and Nord Pool Spot through the European Market Coupling Company (EMCC). Due to problems with the algorithm used first in the EMCC solution, the solution was delayed and first truly implemented in 2009 (though amended). Now, the KONTEK cable is part of the larger ITVC market coupling between the Nordics and the Central Western European region, still implemented through the EMCC.

A key feature of the KONTEK market coupling process is that it has been more market driven than politically driven, in comparison to the process in the Baltics established through the BEMIP. Among other the cooperation between and role of the electricity exchanges is a key feature in this market coupling initiative. There are clear market incentives behind the establishment of the interconnector, and it also fulfils societal goals of security of supply and competition issues. In addition, regulatory support has been present, allowing the market player initiatives to out fold. In part, the market coupling through KONTEK was between more developed electricity markets than what is at least historically the case of the Baltics, decreasing some risk elements for parties interested in developing market coupling initiatives.

In general, legal and governance issues have proven to be the most time consuming task in market coupling projects. To ensure legally binding solutions with multiple parties has proven to be a challenging part.

The Baltic market process can be seen as similar to the development of the Nordic markets, where the countries see the benefit of the cooperation between the countries to secure an efficient market.

The Baltics are in an excellent position to learn from the experience from the various market coupling solutions in Europe and base its future solutions on best practices from Europe. It has, through EMCC, NorNed, KONTEK and TLC (among others), been seen that a market coupling based on an implicit auction is the preferred solution. The current development of integrating stepwise with Nord Pool Spot is a good path for the Baltic region.

5 FINDINGS AND CONCLUSIONS

The Baltic Energy Market Interconnection Plan (BEMIP) has an objective to achieve the full integration of the Baltic states into the European energy market through strengthening interconnections with neighbouring EU countries. The BEMIP provides a clear stepwise plan on how to achieve this goal by integrating the Baltic markets into the Nord Pool Spot by 2015. Successful implementation of the BEMIP should facilitate an increase competition and go some way to delivering security of supply in the Baltic markets and promote the development of sustainable energy sources.

This report has found that while there has generally been good progress to date, there are still significant challenges to overcome for the BEMIP to be successfully implemented. It also found that there have been different degrees of progress in meeting BEMIP milestones in the Baltic states.

New market based investment is required in Baltic electricity markets to maintain security of supply. The outlook for power balance in the region is negative in the absence of new investment due to closure of the Lithuanian nuclear power plant and other legacy plants (e.g. units of Estonian oil shale plant). In addition, the network in the Baltic market is old and requires investment; it is also highly integrated into the Russian system, which currently provides the Baltic states with security of supply. However, another long term political goal is for the Baltics to desynchronise from the Russian network and synchronise to the EU network. The timing of desynchronisation from the Russian network is unlikely to take place before 2020.

Increased interconnection to other EU countries will provide the Baltics, to some extent, with additional supply adequacy and security of supply but this means that Baltic markets need to be developed to a state where they can enter Nord Pool Spot. In the current configuration Estonia will link to Finland and Lithuania will link to Poland and Sweden. However, new investment in generation capacity will be required to meet security of supply requirements.

However, the successful implementation of the BEMIP may not ensure security of supply. Current plans for deployment of nuclear and renewables in the Nordic countries could mean that even with successful implementation of the BEMIP programme, additional measures are required to ensure investment in peaking plant (such as a capacity payment mechanism). An evaluation of such measures falls outside the scope of this report but we note that other Pöyry studies have found this situation does occur in other liberalised and interconnected European markets as the level of intermittent generation increases¹⁰.

In order to incentivise market based investment, competition will need to increase under BEMIP. In Chapter 4 we used a Game Theory approach to examine the impacts of competition in the Baltic markets. This exercise suggested two main conclusions: firstly, the current market structure in the

¹⁰ The challenges of intermittency in North West European power markets- public summary. Pöyry. March 2011. <http://www.poyry.com/linked/en/press/NEWSIS.pdf>

Baltics (i.e. highly concentrated) means that Russian exports pose less of a risk to small generators (through both imports and exports) than expected. While this finding holds in general, we have not considered the case in which trade takes place between the subsidiaries of common parent company: one in Russia and the other in one or more of the Baltic states, which could change the conclusion. However, such dynamics must be set against the political objectives of the BEMIP programme. Secondly, local competition as well as market integration should be addressed in order make the Baltic power market function efficiently. We found evidence that when Baltic countries are importing from the Nordic area and interconnectors are congested, the problems of market concentration are aggravated as the residual market in which only local producers operate is small in size.

It will also be important for private investors to have enough confidence in market liquidity and there are still some gaps regarding the financial markets ensuring liquidity in the Baltic region. A staged approach to a market opening, combined with certain incentives for producers to use the spot exchange and eligible consumers to source from the open market is therefore an important part of the further development in addition to increased regional capacity and interconnectors.

