NORDREGIO
Nordic Centre for Spatial Development

Project: East West Window WG2 Nordregio report – Final version

Version:

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Original date: 2008-03-07

Previous update:

This update: 25/09/08

DRAFT

Final report

Language has not been checked

Towards an integrated Baltic Sea Region

Reporting of the results of the WG2 work in the East West Window project

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Preface

This report is the result of the work achieved in the framework of the Working Group 2 of the East West Window project. The discussions in the Working Group 2 were focused on the issues related to accessibility. In practical terms, the notion of 'accessibility' was operationalise by focusing on three thematic perspectives that have been identified as central for orientating the questions around accessibility: transport, energy and Information and Communication Technologies.

Transport is traditionally associated to the notion of accessibility. In fact, the transport system intrinsically frames the capacity for individuals and businesses in one region to access other actors inside or outside their region. That being said, the analytical work elaborated in the framework of WG2 has brought into light the notion of mobility as a central notion. The idea of mobility brings a more human dimension to the issues of transport, and connects directly to the concerns of regional development for the future. In more concrete terms, the transport system ought to be considered more as a means to enhance mobility rather than an end in itself. Consequently, the chapters dedicated to transport concerns have highlighted the many dimensions of the mobility of persons and goods at different territorial scales: across the border, within the BSR, between the BSR and Europe and, finally, from the BSR globally.

Energy is linked to the transport to some extent, but it has also far broader impacts on the BSR and its regions. In connection to energy, the present report takes three different approaches. First of all, it highlights the different patterns of production of energy, especially looking at the different types of energy produced in different parts of the BSR, and the capacity of current energy infrastructure (pipelines, electricity networks…) to enable a further integration of the whole Baltic Sea Region. Second, the consumption of energy for different sectoral usages (industry, transport, agriculture…) provides an interesting insight on the various national and regional needs in terms of energy mix. Finally, the issue of renewable energies are brought forward in an attempt to provide prospective views on the potential of different regions to meet their own energy needs.

Information and Communication Technologies, usually named *ICT*, are not always explicitly linked to the notion of accessibility. Yet, the development of ICT in many parts of the BSR has acted as a strong catalyst for regional development, and participated in making it one of the fastest growing regions of Europe. ICT have enabled in recent years to curb the influence of what is often called 'peripherality': regions located farther away from large markets have the possibility to develop contact-networks using the latest technologies, internet being the most emblematic one. Yet, personal or business interactions using new technologies do not replace transport journeys and face-to-face meetings, as they increase in fact the needs for physical interactions. Consequently, it becomes obvious that ICT strategies should be developed in parallel to transport ones.

The present report is the outcome of an interactive process that lasted for almost a year. The analytical work and the drafting of the report were performed by the Nordregio team, consisting of Alexandre Dubois, José Sterling and Johanna Roto, with the precious support of Carsten Schürmann (RRG Spatial Planning) for the production of maps on transport networks.

The collection of data and statistics was performed by Nordregio with the support of national experts for each of the BSR country. The authors would like especially to thank:

- Julia Spirina and Professor Yury Zverev (Russian Federation)
- Anna Lutskovich (Belarus)
- Dr. Wilfried Görmar (Germany)
- Wojciech Bizon and Patrycja Jakubowska (Poland)

The authors of the report would like to thank the members of the WG2, who have been an integral part of this process: Vladislavs Vesperis (Latvia), Jussi Rautsi (Finland) and Sverker Lindblad (Sweden). The VASAB Secretariat, based in Riga, has also been of great help in the process by arranging the different meetings for the Working Group.

1. Accessibility strategies for regional development in the Baltic Sea Region

Accessibility strategies are cross-sectoral strategies developed by international, national or regional bodies in order to tackle issues seen as hampering mobility of persons and goods within a territorial context. The development of a well-functioning, reliable transport infrastructure is seen as a prerequisite for regional economic development, although research on the topic has not been able to clearly show a causal link between the two phenomena. However, it is reasonable to assume that transport infrastructure is necessary in order to ensure the mobility of individuals, for instance within labour-markets, and the freight of goods, both regionally and internationally.

Hence, it becomes obvious that an overview of the transport networks across the Baltic Sea Region should be put into the perspective of the needs it answers to. As a matter of consequence, the present study not only focuses on the existing preconditions within the region, but as well investigates the potentials and bottlenecks linked to the use of the transport networks, thus as well focusing on the logistics aspects of transport. The logistic aspects are tightly linked to patterns of trade and commerce which stresses the need to take into consideration the perspective of the end-users when analysing transport networks. Consequently, the analysis of transport infrastructure should be confronted to the demand of infrastructure, that is to say the need for spatial interactions between regions. The demand side is tightly connected to the notion of accessibility: the endowment of transport infrastructure should be put in relation to its potential use.

A second important focal of this study is the transnational and cross-border dimensions of the BSR transport networks. National transport networks often reflect the socio-economic and political structure of the countries. In centralised countries, terrestrial transport networks (road and rail) will tend to be star-shaped, with the metropolitan area of reference at the centre. In more decentralised countries, such as Germany, transport networks will tend to be more web-shaped. However, the work of the VASAB and the Committee on Spatial Development aims at bringing the ‘BSR added-value’ into this national context. This study intends to highlight the ‘Baltic Sea dimension’ of the national transport networks, thus focalising more on the needs and potentials for transnational integration rather than an assessment of the national transport systems.

Finally, with a recent decade strongly marked by the further globalisation of the national and regional economies combined with the necessity to take decisive actions regarding climate change, not the least in the countries around the Baltic Sea, it appeared natural to focus parts of the analysis on how the BSR is included in European and global networks, and how can economic development and environmental concerns can be addressed simultaneously.

1.1. Integrated Baltic strategies for accessibility

The Gdansk Declaration (VASAB, 2005) is the latest document agreed upon by the national ministries responsible for spatial development policies in the framework of the VASAB co-operation. In this policy document, entitled *Connecting Potentials*, the Member States adopted a common strategy for the continuation of the co-operation on spatial planning issues across the Baltic Sea Region.

The theme of accessibility is central to this strategy. Consequently, the document identifies 5 main challenges regarding accessibility that need to be overcome.

First of all, transport networks, and more precisely the development and modernisation of these infrastructure, is a key in enabling connectivity between regions within the BSR but also outside it.

Second, the strategy bears in kind that the BSR is constituted of very different types of regions: metropolitan regions of course, but also regions that are often perceived as peripheral and sparsely populated. Moreover, mountainous and island regions pose as well particular challenges when it comes to spatial accessibility.

Third, the achievement of the joint strategy is highly dependent on the way national resources are allocated in order to improve internal and external accessibility. Consequently, accessibility is not only a matter of integration between transport and spatial planning, but also between the different national policies. The document stresses the fact that Germany and the Nordic countries are, on this account, more advanced than the Eastern part of the BSR, where many efforts still need to be made in order to integrate national policies.

Fourth, the notion of *inter-modal logistic chain* is highlighted as a specific challenge for the region. This notion bears two major meaning. First, it implies that different transport modes should be developed in order to respond to different needs. The latter brings the territorial dimension of transport policies into the light: different regions necessitate a different mix of policies answering to their accessibility needs. Second, logistic chain implies a enhanced focus on the actors impacting transport policies: transport challenges should not only be perceived only as infrastructure ones, but also involving the transport operators, i.e. the actors that make transportation possible (e.g. airlines, railway companies…).

Finally, the document stresses the importance of EU policies with regards to accessibility issues. Improved accessibility is seen as an important part of the Community Cohesion Policy, and the planned investments in the Trans-European Transport Network (TEN-T) are seen as crucial for improving the connectivity of the BSR to the rest of the European continent.

The Gdansk Declaration (VASAB, 2005) also focuses strongly on the notion of *Transnational Development Zones*. These zones can be characterised as an area of co-operation between local and regional actors situated along a

common transport infrastructure. These areas, often developed in the framework of Interreg IIIA (Cross-border) and IIIB (Transnational) programmes represent a new form of bottom-up approach for integrating transport and spatial planning strategies.

1.2. European policies improving accessibility in the BSR

As discussed before, the Gdansk Declaration (VASAB, 2005) clearly acknowledges the impact of European policies in improving both the internal and external accessibility of the Baltic Sea Region. In that respect, the infrastructures to be developed in the framework of the TEN-T policy are often considered to be the future backbone of the BSR multimodal transport system. Moreover, the region has, in the recent years, and will, in the near future, be a strategic territory for the European Union. Indeed, the fact that 9 out of 11 countries of the BSR are belonging to the EU or EEA (Norway) boosts the region as an interface territory between the EU, on the one hand, and Russia and Belarus on the other hand.

In this framework, it is not surprising that the main European bodies, namely the European Parliament and the European Commission, have developed (for the former) or are currently in the process of developing a dedicated strategy (for the latter) for the Baltic Sea Region.

This section will be divided into two main parts: first, we will provide an overview of the main elements of the European Parliament's strategy for the BSR that deal with issues related to accessibility; and second, we will provide a description of the main TEN-T projects that will impact the region.

The strategy for the Baltic Sea Region drafted by the European Parliament (2005) touches upon accessibility on two main accounts: transport and energy. As regards transport, the main focus of the strategy is to emphasise the necessity for a greater integration of the transport systems as a means for the tighter integration of the regional and national economies of the region. In order to do so, the harmonisation of certain technical standards will be necessary (European Parliament, 2005). Moreover, the document stresses the necessity for the region to be endowed with transport infrastructure to the modern needs. The current lack of compatibility and integration of the different national transport systems around the Baltic Sea is pointed out. However, the strategy insists on the potential for the region to play a central role for the development of West-East transport corridors. Finally, the necessity to connect Poland and the Baltic States with new transport infrastructure, the "Rail Baltica" project is perceived as the most obvious and persistent bottleneck for the region.

As regards energy issues, the document stresses two main points. First of all, the need to develop the production and consumption of renewable energies across the region is highlighted. The region is still heavily dependent on oil to this date. Second, the lack of integration of the Baltic electricity networks to other countries is an obstacle to the development of an integrated energy market in the region.

The development of the Transnational European Networks represent**s** a key part of the EU's strategy to achieve an integrated Internal Market. Consequently, it is not surprising that the main identified issue relates to "the interconnection and interoperability of national networks as well as access to them" (TEN-T homepage). The TEN-T programme is divided into 30 priority projects, of which 6 are entirely or partly located on the BSR territory.

- The Öresund fixed link project was completed in 2000 when the bridge was opened to the public. The bridge provides a fixed connection between the cities of Copenhagen and Malmö by both rail and road.

- The Nordic Triangle project aims at connecting the four Nordic capitals as well as the most densely populated region of the respective countries. The project can be divided into two main parts: first, the connection of the cities of Stockholm, Oslo, Gothenburg and Malmö; second, the connection of south Finnish cities (Turku, Helsinki to the Russian border). The project intends to develop both road and rail connections.

- The project known as the Fehmarn Belt aims at improving the road and rail connection between the most densely populated regions of Denmark (Sjaelland and Copenhagen) and the northern German cities of Hamburg, Bremen and Hanover. The road section of the project mainly consists in the construction of a bridge from the Danish city of Rødby.

- The priority axis "Motorways of the Sea" has a crucial importance for the Baltic Sea Region. The Baltic Sea is a water body shared by most of BSR countries, and the development of maritime links, both for cargo and passengers, is central for improving the connectivity within the region.

- The Gdansk-Warszawa-Brno axis (motorway and rail) is of prime importance for improving the connectivity between the Polish coats and the capital region of Poland, but also between the BSR as a whole and the rest of the countries of Central and Eastern Europe.

- The Rail Baltica project, linking the some of the main Baltic States cities (Tallinn, Riga, Vilnius, Kaunas) with each other but also with Warszawa in Poland, is often perceived as the project of prime importance for the whole BSR as it would resolve of the main accessibility challenges in the region, i.e. the poor north-south connections on the Eastern shore of the BSR.

The following figures 1 and 2 provide an overview of the planned TEN-T projects in the BSR (linkages with non-EU countries, such as Russia or Belarus are traced in reference to TINA and TRACECA networks).

Figure 1: Planned TEN-T rail network in the BSR

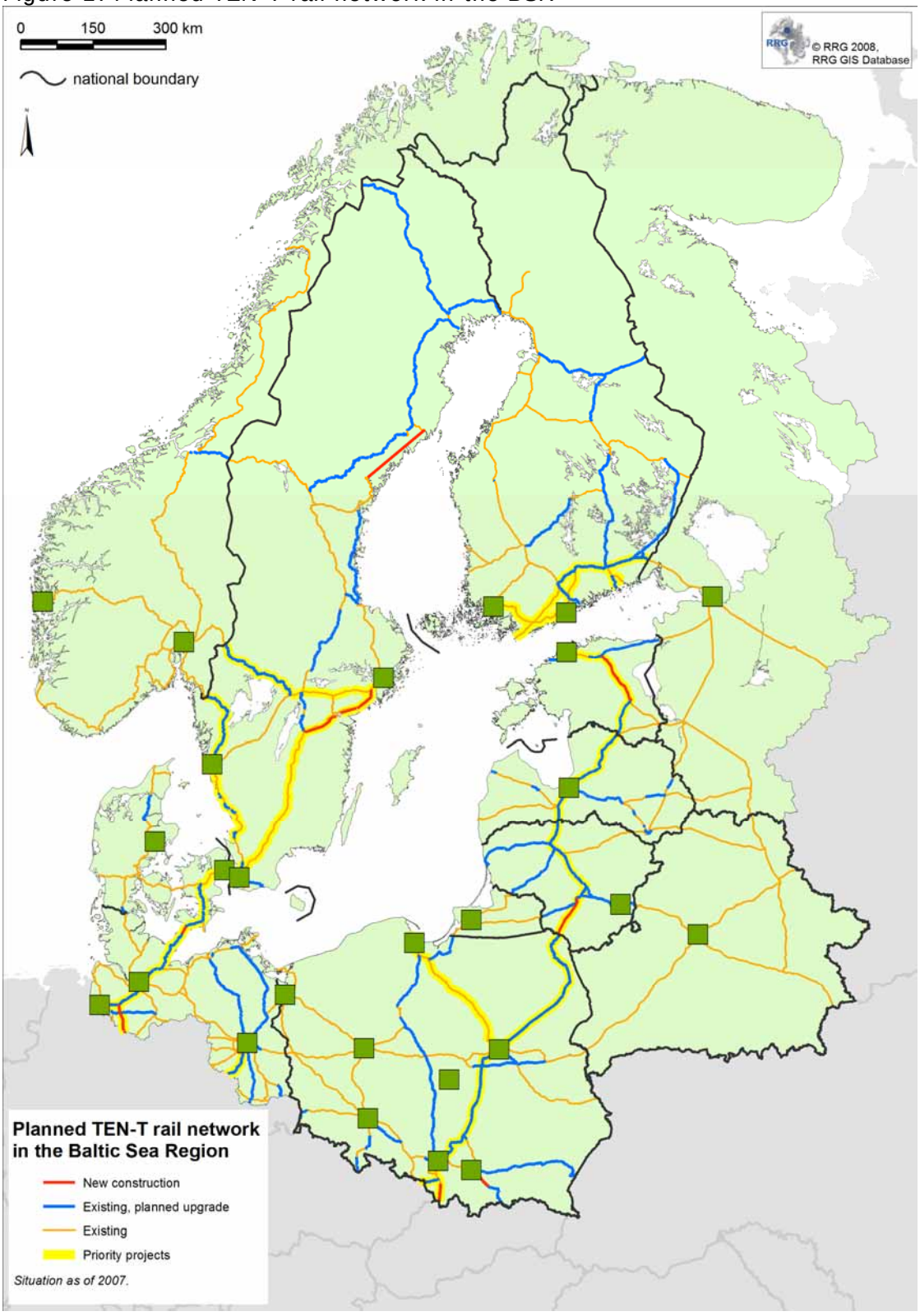
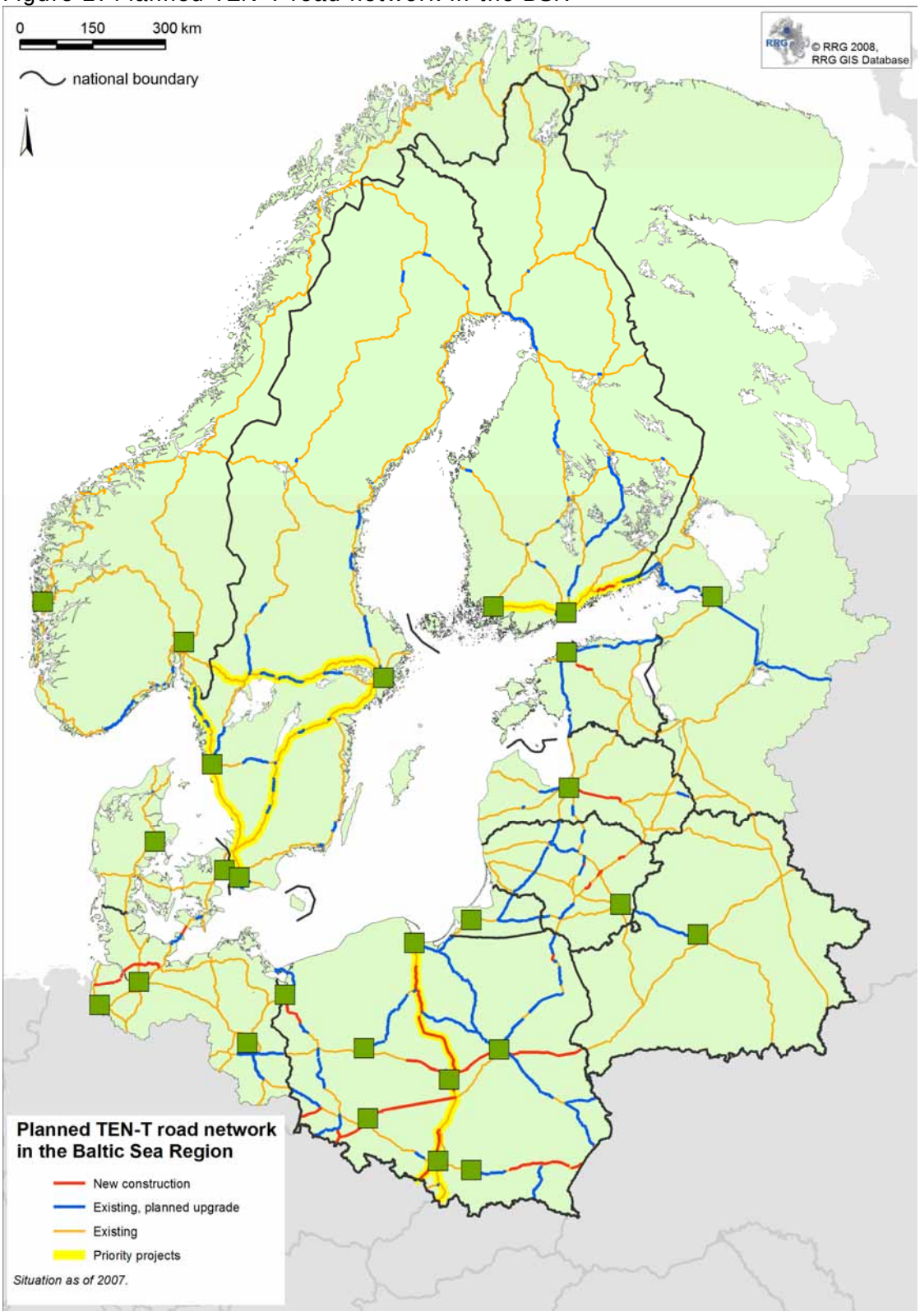


Figure 2: Planned TEN-T road network in the BSR



2. Transport networks in the Baltic Sea Region

The purpose of transport networks is to enable the mobility of persons and goods in order to create stronger spatial interactions between places. Consequently, the transport infrastructure should reflect this need for enhanced mobility. In concrete terms, it means that the transport networks should deserve the areas where there is human presence.

This chapter aims at investigating the status of the existing transport networks around the Baltic, as well as some of the major planned infrastructure. These networks can be seen as both the remainders of the fragmented past of the region and its potential towards further integration. Indeed, the transport networks around the Baltic are strongly reflecting the history and structure of the different countries it is constituted of. With the latter in mind, the present study aims at highlighting the transnational and cross-border dimensions of these networks. Consequently, the analysis with very much focus on the potentials that these infrastructures represent for enhanced spatial interactions between countries and between regions, as well as the identifying the structural, persistent bottlenecks that hold back the integration of the whole region.

These bottlenecks can take different forms. First of all, the absence of infrastructure in some parts of the region represents obviously a hindrance for developing interactions between cities or regions. In our transnational perspective, this is often translated by a lack of reliable and compatible connections between the different national transport networks, especially for road and rail infrastructure. Second, if there is a functioning infrastructure, there bottleneck can be due to the lack of services that take advantage of this possibility. In the first case, the elimination of the bottleneck is connected to the need for further infrastructure; in the second case, the bottleneck can be alleviated by providing incentives for actors to develop appropriate services.

Besides the potential to connect cities and regions within its boundaries, a crucial issue for the development of the BSR transport network is its capacity to insert the macro-region in European and global networks, whether it is by road, rail, ferry or air transportation. This chapter aims at highlighting the importance of different modes of transportation for the integration of the BSR at different scales: global, European, intra-BSR and, finally, cross-border/regional.

2.1. Between fragmentation and integration: an assessment of the road and rail transportation networks in the BSR

The assessment of the situation of the current transport network around the Baltic Sea needs to answer to mainly three questions:
- To which extent are the inhabited parts of the region connected to the transport infrastructure?
- How are the different national transport networks integrated with each other?

- Would the quality and capacity of the infrastructure support or obstruct enhanced integration between places?
- How are the BSR cities and regions connected to the rest of Europe and the world?

2.1.1. A network adapted to the territorial specificities of the BSR

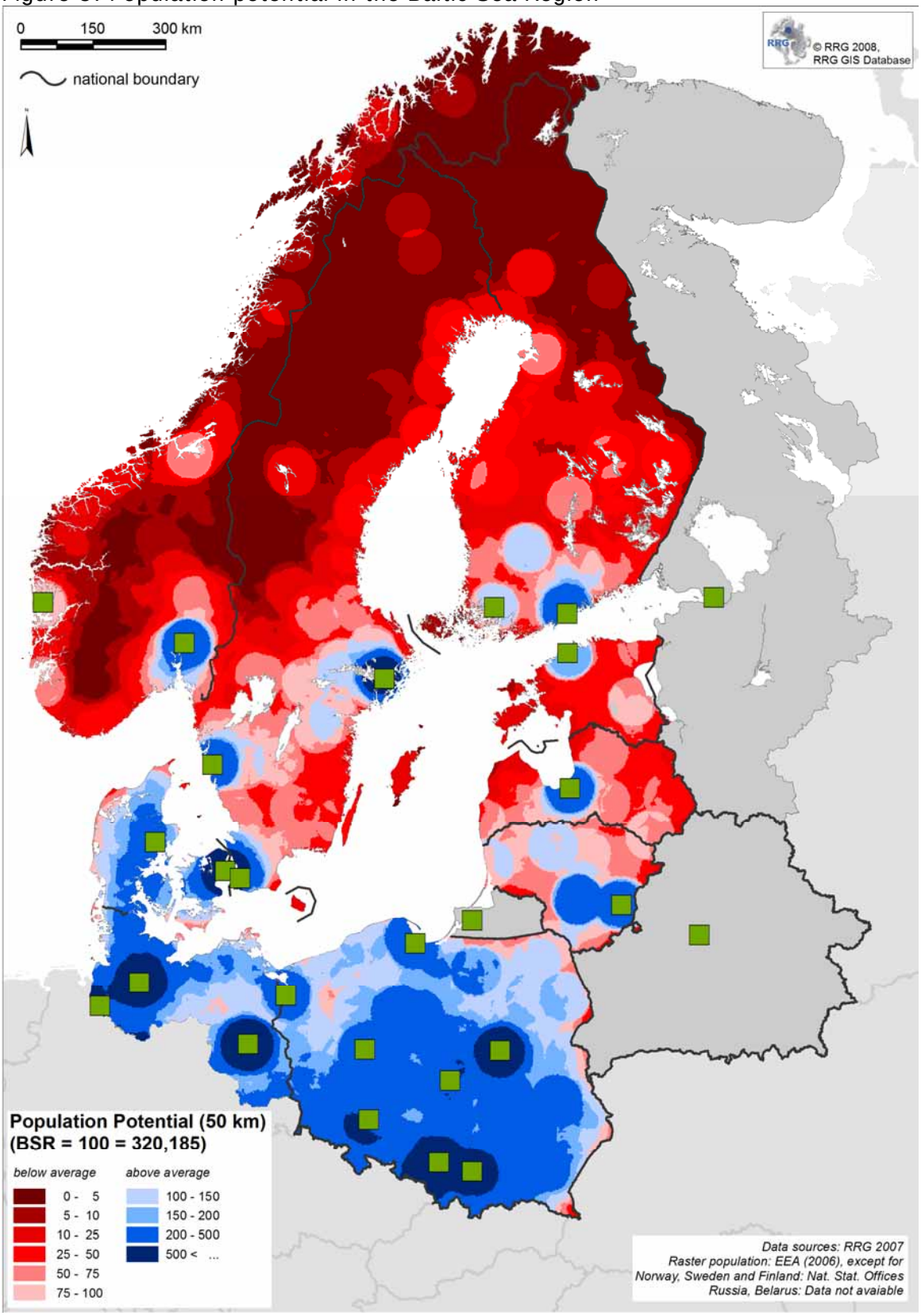
The main purpose of transport infrastructure is to enable the mobility of goods and persons in a local (travel-to-work), cross-border (trade and commerce, sort-time leisure trips) and trans-national (long-haul goods shipment, long-distance flights). As a matter of consequence, an essential characteristic of a transport network is its capacity to reach the largest share of the population. This capacity is thus very much linked to the pattern of population distribution over the whole BSR territory.

As shown in the analytical work performed by WG1, the BSR territory can be divided into 3 main categories of territories, regarding the settlement and population structure. First of all, in many BSR countries, a large share of the population is living in the largest metropolitan areas. These areas have been identified as MEGAs, identified as 'green squares' in figure 3. Second, there are areas characterised by a dense network of small and medium-sized towns. This is especially the case in Germany-BSR, Poland as well as the Western part of Denmark and the southern part of Sweden and Finland. Finally, areas qualified as peripheral, i.e. distant from the main metropolitan areas of the BSR, and sparsely populated (dark red areas in figure 3), i.e. with a loose structure of smaller towns and villages, complete the picture and extends to the northern parts of the Nordic countries, the central and northern territories of North-West Russia (with the exception of Murmansk) as well as in Western and Eastern parts of the Baltic States (See Gloersen *et al.*, 2006 for more precise definition of sparsely populated areas).The adaptation of the transport networks to these specific territorial conditions is necessary in order to ensure mobility of goods and persons and access to services for businesses and individuals.

The mapping of the population potential in the BSR provides empirical material that highlights this specific territorial structure of the BSR (See figure 3). The population potential represents the total population that can be reached in a radius of 50km around each point in the BSR. The threshold of 50 km has been chosen as it represents the limits of the willingness to travel on a daily basis, for instance for work or other day-to-day activities. Indeed, it is often assumed that a certain critical mass of population should be reached in order to sustain the provision of basic services in a market-based approach. Areas with a high population potential (i.e. metropolitan areas) often enjoy both a more specialised and amore diversified range of services.

In that regard, the transport networks, especially the road and rail ones, are central as enablers and catalysers of these interactions. But taking into consideration the strong variations of the territorial structure in the BSR, the transport network should fulfil different requirements in different territories.

Figure 3: Population potential in the Baltic Sea Region



As for metropolitan areas, the main issue regarding intra-regional transportation is linked to traffic congestion and pollution. The terrestrial transport network, especially the road one, should meet good quality standards, have a high carriage capacity and connects the suburbs to the city centre as well as offering bypass possibility for suburb to suburb travels. Moreover, the development of reliable and frequent connections to other main markets and metropolitan areas, both in the BSR and in Europe, is a necessity in times of enhanced economic globalisation.

In the case of our second type of territories, characterised by a dense network of medium-sized towns, the capacity of the transport network to connect these nodes with each other is essential in building larger, integrated labour-markets based on commuting, i.e. enabling to aggregate the local catchment areas into a larger territorial unit. Building such type of intra-regional transport linkages is, for instance, a central component of the notion of regional enlargement (*regionförstoring* in Swedish) used in regional policy context in Sweden.

In our last type of territory, the specificity of the territorial context, characterised by long distances between towns and/or a diffuse settlement structure, and the often thinning-out and ageing of the present population (See WG1 results) poses stark challenges for developing a sound transport system in those areas, and poses a political trade-off between financial viability (construction and maintenance costs) and regional development policies, providing each region the necessary 'tools' for sustaining economic growth. For the two latter types of territories, the secondary road and rail networks are playing a vital role. These areas can be found in Northern Fenno-Scandia, Eastern Finland and North-Westernmost regions of Russia (Murmansk Oblast and Republic of Karelia).

This section aimed at shortly introducing the importance of the transport networks, especially the terrestrial ones, in connecting the BSR regions between them. Consequently, it becomes more obvious that the increase of trade and commerce interactions within the BSR is tightly connected with the quality and capacity of the transport networks. The next section will focus on the existing road and rail infrastructure, especially focusing the discussion on potentials and bottlenecks.

2.1.2. A dense, but uneven, secondary network of roads and railways

Figures 4 and 5 displays the extent of the existing road and rail infrastructure, as of 2007. A first impression from these maps leads to the conclusion that the terrestrial transportation network, notwithstanding the carriage capacity of the road or railway, is rather dense, connecting all parts of the region.