Another significant issue is related to the market interface with 3rd party countries. This is an EU level issue but this is especially a Baltic market issue because of the configuration of interconnection into the Baltic markets from Russia and the large transfer capacity from Russia relative to the size of the Baltic markets. In brief the main issues are:

- Russia is not part of ETS nor has a mechanism of its own for setting a price for emissions– how does the reciprocity considerations link to Russia’s possible WTO membership?
- Different electricity market design principles in EU and Russia. In Russia there is nodal pricing (there is no single market price but market price is set separately for each node, in addition there is a separate capacity market)¹¹.

The current lack of a common understanding of a market interface with 3rd party countries, and the lack of reciprocity between Baltic States and 3rd party countries is a cause for concern amongst investors because of the risk that cheap imports pose. Arguably this could be one of the reasons why there is difficulty in getting firm investor commitment to the Visaginas nuclear power plant. There are also concerns over Kaliningrad as it has an energy deficit and Russia currently supplies electricity to the exclave via Belarus, Estonia and Latvia. Although new generation capacity in Kaliningrad is planned, the challenges associated with managing direct supply from Russia that runs through the Baltic states remain.

Finally, progress with the implementation of BEMIP is at different stages in different Baltic markets due to local conditions. In Estonia, progress has been driven by ESTLINK connection to Finland and the desire to connect to the Nord Pool Spot (which has recently happened and the process can serve as a valuable template for connections between Sweden and Lithuania). The same

¹¹ There is an ongoing study to understand the implications of connection to the Russian market at the Lappeenranta University of Technology.

situation will drive the need for market reform in Lithuania as it plans to connect to Sweden and Poland under the BEMIP. At the moment Latvia has no planned interconnection to other EU markets and hence its security of supply will depend on being able to freely import from Estonia and Lithuania. As a result Latvia will be dependent on imports from Lithuania and Estonia. This may have influenced the decision for Latvia to take an alternative route in TSO reform and the more conservative progress with BEMIP action items. The point is that there will need to be a common transparent power market for physical and financial trading across the Baltic states which should also reflect issues such as transfer constraints thereby ensuring all states have sufficient incentive to implement the BEMIP.

A. APPENDIX 1: COMPETITION IN THE BALTIC ELECTRICITY MARKET: A GAME THEORETICAL ANALYSIS

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June 2011

EXECUTIVE SUMMARY

In this paper we construct a simple oligopoly model to analyze the Baltic electricity market. We try to gain some intuition what will happen in that market after the integration into Nord Pool. Integration will take place by 2015.

At the moment there are 3 main local producers in the Baltic market with capacities somewhere between 1200 MW and 2000 MW and marginal costs roughly between 40€/MWh and 50/MWh. There are also many small suppliers with total capacity about 500 MWh at marginal cost a bit over 40€, and an additional 500 MWh at marginal cost about 60€. InterRAO has a monopoly right for all the electricity export activity from Russia. Russia could export to the Baltic area at best with over 4000 MW of capacity, at least that would be technically feasible. It can be assumed that InterRAO can purchase and export electricity with a very low marginal cost. For the analyses we have assumed that the cost of Russian exports is 30€/MWh. The current transmission capacity to Nord Pool (Finland) is 350 MW but will be expanded to 1000 MW. In addition there will be a link between Sweden and Lithuania (NordBalt-interconnector) having a capacity of 700 MW.

The load in the Baltic area varies roughly between 2000 MW and 6000 MW. Therefore the Baltic market is roughly third of the Finnish market and a sixth of the Swedish market. The prices in the Elspot market have varied from 30€ to several hundreds of euros. If extreme prices are excluded then price has varied somewhere between 35€ and 70€ per MWh.

We will use the existing capacity and cost figures as a starting point and compute the prices and quantities that would prevail in equilibrium prior to integration for some reasonable specifications of the demand. The prices and quantities in the model vary between 46€ and 1900 MW (low demand) and 90€ and 5800 MW (high demand) (see Tables 2 and 4, pp. 13-14)

Then we study what will happen if the Russian exports are restricted to 1000 MW. The prices and quantities do not change much (Tables 3 and 5, pp. 14-15). Actually prices are often slightly lower than in case when Russian exports are unrestricted. The reason is that while Russia's output is restricted the other firms' total output more than offsets the lost supply and hence the price falls. Another notable implication is that the local producers are operating at full capacity in many cases. The prices would be even lower without capacity restrictions. So it seems that there is some room for additional production capacity.

After integration the Baltic submarket is a rather small fraction of the enlarged Nord Pool (10% in our model). We assume that competition elsewhere in the Nord Pool is nearly perfect and that the production decision of the Baltic firms would not essentially change the production plans of other firms in Nord Pool. The upshot is that prices tend to be higher than they were before integration (Tables 7 and 8, pp. 18-19).

The reason is the extreme assumption that there is perfect competition elsewhere in Nord Pool. That makes the Scandinavian firms look like very strong competitors for the Baltic producers. A more realistic assumption would be that competition is oligopolistic in the whole Nord Pool area. That would make predicted prices in the model lower than what they are now. The

reason is that the Baltic producers will increase production if they anticipate that the other firms will reduce their production as a reaction. And it is rational for the other firms to cut down their production if they believe that the Baltic firms will produce more.