Figure 4: Existing road infrastructure in the BSR

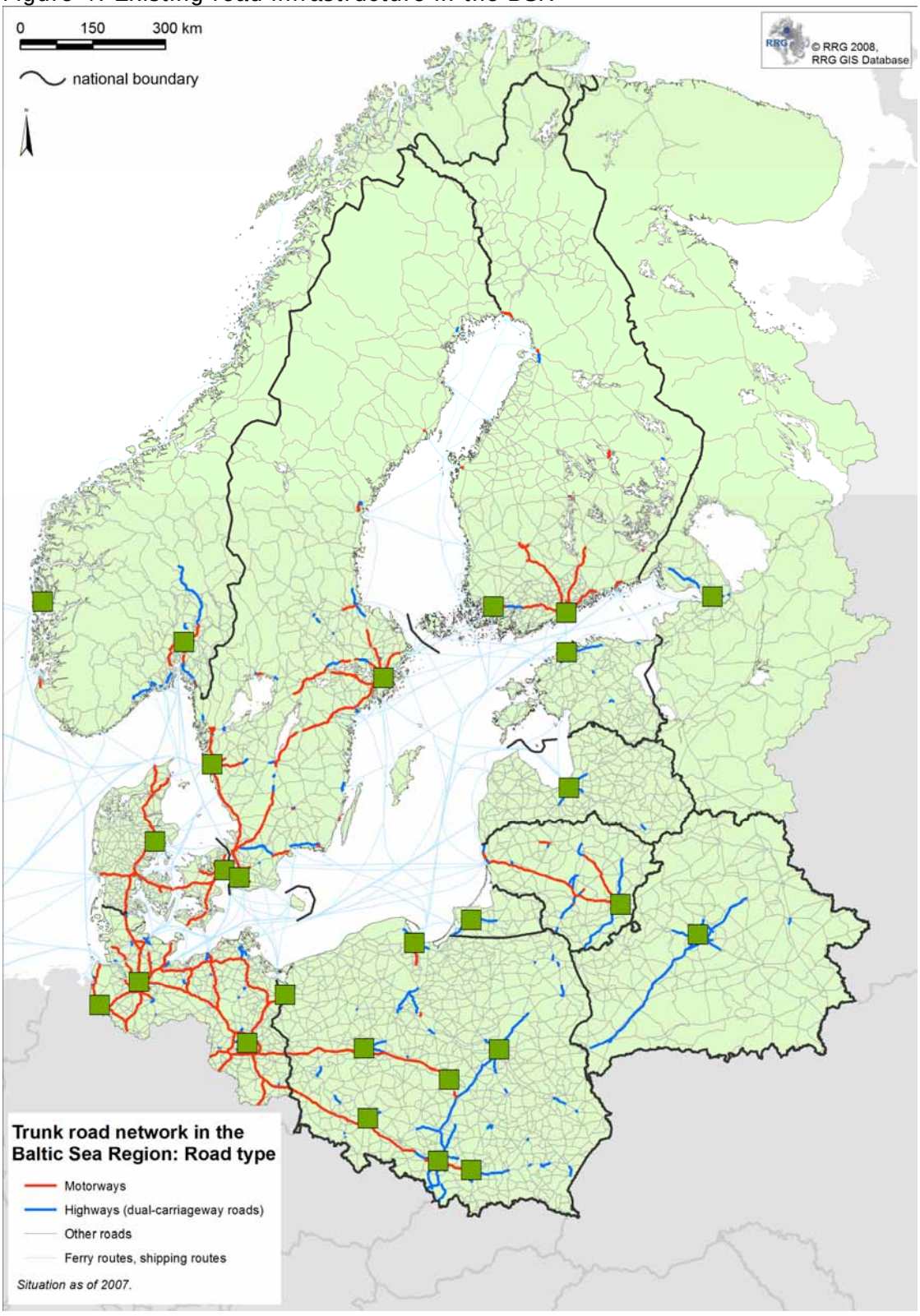
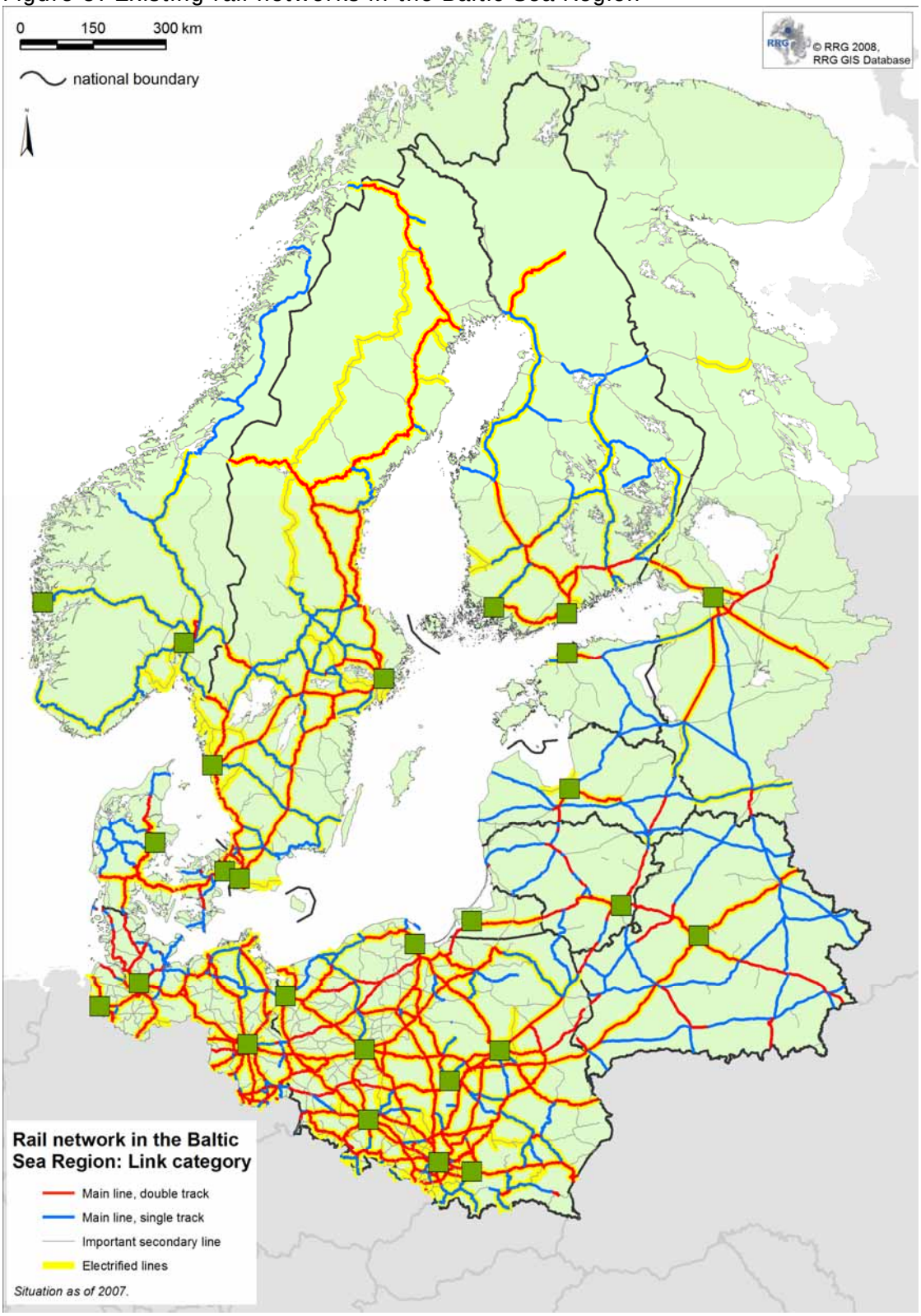


Figure 5: Existing rail networks in the Baltic Sea Region

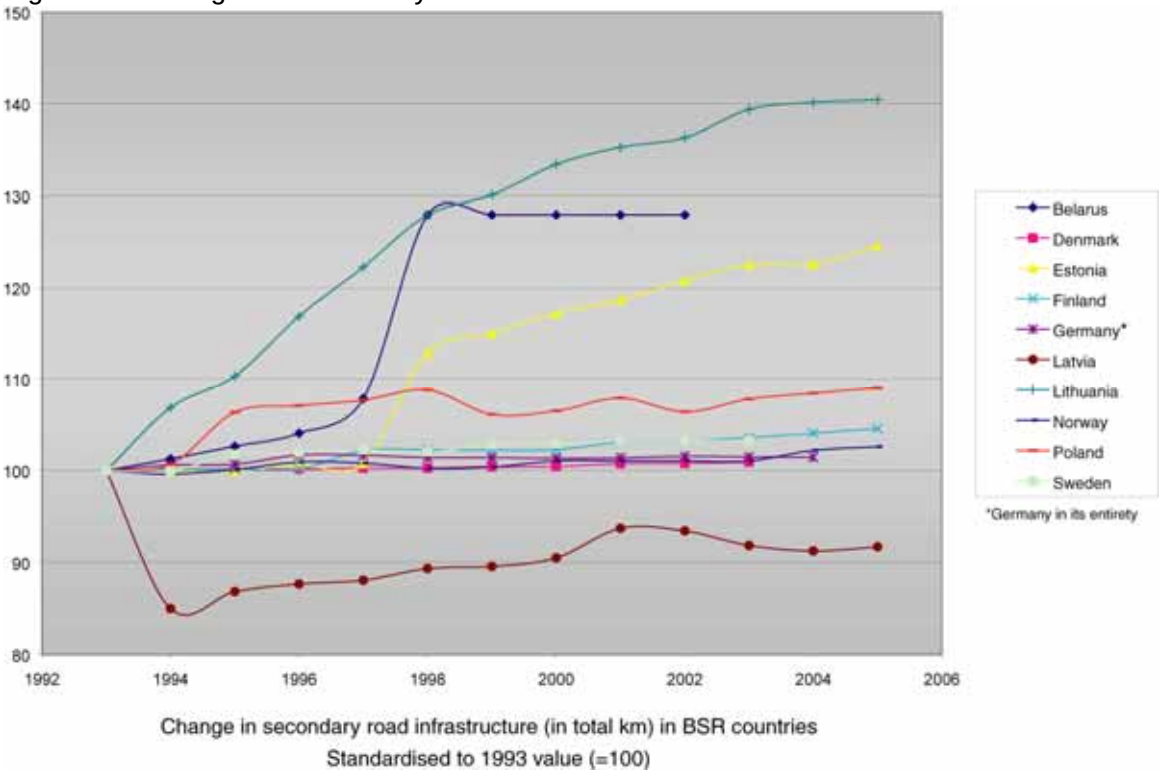


The rather densely populated Denmark, BSR-Germany and Poland enjoy a rather dense network of roads. The contrast is sharp with the northern parts of Norway, Sweden and Finland, including the North-Western edge of the Russian Federation. These areas are considered as sparsely populated, i.e. with small settlements with long distances between each other. In line with this unique settlement structure in the European context, the road network in those areas is looser, but none the less covering the main small and medium-sized towns. Conversely, the road network is denser around the main metropolitan areas. This is obvious in the territories surrounding Helsinki, Saint Petersburg and Oslo, but can be assumed as relevant as well for all other large metropolitan areas in the region (i.e. the MEGA from WG1).

Measuring the density of road infrastructure endowment takes all its sense when analysing the potential of the transport network to enable short-haul, daily interactions. Indeed, if high capacity infrastructure such as highways, motorways or main double-track railways permits a good connectivity to/from the main metropolitan areas, the secondary transport networks correspond to the largest part of the transport networks and are important both for intra-regional travels but as well enables to connect each region to the primary networks (feeding function).

Figure 6 provides inputs on the recent changes in the secondary road infrastructure in countries around the Baltic Sea. Changes in the total length of road networks can depend on the construction of new infrastructure (missing links) or on the upgrading of existing links (structural bottlenecks).

Figure 6: Change in secondary road infrastructure endowment



Source: UNECE (2008)

From figure 6, one can identify two main dynamics. Lithuania, Belarus and Estonia belong to the first category of countries that have improved substantially the extent of their secondary road network. From 1993 to 2005, Lithuania has augmented its secondary road capacity by more than 40%, Belarus by nearly 30% and Estonia by 25%. If this trend is mainly due to improve the rather low quality of the network, it shows that there is a dynamic towards a network of higher quality standard, thus more able to support an increase of traffic. This is consistent with the account made by Kovács and Spens (2006) on the state of the road network in the Baltic States, assessing the main issues as related to the low percentage of paved roads and a low capacity to support heavy vehicles, necessary for goods transportation.

Other countries around the Baltic Sea have had a rather mild positive change when it comes to secondary road networks. This is hardly surprising for the Nordic countries and Germany, which already enjoy a high quality standard of their road network. The mild increase for Poland and Latvia (with the exception of a short decrease between 1993 and 1994 probably due to the downgrading of some secondary roads) might be due to a stronger focus on upgrading existing infrastructure instead of building new ones. However, in spite of this mild increase, the endowment in secondary road infrastructure in Latvia is still below the 1993 level.

As a conclusion for this section, it is important to pinpoint that the reliability and carrying capacity of the network, i.e. its capacity to support motorised traffic, is still one of the key challenges for the BSR. This will be further developed in the section focusing on 'bottlenecks'.

2.1.3. A fragmented, but 'busy', primary road network

If secondary road and rail networks are important preconditions for enabling intra-regional interactions, motorways, highways and main railway lines have significant important in binding together the largest metropolitan areas in the region, essentially in the form of long-haul, goods transportation. Moreover, the metropolisation trends in Europe and in the BSR give an even stronger importance to the metropolitan areas when it comes to national and regional economic development (Nordregio *et al.*, 2007).

Figures 2 and 3 have already shown a picture of the state of the motorway system and railway system in the BSR. However, in this section, the analysis of these figures will be focused on the primary network.

A first remark is that the primary network is fragmented. Indeed, Germany and Denmark, the most densely populated territories of the BSR, are the only part of the region that present a rather dense and integrated network of motorways. To a certain extent, southern Fenno-Scandia and south-western parts of Poland can be deemed to be connected to this network.

Indeed, in the other three Nordic countries studied, i.e. Norway, Sweden and Finland, most of the motorways are departing from or arriving to the main metropolitan areas: Oslo for Norway, Stockholm, Malmö and Gothenburg for

Sweden and Helsinki for Finland. This creates a star-shaped pattern of motorways around these cities. However, in these three countries, there is actually no motorway network of national extent, i.e. covering the whole national territory. Indeed, there are only small bits of motorways or highways around other cities (Stavanger, Gävle, Sundsvall or Oulu), but these are not connected to other national motorways. In the case of Sweden, it appears that the routes Stockholm-Malmö and Stockholm-Gothenburg is disrupted, thus preventing Stockholm to be integrated to the 'continental' motorway network coming from Denmark. However, the recent construction of the Öresund Bridge between Copenhagen and Malmö has significantly improved the potential connection of Norway and Sweden to the rest of the European motorway network.

In Poland, the situation regarding motorways and highways is rather complex. Two motorways are actually linking the main central Polish cities with Berlin. The routes Berlin-Poznan-Lodz and Berlin-Wroclaw-Katowice-Krakow thus enhance the possibility for interactions between Poland and Germany, and in general the integration of Poland with the populated areas of North West Europe. A highway also connects Katowice-Krakow with Warszawa. What is interesting in the Polish case is the lack of large road infrastructure (motorway) dedicated to the intra-national connections. This results with fewer opportunities for regional integration within the country, whereas on a national standpoint, the largest metropolitan areas except Tri City and Warsaw are connected to the external markets. In the rest of the country, there are only scattered trunks of motorway/highway network.

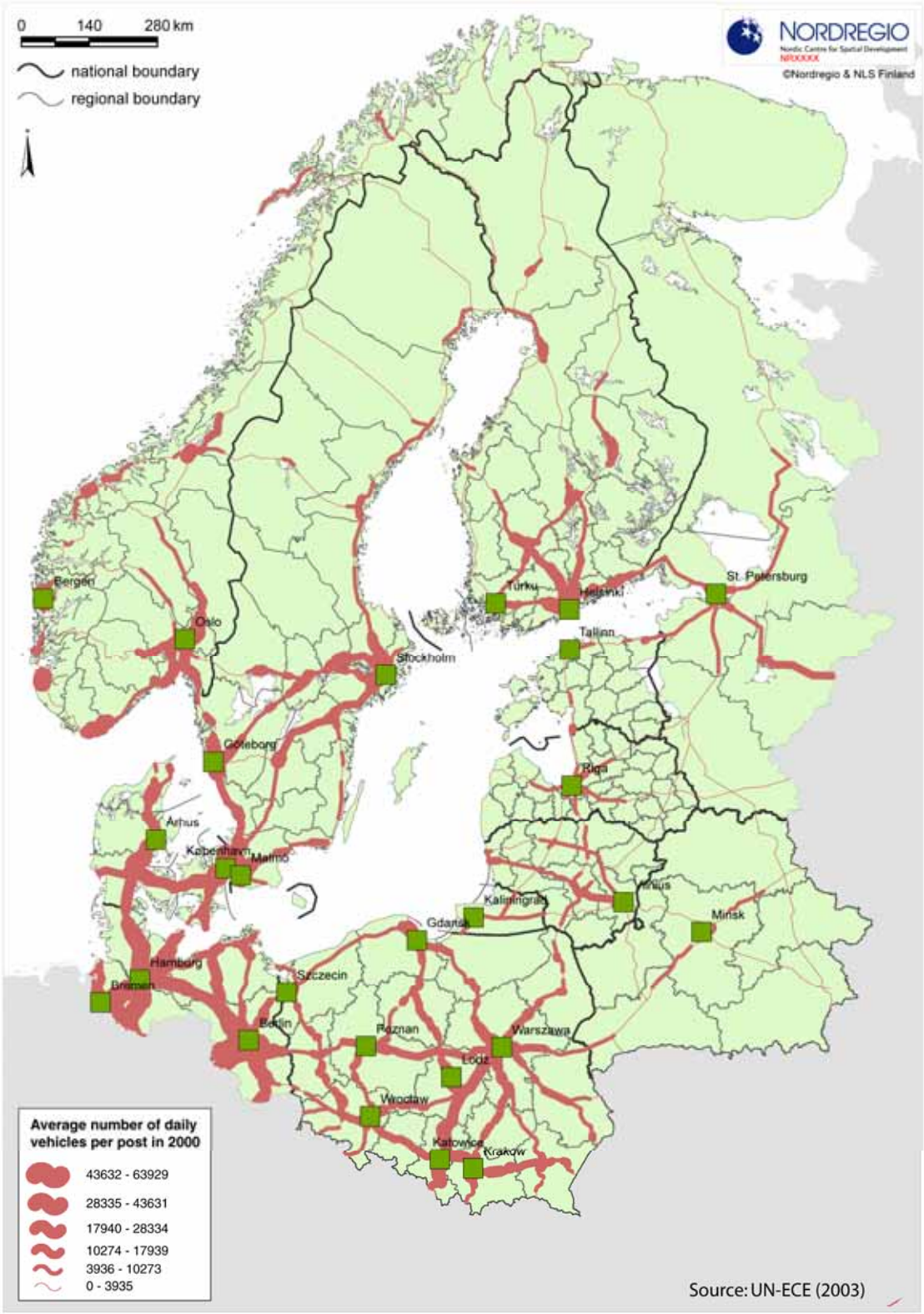
In the Baltic States, the road sections with high capacity are concentrated around the capital regions, and the network does not enable to connect other urban areas with the capital region. In that regard, Lithuania has a rather developed infrastructure as there is a motorway connecting Vilnius and Kaunas to the seaport of Klaipeda. The Baltic States are missing high-quality road networks in North-south direction (connecting the three Baltic states with each other), as well as missing high-quality East-West links connecting the three countries with Russia.

In Kaliningrad and North West Russia, few roads have the sufficient capacity to be considered as a motorway. However, there are some few sections around the city of Kaliningrad and Saint Petersburg in the direction of respectively Gdansk and the Finnish border. In Belarus, the road connecting Minsk to Poland and Moscow is partially considered as a highway on the Belarus territory. However, this specific road capacity is not pursued in either Russia or Poland.

Consequently, one can identify three main bottlenecks related to the existing motorway and highway network in the BSR. First of all, as highlighted above, the existing networks are still very influenced by the national systems. The fragmentation of the road network between countries acts as an obstacle for the further integration of the region and for the mobility of persons and goods across the border. If improvements have been made in order to connect the various national systems, especially at the borders of Poland (Kovács and Spens, 2006), there are still many missing links, especially on the eastern part of the BSR, where Poland, the Baltic States as well as Russia and Belarus ought

to be better connected to each other with motorways. The lack of North-South connections is thus a hinder for further integrating the BSR. Second, the quality of the existing infrastructure is still very uneven. Indeed, as shown in figure 4, the carrying capacity and the quality of the motorway infrastructure can be deemed as low in European standards, especially on the eastern shore of the Baltic Sea. These quality issues act as a limiting factor for the mobility of goods and persons and necessitate large investments in order to be overcome. Finally, if there are some persistent structural bottlenecks for the road system, some institutional bottlenecks can still be felt. Indeed, even if the recent accession of Poland and the Baltic States to the EU (2004) and the Schengen area (2008) considerably reduces the administrative obstacles to mobility, the lack of interoperability of national road infrastructure slows down the process of integration throughout the region, especially with regards to Belarus and Russia.

Figure 7: Traffic on the main roads of the BSR road network



If structural conditions are important factors for explaining persisting transport bottlenecks across the BSR, the increase in usage of infrastructure acts as well as a strain on the road infrastructure. Figure 7 displays the state of the road traffic (all types of vehicles) on the main roads, so-called E-roads, in the BSR.

The above map brings into light the arguments stated earlier in this section. Traffic loads in the BSR are highest around the German agglomerations of Berlin, Hamburg and Bremen. In those areas, the daily traffic goes up to nearly 100,000 vehicles on some sections. The traffic on the motorway linking Berlin and Hamburg is as well very high, as it reaches on average nearly 50,000 vehicles per day. The traffic load on the Danish motorway system belongs to the higher in the region, with circa 50,000 vehicles on average per day on the busiest roads. Around Copenhagen, the traffic reaches the threshold of 75,000 vehicles per day.

In Sweden, Norway and Finland, the highest traffic volumes can be found around the capital regions on the roads linking the city centre to the suburbs. The volume on these arteries can reach nearly 90,000 vehicles per day in Stockholm and more than 70,000 in Oslo, these being averaged over the year's total. In Helsinki, the traffic is somehow lower, attaining approximately 35,000 vehicles per day. Outside the capital regions, the busiest motorways are the ones connecting together the main metropolitan areas, i.e. between Turku, Tampere and Helsinki in Finland and between Malmö, Gothenburg and Stockholm in Sweden. On these roads, the average annual daily traffic fluctuates between 10,000 and 20,000 vehicles per day, on average. Other E-roads in the Nordic countries show rather low daily traffic, with the exception of limited sections nearby medium-sized towns (Stavanger, Umeå or Oulu). The E18 road from mainly Finnish seaports to Russia is a special case. Its average number of vehicles per day is ca 22,000 vehicles, especially lorries transporting private cars and expensive consumer goods, from Western Europe (Finnish seaports to Russia). The road and customs capacity is inadequate, causing sometimes queues of 40 kilometres. Both Finnish and Russian authorities are trying to find solutions to this mass of lorries because it damages the road on the Finnish side and causes disturbance like emissions to settlements close to the border.

In Poland and the Baltic States, the traffic volumes are much lower than in the previously mentioned regions. The axis Katowice-Warsaw witness average daily traffic that mounts to approximately 30,000 vehicles per day on average. However, this artery has shown a rather pronounced increase in traffic. Otherwise, the traffic is especially high in the vicinity of the main agglomerations. Traffic around Warsaw can reach up to 40,000 vehicles per day, around Wroclaw, Katowice and Krakow 20,000 per day, while around Riga, Vilnius, Tallinn and Saint Petersburg, the daily traffic reaches nearly 12,000 vehicles; all these traffic figures are not maximum peaks, but average made on the yearly traffic.

If the above section has highlighted the main characteristics linked to the usage of the primary road network in the BSR, the dynamics of the road traffic provide interesting insights for the future of the network.

2.1.4. Increased traffic and vehicle stocks

The traffic on the main roads of the BSR is increasing. Table 1 displays the change in the traffic, for all types of vehicles, on the E-roads of BSR countries. Based on figures from 1995 and 2000, it appears that all countries in the region have experienced a growth of the traffic.

The country that has witnessed the highest growth in the region is Latvia, with an increase of 90,9%. Russia has also witnessed a strong increase in traffic (84,2%), although the figure are not limited to the BSR part of the Federation. The traffic on E-roads of Lithuania has increased, for the same duration, by about 50%. Other countries of the BSR has witnessed an increase of traffic between 25 and 40%, with the exception of Sweden and Germany where the increase has been milder (9,3%).

The increase of the traffic presents a clear challenge for the infrastructure itself. Earlier, we have pointed at to the fact that road infrastructure, especially on the Eastern part of the BSR, can be characterised by either rather limited carriage capacity, limited number of lanes or rather low quality standards. Consequently, the increase of traffic combined by slow improvements of the infrastructure may lead to an increase in the number of bottlenecks in those territories.

Table 1: Change in E-road traffic from 1995 to 2000

Country	Total vehicle-km in 2000	E-road vehicle-km in 2000	Change in E-road traffic 1995-2000
Belarus	22047	1367	28,5%
Denmark		8650	27,5%
Germany*	405402	168818	10,3%
Latvia	6817	2045	90,9%
Lithuania	-	2555	51,2%
Norway	29000	9895	36,8%
Poland	203265	20828	28,7%
Sweden	46200	16200	9,3%
Russian Federation**	47060	47060	84,2%

* Whole country

** Western regions of Russia

Source UNECE (2008)

The increase of traffic can be coupled to two phenomena. First of all, it shows that there is an increase of activities that necessitate a more frequent use of vehicles. On that regard, the economic development that almost all BSR countries have enjoyed in the recent past can be seen as a parameter that increases the traffic on roads. Increased mobility and possibilities for interactions, especially regarding cross-border traffic, correspond one of key objectives of future BSR co-operation. Second, the increase in mobility is reflected by an increase in the number of vehicles. Here, the improvement of the economic situation of the households can be seen as a key driver for catalysing the increase of the volume of vehicles. Table 2 shows the trend, from 1980 to 2003, related to the ownership of cars in the BSR countries.

Table 2: Change in the number of vehicles per 1000 inh. in BSR countries

Country	1980	1990	2000	2002	2003
Denmark	271	309	347	351	351
Finland	256	389	412	422	436
Germany*	330	385	532	541	546
Sweden	347	421	450	452	454
Estonia	84	154	339	295	321
Latvia	66	124	235	266	280
Lithuania	74	132	317	341	365
Poland	67	138	259	289	294
Norway	302	380	412	417	422
Belarus	:	59	:	:	:
Russian Federation*	33	60	140	156	161

* Whole country

Source UNECE (2008)

In this case as well, all countries around the Baltic Sea have witnessed a steep increase of the total number of vehicles registered since the 1980. Not surprisingly Germany is the country with the highest number of vehicles registered with 546 vehicles per 1000 inhabitants in 2003. Sweden (454), Finland (436) and Norway (422) have as well high number of vehicles. However, it seems that the increase in those countries has become slower in the recent years. As for Poland, Russia and the Baltic States, the number of vehicles per 1000 inhabitants has more than doubled since 1990. This steep increase in the number of vehicles necessitates, in parallel, efforts to improve the road infrastructure in order to avoid congestion and saturation of the traffic as well as accidents, which would act as an obstacle for mobility.

2.1.5. Bottlenecks on the road network

The identification of the bottlenecks on the road system cannot be resumed to the identification of missing links that prevent the integration of the transnational network, even if they are often the most obvious or emblematic ones. It is important to bear in mind that a missing link can be considered as a bottleneck in the case there is an advocated need for mobility, but no adequate infrastructure to efficiently fulfil this need. The case of the Öresund Bridge, completed in 1999, was maybe the most emblematic missing links in the BSR: there was already a strong integration of the Copenhagen-Scania labour markets and the bridge would further increase this integration. The commuting figures since the opening of the bridge (up to nearly 15,000 persons daily in 2006) makes the Öresund region one of the most integrated cross-border regions in Europe. The case of the Öresund Bridge shows us that missing links should not only be dealt with as an infrastructure issue, but should be connected to labour-marked and regional economic integration for being successful.

To date, the road network on the eastern shore of the Baltic Sea are the most scattered and fragmented ones and do not permit the full integration of the various regional labour-markets in a transnational perspectives. However, the need for better and more reliable road (and rail for the matter) infrastructure should be coupled with 'softer' measures linked to labour-market policies, enhancing a greater cross-border mobility of the labour-force and greater

exchanges of goods, thus fostering integration by playing on the complementarities of the regional economies. The future completion of TEN-T priority projects in the BSR, which will provide the region with high quality road (and rail) infrastructure, should thus be accompanied by adequate labour-market policy measures.

However, as stated before, bottlenecks are not only an issue of 'obvious' missing links. Indeed, a bottleneck can happen when the existing infrastructure cannot handle the traffic of vehicles. As shown in the previous tables, each country has witnessed an increase in traffic over the recent years. In nominal terms the increase of the traffic will be the highest around the main metropolitan areas. However, these regions usually have the best endowment in road infrastructure, which often enable them to better absorb the increase in traffic. But in less densely populated regions, with a scarce road infrastructure, high traffic increase can cause important bottlenecks that have strong repercussion for the regional labour-markets. In that respect, the lack of 'good match' between the traffic loads on the one hand and the quality of the road infrastructure and the number of lanes available may lead to potential regional bottlenecks.

For example, in the Nordic countries, some road sections nearby the medium-sized towns of Trondheim, Sundsvall and Rovaniemi has witnessed a yearly growth in traffic of more than 50%. In northern Norway and Finnish Lapland, road traffic has increased with more than 50% on some sections. On many other road sections in the northern parts of the Nordic countries, traffic growth is lying between 10 and 50% per year. Previous studies (Gloersen *et al.*, 2006) have shown that road infrastructure in those areas are already exposed to structural difficulties (high maintenance costs, harsh weather…). The steady increase in traffic exposes further these regions to enhanced traffic bottlenecks.

On the other side of the Baltic Sea, the increase in traffic is highest on the main transnational axes. The roads connecting Saint Petersburg, Tallinn, Riga and Kaunas are witnessing steady increase in traffic growth, on average between 10 and 50% on a yearly basis. In that context, it is important to notice that some small sections are bearing most of the growth. Indeed, the small road sections at the border to Estonia and Latvia displays an increase in traffic of 125% per year, while the road section nearby the Estonia city of Narva, on the axis between Tallinn and Saint Petersburg, has observed an increase in traffic of more than 70% per year. In Poland, road sections on the main national axis have witnessed growth in traffic between 10 and 50% on yearly average.

The discussion here above emphasises the fact that bottlenecks on the road system are mostly felt locally. Indeed, bottlenecks are often due to the strong strain, in the form of high traffic loads, put on small part of the infrastructure. Consequently, the capacity of the BSR road network to support the further integration of the region on a transnational, cross-border or inter-regional perspective often depends of the capacity of small portions of the road network to support high traffic loads. Moreover, the previous discussion highlights the fact that bottlenecks are not only a metropolitan phenomenon, as high traffic growth is found even in less densely populated regions. Finally, road sections in

border regions are key infrastructure for enabling the further integration of the BSR road networks.

Moreover, potential bottlenecks can be identified by comparing the capacity of the main BSR roads and their daily traffic. This is particularly interesting for regions outside the main metropolitan areas. Indeed, when comparing the results of figures 4 and 7, it becomes evident that at some specific nodes, there is a mismatch between the size or capacity of the road and their respective traffic. Rather dense daily traffic can be found around the medium-sized towns of Kristiansand (NO), Kalmar (SE), Jyväskylä (FI) or Kuopio (FI) even if these cities do not have well developed highway systems. These cities act as centres for their respective regions and thus good access to cities has repercussion to their broader hinterland. This may develop into more serious regional bottlenecks.

Finally, some road corridors in the BSR display a large traffic volume without seeming to have an appropriate highway infrastructure to support it. This is the case for the Gothenburg-Stockholm (via Mariestad), Stockholm-Malmö (via Kalmar), Turku-Tampere, Szczecin-Gdansk, Gdansk-Warsaw or Warsaw-Kaunas. These corridors are often intra-national, but they have a transnational dimension as they can be used as passage for lorries or vehicles coming from other regions.

In some cases, national borders may also act as a source of bottlenecks. In that regard, the strategy for the BSR to remove those institutional obstacles should be focused on crossings with Russia and Belarus. Indeed, the accession of Poland and the Baltic States to the European Union in 2004 and to the Schengen area in 2008 has enabled to remove bottlenecks at the borders due to the impermeability of institutional borders, even if some structural ones still remain.

Finally, other types of bottlenecks, of a more institutional nature, may as well provoke significant disturbances for the integration of North West Russia, Kaliningrad and Belarus with their neighbouring regions. Due to the recent accession of Poland and the Baltic states to the EU and Schengen Agreement, the main institutional bottlenecks in the BSR take place at the Russian and Belarus borders. The following table provides examples of some crossing points.

Crossing name From - To	Average waiting for busses in 2006 (in hours)	Average waiting for trucks in 2006 (in hours)
Vaalimaa (FI) – Torfyanovka (RU)	3	1
Torfyanovka (RU) – Vaalimaa (FI)	6	6
Bagrationovsk (FI) – Bezledy (PL)	N/A	1-4 (both ways)
Chernyshevskoye (RU) – Kibartay (LT)	8-25	2
Sovietsk (RU) – Panemune (LT)	4	2

Source: University of Kaliningrad, Finnish Border Guard

The latter examples show that crossing the borders between EU countries and Russia-Belarus is still an important bottleneck that may cause a significant disruption in the road traffic, as the waiting time reaches several hours for both coaches and trucks at many crossing points.

2.1.6. Lack of interoperability: an obstacle to the integration of national rail networks around the Baltic Sea

Increasing traffic loads and sluggish investments for improving the quality and quality of infrastructure have been identified as the main challenges to be dealt with in the case of the road network. The rail infrastructure of the BSR is important for the connectivity of the region to the rest of the European continent, but also for the integration of its regions, not the least the largest metropolitan areas.

As for the rail networks, the lack of interoperability, stemming from different technical standards, of the different national networks acts as a clear limiting factor for enhancing mobility of persons and goods on a transnational basis. Before describing the reasons behind this lack of interoperability, a quick overview of the main characteristics of the railway networks in the BSR is necessary. Of particular interest are the lines that can support a high traffic between cities. In that regard, focusing on the extent of double-track and electrified lines across the region provides a good overview of the potential for the railway system to sustain and support increasing mobility needs.

Both BSR-Germany and Poland enjoy a dense network of electrified and double-tracked railway lines. These two systems are connected at a half a dozen crossing point. The quality of the infrastructure between the crossing points varies as some are only equipped with non-electrified lines and some with single-track lines. Also the different electricity voltages used in both countries to power train engines adds an extra hour or less during the changing of engines in the border. However, the connectivity between the two systems can be deemed as fairly good. Sweden, Norway and Denmark enjoy a rather good inter-connectivity of their railway system as the electrified, double-track lines network shows not disruption at the borders. The connectivity to the Danish and ‘continental’ networks has been improved with the construction of the Öresund Bridge. Although the Danish and North German railway systems are connected to each other with double-track lines, these lines are not electrified, which may limit, for instance, the use of high-speed trains from Germany to Scandinavia.

The situation in the Baltic States is much different. The network of electrified and double-track lines is still in its infancy, despite the fact that rail has traditionally been the most used means of transportation in those countries. Moreover, the lack of modern north-south rail connections linking together the Baltic national networks is a clear hindrance for enhancing the intra-Baltic mobility of persons and goods. The existing shape of the rail network in those countries still reveals their former belonging to the Soviet Union. Indeed, the

emphasis on East-West connections, physically linking the Baltic States to Moscow but not between them has acted for years as a hindrance for rail transportation.

In the case of Kaliningrad, the importance of East-West connections to the rest of the Russian Federation, via Vilnius and Minsk, rather than the development of north south connections to Gdansk or costal parts of Lithuania, is a reminder that there are strong institutional and political inertia at play in the region. North West Russia is connected to Finland with a double track line. To date, the line is totally electrified in the Russian part and only partly electrified on the Finnish one. This strong inter-connectivity of the railway systems of southern Finland and North-West Russia is hardly surprising as the Finns had strong trade and commerce ties with Russia during the Soviet times.

Overall, the network of electrified, double-track railway lines in the BSR can be deemed to be as only partially integrated. The process of integration has so far functioned by the integration of different 'blocks': Germany-Poland, Denmark-Sweden-Norway, Finland-NW Russia and Baltic States-Kaliningrad-Belarus-NW Russia, although the integration within the latter block is the weakest. The potential for further integrating the region as whole lies in the capacity to improve the inter-connectivity of these different 'blocks'.

For so doing, a significant challenge, in the form of lack of structural compatibility between the national rail infrastructures, remains ahead. Here, the problem lies in the differences in the standard of rail gauge. On the one hand, Germany, Scandinavia and Poland have the same technical standards that make it possible to cross the border without changing train on one or the other side of the border. Moreover, these countries share the same technical standards as the rest of the continental European countries, which, for instance, facilitates the transportation of goods from these countries to the rest of Europe. Finland, Russia, Belarus, and the Baltic States have a different standard in rail gauge. The standards between these two groupings of countries are not compatible, which means that rail transportation across these countries necessitates to changing train at crossing points. This, of course, acts as a bottleneck as it slows down the cross-border traffic. These bottlenecks materialises in concrete terms on locations along the Polish border, Poland acting as the interface between the two gauge systems.

For instance, for Finland, the gauge standard difference is not a major problem because there are no rail connections to the BSR except Russia. Most of the cargo is first transported in containers and then shifted to ships for export or import. The gauge difference can even be an advantage for the Finland and the entire EU because it gives, via multi-modal transport chains, Finland /EU easy technical access to the entire Russian rail network. A fast rail connection from Helsinki to St. Petersburg is already in the current completion.

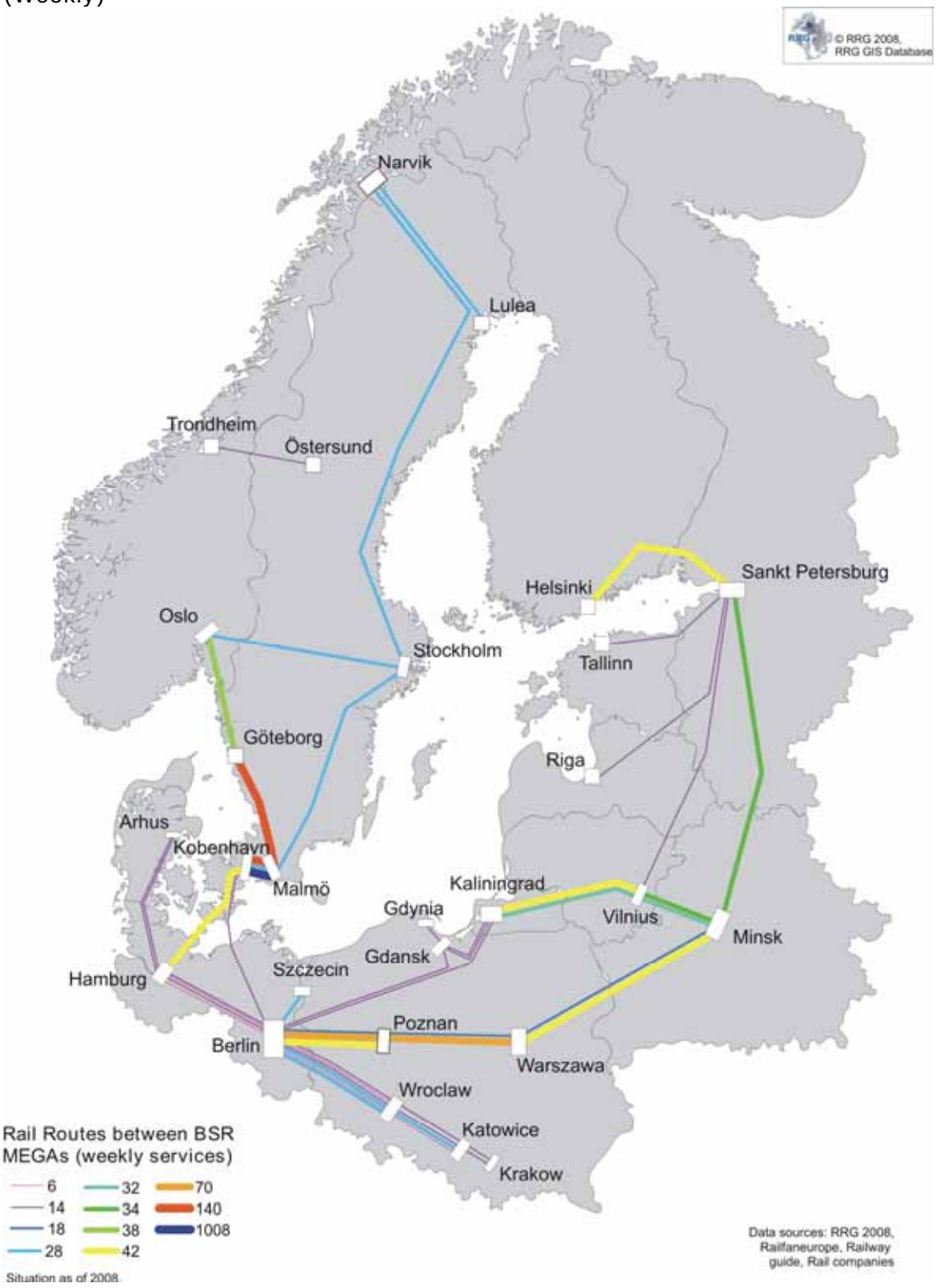
Consequently, the development of multi-modal platforms in Finland and Poland can be said of outmost importance for the integration of the East-West dimension of the BSR.

As stated earlier, the rail network has a preponderant role in fostering the integration of the BSR both on an inward (between BSR cities) and outward

(connection to rest of Europe) perspective. Due to the nature of the Baltic Sea Region, with the Baltic Sea acting as a natural obstacle for developing terrestrial means of transportation, rail connections cannot link all BSR cities between them, as for instance a Stockholm-Riga connection is obviously impossible to build. However, it plays a significant role in connecting the cities and regions belonging to respectively the north-west shore and the south-east one.

Figure 8 displays the extent of the connections and the route frequency on the main transnational routes in the BSR.

Figure 8: Route frequency on main BSR international rail connections in 2008 (Weekly)



From figure 8, one can draw two main conclusions.

First of all, it stresses the importance of certain cities as 'hubs' of the BSR rail system. This is especially true for Berlin, but also, although to a lesser extent, for Copenhagen and Warsaw. Indeed, Berlin plays a central role for the connection of Poland to the rest of continental Europe. The main route from Berlin is connected to Warsaw and Poznan, with respectively 70 and 42 direct weekly connections. However, the importance of Berlin in the BSR rail system is as well due to the multitude of connections to many different destinations in Poland. In spite of the fact that these connections are not very frequent (below 20 weekly connections), their degree of connectivity improves substantially. As for Copenhagen, its geographical position makes it the natural gateway for southern Scandinavia. Trains from Stockholm, Gothenburg and Malmö are connected to the Danish capital, which, in a similar way to Berlin, enables the passengers to continue towards the rest of continental Europe. Warsaw plays as well an important role as a hub to Belarus and indirectly to Lithuania and North West Russia.

The second conclusion is linked to the still poor level of connectivity of the main metropolitan areas on the Eastern shore of the Baltic Sea, i.e. between Poland, the Baltic States, Western Russia and Belarus. Figure is focusing essentially on direct connections, i.e. without having to change train. However, our main interest in this section is to highlight the potential for the rail network to easily connect metropolitan regions of the BSR together. From figure 8, it is confirmed that the level of rail connectivity between Poland and the Baltic states is very low. There are, to date, no trains linking directly (i.e. with change) of the following cities: Warsaw, Vilnius (or Kaunas), Riga and Tallinn. As mentioned earlier, this is due to the fact that there are no or not adapted rail infrastructure capable of doing so. This lack of rail connectivity between the Polish and Baltic capitals is still probably the most serious bottleneck for the complete integration of the Baltic Sea Region. Of course, as shown in the following chapters, air and maritime connections may act as a substitute to the relative weakness of the rail system.

A final interesting notice on figure 8 is the fact that the rail system on the eastern shore of the BSR still bears the marks of the belonging or acquaintance with the former Soviet Union. Indeed, if Tallinn, Riga and Vilnius are barely connected to each other, they all have direct connections to Saint Petersburg, even if the frequency of the routes is rather low (7 weekly direct trains each). In that regard, Minsk appears to be central by acting as the centre for the connections between North West Russia, Kaliningrad and Poland, and Belarus of course. Indeed, Minsk has not only direct rail connections to Warsaw, Vilnius, Kaliningrad and Warsaw, but is as well the necessary cross-roads for mobility between these cities.

However, it is necessary to bear in mind that the lack of integration of the railway systems is also due to legal constraints. Trains operating in one country are often not allowed to operate in the neighbouring one. This means that it is often required to change train at the border.

Table 3 provides further indications on the implications of the poor connectivity of the rail system on the Eastern shore of the BSR by assessing the time that it takes to travel between these cities.

Table 3: Shortest travel times between main cities on the eastern shore of the BSR

Shortest travel time between BSR cities in Hours: Minutes (Number of train changes)		TO					
		Minsk	*Vilnius*	*Kaliningrad*	*Riga*	*Tallinn*	*Saint Petersburg*
FROM	*Warsaw*	8:38 (3) 9:16 (0)	9:00 (Bus) 9:26 (2)	8:04 (1)	13:20 (Bus) 24:31 (4) 24:32 (3)	17:00 (Bus) 40:36 (6) 41:18 (2)	22:27 (4) 28:32 (0)
	Minsk		4.30 (0)	11:03 (0)	14:57 (2)	29:31 (1)	13:33 (1) 13:52 (0)
	Vilnius			6:15 (0)	4:20 (Bus) 14:49 (1)	34:26 (2) 9:30 (Bus)	13:08 (0)
	Kaliningrad				22:14 (2)	14:10 (Bus) 41:20 (2)	20.33 (1) 25:21 (0)
	Riga					4:25 (Bus) No train route	12:20 (0) 14:20 (Bus)
	Tallinn						8:02 (0) 8:00 (Bus)
	Saint Petersburg						

Source: Deutsche Bahn (2008), Eurolines (2008)

The travel times displayed in table 3 reinforce the perception of an eastern shore of the BSR in need for more integration. The poor quality of the rail infrastructure in this part of the BSR and the lack of interoperability of the exiting tracks across the border are not only causing high travel times, but they also necessitate a great effort from the traveller: multiple changes are often needed along these journeys. To join Warsaw and Tallinn, it takes no more than 40 hours and 6 changes to complete the journey. The main problem related to rail infrastructure is witnessed between Poland, Lithuania, Latvia and Estonia. For the journeys between capital regions, bus connections are often faster, as, for instance, between Warsaw and Vilnius. There is still, to date, no train connection between Tallinn and Riga. In an earlier report commissioned by VASAB (Nordregio *et al.*, 2000), it was already stated that no train connection was available between these two cities in 1999: nearly a decade after, the situation is still the same. Of course, the lack of integrated rail infrastructure between Latvia and Estonia is not problematic per se for the transport of passengers: bus and air connections act as very efficient substitute to train connections. However, when it comes to the exchange of goods between the two countries, the absence of rail infrastructure implies an increased used of road infrastructure.

2.1.7. Conclusion: Persistent bottlenecks and structural challenges for integrating transportation network in the BSR

The previous sections have provided an overview of the current state of the road and rail infrastructure across the region. It has as well enabled to highlight the potentials and challenges linked to the further integration of the region. Indeed, the future increase in trade and commerce patterns, materialised by increased mobility of persons and goods, within the region is highly dependent on an extensive and reliable network to support and sustain it.

The bottlenecks and challenges identified in this report are the following:

- Growth in traffic around the main metropolitan areas, leading to increased congestion;
- Fragmentation of the network of motorways and highways, especially the capacity to transport goods and freight using by road;
- Low quality of the secondary road and rail networks, limiting the potential for intra-regional daily interactions outside the main metropolitan areas;
- Growth in the volume of vehicles, leading to an future increase in traffic and implying the upgrading of the transportation network;
- Few persistent institutional bottlenecks leading to high waiting times at the border;
- National differences in terms of technical standards, leading to a lack of inter-operability of the networks.

The bottlenecks and challenges are not new. Of course, large investments in transport infrastructure and the accession of Poland and the Baltic States in the last decade have enabled to remove or reduce the impacts of these bottlenecks that are often felt at the borders between countries. The removal of the remaining challenges will need both ‘hard’ and ‘soft’ policy measures. ‘Hard’ measures aim at improving the structural and technical aspects of the transport infrastructure. These types of measure are often long-term and capital intensive measures. ‘Soft’ measures are more linked to logistics patterns and the use of the infrastructure, providing incentives for developing interactions between actors located in different places or for shifting towards environmental-friendly means of transportation. These measures can be implemented more rapidly and often necessitate less financial investments.

However, the role of the road and rail networks for integrating the BSR consists essentially on enhancing *cross-border interactions* between BSR regions or cities in relative physical proximity, thus fostering integration on a country-to-country basis. This is due to the nature of the BSR itself. Indeed, the Baltic Sea acts as a physical obstacle to development terrestrial transportation networks. Connecting Stockholm and Riga directly by road or rail is impossible and indirect connections via other countries would make the time spent for travel skyrocketing. For *transnational interactions*, i.e. interactions between more distant regions or cities, maritime and air transportation are central for binding together the Baltic Sea Region.

2.2. Overcoming the Baltic Sea: air and maritime transportation

Air and maritime transportation are central assets sustaining the further expansion of transnational mobility patterns, both related to the transportation of goods and persons, within the BSR. The air and maritime transportation networks are very different in their nature than road and rail networks. Indeed, the infrastructure is not made of links but of nodes. Consequently, both are often defined as point-to-point transportation systems. Air and maritime connections are intangible. However, they are departing from and arriving to very tangible infrastructure: the ports and seaports are the necessary infrastructure to develop air and maritime connections from any location. Moreover, the development of airlines and ferry companies is necessary for operationalising these connections.

The analysis in this section will be divided in two main sub-parts. First of all, it will provide a short overview of the location of ports and seaports around the Baltic Sea. A particular emphasis will be put on the importance of each node in the BSR air and maritime system, by comparing the volume of passengers and cargo transiting to these nodes: what are the largest airports and seaports in the region? How are the nodes distributed over the territory? What is their role for regional development?

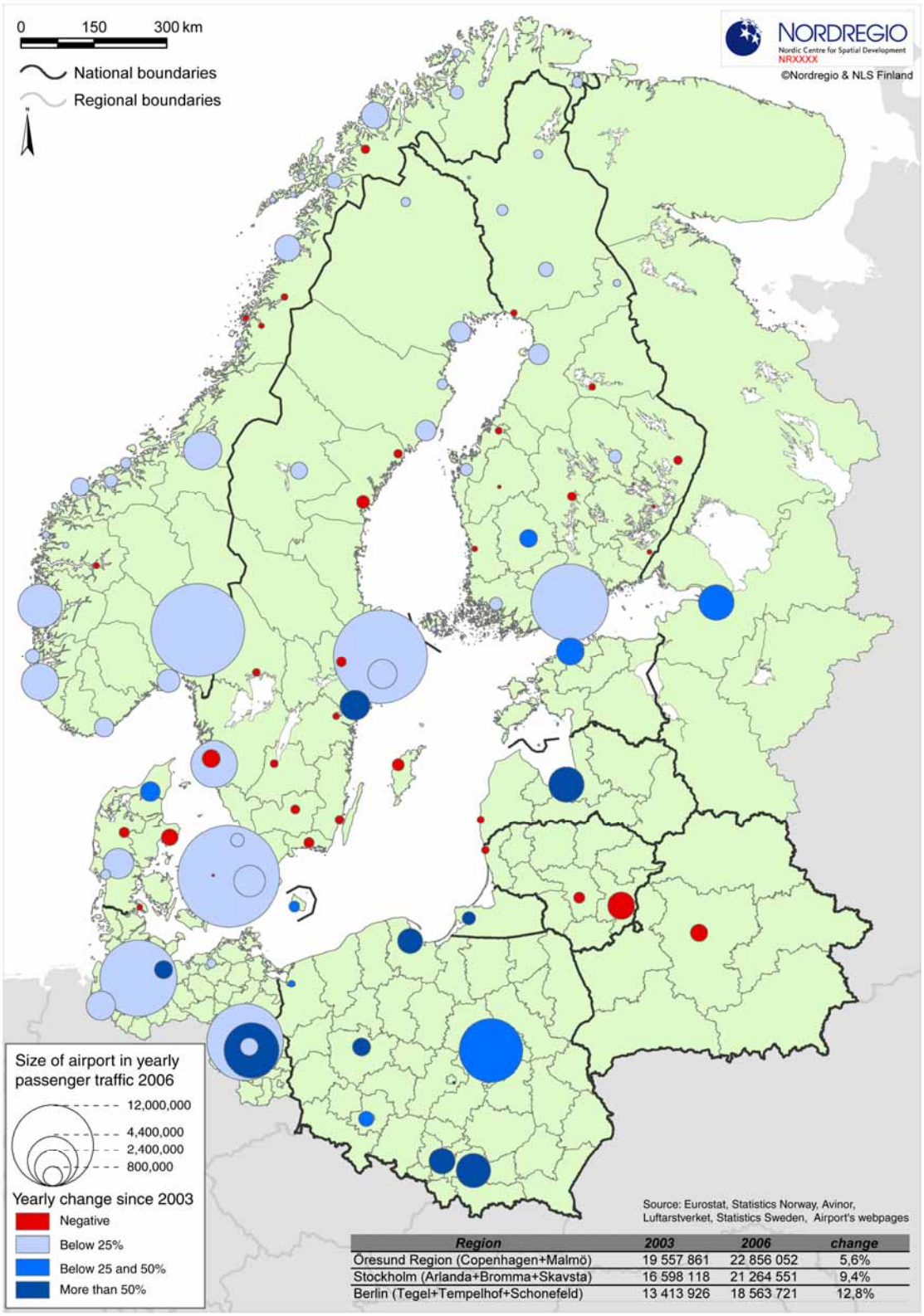
Then, the analysis will focus on the transnational dimension of operationalised routes and connections between BSR airports and seaports. Intra-national connections will not be analysed in this regard, as the body of literature in each country regarding those aspects are already substantial. The focus on the relational dimension will enable to identify the relative intensity of connections between the main regions and cities around the Baltic Sea.

2.2.1. Airports and seaports in focus

In this section, the analysis will be focus on the role of airports and seaports in further integrating the regions of the BSR. The regional impact of these facilities will not be addressed in this section, but will be rather addressed in the chapter of this report dedicated to local accessibility measurements.

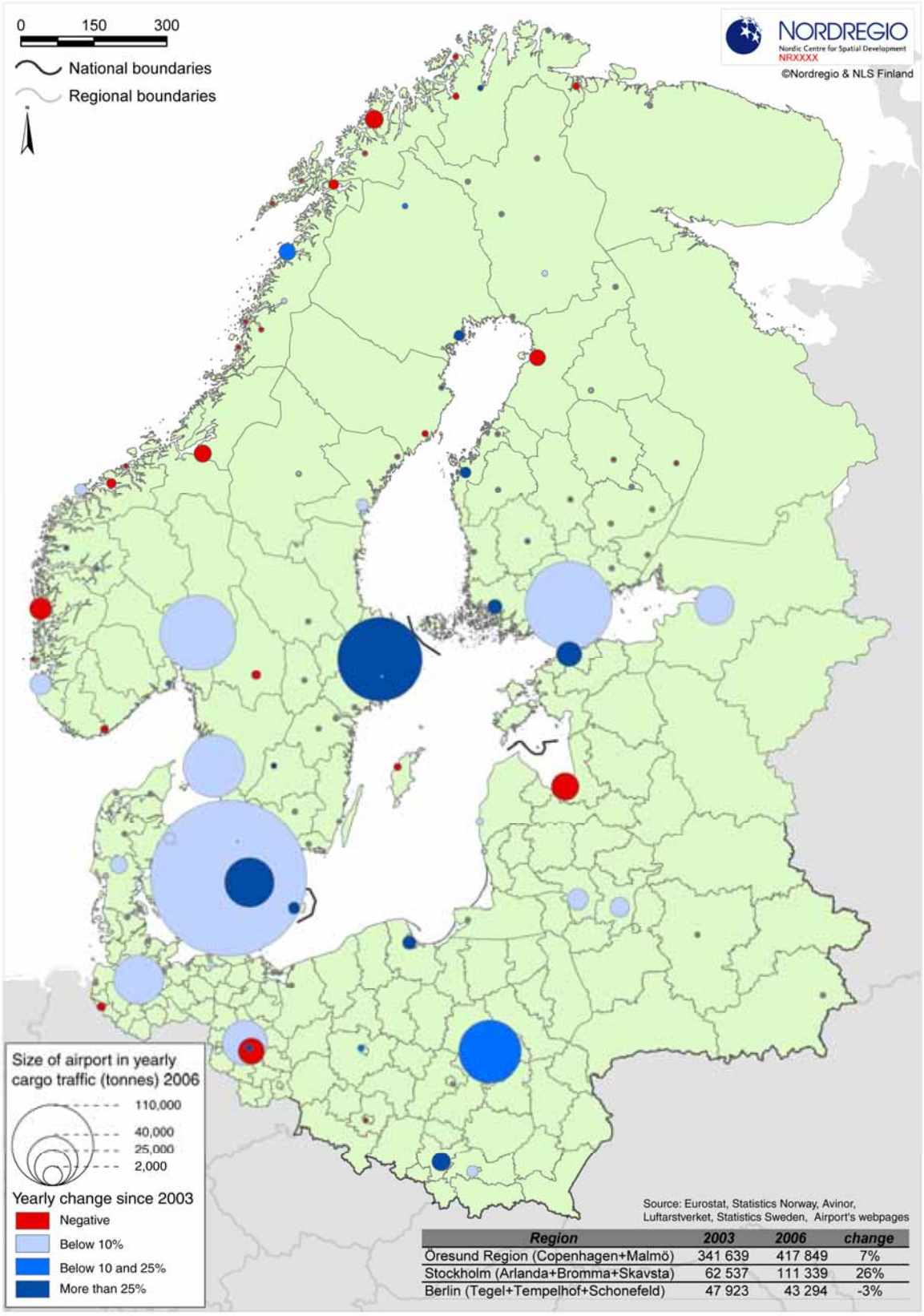
Airline and ferry connections have acted as the driving forces for developing interactions, whether related to business, leisure or cargo trips, between regions and cities around the Baltic Sea. As mentioned earlier, these two means of transportation have enabled to bridge the natural obstacle that the Baltic Sea is. Airport and seaport infrastructure are one of the essential components as they are the necessary nodes from which routes are departing and arriving. These facilities are not only connecting the main cities between each other; they also act as a gateway for a vast territory around it to access international networks. While seaports are handling the largest share of the intra-BSR cargo shipments, airports have been central in developing business, e.g. one day return-trips, and leisure connections between parts of the BSR.

Figure 9: Main international passenger airports in the BSR (2006)



Region	2003	2006	change
Öresund Region (Copenhagen+Malmö)	19 557 861	22 856 052	5,6%
Stockholm (Arlanda+Bromma+Skavsta)	16 598 118	21 264 551	9,4%
Berlin (Tegel+Tempelhof+Schonefeld)	13 413 926	18 563 721	12,8%

Figure 10: Main international cargo airports in the BSR (2006)



Region	2003	2006	change
Öresund Region (Copenhagen+Malmö)	341 639	417 849	7%
Stockholm (Arlanda+Bromma+Skavsta)	62 537	111 339	26%
Berlin (Tegel+Tempelhof+Schonefeld)	47 923	43 294	-3%

Looking at the airports and seaports in the BSR, there are two main aspects that should be highlighted: the location and relative size of the passenger and cargo traffic transiting through the facilities on the one hand, and the recent dynamics in traffic on the other hand.

Figures 9 and 10 display the spatial distribution of airport facilities around the BSR. It does not aim at picturing the full airport infrastructure, as it mainly focuses on the main facilities, i.e. the facilities that attain a minimum threshold of passenger or cargo per year. Of course, smaller airports may have a significant impact for the local communities, especially as these airports are often connected to the capital region, but with too little volume for them to be of significance for our transnational study.

From the overview provided by figure 9 on the main BSR airport for passenger transport, conclusions can be drawn on two main dimensions.

First of all, the airports of Copenhagen, Stockholm (Arlanda) and Oslo represent the main nodes in the BSR airport network. The total number of passengers transiting in those airports is of approximately 20,000,000. If this is considerable in BSR terms, these are quite low number in a European perspective. The Copenhagen airport is, to date, the only airport located in the BSR that belongs to the top-20 of European airports (Matthiessen, 2004). The airports of Helsinki (Vantaa), Hamburg and Berlin (Tegel) belong to the second category of airports, with a total of yearly passengers approaching 10,000,000 in 2006. Consequently, the largest airports in the BSR are still located in the Western parts of the BSR. On the Eastern part, only the Warsaw airport has passenger traffic volumes that approach the ones of BSR-Germany and the Nordic countries, with more than 8,000,000 passengers in 2006. Airports in Krakow, Vilnius, Riga, Saint Petersburg and Tallinn belong to the group of airports that have a strong national/regional importance, but still low BSR significance. As for the spatial distribution of airports, the main remarks can be summarized as follow:

- Persisting strong imbalance between Western and Eastern BSR;
- Importance of national hubs in connecting national and BSR networks;

But, the structure of airports in the BSR is in perpetual change. Indeed, in order to better understand the undergoing processes, it is necessary to take a dynamic perspective on the matter. Most airports around the BSR have witnessed a sharp increase of their volume of passengers. The largest hubs, belonging to the first and second categories, have witnessed a mild growth when compared to medium-sized airports. Indeed, airports in Warsaw, Tampere, Aalborg, Tallinn and Saint Petersburg have shown yearly passenger traffic growth between 25 and 50%. The growth has been even more evident in Berlin (Schonefeld), Riga, Gdansk, Katowice and Krakow, where it has reached thresholds above 50% per year.