The prediction of the model is that the total transmission capacity 1700 MW would be quite sufficient in most cases. In the model, the (net) imports to the Baltic area range from -850 MW to +1600 MW. When the demand is high (during weekdays in the winter), the Baltic producers would often be producing at full capacity. Restricting the Russian export to 1000 MW would of course make this event more likely. During low or normal demand the transmission lines would rarely be congested. Still, some new production capacity might be needed to secure the supply in all circumstances.

Our model does not give much support to the belief that the Baltic producers couldn't manage in the new situation after integration. The enlarged market is not only a threat but also an opportunity to profitable investments. The recent German decision about getting rid of nuclear power production seems also to support this view.

MODELING COMPETITION IN ELECTRICITY MARKETS

General

Traditionally electricity markets have been modelled by perfect competition. In such a model the behaviour of producers has a simple description: a firm should produce a quantity such that the marginal cost of production equals the market price of the good produced. An equilibrium in perfectly competitive markets can also be computed relatively easily – at least in principle. Given the demand function that describes the behaviour of buyers, compute first the total supply function of firms by using the simple decision rule of firms, and then find the price such that demand equals supply.

But the main reason why perfect competition is viewed as a desirable mode of competition is its welfare implications. In perfectly competitive markets the total welfare (the sum of profits and consumer surplus) is maximized. Under perfect competition the market prices correctly signal scarcity of resources and guide production and investments where they are valued most by the society in general.

The main assumption of this model is that all producers are so small (relative to the size of the market) that a single firm's decisions have no impact on the market price. If this is true, then firms need never worry about their competitors' decisions. However, in the wholesale market of electricity the validity of this assumption may be questioned. Although there may be quite a large number of small producers in the market, there typically are also a few big ones whose decisions could have a notable impact on prices. This seems to be the case in Baltic countries as well as in Scandinavia. Imperfect competition means that the fruits of competition cannot be fully reaped. Total welfare need not be maximized and market prices need not be sufficient signals of beneficial investments.

When markets for some good are not “naturally” perfectly competitive, there may still be ways to increase competition or to alleviate the problems caused. One way is a direct quantity or price regulation.

The problem with direct regulation is that prices need no longer signal correctly scarcity or profit opportunities. This may result in under- or over investments in some form of electricity production within the industry, or nonoptimal investments in the whole electricity production.

Another crude form of regulation is to split existing big firms into many smaller units in the hope that competition works better under the new industry structure. The problem is that there are scale economies present in the production of electricity and efficient production in such cases means large firm size.

Instead of making firms smaller relative to markets one could make markets larger relative to firms. In electricity wholesale market this means enlarging the transmission network and strengthening its links and also designing the rules by which such a market should operate. This way was chosen when Nord Pool was created among Scandinavian countries and Finland, and the purpose is that Baltic area will be integrated into Nord Pool by 2015.

Nord Pool Spot

In the Nord Pool Spot (“Elspot”) sellers and buyers submit offers and bids consisting of price and quantity combinations for each hour a day (12-36h) before the scheduled delivery. In addition to the spot market, there is also real time market (“Elbas”) which closes an hour before scheduled delivery to allow producers to make last minute adjustments in production. Forward contracting (both financial and physical) is also a possibility for the market participants.

Elspot is a centrally operated market place. The individual bids for a given hour are summed up to form a total demand functions and the total supply function is formed in the same from individual offers. The so called “system price” is found where supply and demand curves intersect. After that it is checked whether transmission capacities suffice for the desired quantities. If this is the case then the system price is the spot price for the given hour. Anyway the system price serves as reference price for contracts.

If the desired quantities would cause congestion in some transmission links, the Nord Pool is split into two or several submarkets according to pre-specified bidding areas. The area prices are computed by the local TSO (a transmission system operator in each country) by using bids and offers in that particular area only. Currently there is one bidding area in Finland, two areas in Denmark, four areas in Sweden and Norway consists of several smaller areas. The Baltic countries will form separate bidding areas, but since there are rarely any bottlenecks in the transmission grid between the three countries, the prices in these countries will usually be the same.

When demands and supplies in areas are calculated, the transmission links are used as efficiently as possible to transfer electricity from excess supply areas to excess demand areas. At this point the area prices become known and prices could be different between areas. But the price differences reflect

now the cost of congestion to the network. It is also possible that some links within a price area gets congested. These problems are handled by the local TSO by counter trading.

Oligopoly Models of Electricity Markets

There are two main ways to model oligopolistic competition in the wholesale electricity markets, the Cournot model and the Supply Function Equilibrium model.

In the Cournot model the demand side is modelled by a demand function. Firms make their production decision simultaneously without knowing the decisions of their competitors. A market price and profits become known after production decisions have been made. A firm tries to maximize its own profits given its expectations about how much the other firms will produce. An equilibrium (a Cournot equilibrium, or a Cournot-Nash equilibrium) consists of a quantity produced for each firm such that each firm gets the maximum profit given the quantities of other firms.

In a Supply Function Equilibrium model firm's strategy is a price-quantity schedule specifying how much a firm is willing to produce at each possible unit price (Klemperer and Meyer 1989; Wilson 2008; Holmberg and Newberry 2010). In essence each firm chooses its own supply function. A simple example: a producer offers 100MW per hour each hour of a day no matter what is the price. In this case a firm behaves just like in a Cournot model.

The buyer side in a Supply Function Equilibrium model can be modelled by a demand function or alternatively buyers could be strategic players and choose bid functions. A bid for a buyer specifies how many units a buyer is willing to buy at any given price. A simple bid: a buyer announces that he will buy 10 MW each hour when the price is at most 50€ per MWh. In a Supply Function Equilibrium, each agent chooses his supply function (or bid function) to maximize his profits, given his expectations about what the other sellers and buyers will do. As in the Cournot model, in equilibrium the expectations turn out to be correct.

The Supply Function Equilibrium seems to give a more detailed description of the markets. On the other hand the Cournot model is much simpler. To compute a Cournot equilibrium, a nonlinear system of equations must be solved. To compute a Supply Function Equilibrium, a nonlinear system of differential equations must be solved. The Cournot equilibrium exists and is unique in a wide class of models. The Supply Function Equilibrium may fail to exist or it need not be unique. Needless to say, there is no general consensus about which one is a better model. Willems et.al (2009) test these models in German electricity markets and observe that both models explain practically the same fractions of observed price variations. Thanks to this result we choose the Cournot model because it is much simpler to analyze.

The Baltic Market

At the moment there are 3 main local producers with capacities somewhere between 1200 MW and 2000 MW and marginal costs roughly between

40€/MWh and 50/MWh. There are also many small suppliers with total capacity about 500 MW at marginal cost a bit over 40€, and an additional 500 MW at marginal cost about 60€. InterRAO has a monopoly right for all the electricity export activity from Russia. Technically speaking Russia could export to the Baltic area at best with over 4000 MW of capacity). It can be assumed that InterRAO can purchase and export electricity with a very low marginal cost. For the analyses we have assumed that the cost of Russian exports is 30€/MWh. The current transmission capacity to Nord Pool (Finland) is 350 MW but will be expanded to 1000 MW. In addition there will be a link between Sweden and Lithuania (NordBalt-interconnector) having a capacity of 700 MW.

The load in the Baltic area varies roughly between 2000 MW and 6000 MW. Therefore the Baltic market is roughly third of the Finnish market and a sixth of the Swedish market. The prices in the Elspot market have varied from 30€ to several hundreds of euros. If extreme prices are excluded then price has varied somewhere between 35€ and 70€ per MWh.

The prices in the Baltic area are still under regulation to some extent. At the end of April 2011 the wholesale price in Estonia was about 40€ and the system price in Nord Pool about 54€. At these prices Estonia has been exporting electricity at full capacity. (It must be noted that as of January 2013 when Baltic producers must start buying emissions allowances their marginal costs will start to reflect the whole (opportunity) value of carbon dioxide.

With these quantity figures, it seems that if the Russian import is excluded completely, Baltic countries need some more production capacity to satisfy their own demand. Or at least the capacity margin would be fairly small. This is because when there is high demand in the Baltic area, the demand is most likely high also elsewhere in Nord Pool area. If imports from Russia are continued roughly at the same level as now, the need for extra capacity may be smaller but need not go away totally.

At the moment the general welfare in the Baltic area is still a little bit behind that of the Scandinavian countries. The most likely scenario is that the economic growth will be higher in Baltic area than in Scandinavia and Finland. Therefore also the demand for electricity probably increases. Finally, when the Baltic area is integrated in Nord Pool, the investment in new production capacity is less risky than without integration, since larger capacity gives a competitive edge under oligopolistic competition.

It is important to understand that the model is static, and thus only captures competitive situation in one given hour. Demand for electricity varies considerably from one hour to another, which means that in static model the outcome of two different hours can be very different. In reality, strategic bidding hour-by-hour is more difficult due to limitations in power plants' technical flexibility.

The model illustrates the market for power (MW), not energy (MWh), which is essentially the nature of electricity markets: the market must clear during every moment: Electricity produced at 12:00 is a different product than production at 13:00. In the next Section we study these questions more closely.

THE MODEL AND RESULTS

Cournot Oligopoly

The Baltic area will be one bidding area within Nord Pool, and since the network capacity in that area is quite large, we can model the demand side by a single demand function. Since quantities are the strategic choices of the producers its convenient describe demand by using the inverse demand function $p = P(Q)$. Here the market price of a unit (MW) of electricity depends on the total supply $Q = \sum_j q_j$, where q_j is the quantity supplied by firm $j = 1, \dots, n$. Let $Q_{-i} = \sum_{j \neq i} q_j$ denote the quantity produced by all producers except i . If the constant marginal cost of production of firm i is c_i , then the profit of firm i from quantity q_i , given the total production Q_{-i} of his competitors, can be written as

$$1) \quad \pi_i(q_i, Q_{-i}) = P(Q)q_i - c_i q_i$$

If firm i believes that his opponents' total production is Q_{-i} , then the optimal choice q_i of firm i can be found by solving the following first order condition

$$2) \quad \frac{\partial \pi_i}{\partial q_i} = P'(Q)q_i + P(Q) - c_i = 0$$

Assuming that second order conditions are satisfied. By rearranging terms and dividing by $p = P(Q)$ we get the following well-known formula:

$$3) \quad \frac{p - c_i}{p} = \frac{q_i}{\epsilon Q},$$

Where $\epsilon = \epsilon(p)$ is the elasticity of demand at price level p . The elasticity is defined by $\epsilon = -Q'(p)p/Q(p)$ where $Q(p)$ is the ordinary demand function, i.e., the inverse function of $P(Q)$.