The evidence highlighted here above clearly shows that there is an overall strong dynamism for passenger traffic airports in the BSR, and that this dynamism is especially marked in airports of smaller sized. If this trend continues in a medium-term perspective, this will reduce the current imbalances between the Western and Eastern parts of the BSR. The differences in dynamism can be deemed to be link to the maturity of the air transport

network in the different BSR countries. In Germany, the Scandinavian countries and Finland, air transport has been dominated by the national carriers, respectively Lufthansa, SAS and Finnair, although newcomers, essentially in the form of low cost carriers, provide alternative options for travelling from/to these countries. In Poland and the Baltic States, the national carriers were in a more delicate situation, but the institutional opening (EU and Schengen accession) combined with the rise of interest for low cost carriers to Eastern destinations, are explanatory factors for the recent strong increase in traffic.

Low cost carriers have played an essential role in the recent dynamism of passenger traffic in the BSR. Until recently, the airports in the Baltic Sea Region were hardly connected to the networks of low cost carriers (Dobruszkes, 2006). This move towards the East of the low cost carrier cannot be better highlighted than with the example of *Ryanair*, the largest European low cost carrier. In 2004, only Tampere, Stockholm, Hamburg and Berlin were 'Ryanair destinations' in the BSR. In 2008, the picture has changed completely. Indeed, if Stockholm is still the main Ryanair hub in the region, the network of Ryanair airports has expanded dramatically: Riga is now as well as central hub for the Eastern part of the BSR, and to a lesser extent so is Kaunas; more importantly, 10 Polish airports are now parts of this network, substantially improving the accessibility of Polish regions to Western European destinations. The case of the Hungarian-based low cost carrier Wizzair, having several hubs in Poland, is a remarkable example of the role of carriers in improving the accessibility of regions to external BSR or European markets.

Table 4: Top-25 passenger airports in the BSR

	Airport	Number of passengers 2003	Number of passengers 2006	Yearly change between 2003 and 2006, in %
1	København/Kastrup Airport	17 677 326	20 862 815	6,01%
2	Stockholm/Arlanda Airport	15 289 438	17 795 221	5,46%
3	Oslo/Gardermoen Airport	13 646 980	17 672 256	9,83%
4	Hamburg Airport	9 633 957	12 014 704	8,24%
5	Helsinki-Vantaa (Finavia) Airport	9 561 414	12 013 557	8,55%
6	Berlin-Tegel Airport	11 150 195	11 836 750	2,05%
7	Warszawa/Okecie Airport	4 325 814	8 116 876	29,21%
8	Berlin-Schönefeld Airport	1 813 805	6 091 966	78,62%
9	Göteborg/Landvetter Airport	3 682 274	4 362 095	6,15%
10	Bergen/Flesland Airport	3 413 550	3 918 430	4,93%
11	Trondheim/Vaernes Airport	2 614 133	2 935 799	4,10%
12	Stavanger/Sola Airport	2 561 561	2 785 031	2,91%
13	St Petersburg Airport	1 292 100	2 529 400	31,92%
14	Riga Airport	711 848	2 502 295	83,84%
15	Krakow/Balice Airport	517 015	2 367 257	119,29%
16	Malmö/Sturup Airport	1 880 535	1 993 237	2,00%
17	Billund Airport	1 551 731	1 868 515	6,80%
18	Stockholm/Skavsta Airport	974716	1 773 635	27,3%
19	Bremen Airport	1 666 734	1 709 005	0,85%
20	Stockholm/Bromma Airport	1 308 680	1 695 695	9,86%
21	Tallinn Airport	710 336	1 533 706	38,64%
22	Vilnius Intl Airport	N/A	1 447 071	N/A

23	Tromsø Airport	1 322 807	1 420 631	2,47%
24	Katowice/Pyrzowice Airport	168 126	1 357 914	235,89%
25	Bodø Airport	1 262 224	1 315 776	1,41%
26	Gdansk/Lech Walesa Airport	269 960	1 249 753	120,98%
27	Torp Airport	1 003 428	1 061 505	1,93%
28	Luleå/Kallax Airport	851 664	924 273	2,84%
29	Oulu Airport	733 320	858 803	5,70%
30	Umeå Airport	772 419	853 378	3,49%

Source: Eurostat, Statistics Norway, Avinor, Luftarstverket, Statistics Sweden, Airport's webpages, Luftfartsstyrelsen, Federal Statistic Office Germany

The distribution of the main cargo airports of the BSR is displayed in figure 10. The importance of the airport is displayed in terms of total yearly tonnage transiting through each airport. In that regard, the pattern can be deemed as more centralised than for the passenger traffic. In concrete terms, it means that the difference between the largest airports and the smaller ones is more pronounced.

Copenhagen is by far the largest cargo airport in the BSR, with a yearly tonnage transiting in the facility of nearly 400,000 tonnes. Helsinki (Vantaa), Stockholm (Arlanda) and Oslo airports belong to the second category, with a yearly tonnage of respectively 120,000, 100,000 and 90,000 tonnes. Warsaw and Gothenburg airports, with approximately 60,000 tonnes each, constitute the third group of airport in relation to their importance as cargo hubs.

As for the passenger traffic, the cargo traffic in BSR airports is very dynamic. Indeed, recent trends, calculated between 2003 and 2006 and displayed in table 5, show that all cargo airports in the BSR top-10 have experienced growth in transiting cargo volumes. The most significant increase in this top-10 has been experienced by the Sturup airport near Malmö, with a yearly growth of 180%. The airport of Turku in Finland is the airport that has had the most important yearly growth in recent years, with an average rate of 241% per year since 2003. At the other end of the spectrum, other airports have undergone a decrease in their cargo activities, although the decrease is almost negligible except for the airports of Berlin (Schonefeld) and Billund.

Table 5: Top-25 cargo airports in the BSR

	Airport	Total freight and mail on board in tonnes 2003	Total freight and mail on board in tonnes 2006	Yearly change between 2003 and 2006, in %
1	København/Kastrup Airport	335 731	380 024	4%
2	Helsinki-Vantaa (Finavia) Airport	94 170	118 695	9%
3	Stockholm/Arlanda Airport	62 537	111 278	26%
4	Oslo/Gardermoen Airport	69 239	90 136	10%
5	Warszawa/Okecie Airport	42 754	60 251	14%
6	Göteborg/Landvetter Airport	58 935	59 658	0%
7	Hamburg Airport	36 945	39 123	2%
8	Malmö/Sturup Airport	5 908	37 825	180%
9	Berlin-Tegel Airport	29 830	31 892	2%
10	St Petersburg Airport	21 962	23 348	2%
11	Riga Airport	13 531	11 715	-4%

12	Berlin-Schönefeld Airport	17 672	10 649	-13%
13	Tallinn Airport	5 051	10 053	33%
14	Bergen/Flesland Airport	7 859	7 430	-2%
15	Stavanger/Sola Airport	6 060	6 957	5%
16	Kaunas Intl Airport	N/A	6 849	N/A
17	Vilnius Intl Airport	N/A	5 564	N/A
18	Katowice/Pyrzowice Airport	1 715	5 277	69%
19	Tromsø Airport	5 630	5 197	-3%
20	Trondheim/Vaernes Airport	5 145	4 694	-3%
21	Billund Airport	6 144	4 672	-8%
22	Bodø Airport	3 001	4 188	13%
23	Oulu Airport	4 254	4 055	-2%
24	Turku Airport	398	3 271	241%
25	Gdansk/Lech Walesa Airport	1 573	2 812	26%

Source: Eurostat, Statistics Norway, Avinor, Luftarstverket, Statistics Sweden, Airport's webpages, Federal Statistics Office Germany
**St. Petersburg airport data for 2004 and 2005*

In fact, the geography of BSR cargo airports is very much linked to the requirements of modern logistics. Indeed, the centralisation of these activities in a handful of airports stresses the importance of intermodality in modern logistics process, i.e. the capacity to shift from air transport to other means of transportation (road, rail), and the role of these airports as gateways for the whole national territory.

As mentioned earlier in this chapter, seaports also play an important role as nodes of the maritime transport network, both for the travelling of passenger and the shipping of cargo. The figures displayed in tables 6 and 7 enable to identify the most important seaports when it comes to respectively passenger and cargo transportation.

Table 6: Top-25 passenger seaports in the BSR (in thousands of passengers)

Seaport	Country	Total Number of passengers 2001	Total Number of passengers 2006	Yearly change 2001-06
Helsingborg	SE	11 771	10 776	-1,7%
Helsingør	DK	11 513	10 721	-1,4%
Helsinki	FI	9 010	8 548	-1,0%
Stockholm	SE	7 001	8 054	3,0%
Rodby (Faergehavn)	DK	6 028	6 789	2,5%
Puttgarden	DE	5 895	6 789	3,0%
Tallinn	EE	6 539	6 447	-0,3%
Turku	FI	4 074	3 620	-2,2%
Mariehamn	FI	2 377	3 099	6,1%
Frederikshavn	DK	3 739	2 859	-4,7%
Oslo	NO	2 539	2 602	0,5%
Rostock	DE	1 963	2 282	3,3%
Odden	DK	2 211	2 270	0,5%
Göteborg	SE	2 658	2 197	-3,5%
Ystad	SE	1 285	1 937	10,1%
Hirtshals	DK	1 855	1 916	0,7%

Esbjerg	DK	1 860	1 805	-0,6%
Nordby Havn, Fanö	DK	1 706	1 723	0,2%
Trelleborg	SE	1 855	1 697	-1,7%
Aarhus	DK	1 250	1 686	7,0%
Ronne	DK	1 423	1 508	1,2%
Gedser	DK	1 172	1 507	5,7%
Visby	SE	1 294	1 472	2,8%
Kiel	DE	1 045	1 384	6,5%
Kappelskar	SE	1 281	1 382	1,6%

Sources: Eurostat for Denmark and Finland confirmed with Merenkulkulaitos year statistics and Statistics Denmark; Swedish Institute for Transport and Communications Analysis, Statistics Norway, Federal Statistical Office of Germany, Polish seaports, Statistical Yearbook of The Republic of Poland, St Petersburg port authority. Eurostat for Latvia, Lithuania, Estonia

The largest passenger ports in the BSR are the 'Siamese' ports of Helsingborg and Helsingor. These two cities are the closest Danish and Swedish cities and are connected by a dense network of ferry connections (up to 1000 weekly). The two ports are the busiest seaports of the BSR due to the high intensity of short-haul connections. The ports of Helsinki and Stockholm are respectively third and fourth in the BSR passenger ports ranking. The intensity of ferry connections departing from both cities explains their high ranking. From the top-4 seaports of the BSR only the port of Stockholm has witnessed an increase of passenger traffic, corresponding to 3% per year. Tallinn is the only passenger seaport not situated in the Nordic countries or Germany, and is ranked 7th with a yearly total of passengers in 2006 of 6,447 thousand passengers.

Table 7: Top-25 cargo seaports in the BSR (in thousands of tonnes)

Seaport	Country	TOTAL 2000*	TOTAL 2006	Yearly change 2000*-06	GOODS TRANSPORTED BY CARGO VESSELS UNLOADED TOTAL		GOODS TRANSPORTED BY CARGO VESSELS LOADED TOTAL	
					2000	2006	2000	2006
Hamburg	DE	76 950	115 529	8,4	46 073	68 860	30 876	46 669
Bergen	NO	85 344	67 864	-5,1	23 813	14 205	61 531	53 659
St. Petersburg	RU	41 309	54 227	6,3	N/A	N/A	N/A	N/A
Tallinn	EE	36 480	41 243	3,3	3 406	5 633	33 074	35 610
Bremerhaven	DE	24 835	40 350	10,4	11 661	18 925	13 174	21 425
Göteborg	SE	33 261	39 912	3,3	17 132	20 149	16 128	19 763
Ventspils	LV	37 937	27 746	-5,4	396	3 069	37 541	24 677
Gdansk	PL	16 471	23 759	22,1	4 024	4 300	12 447	19 459
Riga	LV	14 820	23 758	12,1	1 598	2 873	13 222	20 885
Klaipeda	LT	20 953	21 347	0,4	3 475	5 506	17 478	15 841
Lübeck	DE	17 954	21 056	2,9	10 887	12 142	7 067	8 914
Skoeldvik	FI	12 799	19 739	9,0	7 951	11 531	4 848	8 208
Rostock	DE	18 634	19 058	0,4	10 984	9 875	7 649	9 183
Brofjorden Scanraff	SE	19 302	18 591	-0,6	9 740	9 541	9 563	9 050
Fredericia	DK	16 044	16 101	0,1	2 732	2 567	13 440	13 541
Narvik	NO	13 001	16 074	5,9	401	494	12 600	15 580
Bremen	DE	14 389	15 286	1,0	10 048	10 993	3 062	4 293
Kaliningrad	RU	5 800	14 619	30,6	N/A	N/A	N/A	N/A
Gdynia	PL	8 382	14 105	34,1	3 627	7 862	4 755	6 243
Karmsund/Haugesund/ Karmøy	NO	12 869	14 086	2,4	2 721	3 409	10 148	10 676
Aarhus	DK	9 847	11 913	3,5	6 203	7 676	3 644	4 237
Helsinki	FI	10 085	11 733	2,7	5 110	5 963	4 976	5 770

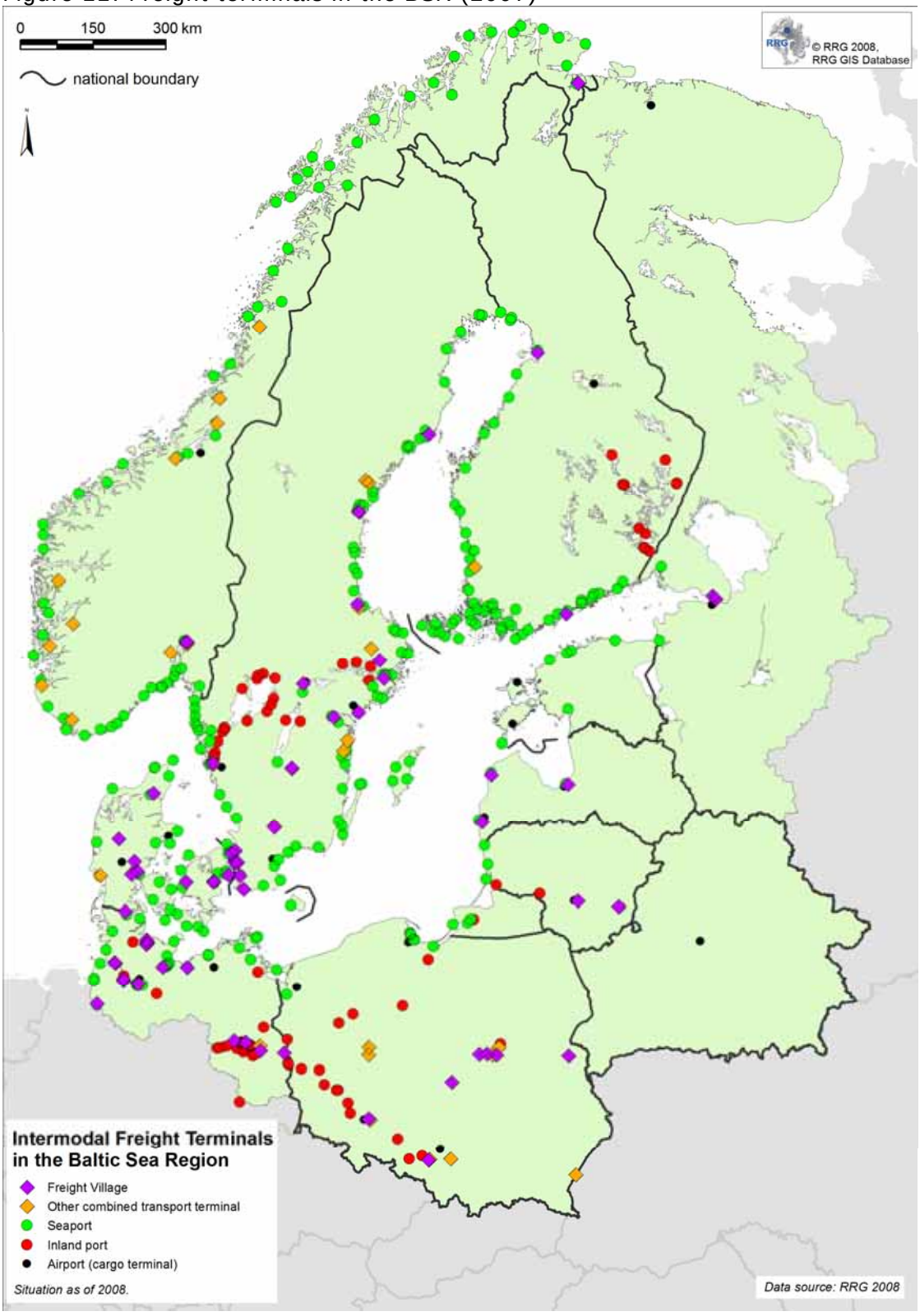
Tonsberg	NO	9 201	11 492	6,2	4 887	6 202	4 314	5 289
Trelleborg	SE	10 334	11 381	1,7	4 599	5 679	5 735	5 702
Grenland/Skien/Porsgrunn/Bamble	NO	9 439	10 156	1,9	3 936	4 418	5 503	5 738

GOODS include: Liquid bulk goods, dry bulk goods, freight large containers, Ro-Ro, mobile self-propelled units, Ro-Ro, mobile non-self-propelled units and other cargo not elsewhere specified.
** 2001 for Latvia, Lithuania and Russia and 2002 for Estonia and Norway
Sources: Eurostat for Denmark, Finland, Sweden, Norway confirmed with Merenkulkulaitos year statistics, Swedish Institute for Transport and Communications Analysis, Statistics Denmark. Others: Federal Statistical Office of Germany, Polish seaports, Statistical Yearbook of The Republic of Poland, St Petersburg port authority, Region Blekinge for Kaliningrad port; Eurostat for Latvia, Lithuania, Estonia

The ranking of the top 25 cargo seaports displays a lesser dominance of German and Nordic seaports over ports on the eastern shore of the Baltic Sea. This is especially true when it comes to bulk cargo. However, high quality goods needing careful handling are mostly shipped via German and Nordic seaports. Hamburg is the busiest BSR cargo seaports by far, with more than 115,000,000 tonnes loaded and unloaded. The Norwegian port of Bergen, formerly number one in the BSR, is second in the ranking with less than 70 million tonnes transported. The seaports of Saint Petersburg and Tallinn are third and fourth in the ranking with respectively 54 and 41 million tonnes of goods loaded and unloaded. Beyond the mere ranking, table 7 reveals as well the recent dynamism of the seaports. In that matter it is interesting to notice the most dynamic seaports are situated on the eastern shore of the BSR, highlighting the mounting importance of these regions in the economic and commercial integration of the BSR. The seaports of Gdynia (Poland), Gdansk (Poland), Saint Petersburg (Russia), Kaliningrad (Russia) and Riga (Latvia) enjoyed a yearly increase in cargo traffic of respectively 34.1%, 22.1%, 14.8%, 14.8% and 12.1%.

The freight terminals displayed on figure 11 comprise dedicated freight villages, intermodal transhipment terminals and other container or transport terminals (ICT), as well as seaport and inland ports and other rail stations for combined transport. Seaports and inland ports are included because by definition the ports are interfaces between sea-born transport and land transport modes. Similarly, a number of important airport cargo terminals are included because they represent interfaces between the air mode and land modes. Otherwise, intermodal terminals are defined as infrastructure facilities where containers, semi-trailers, trailers and lorries and railway carriages can be transhipped from one mode to the other, e.g. from roads to railways ('rolling road trains', 'iron highways') or from road or rail to ships. In particular the layer includes all villages and terminals, but is not limited to, that are members in the following logistic organisations or companies: Deutsche GVZ Gesellschaft (DGG, Germany), Deutsche Umschlaggesellschaft Schiene-Straße (DUSS, Germany), Eurotrans Partners (Eurotrans), European Association of Freight Villages, Interporti (Italy), ProLogis, Sogaris (France), Stanton Grove (UK), TDG, and International Union of Combined Road-Rail Transport Companies (UIRR). (Source: RRG)

Figure 11: Freight terminals in the BSR (2007)



2.2.2. A dense network of internal air connections

The previous section has highlighted the importance of airports as the nodes of the air transport networks. These facilities are the *sine qua non* condition to develop air travel connections between cities and regions of the BSR. As mentioned earlier, the air carriers are the necessary actors that enable to operationalise these connections, often in close collaboration with national, regional or local authorities.

In this section, the analysis will focus on the currently existing patterns of air travel connections between the main metropolitan regions of the BSR, and especially emphasising the *transnational dimension* of these interactions, i.e. with origin in one BSR country and destination in another BSR country. As stated earlier, these types of passenger travels are essential for developing connected business or leisure interactions. Connectivity to other European and global destinations will be developed later in this report.

The analysis of air travel connections provides a measurement of the intensity of interactions between the main metropolitan areas (MEGAs) of the region. The gains implied by intensity of interactions have been identified in the literature as economies of density (Dobruszkes, 2006). These economies of density are generated by a trade-off between the number of routes departing from/arriving to one node (i.e. an airport) and the frequency of interactions for each route. In concrete terms, the place of the node is identified by using to analytical dimensions: broad/narrow network on the one hand, and dense/loose network on the other hand.

The network of routes and the intensity of interactions on these routes are of course dependent on the strategies of the various airlines. However, these airline strategies are driven by rules of demand-and-supply, as well as tailored strategies prioritizing flights in the BSR or more long distance ones. For example plane fleet selections are made according to such strategies. In that context, our analysis of air connections based on the number of flights between destinations is a rather good approximation of the intensity of interactions between cities and regions. Consequently, it enables us to identify the most privileged destinations for each region, i.e. the destinations that actors in one region have the most incentive to travel to. These incentives can be based on tourism interests or business interactions. This is a key dimension of the notion of accessibility: the transport system (here air transport) is a means to implement the mobility movements based on the needs of the regional actors.

Figure 12: Air travel connections between MEGA airports within the BSR (2008)

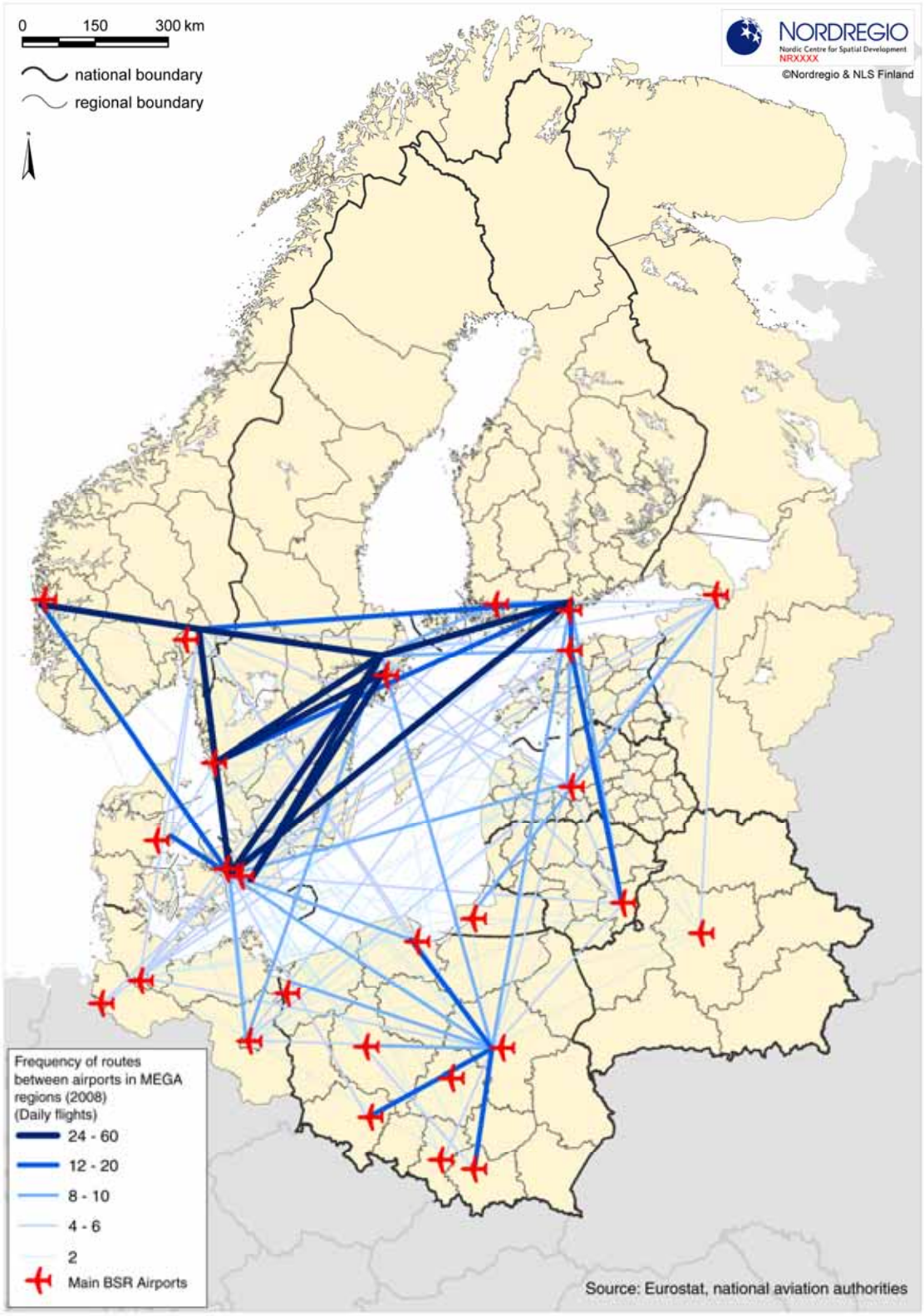


Figure 12 displays the patterns of air travel between the main metropolitan regions in the BSR. The map shows that there is a dense web of direct flights

between these regions. In concrete terms, this means that it takes rather little time for a person to travel directly from one MEGA to another, as the flights are direct and thus do not necessitate to change airplane. This leads to lower travelling time, and thus reduced travelling costs, making possible one-day return trip between BSR MEGA regions.

The figure above also highlights the intensity of interactions by measuring the frequency of air connections per day. High frequency routes are displayed as darker and thicker strokes. Clearly, the map highlights first and foremost the high degree of interactions between the MEGA situated in the Nordic countries, and not the least between the capital regions. This is due to strong institutional, cultural and historical ties between these countries, but also due to the rather high degree of integration between the labour markets and business structure. The Nordic capitals are, on average, connected by more than 30 daily routes, the most frequent route being between Copenhagen and Oslo (50 daily connections). Other routes of significance are Copenhagen-Stockholm (38), Stockholm-Helsinki (38), Stockholm-Oslo (34) and Helsinki-Copenhagen (28).

Other Nordic metropolitan areas, such as Gothenburg, Malmö, Bergen, Århus and Turku, are as well tightly connected to this Nordic web. However, in this case, the connections are essentially directed towards their own capital region rather than directly to other Nordic destinations. The routes Oslo-Bergen, Stockholm-Gothenburg and Stockholm-Malmö are thus very frequent, with more than 20 daily connections.

Routes between Nordic MEGAs are the most intense within the BSR. However, if the patterns of air connections do not reveal an as dense web of connections between groups of countries, it nonetheless enables to highlight some very important bilateral connections. In that regard, the most frequent route is between Helsinki and Tallinn with about 18 daily connections. The strong involvement of Finnish businesses in the Estonian economic life as well as the development of Estonia as a tourism destination lies behind the high frequency of flight connections. This is even emphasised by the high frequency of ferry routes between the two cities, especially since the operationalisation of a high-speed ferry line.

The connection between Vilnius and Tallinn is the most frequent route within the Baltic States, with 12 daily connections on average. The routes Riga-Vilnius and Riga-Tallinn are much less significant, with only 6 daily connections each. In Poland, the patterns of air connections primarily show the strong role of the Warsaw airport in the national system. Indeed, the most frequent interactions from/to Polish airports are taking place on national routes. The routes Warsaw-Wroclaw (18 daily connections), Warsaw-Gdansk (14) and Warsaw-Krakow (14), and the enhanced connectivity of Warsaw to other BSR airports, clearly highlights the role of Warsaw as the national hub for Poland, and thus the gateway to international destinations for the rest of the country. In that regard, the pattern of air connections for Poland is in line with the pattern in other European countries.

An interesting remark that can also be drawn from figure 12 is the rather limited extent of internal-BSR connections from/to German metropolitan

regions of the BSR. Airports in Berlin and Hamburg, and to a lesser extent Bremen, have a broad array of connections to other BSR MEGA, but these connections are not that intense, in spite of the fact that Germany is traditionally one of the biggest trade partners of other BSR countries. There are two possible explanations for this. First of all, one must bear in mind that neither Hamburg nor Berlin are hubs for the German national carrier, Lufthansa. Another explanation could be that Hamburg and Berlin are privileging destinations situated in North-West Europe rather than BSR destinations. The overview of European and global connections of BSR airports developed hereafter will highlight this possibility.