Equation 3) says that the relative price-cost markup $(p - c_i)/p$ of firm i equals its market share q_i/Q divided by elasticity of demand. In a Cournot-Nash equilibrium, equation (3) holds for all firms simultaneously and therefore $Q(p)$ is the total supply at equilibrium and $p = P(Q)$ is the equilibrium price. The left hand side of equation is known also as the Lerner index and it measures the market power of firm i . The higher is this index or mark-up, the more a firm has market power and the larger is its market share.

We will later give a concrete demand function and compute the corresponding equilibrium quantities q_i for all firms, but let us manipulate equation 3) further to give another useful expression. Summing equation (3) over i gives us

$$4) \quad \frac{\sum_i (p - c_i) q_i}{p} = \frac{1}{\epsilon}$$

So the sum of relative mark-ups or Lerner indices of firms equals the inverse of the elasticity of demand. By rearranging terms in 4) we can rewrite it as

$$5) \quad \frac{\partial}{\partial \epsilon} \left(\frac{1}{n} \sum_{j=1}^n c_j \right) = \frac{1}{n} \sum_{j=1}^n \frac{\partial c_j}{\partial \epsilon}$$

So the sum of marginal costs of firms equals the price times $n - 1/\epsilon$. Since the right hand side of 5) is positive, this gives a lower bound for the size of demand elasticity for a given number n of active firms. For example, if $n = 5$ then elasticity must satisfy $\epsilon > 0.2$. (In perfect competition with constant marginal costs, only the lowest cost firms would survive in the market and in a competitive equilibrium elasticity of demand would be close to infinity.)

Demand Functions

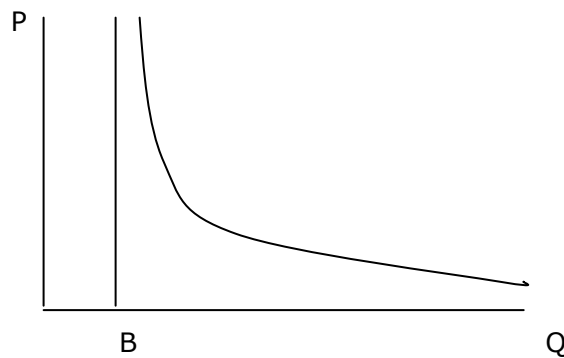
We will use the following class of demand functions in this study:

$$6) \quad P(Q) = \frac{A}{(Q - B)^\alpha}, \text{ for } Q > B,$$

Where A , B and α are positive constants. The elasticity of demand at $p = P(Q)$ is

$$7) \quad \epsilon = \frac{Q - B}{\alpha Q}$$

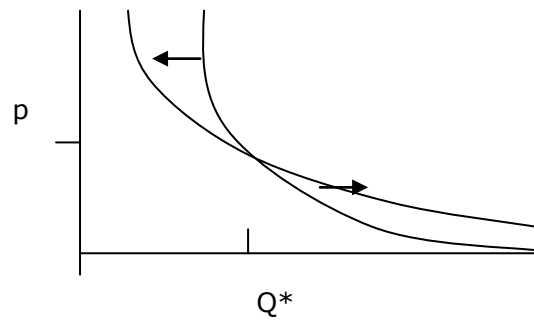
Figure 16 The graph of the demand function of equation (6)



This demand function describes a consumer side such that the quantity consumed must never fall below the constant B . This form corresponds roughly the observed aggregate bid functions. By changing B or α elasticity can be adjusted. By changing A or B the size of the market can be adjusted. When $B = 0$, we have the standard constant elasticity ($\epsilon = 1/\alpha$) demand function.

When the Baltic market is integrated into Nord Pool, the Baltic demand function becomes more elastic. This can be demonstrated by lowering B or increasing α .

Figure 17 Integration makes demand more elastic



To

read

Figure 17, suppose for the sake of argument that the Scandinavian price p remains constant after integration. If the Baltic firms would produce less than Q^* then after integration the Baltic price would increase less than in a corresponding situation prior to integration. This is because higher price in the Baltic area causes imports from Scandinavia. Therefore the demand curve facing producers in the Baltic home market becomes flatter after integration, as demonstrated in Figure 2.

Equilibrium Outcomes

It can be shown that when the demand function $p = P(Q)$ is given by equation 6), the first order condition 3) suffices to characterize the optimal production level of firm i . Inserting this demand function and the elasticity $\square$ from equation 7) into equation 3) gives us

$$8) \quad q_i = \frac{[A - (Q - B)^a c_i](Q - B)}{aA}$$

By summing over i we get

$$9) \quad Q = \frac{[nA - (Q - B)^a \sum_j c_j](Q - B)}{aA}$$

Note that equations 8) and 9) hold when capacity constraints do not bind ("interior equilibrium"). If firm i has production capacity k_i such that the quantity q_i satisfying 8) would exceed the capacity, $q_i > k_i$, then the following inequality would hold:

$$k_i < \frac{[A - (Q - B)^a c_i](Q - B)}{aA}$$

The method for finding equilibria is roughly as follows:

- 1) Fix numerical values for parameters A , B and a ;
- 2) Choose n firms, $n \geq 1$;
- 3) Try to solve numerically equation 9) for the values of Q ; and
- 4) If a solution Q in step 3. is found, then solve equilibrium price by using equation 6) and production rates for individual firms by using equation 8).

Then one has to check also that no firm produces more than its capacity. If capacity constraint is binding for some firms, then we get equilibrium by holding the production of those firms constant at their capacity level and then solving equilibrium values for the rest of the firms by using 8) and 9). It is possible that this technique must be applied iteratively, since as some firms production is constrained, the other firms may want to increase their production.

It may also happen that no solution in step 3. is found, no matter how many of the chosen n firms are set at their capacity level. Then one must start

again either from step 2. (by changing the number or identity of the chosen firms) or from step 1.

Numerical Results

In this section we solve numerically equilibria for some parameter values of demand function 6) and for some specific values of marginal costs and capacities. We will assume that there are 4 potential active producers, indexed by $i = 1, \dots, 4$, in the market. There could also be a number of very small producers, or small generators of large firms. We assume that such producers are non-strategic price takers, and therefore we can assume that their behaviour is reflected in the parameters of the demand function facing the active producers. For example, if the parameter $B = 3800$, and we want to describe a situation when there are already some non-strategic producers whose total output is 500 MW, then we just adjust the parameter B to the new value $B' = 3300$. We make the following assumptions about the marginal costs and capacities of the firms. Marginal costs are in euros per MW produced in an hour.

Table 6 Marginal costs and capacities

	Firm 1	Firm 2	Firm 3	Firm 4
marginal cost	30	40	45	50
capacity	4600	1200	2000	1600

There will also be transmission capacity to the Scandinavian market either for 1000 MW or 1700 MW. The effects of these transmission lines are studied in the next section.

We will use three different specifications for parameters (A, B) of the demand function in equation 6)

$$P = \frac{A}{(Q - B)^a}$$

These values are (60, 1700), (75, 3800) and (100, 5600). The value $(A, B) = (60, 1700)$ is meant to describe the situation when demand is low, and higher parameter values mean higher demand. In all these cases the value of a is either 0.05 or 0.025. By adjusting a we can change the curvature of the demand function.

We will denote the output vector by $q = (q_1, q_2, q_3, q_4)$, total production by Q , price by P and demand elasticity by ε in the tables below.

Table 6 – Equilibrium outcome without production quotas, $a = 0,05$

Table 7 Equilibrium outcome without production quotas, $a = 0,05$

$a = 0.05$	$(A, B) = (60, 1700)$	$(A, B) = (75, 3800)$	$(A, B) = (100, 5600)$
$(q_1, q_2, q_3,$	$(1291, 495, 98, 0)$	$(1659, 1068, 771, 474)$	$(2017, 1200, 1380, 1168)$

q_4)			
Q	1884	3972	5765
P	46.23	57.98	77.47
ε	1.95	0.87	0.57

Remark 1. When demand is high ($A = 100$ and $B = 5600$), firm 2 produces at full capacity. The demand elasticities are rather high: this is the property that follows from the first order conditions 3) and 4) of Cournot equilibrium.

Remark 2. If we lower parameter A to values 55, 70 and 95, the corresponding prices and quantities are $(P, Q) = (41, 2047)$, $(46.2, 4041)$, and $(73.35, 5777)$. So in the low and high demand case lowering A by 5 units results in the reduction of the price roughly by 5€.

Let us study what happens when firm 1 is given a production quota 1000.

Table 8 Equilibrium with production quota $q_1 = 1000$, and $\alpha = 0.05$

$\alpha = 0.05$	$(A,B)=(60,1700)$	$(A,B)=(75,3800)$	$(A,B)=(100,5600)$
(q_1, q_2, q_3, q_4)	$(1000,520,377,0)$	$(1000,1200,774,475)$	$(1000,1200,2000,1600)$
Q	1897	3999	5800
P	46.07	61.40	76.73
ε	2.08	1.07	0.69

Remark 3. When the most efficient firm is restricted to output 1000, the capacity constraint of firm 2 becomes binding already at the moderate demand situation ($A = 75$, $B = 3800$). When demand is high all firms produce at their capacity. One can show that increasing the production quota of firm 1 to 1500 firm 2 would still be producing full capacity, but firms 3 and 4 would be producing 1677 and 1412, respectively. That is, even then there is not much excess capacity. Clearly, imports from Nord Pool might mitigate this problem unless of course the demand is high also in Scandinavia. We will study imports and exports more closely in the next subsection.