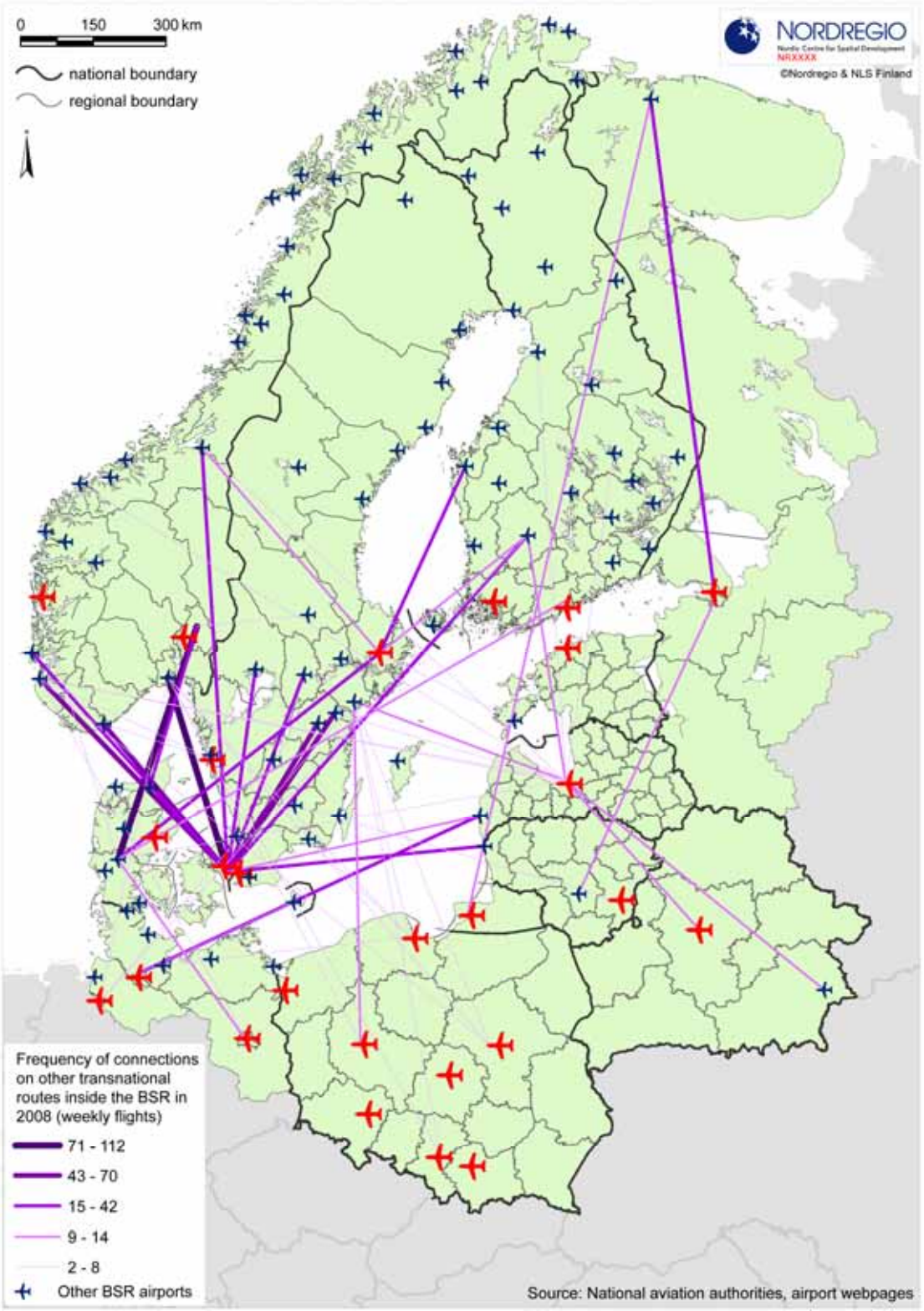
Finally, as for Russia and Belarus airports, the most frequent route is between Kaliningrad and Saint Petersburg, with 10 daily connections.

Figure 12 has highlighted the pattern of air connections between the main metropolitan areas inside the BSR. The focus on metropolitan areas is stemming from the hypothesis that the incentives for interactions between actors located in those areas are higher due to the larger size of the regional market fostering business linkages, and due to the concentration of cultural and historical assets fostering city-tourism.

Figure 13 provides a complementary perspective on the transnational air travel connections within the BSR. The routes displayed in figure 13 are transnational routes between airports that are not necessarily situated in MEGA regions. This highlights the potential for medium-sized regions to develop transnational connections of significance. Indeed, those types of connections can be of high importance, for instance for regional businesses and entrepreneurs in order to seek for investments and capitals from actors located in larger regions. Moreover, figure 13 enables as well to highlight the importance of the low cost phenomenon in the BSR. Indeed, airports hosting low cost carriers are often situated in the periphery of the main metropolitan areas, as these airports provide more flexibility and lower operationalisation costs than in larger airports.

The two main transnational routes highlighted in figure 13 are the ones between Billund and Oslo (Gardermoen) and between Copenhagen and Sandefjord (Torp). Whereas Billund is the main airport serving the western parts of Denmark, Torp hosts many low cost carriers to provide alternative routes to reach Oslo without going through the Gardermoen airport.

Figure 13: Selected intra-BSR, transnational air connections (2008)



An important remark from figure 13 is the numerous and intense air connections between medium-sized cities in Southern Norway and Sweden and

Copenhagen. In that specific case, it becomes obvious that the hub strategies and flight type strategies of air carriers are playing an important role for fostering the connectivity of regions. Indeed, Copenhagen is the international hub of the Scandinavian national carrier SAS. Consequently, it is rather normal that medium-sized cities in the dense parts of Scandinavia are connected to Copenhagen, in order to take advantage of its broad international connection network. The same applies particularly to neighbouring Malmö where the adequate fast train connections with Copenhagen facilitate its connections with other Swedish medium-sized cities destinations.

2.2.3. Ferry connections in the BSR: motorways of the sea

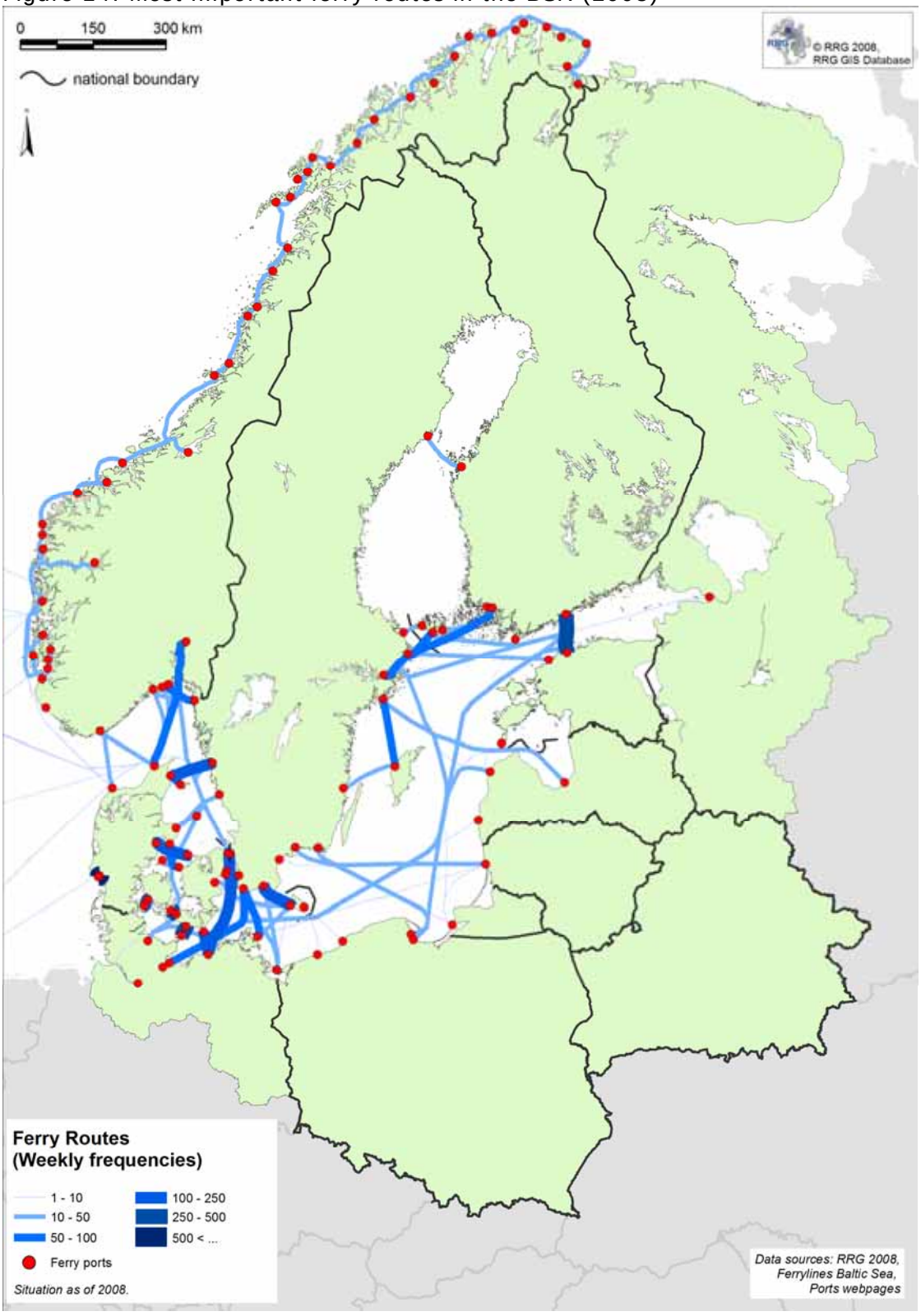
If the Baltic Sea presents a natural obstacle for the expansion of the terrestrial means of transportation such as road and rail networks, it is an outstanding asset for the development of an integrated maritime transportation network between BSR countries and regions.

In earlier sections of this report, we have emphasised the importance of seaports as the necessary nodes of the maritime transportation network. However, the identification and characterisation of the seaports do not enable to draw conclusions on the degree of integration between them. In order to do so, it is necessary to first identify the availability of routes connecting the BSR seaports between them. Based on these identified routes, the intensity of interactions will be measured by collecting data on the frequency of connections per week.

Figure 14 displays the result of this data collection. The most frequent routes are shown in dark blue and thick strokes, whereas the least frequent are shown in light blue and thin strokes. Figure 14 provides two main analytical dimensions, each highlighting two different ways for maritime transportation to promote integration in the BSR: on the one hand short-haul, cross-border interactions and on the other hand long-haul, transnational connections.

In the Baltic Sea, ferry lines are not only used for cruises or leisure trips, but also as a means of transportation for commuting journeys, especially for reaching out to the many islands found in the Baltic Sea. Consequently, the development of ferry lines enables to increase the connectivity of these islands to the mainland, and make it possible to develop a joint labour-market. This type of maritime are characterised by short travelled distances and rather high frequency. This is for instance the case of the route Esbjerg-Nordby in the North Sea shore of Denmark (but belonging to the BSR) that has on average 560 weekly connections in 2007. In Denmark and Norway, the physical geography of these countries, constituted of many different sets of islands, makes the use of maritime transportation essential in the national transport system.

Figure 14: Most important ferry routes in the BSR (2008)



Furthermore, the fact that many countries of the BSR are only separated by a narrow sea channel increases the possibility to use maritime transportation on a cross-border basis. For this specific geographical contexts, maritime transportation becomes the most cost-efficient and reliable means of transportation: distances are too short for using air connections, and the building of bridges or tunnels would be, if feasible, too expensive and not profitable enough. The most used cross-border ferry line in the BSR is the route between Helsingborg in Sweden and Helsingor in Denmark. These tow cities are the closest points between the two countries and strong interactions have been developed for centuries between them. In 2007, the average weekly frequency on the route was of 945 connections. Similarly, ferry connections are well developed between Germany and Denmark. The route Puttgarden-Rødby is the fourth most frequent in the whole BSR with 336 weekly connections. The increase in ferry connections between Tallinn and Helsinki has enhanced the further economic integration between the two regions. The development of a high-speed ferry connections between the two cities, making the journey one-hour long, has significantly increased the potential accessibility between the cities. In 2007, there was 392 weekly connections on average between Helsinki and Tallinn. On the eastern shore of the Baltic Sea, the ferry connection between Gdansk and Kaliningrad acts an efficient substitute to road and rail transportation due, for instance, to differing national technical standards.

These short-haul, cross-border ferry connections are not only important for enhancing the mobility of persons, especially for further integrating regional labour-markets. Ferry connections are also using by trucks and buses in order to transport goods across the borders. In some cases, the use of ferry connections make it possible for trucks to avoid long detours using the existing road network. This is especially the case for connections between Germany and Denmark, and between Germany and Sweden. Furthermore, Ferry routes are also attractive for lorry drivers because the time spent on the ferry can be used as resting period even though the 'truck is moving'. I believe this inter alias explains the continued success of the ferry connection between Helsingborg and Helsingor despite the Öresund-bridge. Consequently, short-haul, cross-border ferry connections can act as efficient substitute to road and rail *missing links*.

In addition to this, maritime transportation is also well developed for longer journeys, essentially for connecting cities and regions on one or the other shore of the Baltic Sea. These long-haul, transnational connections are often very popular for leisure purpose, providing a rather cheap means of transportation for tourists wanting to visit other BSR cities, emphasised by the fact that many ferry routes are implemented during night time, thus providing both accommodation, amusement and transportation. The most frequent of these ferry connections are the routes Stockholm-Mariehamn (70 weekly) and Stockholm-Turku (56 weekly).

Table 8: Top 25 weekly frequencies of BSR ferry routes (2007)

Rank	ROUTE			Number of weekly ferry services route in BSR 2007
1	**Helsingborg**	Helsingør	Helsingborg	945
2	**Esbjerg**	Nordby Havn, Fanö	Esbjerg	560
3	**Helsinki**	Tallinn	Helsinki	392
4	**Rodby**	Puttgarden	Rodby	336
5	**Tårs**	Spodsbjerg	Tårs	252
6	**Helsingborg**	Rostock	Helsingborg	154
7	**Gedser**	Rostock	Gedser	154
8	**Ystad**	Ronne	Ystad	140
9	**Aarhus**	Odde	Aarhus	140
10	**Gothenburg**	Fredrikshaven	Gothenburg	133
11	**Fynshavn**	Bojden	Fynshavn	112
12	**Frederikshaven**	Vestero Havn, Laeso	Frederikshaven	98
13	**Nynäshamn**	Visby	Nynäshamn	84
14	**Hirtshals**	Oslo	Hirtshals	84
15	**Aarhus**	Kalundborg	Aarhus	84
16	**Trelleborg**	Rostock	Trelleborg	80
17	**Stromstad**	Sandefjord	Stromstad	77
18	**Stockholm**	Mariehamn	Stockholm	70
19	**Trelleborg**	Sassnitz	Trelleborg	70
20	**Frombork**	Baltiysk	Frombork	70
21	**Stockholm**	Turku	Stockholm	56
22	**Malmö**	Travemunde-Lübeck	Malmö	56
23	**Elblag**	Baltiysk	Elblag	56
24	**Trelleborg**	Travemunde-Lubeck	Trelleborg	49
25	**Kristiansand**	Hanstholm	Kristiansand	47

Source: Ports webpages, Ferrylines Baltic Sea

As a conclusion, it appears clearly that maritime transportation plays an important role for the integration of regions of the Baltic Sea. In the above section, we have emphasised that this integration can be deemed to occur on two levels. First of all, short-haul and frequent ferry connections may provide a cost efficient solution for enhancing the integration of cross-border labour-markets. These often act as the substitute to missing terrestrial network linkages. Second, maritime transportation is also important for connecting more distant regions, separated by the Baltic Sea, and improve the integration of the whole BSR by enabling long-haul, transnational mobility of passengers (especially for leisure trips) and goods.

2.3. Connectivity of the BSR to European and global destinations

Because of the Baltic Sea itself, mainly air and ferry routes have the potential to support an increased integration of cities within the region. However, there is a need to perceive the BSR an integrated, homogenous entity from the rest of Europe and other worldwide destinations.

In that regard, it becomes interesting to investigate the degree of connectivity of the region to 'other places that matter' in the European and global economy, both in terms of passenger and goods transportation. In that regard, the air and maritime transportation networks should be seen as complementary, due to differences in travel-times and transaction costs, and not as substitute to each other. Indeed, if maritime connections can be deemed to be as the choice of reference for the transport of heavy and voluminous freight, air transport is more adapted for passengers and light freight.

In this section, the analytical work will reflect this differentiation between air and maritime transportation: European and global connectivity of air transport will be analysed from the perspective of passenger traffic, while maritime transport connections will be analysed using goods and freight transport statistics.

2.3.1. Internationalisation of BSR air transport

The mobility of passengers using air transport has been booming in the last decades. This can be deemed to be due to two main phenomena. First of all, the liberalisation of air transport in all developed countries has increased the competition between airlines, resulting in lower prices and growth in air traffic. Second, the end of the cold has made possible to travel to more countries that were before more difficult to reach, not the least from Western Europe.

In the Baltic Sea Region, the internationalisation of the air transport can be deemed to be both an internal and external issue. Indeed, the belonging of Belarus and the Russian Federation to the BSR brings the extra-EU/EEA dimension as a part of the macro-region itself. The previous section of air travel connections within the BSR has clearly shown that air transport plays an important role in integrating the BSR regions to each other.

But, for the BSR, the internationalisation of air transport is as well very much linked to the positioning of the region in European and global networks. If globalisation processes are not new, it is the rate at which this phenomenon occurs that has a strong impact on the patterns of economic and cultural exchanges for the BSR. For regional actors, developing and maintaining a broad contact network to the international has become a necessity in order to be further integrated in international trade and of developing globally competitive industrial and service activities. In that regard, air transportation has acted as a catalyser and enabler for developing such networks. Indeed, the substantial decrease of the travel costs for inter- and trans-continental

journeys has reduced considerably the transaction costs for visiting faraway destinations.

In that regard, the connectivity of BSR airports is essential in order not only to enable BSR actors to visit important destinations, from a commerce or tourism perspective, but also to enable international actors to travel to the region, generating influx of capital and investments. Indeed, in order to be more competitive internationally, cities and regions need to develop their international competitive advantage by ways of economic specialisation and 'niche-thinking'. In order to support such a strategy, the connectivity of these regions to international markets is imperative.

Yet, most of the individual cities and regions in the BSR do not have the capacity to develop a dense, global air transport networks on their own. On the European continent, only the largest airports in London, Paris, Frankfurt and Amsterdam have the capacity to develop such networks. In the BSR, even Copenhagen, which is the largest passenger and cargo airport of the region do not have the capacity to develop such a varied and dense network of global connections. Consequently, the main issue at stake is rather related to the capacity of BSR airports to develop complementary networks, i.e. networks that show specialisation to different destinations. Consequently, the internal integration of the BSR and its integration in international networks are closely related to each other.

In the framework of this analytical report, an overview of the international (i.e. extra-BSR) air transport connections will provide interesting insights on the existence of strong interactions between BSR and international airports. Figures 15 and 16 provide an overview of the intensity (in total number of weekly flights) of air connections between main BSR airports and, respectively European (EU) and world airports.

From these two maps, it is obviously not possible to draw conclusions on the specificity of the air transport networks of each BSR airport. However, they enable to highlight the most important destinations in Europe and the world that can be reached from BSR airports. As for European connections, there is no surprise: airports situated in north-western Europe are the most popular destinations. London, Paris, Frankfurt, Amsterdam, Brussels, Düsseldorf, Zurich, Milan and Vienna are the main nodes to which many BSR airports are intensively connected to, i.e. with more than 125 weekly flights. The latter highlights the importance of these cities as the centres of the European economic structure. Destinations in southern Europe are as well privileged destinations, especially due to their attractiveness as tourism destination.

Another interesting feature revealed in figure 12 is the strong relation between airports on the Eastern shore of the Baltic Sea (Riga, Tallinn, Kaliningrad, Warsaw, Minsk and Saint Petersburg) with main destinations in non-BSR Russia and Ukraine. Indeed, on average, Kaliningrad and Saint Petersburg have more than 125 weekly connections with Moscow. Clearly, it appears more clearly that the different parts of the Baltic Sea Region have developed, due to historical, cultural or economic reasons, strong relational network with different destinations. The potential for complementarity of the BSR airports in terms of destination reached is even more highlighted in figure 15, in which the air

travel connections between main BSR airports and worldwide destinations has been pictured.

The main global destinations accessible from BSR airports can be separated in three main geographical groupings. First of all, New York is a privileged destination from airports situated in BSR-Germany (Hamburg), Fenno-Scandia (Stockholm, Copenhagen, Helsinki) and Poland (Warsaw). Other destinations in Eastern of North America are as well well-deserved. One may notice that few connections are available to destinations on the Western coast of the United States and Canada. This first grouping highlights the strong ties, especially due to trade and commerce patterns but also tourism, between 'old member states' of the BSR and the United States. The second geographical grouping regroups destinations in eastern and south-eastern Asia. The main destinations are Bangkok in Thailand, and to a lesser extent Beijing in China. This destination is especially accessible from Helsinki and Stockholm. This is of course due to the strong demand of the Nordic population to access this popular tourism destination. Furthermore, a reason why Stockholm and particular Helsinki became important gateways for flights towards Asia (China & Japan) may also be linked to the opening of the Russian airspace after the end of the cold war, making flight routes from Europe directly across Russia is shortest for these connections.

Figure 15: Air travel connections between BSR and European airports (2008)

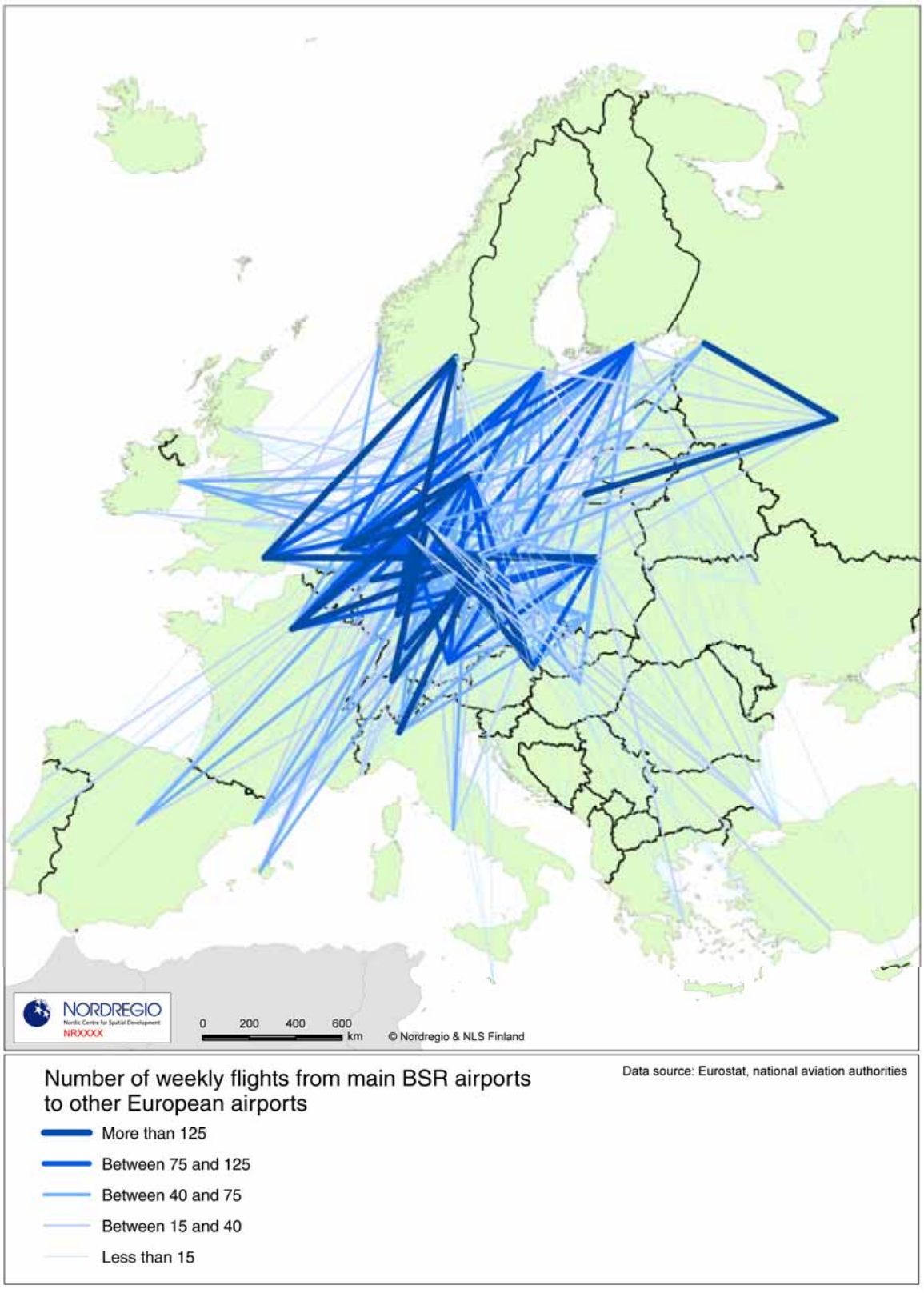
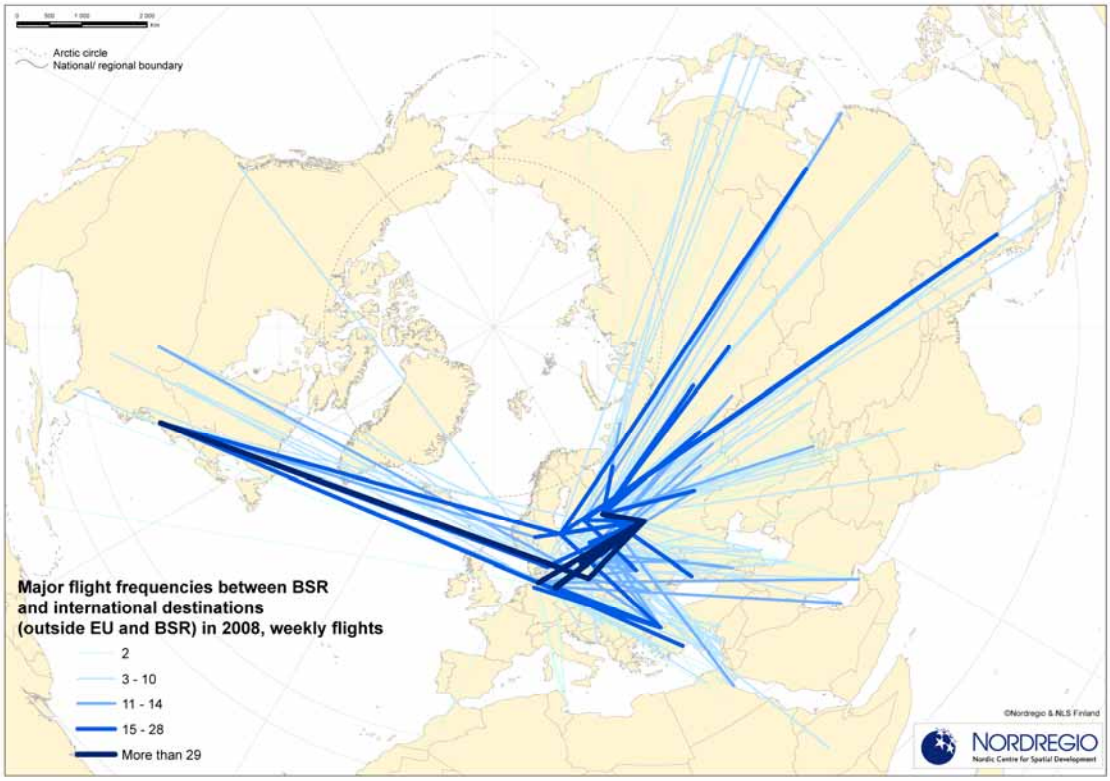


Figure 16: Transcontinental air travel connections from BSR airports (2008)



The third main group of destinations is consisting of regions in the non-BSR parts of the Russian Federation, in Central Asia (Kazakhstan, Armenia, Georgia, Uzbekistan…). For these destinations, Saint Petersburg and Kaliningrad act as the main gateways. A fourth grouping, although less marked, can be said to be constituted of destinations in the Middle East, especially in Egypt, Israel, Qatar and United Arab Emirates. For the two former, Saint Petersburg acts as the main hub, while Hamburg is strongly connected to the two latter.

An interesting remark from the above figure is the destinations that are not accessible from BSR airports. Indeed, the air travel network is rather dense for a handful of connections, but inexistent for many parts of the world. Indeed, there are few or no connection to (relatively) large established markets, such as Canada, Australia and Japan, or emerging markets such as Latin America and India. Moreover, almost no direct connections are available to Africa. Consequently, one can characterise the global networking of air travel from the BSR as specialised. In order to reach other destinations, it is needed to use connecting flights to larger European airports such as London, Paris, Frankfurt or Amsterdam.

The analysis of the two figures inserted above has shown the diversity and complementarity of the destinations that can be reached. However, although the network is rather well established for specific destinations, it is dependent on access to larger airports to access a broader variety of destinations, such as in Western North America, Latin America, Africa and Oceania.

Two main conclusions can be drawn from the analysis of air travel networks in the BSR. First of all, it has become more evident that the improvement of the internal integration between BSR cities and regions has an impact on the integration of these regions in European and global networks as well as the integration of the BSR as a whole in economic and cultural globalisation processes. Second, for individual cities and regions, the issue of integration in the BSR, European and global systems should be perceived as inter-dependent, and the networking strategies to other regional actors situated in the BSR, Europe or other continents should be integrated.

One of the reasons why the report has focused on air travel networks is its importance in order to increase the mobility of persons in line with their needs in terms of access to economic markets or tourism destinations. The low time travels and the reduction of the travel costs have enabled the air transport to make globalisation possible.

Yet, the extension and intensification of economic relations results in an increasing need for shipping goods and freight worldwide. The large volumes of goods that need to be shipped overseas make the use of maritime cargo transportation the most appropriate option, despite the longer travel times. The next section of the report will explore the global pattern of maritime goods transportation from BSR seaports to selected worldwide destinations.

2.3.2. Shipment of goods to global destinations

For Dicken (2007), the recent and increasing deepening of the integration of national and regional markets is primarily organised in extensive and complex transnational production networks. In concrete terms, this means that consumers and producers of goods are less and less close to each other. Consequently, goods need to be shipped over long distances in order to enter their selling market.