Table 9 Equilibrium outcome without production quotas, $\alpha = 0.025$

$\alpha = 0.025$	$(A,B)=(60,1700)$	$(A,B)=(75,3800)$	$(A,B)=(100,5600)$
(q_1, q_2, q_3, q_4)	$(805,477,313,150)$	$(1378,1011,828,645)$	$(1849,1200,1387,1233)$
Q	1745	3862	5669
P	54.55	67.65	89.96
ε	1.03	0.64	0.49

Remark 4. The only difference between Table 7 and Table 9 is the value of α . Firm 2 produces at full capacity when demand is high. Prices are higher and elasticities lower than in Table 3.

Remark 5. If the value of parameter A is lowered to 55, 70 and 95, the corresponding prices and quantities are $(P, Q) = (50.75, 1725)$, $(60.65, 3870)$, and $(85.34, 5673)$. When demand is low or high, the prices drop roughly 4€ when A is lowered by 5 units.

Restricting the production of firm 1 to 1000 we get the following table.

Table 10 Equilibrium with production quota $q_1 = 1000$, $\alpha = 0.025$

$\alpha = 0.025$	$(A,B)=(60,1700)$	$(A,B)=(75,3800)$	$(A,B)=(100,5600)$
(q_1, q_2, q_3, q_4)	$(805,477,313,150)$	$(1000,1171,957,744)$	$(1000,1200,2000,1600)$
Q	1745	3872	5800
P	54.55	67.4	87.59
ε	1.03	0.74	1.38

Remark 6. As in Table 8, when demand is high all firms produce at full capacity. One can show that by increasing the quota of firm 1 to 1500, we get an equilibrium where $q_2 = 1200$, $q_3 = 1584$ and $q_4 = 1406$.

Exports and Imports

There will be a 1000 MW transmission link between Finland and Estonia and a 700 MW link between Sweden and Lithuania. This means both increasing potential competition in the Baltic as well as expanded markets for Baltic producers. It is perhaps easiest to see how these transmission links affect the equilibria by studying some simple examples.

Assume that the Baltic market is about 10% of the combined Baltic and Scandinavian market. Assume further that the wholesale demand in the Scandinavian market is just a scaled-up version of the demand in the Baltic market. If the demand in the Baltic market is as specified in equation 6), and the quantity there is Q_b , then if the quantity in the Scandinavia is $Q_s = 9Q_b$ the prices in these markets should be the same. This means that the demand in the Scandinavian market should take the form

$$10) \quad P^s = \frac{9^a A}{(Q^s - 9B)^a}$$

where the parameters A , B and α are the same as in the Baltic market. Let X be the (net) import to the Baltic market. Then prices are equalized in these two markets if

$$11) \quad \frac{9^a A}{(Q^s - X - 9B)^a} = \frac{A}{(Q^b + X - B)^a}$$

The solution of this equation is

$$12) \quad X = \frac{Q^s - 9Q^b}{10}$$

If $X < 0$ then the Baltic producers export to the Scandinavian market. The available transmission capacity dictates whether or not the prices can be completely equalized.

If demand intensities in the Baltic and Scandinavian markets are highly correlated and if the expected net import EX is close to zero then any need to export or import comes as a surprise. In such a case the presence of transmission lines do not change the equilibrium choices of the previous subsection at all. The realized quantities and prices could change because the realization of X need not be zero. We can demonstrate what happens to the equilibrium outcomes in Table 7 when an unexpected quantity X is imported to or exported from the market. We do this only for the case $\alpha = 0.05$, $X = \pm 500$, and the demand is moderate ($A = 75$, $B = 3800$), the other cases are handled in the same way.

Table 11 Equilibrium, unexpected imports ± 500 MW, (A,B) = (75, 3800)

$\alpha = 0.05$, (A,B) = (75, 3800)	X = +500	X = -500
(q_1, q_2, q_3, q_4)	(1659,1068,771,474)	(1659,1068,771,474)
Q	3972 + 500	3972 - 500
P	57.98 - 3.82	max P > 57.98
ε	3.00	n.a.

Given the situation in Table 11, 500 MW cannot be exported since then the price would go to infinity (or the price would be undefined) since $3972 - 500 < 3800$. In such a case the local TSO would choose the quantity exported such that some maximum price max P would result. The other possibility is that Baltic producers are expected to be net importers or net exporters during a period of time. It is quite possible that the Baltic producers could be, say, net importers during the high demand period and net exporters during the low demand period. Anyway, in such a case the producers would take that into account when making their production decisions.

In principle, producers should try to form an idea how X (or the quantity Q_s) will be distributed, and after that compute the expected profit corresponding to their different production levels. However, in this paper we try build scenarios how producers would behave during a typical, or average, hour during a typical winter or summer day. Hence we don't have to calculate

expected profits, and we may interpret X as meaning an average or typical net import in an hour during a typical day.