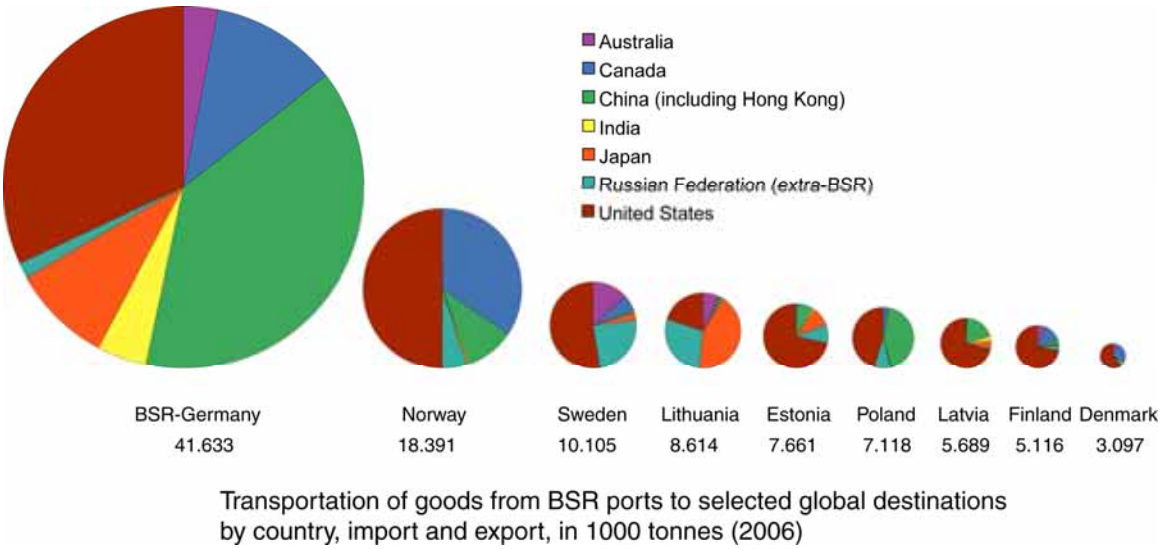
The aim of this particular section of the WG2 analytical report is to highlight the integration of the BSR countries into global patterns of trade. Figure 17 provides an overview of the amount of goods both imported and exported from BSR countries to a selection of countries.

The seaports of Germany located the Baltic Sea Region constitute, when aggregated, the largest platform for the transit of goods and freight from the BSR to our range of global destinations (Australia, Canada, China, India, Japan, non-BSR parts of Russia and the United States), with more than 41 million tonnes. Seaports in Norway and Sweden complete the podium, with respectively 18 and 10 million tonnes. Surprisingly, Finland and Denmark are the countries with the smallest volumes of goods transited. For Finland, this can be explained by the strong volumes of goods shipped to Russia either via the Gulf of Finland or using train. For Denmark, it shows the strong focus of the country towards European and Baltic markets.

Complementarily, the division of this total volume by destination country enables to stress the development of strong bilateral trade relations between

countries. Not surprisingly, the United States are the largest trade partner in terms of shipment of goods for most of the BSR countries. This is the case for all four Nordic countries as well as Estonia and Latvia. For BSR-Germany and Poland, the largest trade partner is China, whereas it is Japan for Lithuania.

Figure 17: Maritime transportation of goods to worldwide destinations



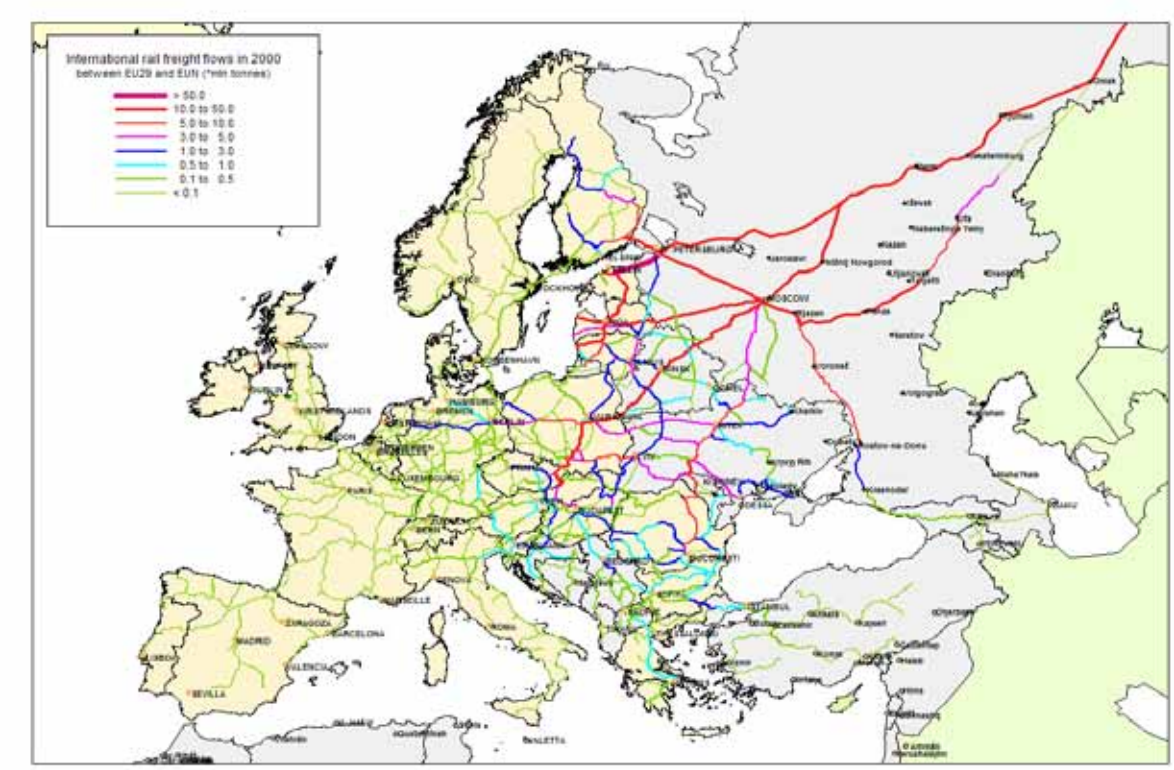
Source: Eurostat. No information on St. Petersburg harbour.

2.3.3. The Baltic Sea Region at the nexus of the EU-Asia corridor

The previous two sections have highlighted the relative position of the Baltic Sea Region in the air and maritime worldwide systems. However, its geographical position makes it play a 'natural' role as an interface between Europe and Asia. The connectivity to Asian markets and natural resources becomes all the more important in times of enhanced globalisation of the world economy, i.e. that trade and business partners are not bound to a reduced neighbouring territory but can be reached globally. In that regard, the railway networks provide a relevant transport system for shipping goods on long distances between the two continents.

Figure 18 illustrates the importance of the Europe-Asia rail freight flows, and the primary role that the Baltic Sea Region plays in this matter. Indeed, the railway corridor from Saint Petersburg to Asia belongs to the most used. In that regard, Saint Petersburg appears clearly to act as a hub between the European and Asian markets. Figure 18 also reveals that the railway corridor the most used for freight transportation is the rail section between Saint Petersburg and Tallinn. Other railway sections between Saint Petersburg and the Baltic States belong also to the densest ones, so is the axis between Saint Petersburg and Helsinki.

Figure 18: International rail freight flows in 2000



Source: European Commission (2005)

Hence, the fact that the Baltic Sea Region lies at the crossroads of the European and Asian long-haul railway system can enhance its position as a potentially strong actor of globalisation. Yet, in order for all BSR countries and regions to benefit from this strategic position, it becomes obvious that the inter-operability of the different national railway systems should be at the core of the BSR's strategy on transport. In that regard, as shown on figure 18, the Russian railway system acts as the natural gateway to Asia. However, in a transnational perspective, one could argue that the critical infrastructures are the ones that connect the Russian railways to the rest of the BSR. This is all the more important as the increase of inter-continental trade due to globalisation will increase the demand for freight traffic. Consequently, the railway sections between Saint Petersburg on the one hand and Helsinki, Tallinn, Riga and Vilnius on the other one become of strategic importance for the BSR's overall inclusion in global trade.

3. Measuring potential accessibility in the BSR

Previous chapters have provided a detailed picture of the state of the different transport systems in the Baltic Sea Region. It has been argued that transport networks (road, rail, air and maritime) are not interchangeable. The usage of one or the other is very much dependent on the purpose of the mobility, whether it is for local or international travels, whether it is for passengers or goods. Consequently, each transport network fulfils a clear role for supporting and enabling regional development potentials and strategies across the macro-region.

Traditionally, accessibility has been defined as the main 'product' of a transport system. A recent pan-European study (Nordregio *et al.*, 2007) has provided a more precise characterisation of the notion of accessibility.

> *There are two main components in a measure of accessibility. The first is the transport infrastructure endowment. This includes all physical, logistical and organisational factors that contribute to connect a region to the outside world. These infrastructure elements are not necessarily located within each region's boundaries. An airport located outside a region's boundaries may for example be a critical component of its transport infrastructure.*
>
> *The second component of accessibility is the destinations made available by this transport infrastructure. The relevance of each destination, and its potential importance for a region's economic development, decreases when the effort required to reach it rises. This effort can be expressed in different ways, depending on the type of accessibility one investigates, e.g. airline distances, road distance, travel-time and transport cost. Inversely, the closer a destination is, the more it becomes attractive and so the more it contributes to the regional level of accessibility.*
>
> *European measures of accessibility generally express the size of the destination region in terms of economic weight (total GDP) or demographic mass (total population). The underlying hypothesis here is that the larger the destination-region, the more valuable it is to have access to. Measures of size can indeed be taken as proxies for the extent and scope of the production inputs that can be imported from each region, and of potential opportunities to export products to it. Measures constructed on this basis will be a main focus of the present report.*
>
> Nordregio et al., 2007, pp 23

Consequently, the measurement of 'potential accessibility' for each region consists in evaluating how the transport infrastructure enables the region to access with relative ease 'regions that matter'. A flaw in this picture is the hypothesis that the relevance of the destination is only a matter of size. It has been argued in the previous chapter that the development of bilateral connections is often a matter of shared history, economic interests or culture. Consequently, proximity is not only a matter of physical distances, but as well institutional or organisational matching.

In spite of that, accessibility measures can be valuable for national and regional actors in order to identify the main spatial patterns of accessibility across a certain territory, whether it is Europe, the nation-state or a region. Moreover, it highlights the potentials for the regions to increase their critical mass by being more connected to their neighbouring regions. In that respect, the transport network creates the link between regional and local communities. This development of a larger critical mass originating from the integration of neighbouring regions by ways of adapted infrastructure can be said to be a central objective for spatial integration in the BSR.

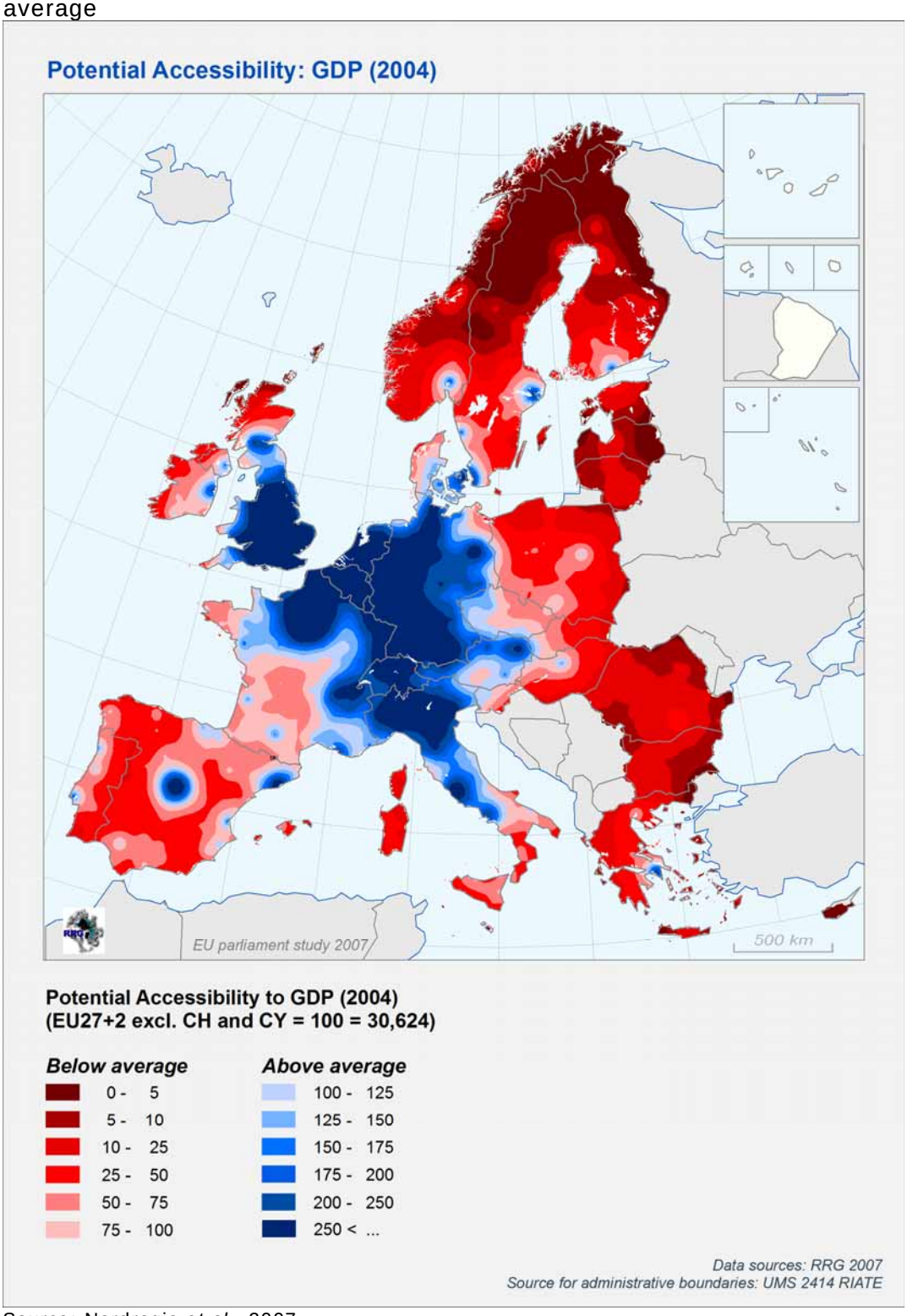
3.1. Measures of potential accessibility in the BSR

Figures 19, 20, 21 and 22 display the results for accessibility by road calculated for 2,5 x 2,5 km grid cells. These 4 figures are complementary with each other as they highlight both the European/BSR structure and the structure related to GDP/population distribution.

Looking at the structure from a European perspective (figure 19 and 21), it becomes obvious that the regions enjoying the best accessibility, both in terms of population and GDP, are the ones in north-western Europe. In general, except with the northern part of Germany and western parts of Poland, BSR territories enjoy a much low accessibility. However, those specific features ought to be highlighted. Indeed, the difference in territorial structure between the population and GDP map is striking in the case of Poland and the Baltic States. Indeed, their potential is much lower when it comes to GDP than population. This of course due to the relative lower standard of economic development in those countries: when compared to old Member States, the size of their regional economies is smaller than the size of their population. However, the rather high accessibility potentials in western Poland show the potential for these territories to be the host of a significant market when the economic catching up process will have given comparable economic standards (in GDP).

The status of the Nordic capitals is worth noting as well. Here, the conclusion is reversed. Indeed, these metropolitan regions display much higher standards in terms of accessibility to GDP rather than accessibility to population. This highlights the high degree of economic development of these regions. This implies as well that the economic zone of influence of these regions goes well beyond their administrative boundaries.

Figure 19: Potential road accessibility to GDP (2004), standardized to EU average



Source: Nordregio *et al.*, 2007

Figure 20: Potential road accessibility to GDP (2004), standardized to BSR average

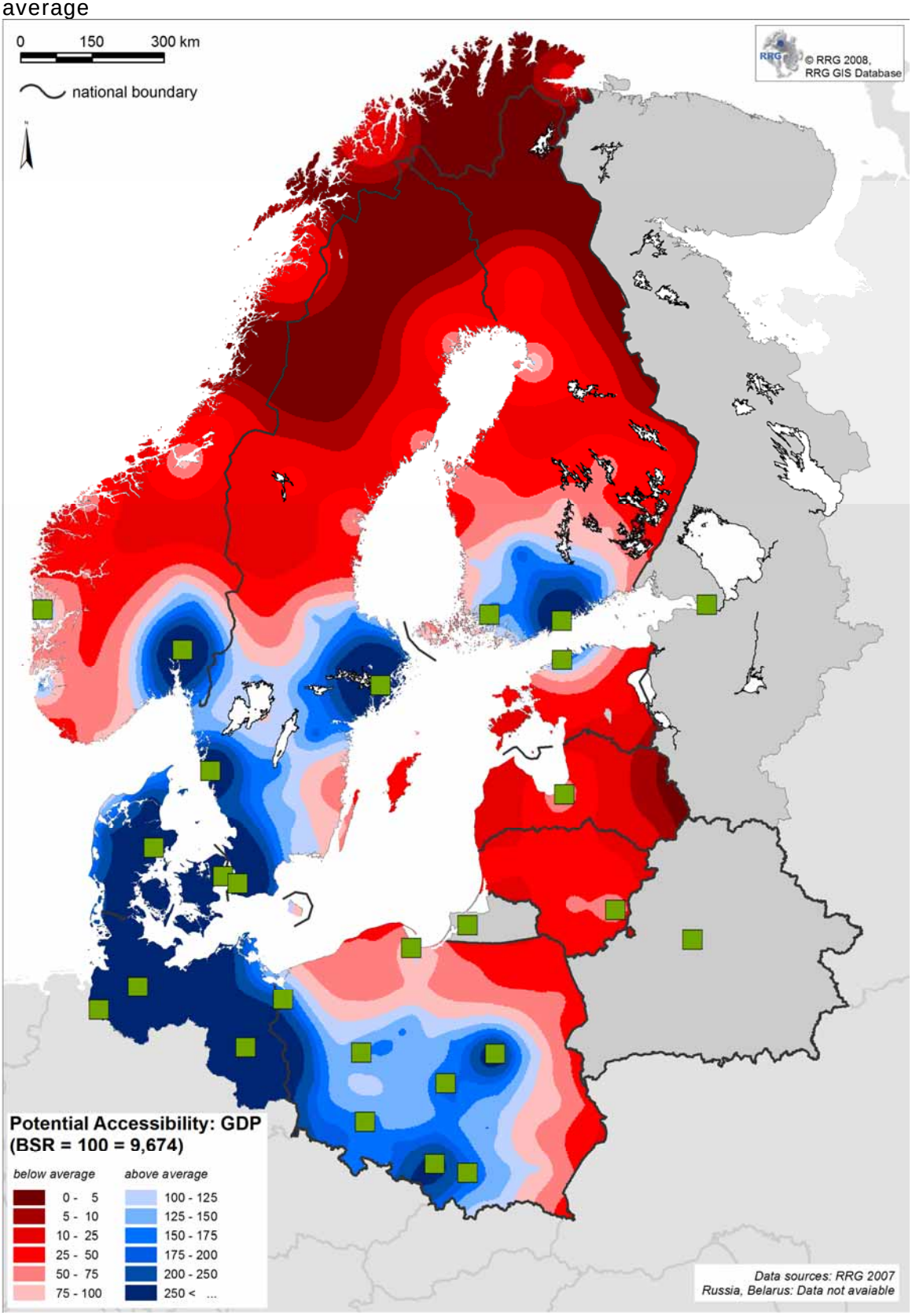
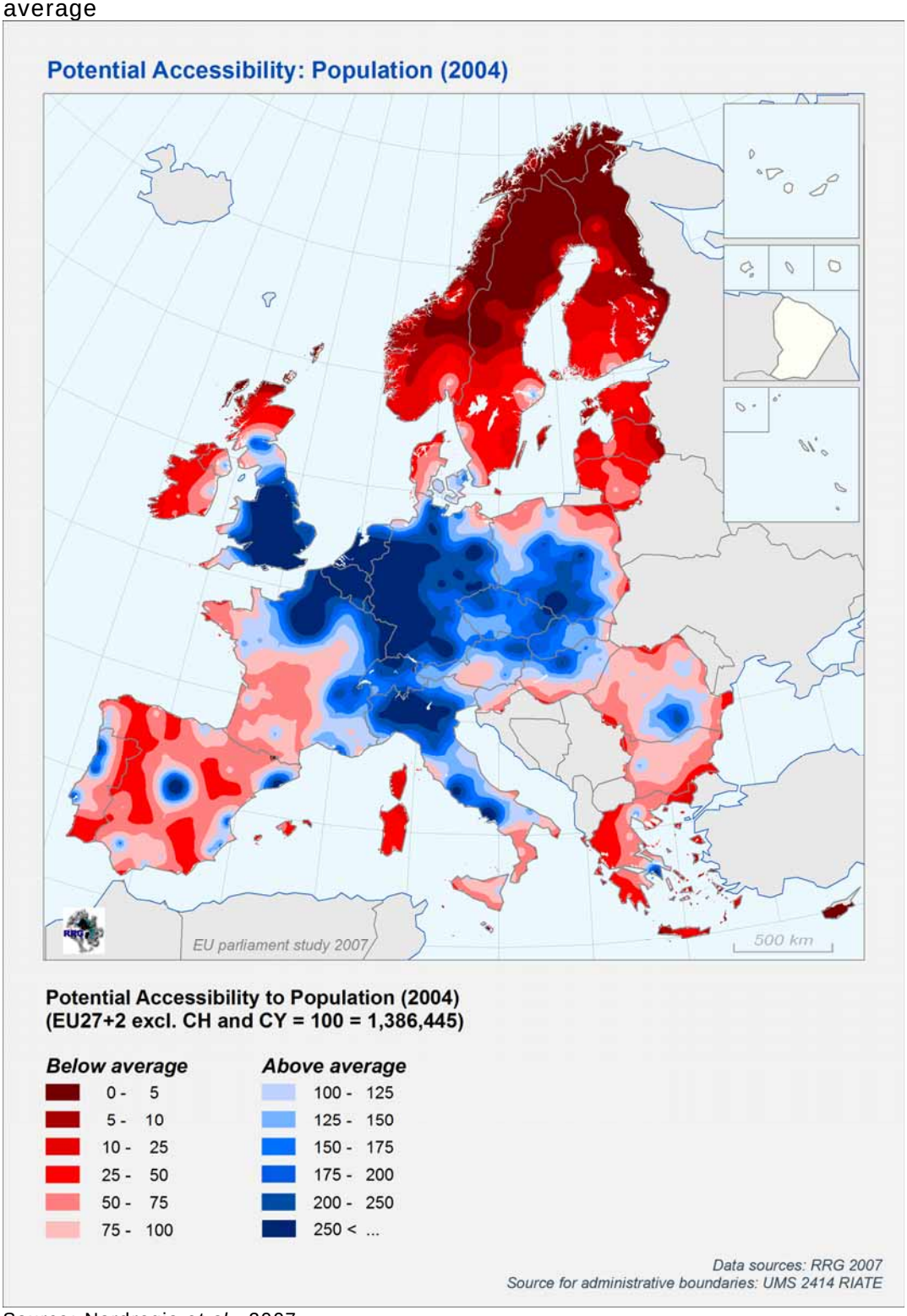
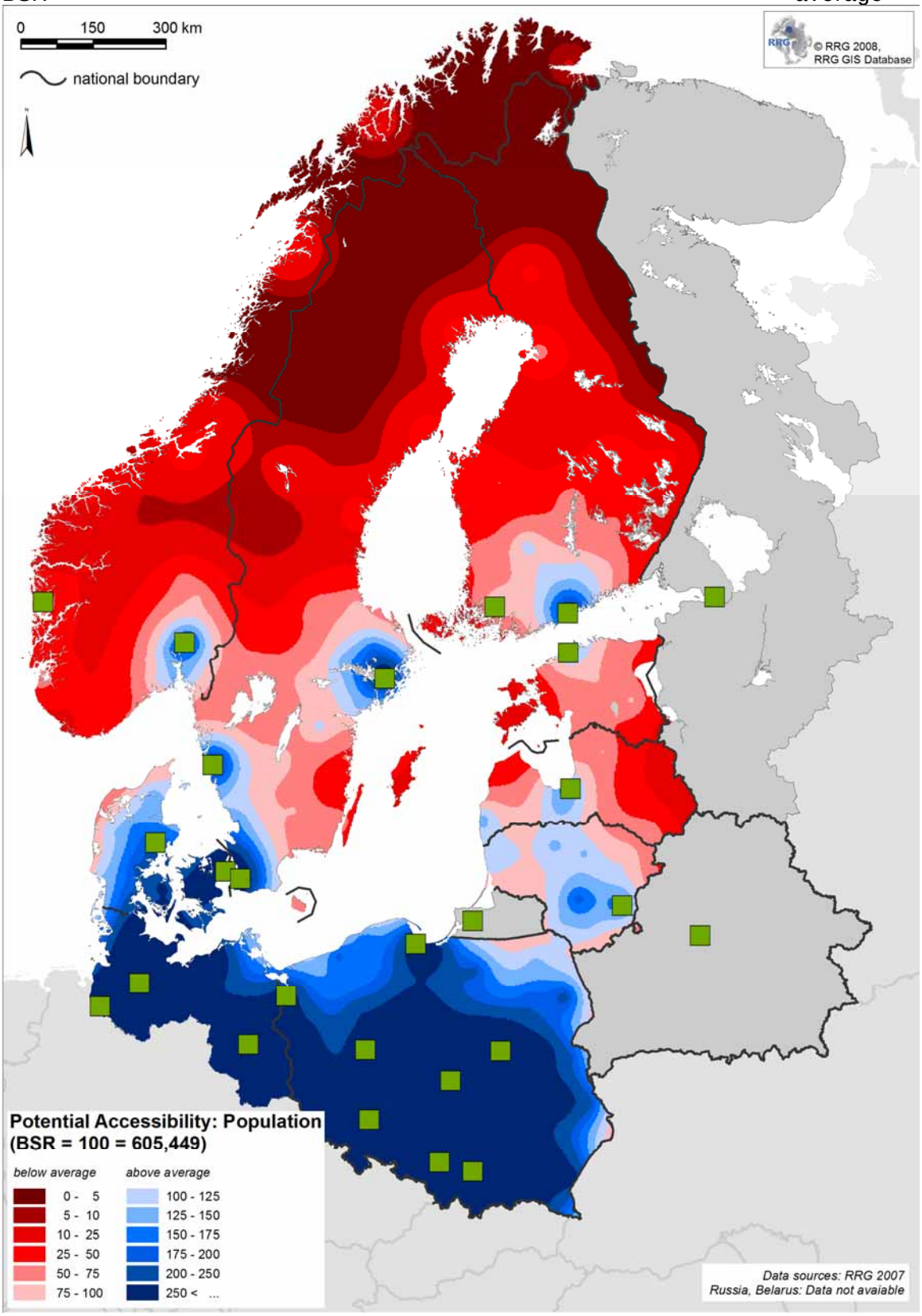


Figure 21: Potential road accessibility to pop. (2004), standardized to EU average



Source: Nordregio *et al.*, 2007

Figure 22: Potential road accessibility to population (2004), standardized to BSR average



As for the BSR territorial context, the maps (figures 20 and 22) highlight the potential for some cities to act as the 'hubs' for the region. This is obviously the case for the identified MEGA (see WG1 results). However, in less densely populated regions, it shows the importance of medium-sized towns in structuring the territory. These towns have the potential to act as regional 'hubs'. This is especially the case in the northern parts of the Nordic countries (Trondheim, Tromsø, Narvik, Sundsvall, Umeå, Luleå, Oulu, Rovaniemi…), but also in the Baltic States (Tartu, Liepaja, Klaipeda, Siauliai…).

In fact, these measures of accessibility can be used for identifying the potential for some inter-regional or cross-border territories to further integrate. In concrete terms, it means that some territories have the potential to create larger cross-border regions, thus creating a greater 'critical mass' of wealth and population enabling a more diversified regional economy and labour-market. This is for instance the case between Liepaja (Latvia) and Klaipeda (Lithuania), but also for the territories between Riga and Vilnius. These cross-border regions would have a greater potential for acting as a strong economic player within the BSR. Consequently, proactive strategies fostering co-operation between actors could strengthen the possibility to build larger cross-border labour-market areas, which could, partly, substitute to the lack of critical mass of each individual regions. Such strategies are already well developed in the Nordic countries, where the integration of medium-sized labour-markets enables is a clear policy objective (e.g. *regionförstoring* in Sweden).

Yet, it is important to bear in mind that potential accessibility should not be interpreted as a measure of the economic development potential of the regions. Indeed, if they provide an insightful picture of the general organisation of a given territory, e.g. Europe or the BSR, it is difficult for regional actors to use them as an evidence base for elaborating adapted regional development strategies. At most, these types of calculations enable to highlight the regions that have the potential, i.e. the critical mass needed, to act as a 'hub' in the territorial structure in question, i.e. to act as a crossroads for businesses and entrepreneurs (Nordregio et al., 2007). This is what has been pointed out in the previous paragraphs. However, low access to population or to GDP does not imply a lack of potential for developing long-term development strategies. Consequently, the use of such indicators should be made jointly with a more thorough investigation of the industrial and economic profiles of the regions, in order to identify the specific accessibility needs of each territory by answering those questions: what are the main clients for the dominant economic sector? Are there sufficient transport and logistics infrastructure that enables a reliable connections to those target-regions?

Indeed, territories characterised as peripheral have regional economic structure that are often much specialised. For example, territories in the northern parts of the Nordic countries have developed 'niches' of global significance (iron, paper pulp…) based on their regional comparative advantage, in that case the relatively good access to natural resources. This high degree of specialisation implies that these industries have clients and customers worldwide. Consequently, these regions have developed specific needs in terms of transport infrastructure as the latter needs to operationalise

the necessity for them to have reliable connections with their customers, whether situated in close proximity or at the other end of the world.

The above section has highlighted the potential role that accessibility measures may have in framing the debates on regional development potentials in the Baltic Sea Region. However, these measures can hardly be used as concrete facts for grounding regional development strategies by regional stakeholders. Yet, recent studies (Nordregio et al., 2007) have shown that accessibility measures may have a more political relevance.

3.2. Access to services as a key for regional development strategies

The previous sections have highlighted the importance of the location of transport facilities (airports, seaports, freight terminals…) to maintain and increase the competitive advantage of the regions. More generally, other types of facilities are believed to be central for regional development issues. Indeed, such facilities, such as universities and polytechnics, are structuring elements in order for the regions to operationalise their regional development strategies.

Traditionally, the issue of quality of access to such services is tackled in terms of endowment by administrative regions. Recent studies (Nordregio *et al.*, 2007) have argued that this way of problematising is of little relevance. Firstly, this way of thinking omits the importance of the location of the services. What is thus of interest is to identify where the services are provided, i.e. where the service facilities are located, and what is the proportion of the population that is covered by the service provision areas around those facilities. Secondly, the use of administrative units is misleading. Neighbouring regions are gaining as well by the proximity to service facilities (airports, terminals, universities, but also hospitals), even if the facility is not physically situated in the region itself!

As a matter of consequence, a pertinent measure of access to services can be operationalised by calculating the travel-time that it takes to individuals and businesses located in all corners of the BSR to access such service facilities. The bottom-line is that above a certain time threshold, the effort that it takes to access the facilities is too high for their use to be cost efficient for the actors, and the society itself. As a matter of consequence, these measures of local accessibility are dependent on three main territorial characteristics: the distribution of the population over the territory, the territorial extent and coverage of the road (or rail) transport networks and the location of the service facilities on the territory. A high local accessibility to services would thus be the result of a high degree of correlation between the three above mentioned dimensions.

Figures 23, 24 and 25 display the resulting travel-time pattern for cargo terminals (maritime and air), facilities of higher education (universities and polytechnics) and commercial airports.

The map for cargo/freight terminals shows that access to these terminals is rather good in most parts of the BSR. Not surprisingly, the high number of seaports on the Baltic and North Sea shores of the BSR provides these areas with a very high access to cargo terminals. The map shows as well the high

importance of inland ports in improving the accessibility to such facilities for the territories further inland. This is obvious in western parts of Poland and in the lake districts of both Sweden and Finland. However, some other parts of the BSR have a much lower access to cargo terminals. This is the case for the northern, inland parts of the Nordic countries. For these territories, whose economies are strongly dependent on the export of natural resources, this low access to cargo terminals poses a structural bottleneck for developing their economic profile. For these specific territories, the development of transversal, east-west road, but especially rail, infrastructure would enhance their access to cargo facilities. In the North West Russia, the inland parts of the territory along the Finnish border have also long travel times to cargo terminals. The eastern parts of Poland (except around Warsaw) and Belarus experience as well long travel times to any type of cargo/freight terminals.

The map picturing the travel time to educational facilities shows a different pattern. Many countries have implemented a decentralised strategy when it comes to the localisation of universities. This is obvious in the case of Poland where the spatial distribution of universities is very well balanced. Moreover, the localisation of the universities appears to be closely correlated to the distribution of population of the territory. Indeed, the parts that are deemed to be rather far away from this type of facilities are also sparsely populated areas. The fact that good access to universities is made possible outside the largest metropolitan areas is a strong competitive advantage for BSR territories and for the BSR as a whole as well. In concrete terms, it implies that individuals who wish to pursue an academic formation have the possibility to stay in their region of origin. Moreover, universities are believed to be indispensable focal points for countries and regions to be able to profile their regional economy into the Knowledge Economy and to meet the targets of the EU Lisbon strategy.

In Belarus, the rather centralised system of universities has for consequence a strong disparity in terms of access to secondary education between Minsk and the rest of the country. In NW Russia, the location of universities in Kaliningrad and Saint Petersburg, but as well in Murmansk, Novgorod, Pskov and Petrozavodsk, enables to provide a fairly good coverage of the population in BSR-Russia. Other areas with low access to universities are the islands of the BSR, with the exception of Gotland.

Figure 23: Travel-time to freight terminals in the BSR

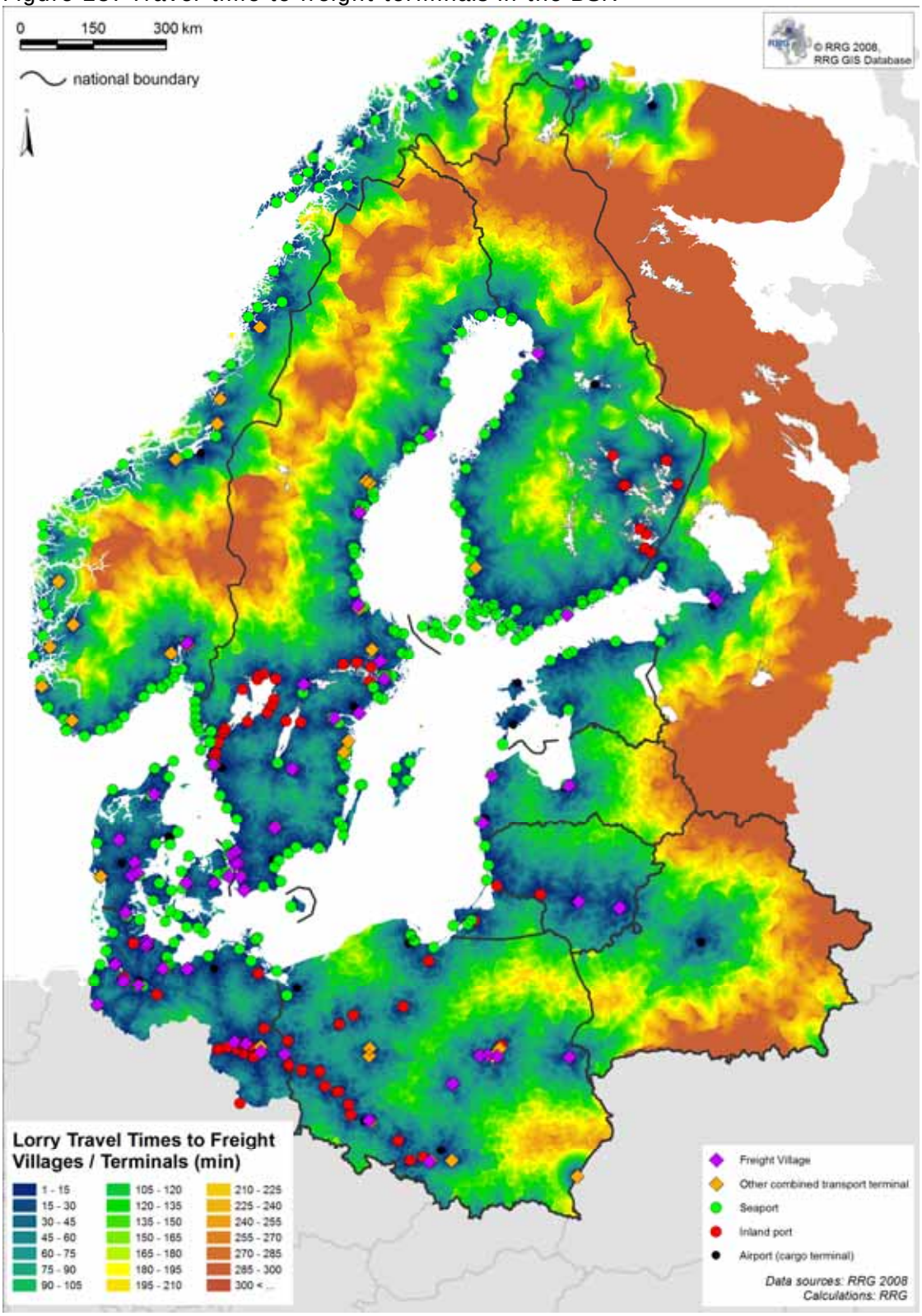


Figure 24: Travel-time to higher education facilities in the BSR

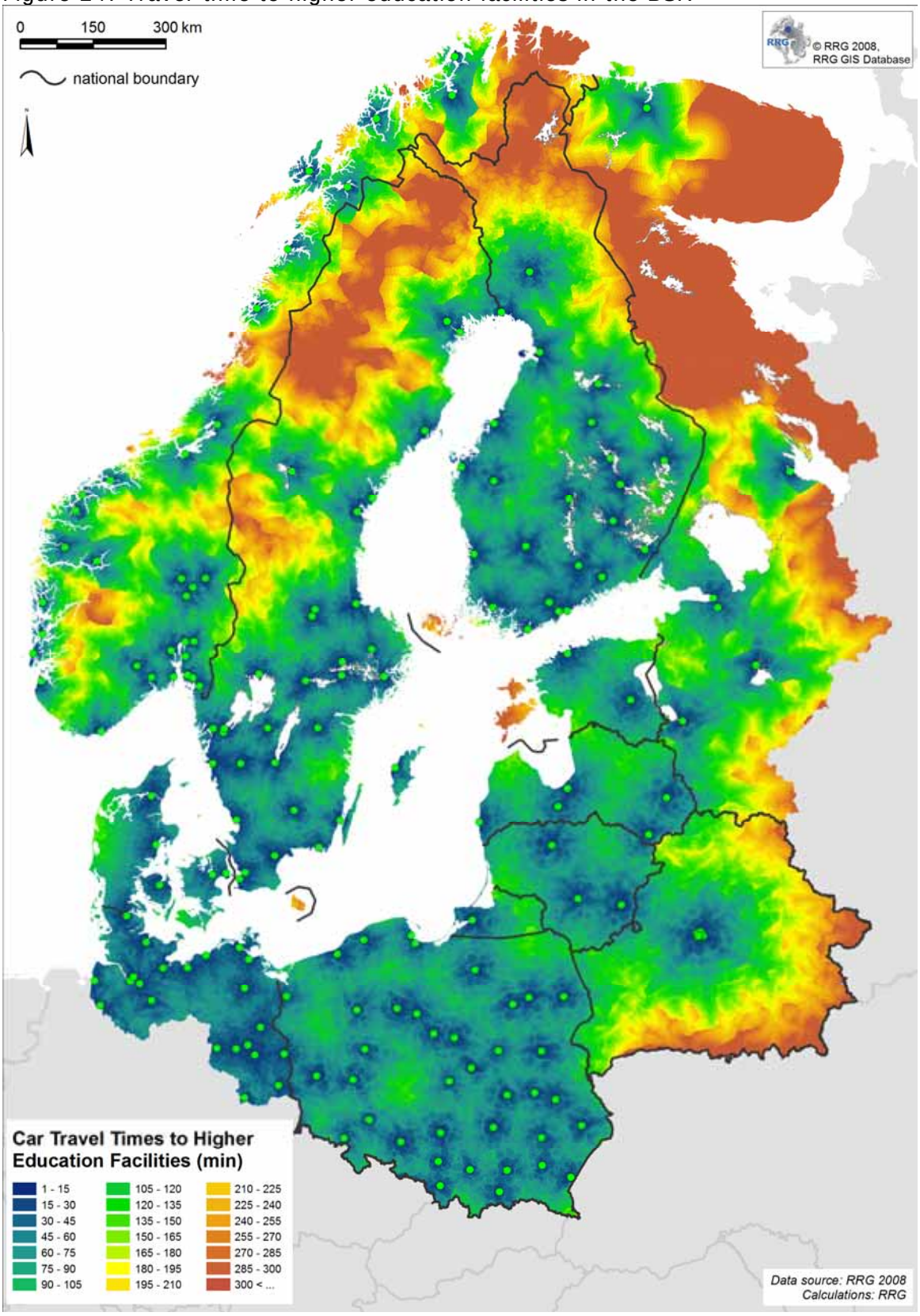
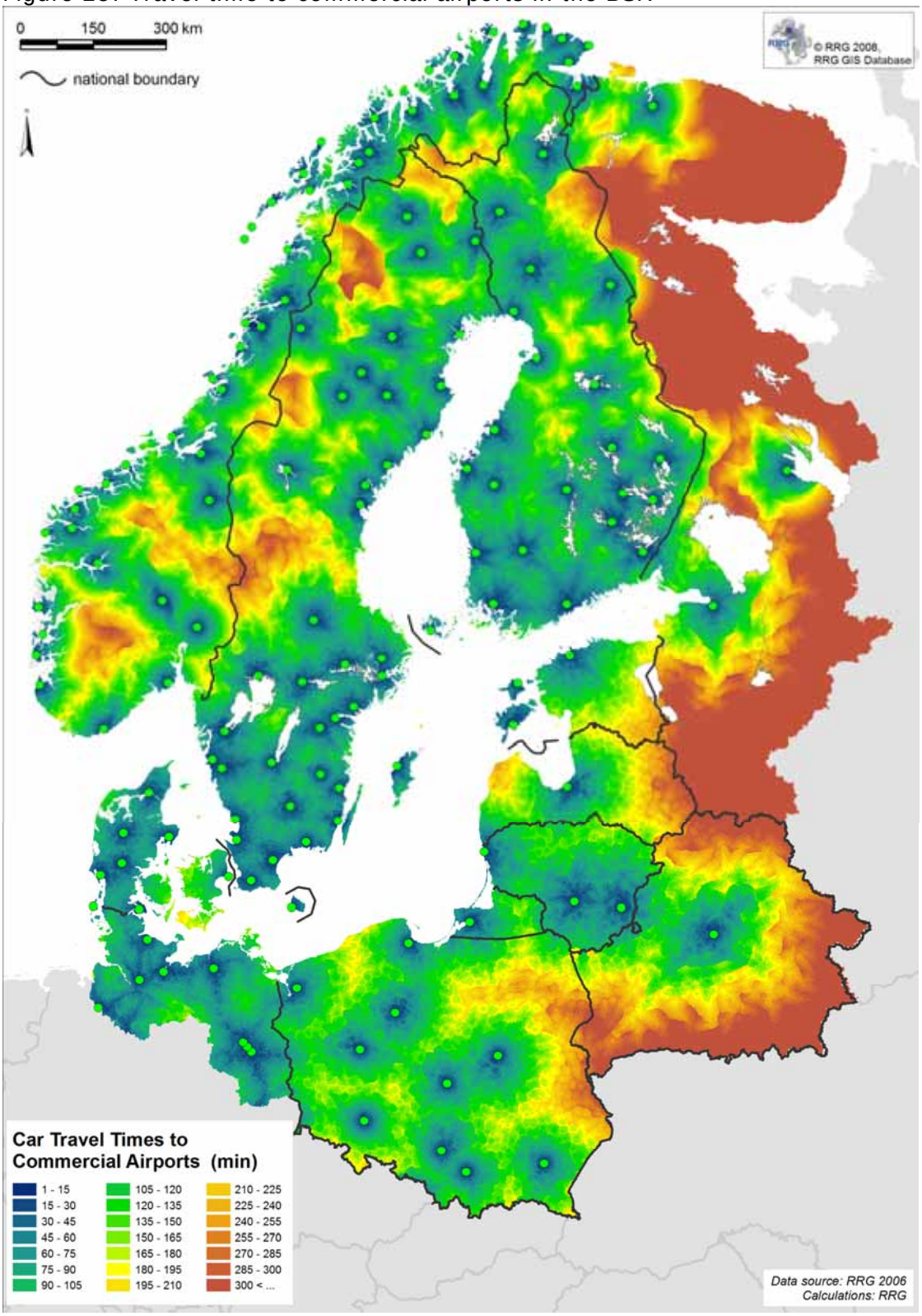


Figure 25: Travel time to commercial airports in the BSR



4. Energy challenges in the BSR

Firstly, there is a need to develop the production and consumption of renewable energies. The region is still heavily dependent on oil. Second, the lack of integration of the Baltic electricity networks to other countries is an obstacle to the development of an integrated energy market in the Region.

Energy issues have become central to spatial development policies. Access to energy is necessary for economic and social development across the Baltic Sea Region.

For the Baltic Sea Region, the issue of energy is not only linked to the development of integrated infrastructure. Of course, the inter-operability of the existing and future energy facilities and networks are important in order to create a shared energy market. The good integration of transmission grids or pipelines is a prerequisite for building such a shared market. However, it is not sufficient in itself: energy issues are strongly impregnated of national interests and thus the development of a shared energy strategy implies as well new regulatory frameworks and the development of an interest shared by all countries of the BSR. In that regard, the role of the EU is not negligible, as it may provide a framework upon which BSR policies can develop a shared understanding of their needs and potentials. The role of the EU is not the least important with regards to energy relations to Russia.

Yet, access to energy in the BSR is also a question of affordability. Reasonably priced energy is the cornerstone for the harmonious development of both individuals and businesses, i.e. that energy should not be a restrictive factor for regional development. How to provide affordable energy should thus be the central concern of policymakers around the BSR.

As all liberalised markets, energy markets are strongly driven by rules of supply and demand. Consequently, the patterns of consumption and production have a significant impact on the access to energy sources. In that regard, spatial development policies can play a central role. The elaboration and implementation of energy-efficient spatial development policies in the BSR should focus on reducing the consumption of energy, without hampering the potential for economic development of its regions. If more advanced countries, such as Sweden, have shown that it is possible to decouple energy consumption increase and economic growth, currently lagging national economies in Poland, The Baltic States, Russia and Belarus are still strongly demanding in energy in order to catch up the more advanced countries.

However, the potential role of spatial development policies goes beyond the development of more energy efficient consumption practices. They may also play a significant role in order to catalyse the production of regionally-based, renewable energy sources. A first step in that matter is to raise the awareness on the potential for each region to contribute to the effort that each country has to make to produce more in renewable energy sources. This regional potential is closely connected to the territorial capital of the region. Spatial development policies should thus focus on how to exploit in the best way this territorial capital.

4.1. Towards an integrated energy network

As stated earlier in this chapter, the integration of the energy networks in the BSR is the necessary first step in order to create an integrated energy network in the BSR. In that regard, the electricity network is of particular importance as it is the form of energy that is used directly by individuals and businesses.

To date, the electricity transmission grids in the countries of the BSR have been essentially designed for supplying the domestic market. Consequently, the technical solutions used in a country are sometimes not used in the neighbouring ones. These differences in technological standards pose one of the main challenges to the interoperability of the electricity networks, i.e. the capacity of the networks to be integrated. Consequently, the integration of the transmission grids across the BSR countries is not only a matter of installing new cables from one country to another but also necessitates adaptation in the exploitation of electricity as well, and thus necessitate a adaptation of national energy policies as well. Figure 26 displays the state of the electricity transmission grid in 2007.

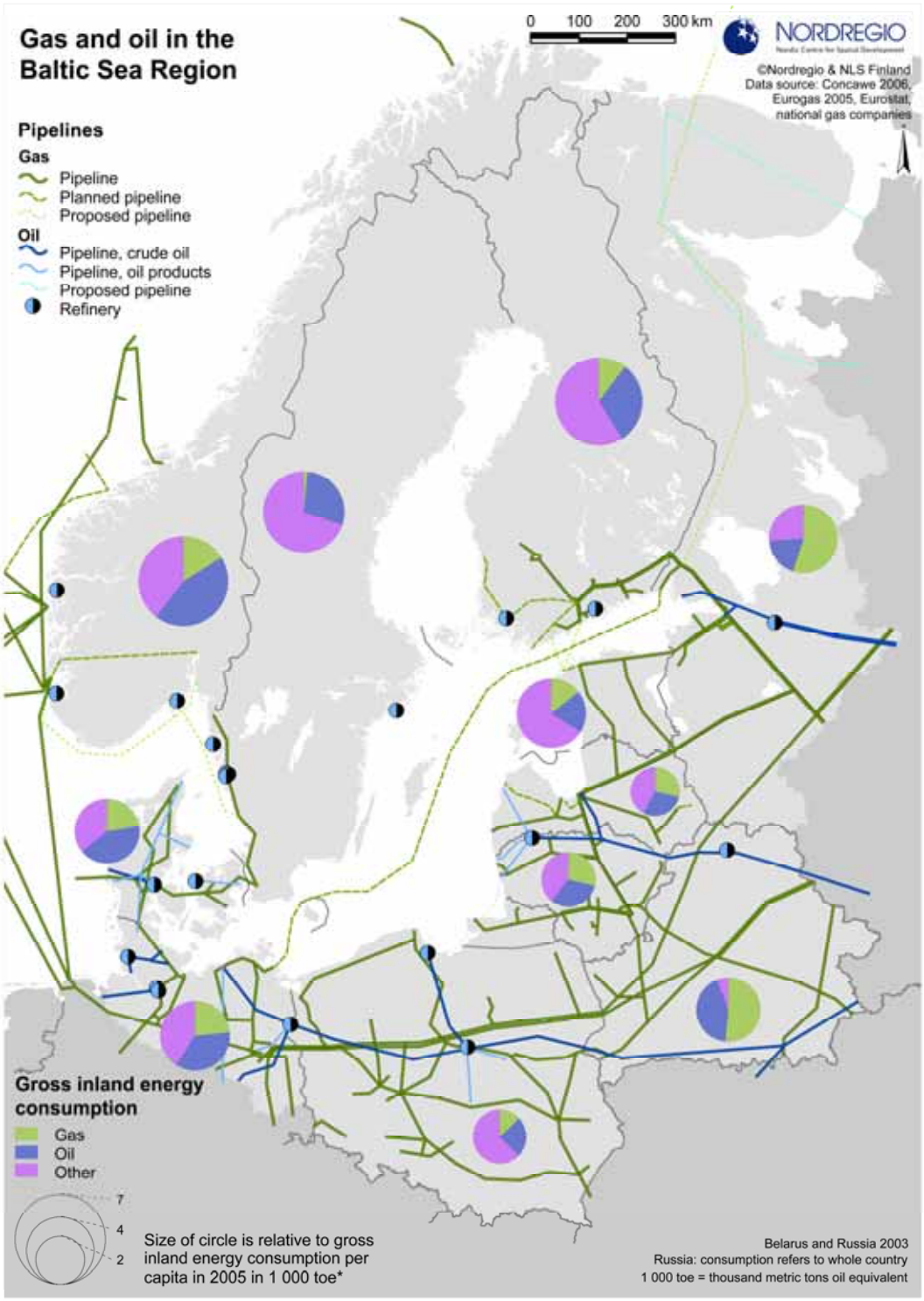
In the Nordic countries, the creation of a joint energy body, Nordel, ensures the compatibility of the electricity transmission systems between the countries, by defining joint technical standards but also by developing joint regulatory frameworks. In concrete terms, the integration of the Nordic electricity networks enables provide the technical framework to connect the electricity facilities (Hydropower stations, thermal power plants, nuclear power plants…) to the consumers wherever both are located. Consequently, it enables to create a shared energy market enabling to ensure the access to energy based on the complementarity of the countries.

On the eastern shore of the BSR, the electricity networks are still very much impregnated of the former belonging of those countries to the Soviet block. The transmission grids of the Baltic States, Belarus and Russia are rather integrated as they share similar technical standards due to the fact that all these countries belonged to the Soviet Union. Poland has developed another technical standard for its transmission grid which is barely connected to both Germany and Belarus or Lithuania.

Consequently, one of the main challenges for the Baltic Sea Region is to create the conditions to develop joint technical solutions enabling a better interoperability and thus providing the conditions for a shared energy market across the region.

Figure 26: Energy transmission grid in the BSR

Figure 27: Oil and gas infrastructure in the BSR



4.2. Main characteristics of energy production in the BSR

For national policymakers, securing the access of the population and businesses to the energy necessary to perform their daily activities necessitates the elaboration and implementation of energy strategies. These strategies are particularly addressing the issues of production, i.e. how to find new sources of energy, and consumption, i.e. how to adapt the consumption of energy to the national production capacity and its economic development, of energy.

In that regard, the territorial capital of the country or region plays an important role for defining these strategies. Indeed, for some types of energy, the production of energy or electricity is strongly linked the natural resources available in each territory. For instance, hydropower and renewable energies are typically energy sources that need to be exploited and transformed into electricity *on-site*, whereas coal and uranium can be transported ion order to feed conventional thermal or nuclear power plants.

The analysis in this section will be divided in two parts. First, a general introduction on the specificities of energy production in the different BSR countries will be developed. Then, the analysis will focus on the identification of potentials for energy production at the regional level, based on their specific territorial preconditions. In the latter, the emphasis will be put on renewable energies, as their production is currently mainstreamed at EU level.

Table 9 presents the main components of the production of energy in the BSR countries in 2005

Table 9: Production of energy in the BSR by type, 2005

	Indigenous production of energy							Energy trade, in ktoe			Total Primary Energy
		% generated from source						Export	Import	Net exports	Supply (TPES), in *ktoe*
	Total production in *ktoe*	Coal	Oil & Gas*	Nuclear	Hydropower	Renewable energies	Electricity and heat				
Belarus	3 802	14,4	52,2	0,0	0,1	33,3	0,0	15 004	37 711	-22 707	26 590
Denmark	31 301	0,0	90,7	0,0	0,0	9,3	0,0	24 383	13 859	10 524	19 610
Estonia	3 722	80,8	0,0	0,0	0,1	19,2	0,0	511	2 000	-1 489	5 096
Finland	16 560	12,9	0,5	36,6	7,2	42,4	0,4	5 376	24 884	-19 508	34 961
Germany**	134 505	42,0	14,0	31,6	1,3	11,2	0,0	41 208	255 677	-214 469	344 746
Latvia	2 294	0,1	0,0	0,0	12,5	87,4	0,0	1 151	3 944	-2 793	4 716
Lithuania	3 927	0,4	5,8	69,8	1,0	18,8	4,3	7 843	12 715	-4 872	8 587
Norway	233 704	0,4	94,0	0,0	5,0	0,6	0,0	206 152	5 710	200 442	32 125
Poland	78 633	87,6	6,1	0,0	0,2	6,1	0,0	19 650	36 327	-16 677	92 969
Russia**	1 184 857	11,7	83,1	3,3	1,3	0,6	0,0	553 314	21 948	531 366	646 680
Sweden	34 781	0,9	0,0	54,2	18,0	26,1	0,8	12 595	32 702	-20 107	52 174

** Includes crude oil, petroleum products and natural gas*

*** Entire country for Germany and Russia*

Source: International Energy Agency (2008)

First of all, the table gives an overview of the energy mix in the total production for each country. The production is divided by type of energy: coal, oil & gas, nuclear, hydropower, renewable energies and miscellaneous production of electricity and heat. The information presented in the table is very important as it enables to give an idea of the national policies regarding energy production, i.e. what are the current energy sources favoured by the national authorities. In that respect, the table enables to identify four main groups of countries, i.e. countries that share similar profiles in terms of energy production.

Norway, Russia and Denmark have a production of energy strongly based on the extraction of oil and gas; in Estonia and Poland, coal extraction represents the largest share of energy production (more than 80%); in Lithuania and Sweden, it is the production of nuclear energy that composes more than half of the total national energy production, respectively 69,8% and 54,2%; in Latvia, the production of energy by Combustible, Renewable and Waste represent 87,4% of the total energy production, which is unique in the region. Finally, three countries show a rather balanced mix of energy in their national production: Germany producing mainly coal (42,0%) and nuclear energy (31,6%); Finland mainly renewable energies (42,4%) and nuclear (36,6%); and Belarus essentially oil & gas (52,2%) and renewable energies (33,3%).

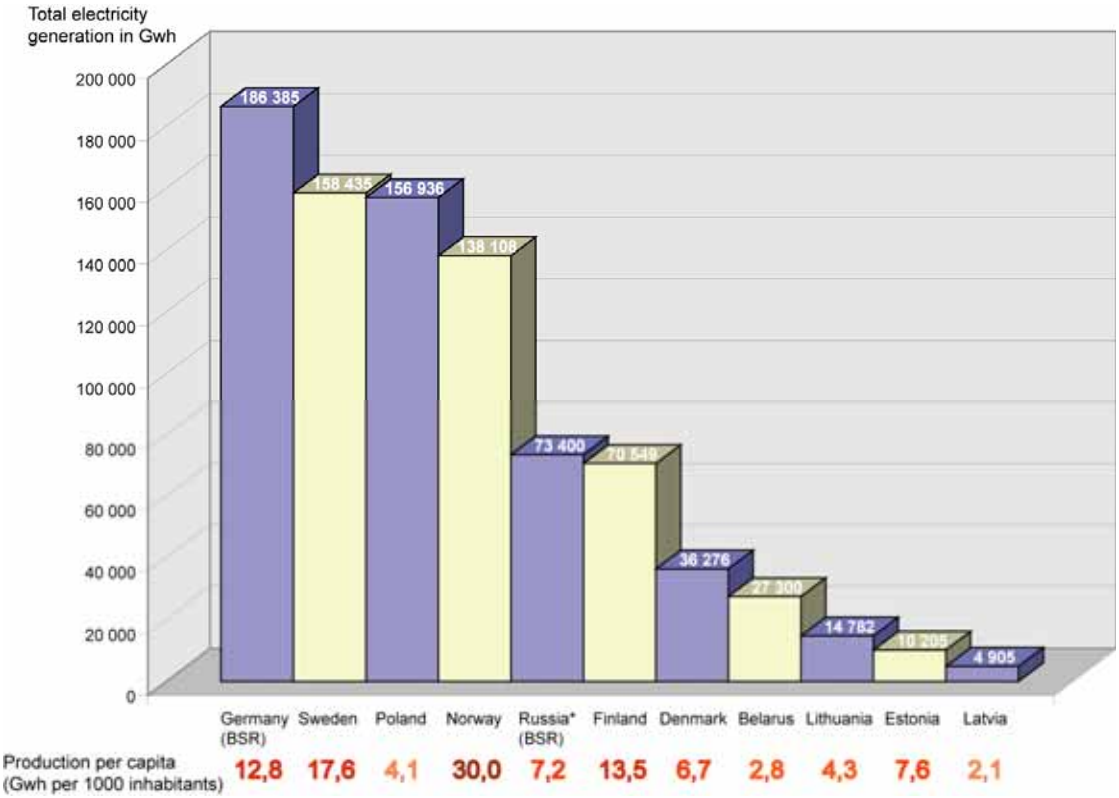
The latter table has shown that the combination of energy production varies greatly across the BSR. This 'energy mix' is highly dependent on the natural resources available in each country (oil or gas fields, coal mines, numerous and larger rivers…). However, the case of nuclear energy is rather different as it is the result of past, long-term national policies rather than based on a specific 'territorial energy capital'. This 'territorial energy capital' is also very important for the development of the production of renewable energies as the energy source itself (wind, sunlight, geothermal…) is beyond human control. However, the capacity to capture this energy by developing adapted energy production facilities (windmills, solar panels…) is at the heart of future national and BSR energy policies.

Yet, in many countries, the national production of energy is a small part of the energy that is actually consumed in each country. Indeed, with the exception of Russia, Norway, and to a lesser extent Denmark, all BSR countries are net importers of energy. Consequently, those countries are dependent on energy imports in order to meet their consumption of energy. Energy dependency is one of the most important topics for energy policies at the EU and national levels.

As highlighted in the previous sub-chapter, the lack of integration of the electricity systems between the BSR countries (at the exception maybe between the Nordic countries) prevents the import and export of large amounts of electricity. In that regard, the domestic production of electricity becomes of outmost importance in order to ensure the supply of electricity for daily activities of both businesses and individuals. Indeed, if in all BSR countries, oil and its related products are essentially used in the transport sector, electricity is a strategic source of energy due to its cross-sectoral importance: it is used in the industry sector, but also in the residential and commercial and public service related ones.

As a matter of consequence, an overview of the production of electricity in the BSR provides an insight on the capacity of the different countries or regions to sustain their activities. Figure 28 provides such an overview.