If the transmission lines are not congested, the demand function facing the Baltic producers would be the right hand side of equation 15). If transmission lines are not congested, then inserting the value of X from 12) into the right hand side of 11) we get that the demand function facing the Baltic producers is:

$$13) \quad P^b = \frac{10^a A}{[Q^b + Q^s - 10B]^a}, \text{ if } X \neq 0, \text{ and } P^b = \frac{A}{[Q^b - B]^a}, \text{ if } X = 0$$

If K denotes the available capacity of the transmission lines and this capacity is not enough for X , then only the quantity $X' = K$ could be transmitted and the demand would become

$$14) \quad P^b = \frac{A}{(Q^b + X' - B)^a}$$

We demonstrate next the effect of (net) imports in case demand is like in equation 13), i.e., when transmission lines do not become congested. We do this in case of Table 4 when demand is low ($A = 60$, $B = 1700$) or high ($A = 100$, $B = 5600$). After that we discuss the effects of imports when transmission lines are congested (demand is like in equation 14)), and when the quantity of firm 1 is restricted to $q_1 = 1000$. The other cases can be analyzed in the same fashion.

In Table 10 the total quantity Q_b is 1745 when demand is low and Q_b is 5669 when demand is high. If the Scandinavian production Q_s would be $9 \times 1745 = 15\,745$ when demand is low, then $X = 0$. Suppose instead that Q_s is expected to be 14 500 or 16500. In these cases, if the Baltic producers would not react at all, the net imports would be roughly $X = -124$ or $X = +75$ by equation 12). However, when Baltic producers take rationally into account Q_s , we get the following tables.

Table 12 Imports, no quantity or transmission constraints, (A,B) = (60, 1700)

$\alpha = 0.025$	$Q^s = 14\ 500$	$Q^s = 15350$	$Q^s = 16\ 500$
$q = (q_1, q_2, q_3, q_4)$	(1084,688,491,294)	(704,453,327,202)	(205,137,101,67)
Q^b	2557	1686	510
X	-851	+18	+1191
p^b	57.45	58.11	60
ε	0.13	0.085	0.024

Remark 7. If the value of A is lowered to 55, then the prices in

Table 12 would fall roughly by 5€. The production by Baltic firms would increase approximately by 3-20 MW.

Remark 8. If we put $\alpha = 0.05$ in

Table 12, the Baltic total production Q_b would be 2658, 1744, 523 corresponding to Scandinavian production figures 14500, 15350, 16500. The prices would be about 3-4€ lower than in

Table 12. Elasticities are calculated from the demand function in 13) which describes the situation after integration. Therefore the elasticities are much lower than those derived in the previous subsection.

The question is why are prices so much higher after integration, shouldn't we expect increased competition and therefore lower prices than those in Table 9? The answer is that we have treated Scandinavian production as constant, or in other words, as if Scandinavian producers were perfect competitors. Facing so tough competition the Baltic producers have to cut down their production rates more than they had to in case they were competing with oligopolistic Scandinavian producers.

To see this, consider the following example. If we put $Q_s = 15\,705$ in

Table 12, the Baltic production would be 1323, and the price would be 58.48€. The net import would be $X = 380$. But $Q_s = 15\,705$ is exactly the amount that - were the Baltic firms producing 1745MW as they are doing in the corresponding Table 9 - the prices in the integrated market would be 54.55€ as in Table 9. That is, net imports would be zero.

Our model is a bit too simple in this respect: although the Baltic market is only about 10% of the integrated market, the production in Scandinavia should anyway respond - at least a little bit - to changes in the Baltic production rates. And that would mean somewhat lower prices than in

Table 12. However, unless this means dramatically lower prices than those in

Table 12, it seems that after integration production capacity could be increased a bit in the Baltic area: the mark-ups corresponding to

Table 12 are very high, ranging from 7.45 to 20€ for firms 2, 3 and 4.

Table 13 Imports, no quantity or transmission constraints, (A,B) =(100, 5600)

α =0.025	$Q^s = 49\ 000$	$Q^s = 50\ 400$	$Q^s = 52\ 000$
Q	(2284,1200,2000,1600)	(1811,1200,1397,1258)	(1218,1034,942,850)
Q^b	7084	5666	4044
X	-776	-59.4	+1 560
p^b	94.82	95.40	96.38
ε	0.06	0.044	0.031

It is clear that if firm 1 is restricted to output $q_1 = 1000$, then the

Table 13 would change so that the other firms would be producing at full or almost full capacity, except in the last column where Scandinavian production is very high. On the other hand, this restriction in the case of low demand (

Table 12) wouldn't change much anything. So the conclusions about sufficiency of capacity of other firms remains basically the same.

Transmission lines may become congested (even when demand is low) if the production in Scandinavia is high. In such a case, the prices would not be equalized and the price in the Baltic area would be even higher than in the right hand columns of

Table

12

and

Table 13.

We have assumed here that demand in Scandinavia is of similar type as in the Baltic countries, except that the Scandinavian market is larger. Further, we assume that high demand periods and low demand periods follow the same cycle in these markets. It is clear that transmission lines could get congested more easily if the demand cycles are different.

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