Figure 28: Generation of electricity in BSR countries, 2005 (in Gwh)

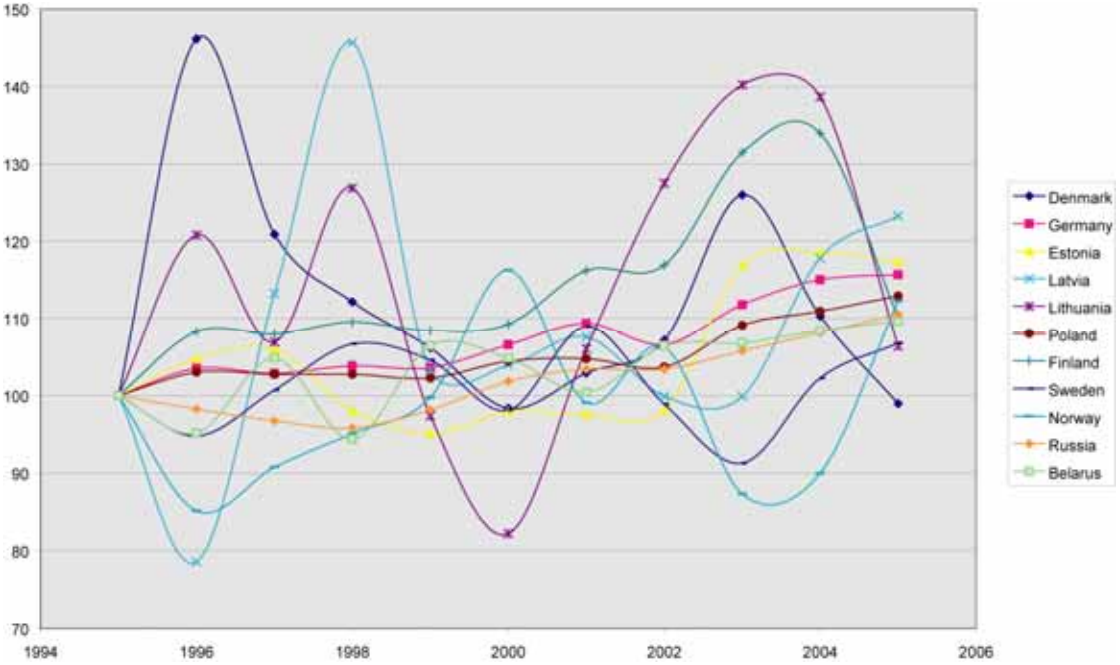


Source: International Energy Agency (2008)

The part of Germany belonging to the BSR is the largest producer of electricity in the region, followed by Sweden and Poland. Norway, with its large hydropower capacity is the fourth largest producer of electricity, but shows the highest rate of production per capita of the whole region, with an equivalent of 30,0 Gwh per 1000 inhabitants. The production per capita is a key indicator as it highlights the capacity of a region or country to supply enough electricity to sustain daily activities occurring domestically. For this particular indicator, Norway is followed by Sweden (17,6 Gwh per 1000 inh.) and Finland (13,5 Gwh per 1000 inh.). An interesting remark can be made on the rather low rate for Latvia (2,1), Belarus (2,8) and Lithuania (4,3), highlighting possible shortage of electricity if the demand, by businesses or individuals, increases sharply.

Complementarily to this rather static picture of the production electricity, figure 29 provides an overview of the medium-term dynamics of electricity production. Since 1994, the country that has witnessed the largest increase in electricity production is Latvia: in 2005, the production was approximately 25% higher than in 1995, which is rather low considering the soar of the Latvian (and other Baltic) economies in the last decade. An interesting feature of figure 29 is the large fluctuations of electricity production over the years. Indeed, from year to another, the production can increase, or decrease for the matter) by nearly 50%. This was the case for Sweden between 1995 and 1996.

Figure 29: Evolution of electricity generation in BSR, 1995-2005 (100= year 1995)



Source: International Energy Agency, National Statistical Offices (2008)

The material presented earlier in this sub-chapter provides interesting insights on the main characteristics of energy and electricity production at the national level. The maps on electricity production capacity and electricity production presented in figures 30 and 31 highlight interesting territorial variations.

Electricity production capacity represents the maximum quantity of electricity that can be produced by all the production facilities in a given region, if they would function at full capacity. Of course, it is a very theoretical measure as the production of electricity by some sources (hydropower, solar, wind…) is dependent on natural phenomena that cannot be controlled. In figure 30, the size of the balls represents this maximum capacity for electricity production.

In addition to this, the production capacity usage, i.e. the ratio between the actual electricity production and maximum capacity, provides an idea of the regions that are under-using their capacity or the ones that are close to full capacity. This indicator is represented in figure 30 by the gradient of orange colour from light (low usage pertinent differences in production capacity usage not only across the BSR, with a ratio of capacity usage ranging from 4% in Åland (Finland) to 78% in Hamburg (Germany), but also within countries. For instance, the production capacity ratio ranges from 4 to 78% in Finland. This indicator raises interesting questions for developing BSR strategies: What are the regions that are under-utilising their production capacity? What are the regions that are in need of further development of more and more efficient production facilities?

Figure 30: Electricity production capacity in 2005

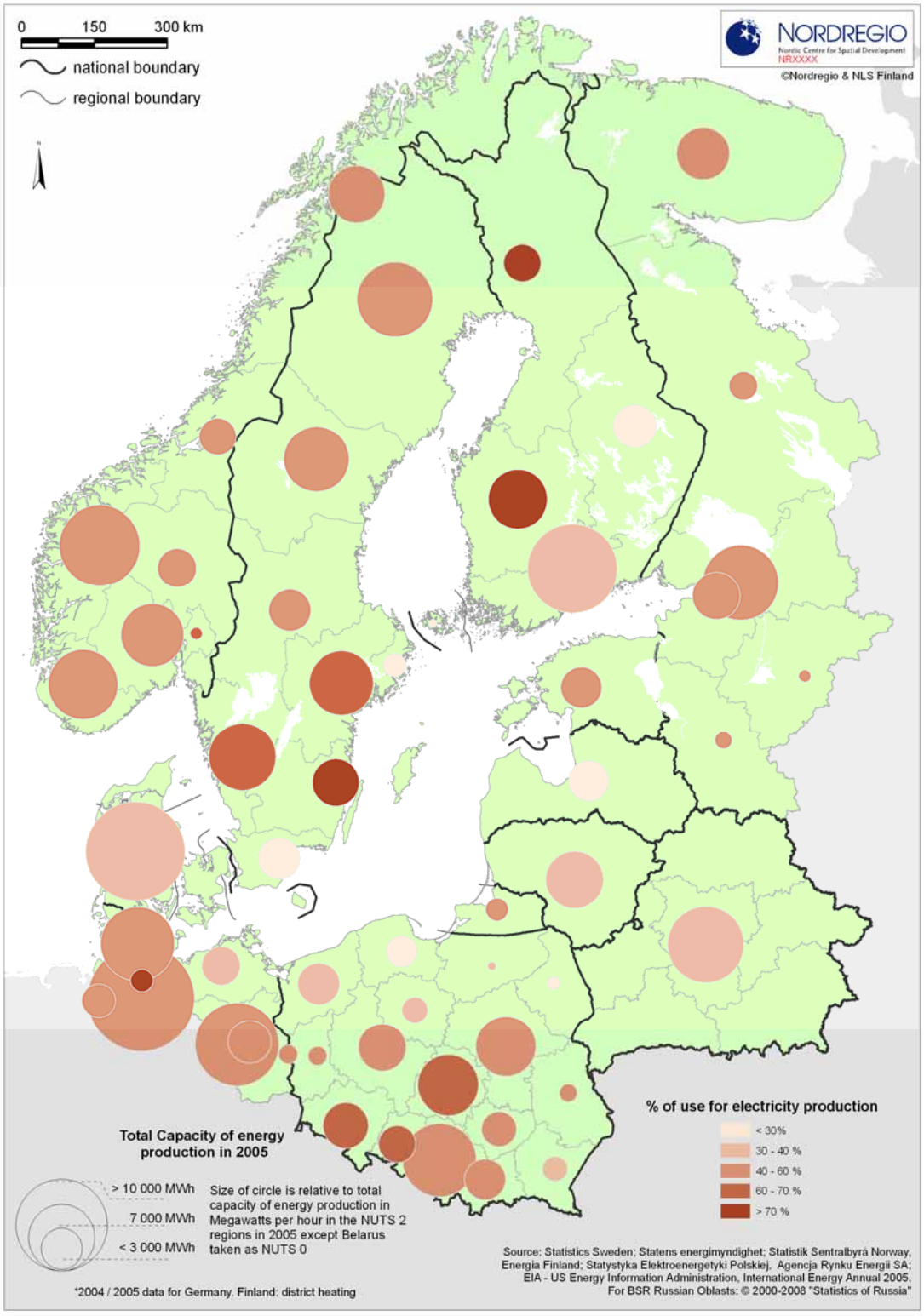
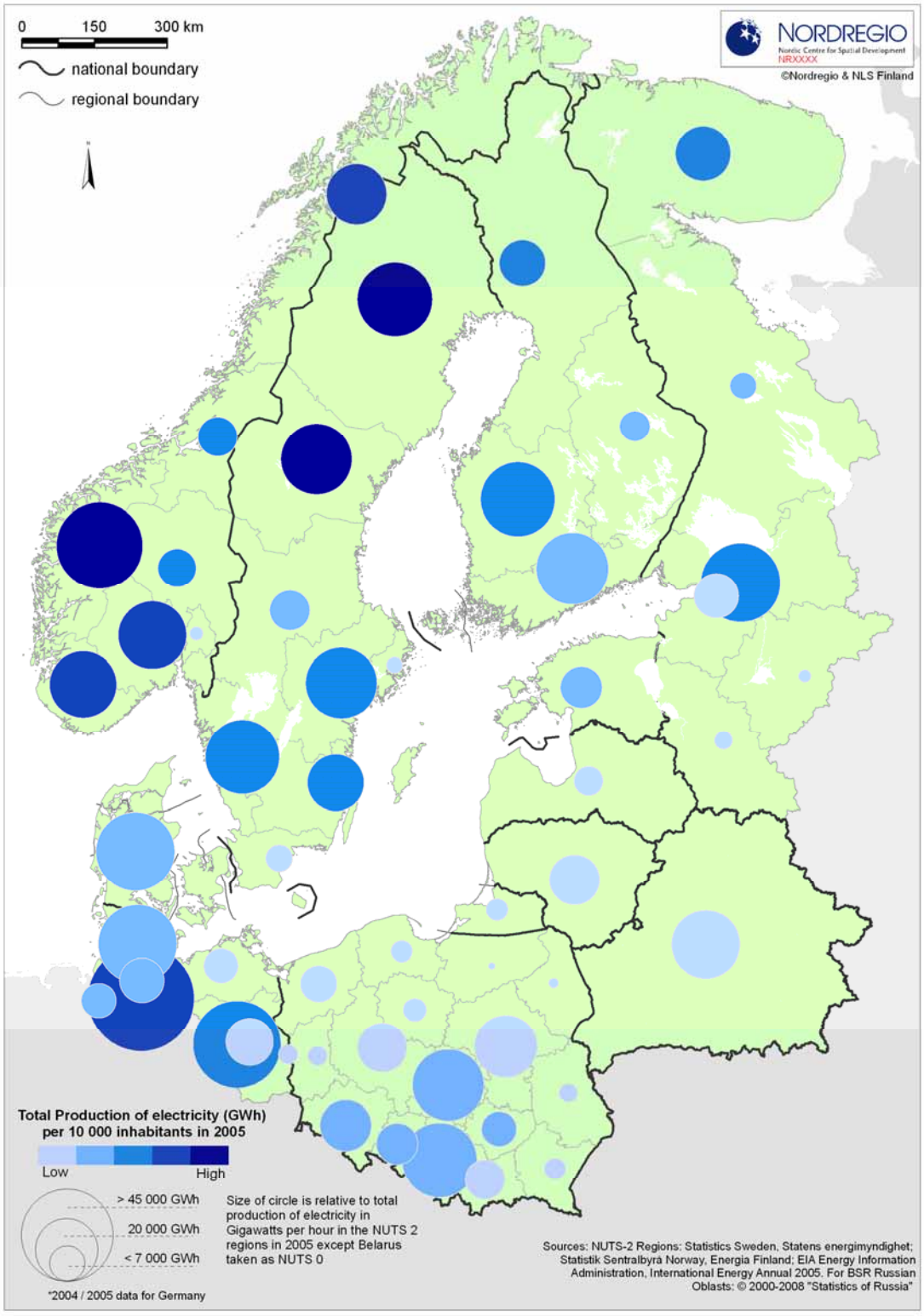


Figure 31: Electricity production per capita in 2005



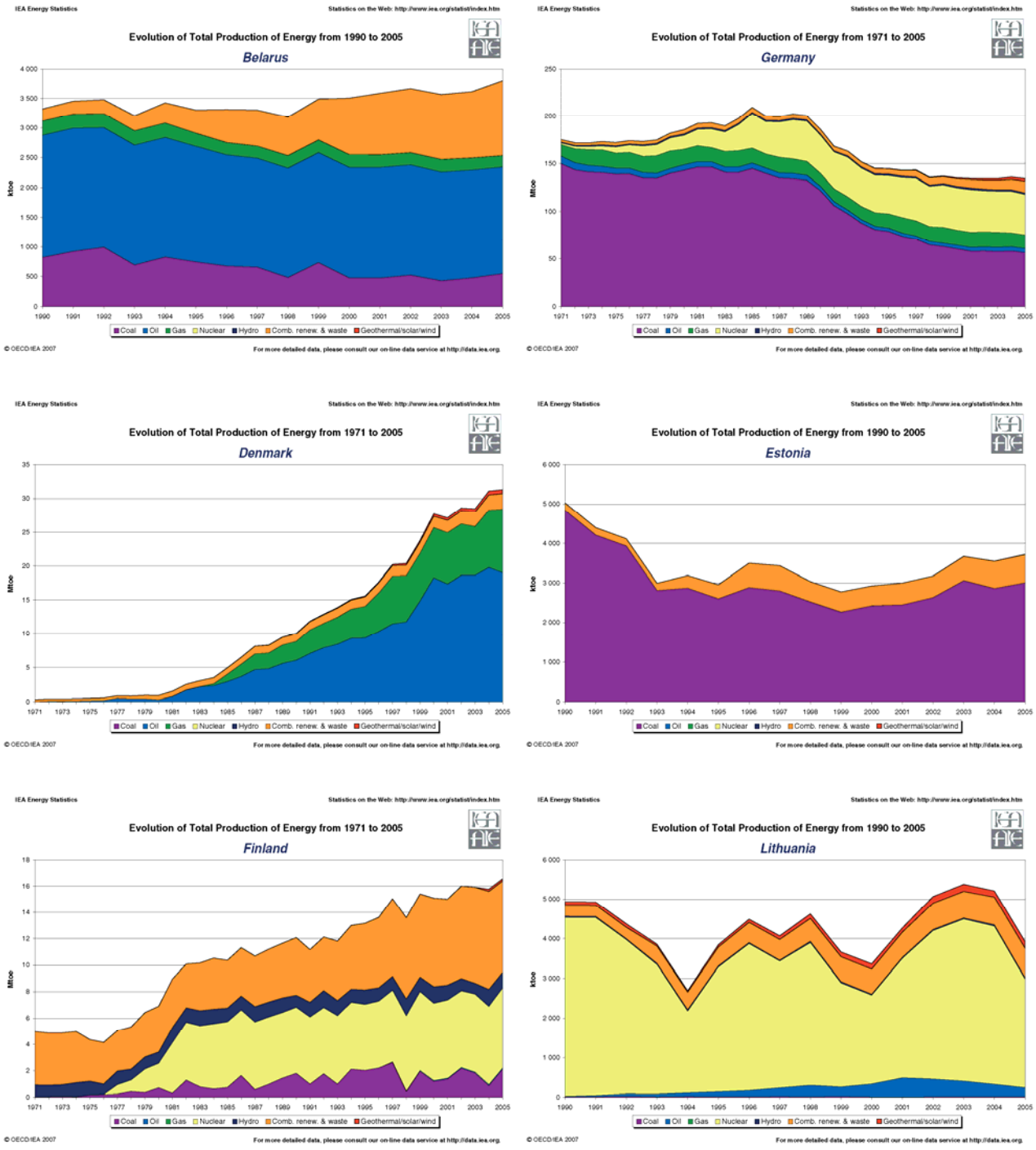
The electricity production capacity is very much connected to the infrastructure in place in each region and country, as it depends on the location of power facilities (nuclear plants, solar stations, windmills, hydropower plants…) on their territory. The production of electricity by region is dependent on this capacity, but also on the needs in energy. Figure 30 has already highlighted this aspect.

Figure 31 displays another important aspect that needs to be taken into consideration when analysing electricity production, namely the ratio between the production of electricity and the regional or national population. The calculation of the production per capita indicator makes it possible to assess the variations across the BSR on how the regional or national electricity production satisfies its indigenous needs: a high ratio would identify an over-production of electricity compared to the regional needs, and thus a possibility for exporting electricity; while a low ratio would flag smaller margins and a necessity for importing electricity from other parts. Regions of the BSR were the calculated ratio is high are situated in northern Sweden, in South-Western and Northern Norway and in Lunenburg (Germany). On the eastern shore of the BSR, the ratio is rather low with the exception of southern Poland and in Leningrad and Murmansk oblasts of Russia. Evidently, large metropolitan areas, such as Oslo or Stockholm, show both a low production of electricity and a low ratio: this is due to the lack of space for installing large power plants and the high population figures.

The previous material displayed in this chapter has particularly highlighted the distribution of the total production of energy between the different potential sources. However, in order to give a more complete picture of the energy situation around the BSR, it is necessary to provide as well a more dynamic picture, highlighting the mid-term and long-term trends regarding energy production.

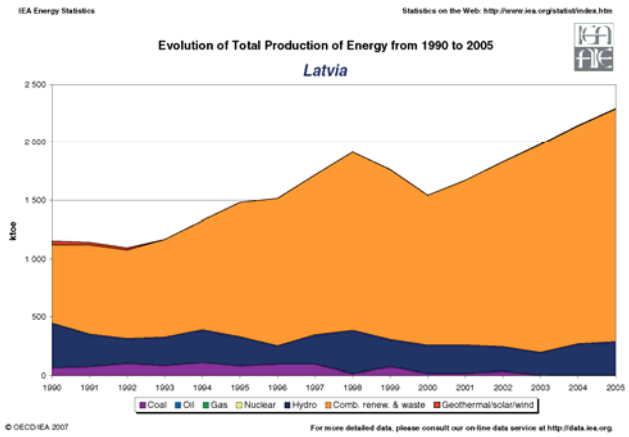
In that regard, two main features are important to highlight for each country. First of all, the evolution of the total production gives provides some input on the potential for each country to sustain the timelessness of the activities of its businesses and individuals without having to call for large imports of energy. Second, the evolution of the production by source provides an insight on what sources are privileged, due to both availability of natural resources on the national territory or the result of long-term national policies. Figure 32 displays this dynamic picture on both accounts.

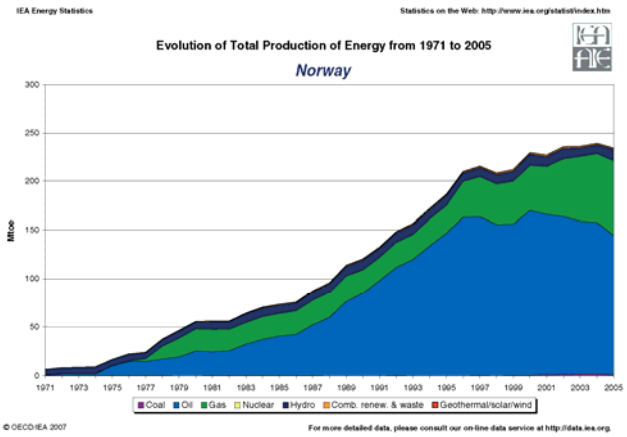
Figure 32: Evolution of total production of energy in the BSR countries

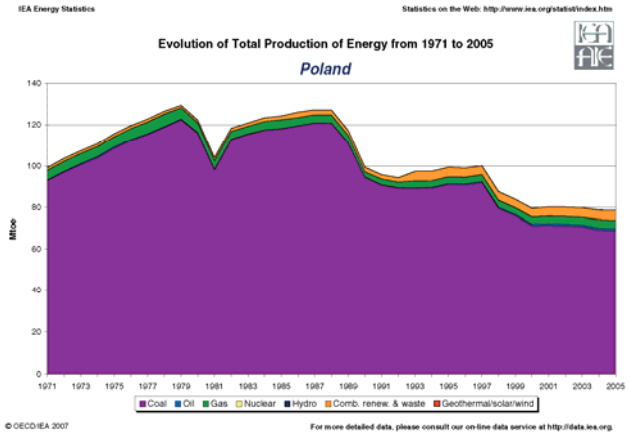


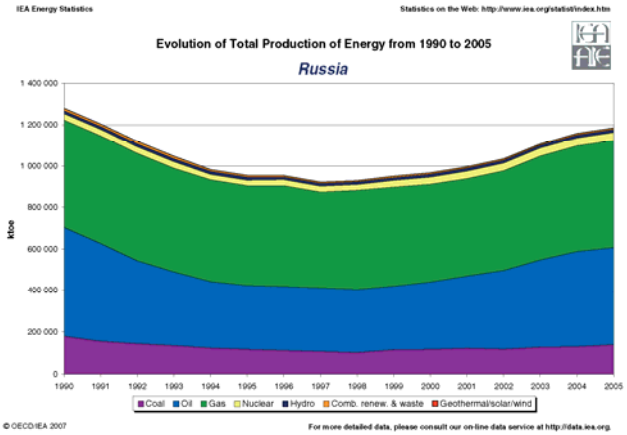
Source: International Energy Agency (2008)

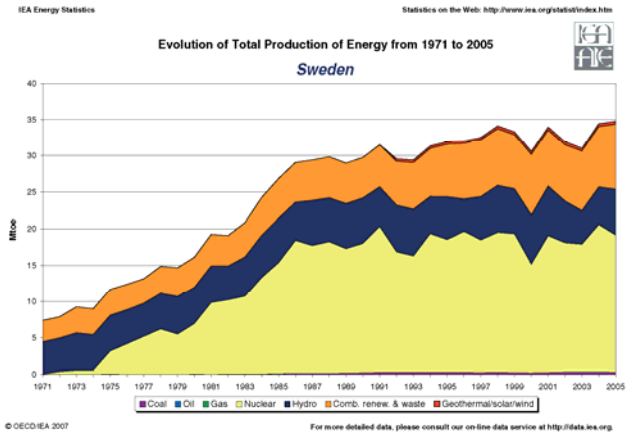
Figure 32: Evolution of total production of energy in the BSR (cont.)











Source: International Energy Agency (2008)

Five countries of the Baltic Sea Region have significantly increased their total production of energy since 1971 (Denmark, Finland, Norway and Sweden) or 1990 (Latvia). This soar in the total production is due not only to the discovery of new, exploitable natural resources (Denmark, and Norway), but also to the efforts of national policies in developing new power facilities (Finland, Sweden or Latvia). In Finland, the increase in total production is largely the consequence of substantial increase in the production capacity in nuclear and combustible renewable and waste energies. The same is true for Sweden, although the increase in nuclear energy was much larger than for combustible ones. In Denmark and Norway, the exploitation of the natural gas and oil resources in the North Sea has boosted the total production of energy. Of course, if the trend is the same in both countries, the production of energy in Norway and Denmark are not comparable in absolute terms: Danish energy production represent one tenth of the Norwegian one. Finally, Latvia owes its increase in energy production due to an increase in combustible renewable and waste energies.

Belarus and the Russian Federation belong together to the grouping of countries that have witnessed rather stagnating production energy. In Russia, the distribution of the total energy production has been as well rather stable since 1990. In fact, in the Russian case, the production decrease from 1990 to 1997 and then increased since then in order to reach a level comparable of that in 1990. For Belarus, if the total production has increased by a very small percentage, the composition of the energy production mix has nonetheless evolved. The share of coal production has been reduced at the benefit of combustible renewable and waste energies.

Finally, four countries have witnessed a decrease in their total production of energy. In Germany, the decrease is essentially due to a strong decrease in coal exploitation, while nuclear energy has taken a greater share in the national energy mix. In Estonia as well, the decrease in the exploitation of coal has led to a decrease in total energy production; this decrease not being compensated by the slight increase in the production of combustible renewable and waste energies. In 2005, the Lithuanian total production of energy was one fifth lower than the one in 1990. However, when looking at the trend in-between those 2 years, one can notice that the production has witnessed large variations during this time, essentially the consequence of the variation of the production of nuclear energy. Finally, the Polish production of energy, almost entirely consisting in coal exploitation, has decreased between 1971 and 2005.

4.3. Energy consumption in the BSR

The previous chapter has highlighted the main characteristics of the production of energy in the Baltic Sea Region. This present chapter will develop an analytical base for understanding the main features of the consumption of energy across the region.

In the previous chapter, it has already been said that different types of energy source (oil, gas, nuclear…) are used for different purposes: oil and petroleum products are essentially used in the transport (petrol) and residential (home fuel oil) sectors; coal in the industry sector; gas in the industry and residential sectors; combustible renewable energies (bio fuel, biomass…) in transport and residential sectors; while electricity, originating from all possible sources (nuclear, hydropower, solar…), is used across all sectors. The latter means that the consumption of a specific energy source is tightly related to the needs of a specific sector of human activities.

Table 10 provides an overview of the distribution of energy consumption (all types considered) by sector in the BSR countries. The identified sectors are the following: industry, transport, residential use, commercial and public services, agriculture and forestry, and finally fishing activities. In each country, the largest share of energy consumption (approximately 80%) takes place in the industrial, transport and residential sectors, the others constituting a more negligible quantity.

Table 10: Energy consumption in BSR countries, by sector (2005)

		Energy consumption by sector (in ktoe)						
	Total consumption in ktoe	Industry	Transport	Residential use	Commercial and Public Services	Agriculture / Forestry	Fishing	Non-Specified
Belarus	*16 335*	33,4%	12,4%	35,8%	10,2%	6,3%	0,0%	2,0%
Denmark	*15 488*	18,3%	34,7%	28,5%	12,7%	4,5%	1,2%	0,1%
Estonia	*2 801*	23,2%	26,5%	33,2%	13,5%	3,6%	0,0%	0,0%
Finland	*24 783*	46,3%	19,9%	19,6%	7,0%	2,9%	0,2%	4,0%
Germany*	*235 662*	24,6%	26,9%	27,0%	10,3%	1,1%	0,0%	10,1%
Latvia	*4 043*	20,7%	25,3%	35,9%	15,5%	1,9%	0,6%	0,0%
Lithuania	*4 514*	22,1%	32,2%	30,7%	12,6%	2,3%	0,0%	0,1%
Norway	*18 642*	35,2%	27,0%	20,4%	13,2%	1,7%	2,4%	0,1%
Poland	*57 073*	27,4%	22,1%	32,2%	10,4%	7,8%	0,0%	0,0%
Russia*	*387 260*	33,0%	24,5%	28,5%	8,9%	2,5%	0,1%	2,3%
Sweden	*33 065*	36,1%	26,2%	22,1%	13,0%	2,3%	0,1%	0,1%

** Entire country for Germany and Russia*

Source: International Energy Agency (2008)

The share of energy consumed in the industry sector out of the total national consumption varies greatly between BSR countries. The minimum share is found in Denmark, where it amounts to 18,3% of the national consumption, while it reaches up to 46,3% in Finland, which is the BSR maximum. Other countries that have an energy consumption for the industry sector greater than 30% are Sweden (36,1%), Norway (35,2%), Belarus (33,4%) and the Russia Federation (33,0%). Surprisingly, Germany, despite its large industrial infrastructure, has an energy consumption for its industry sector mounting to only 24,6% of the total national consumption, which is lower than many other BSR countries.

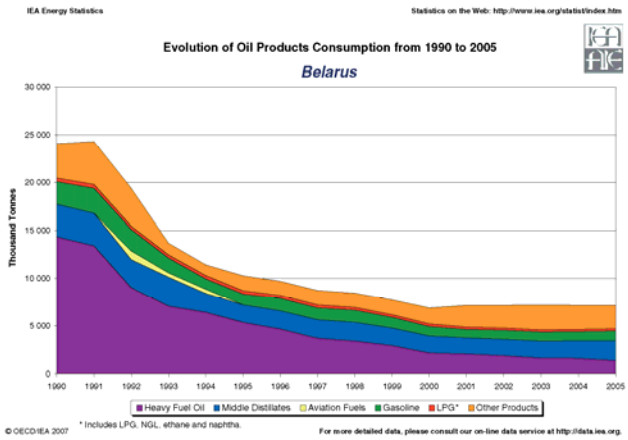
The transport sector is as well an important item in the national energy consumption. As stated earlier, energy consumed in the transport sector is very much linked to the national consumption of oil and petroleum products as it is still, to date, the main fuel used by private cars and lorries. As in the case of the industry sector, the range of national situation is rather wide. The maximum percentage found in the Baltic Sea Region can be found in Denmark, where 34,7% of the total national energy consumption is made in the transport sector. The minimum found is in Belarus, where it corresponds to only 12,4% of the total national consumption. Finland is the only other country that shows a share below 20%, with 19,9%, whereas Lithuania is the only other BSR country beyond 30% (32,2%). All other countries have a percentage of energy consumed in the transport sector between 20 and 30%.

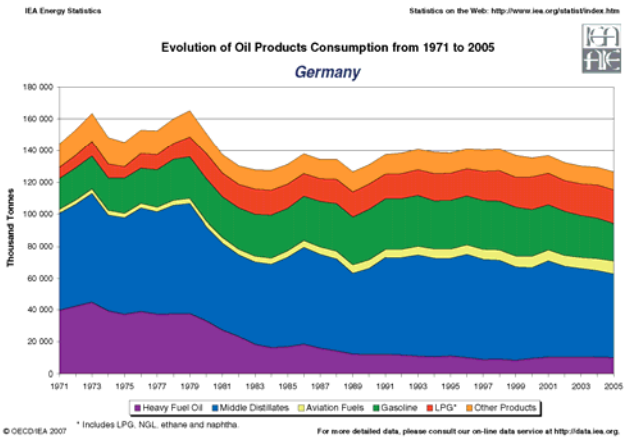
The third item of importance regarding energy consumption corresponds to use of energy by households. The residential use of energy is, on average, the largest in the whole BSR. Finland is the BSR country with the lowest percentage of total energy consumption for residential use, with less than 20% of it (19,6%). Norway and Sweden have also rather low percentage for energy consumption for residential purpose with respectively 20,4% and 22,1%. The highest percentage is found in Latvia with 35,9%, followed closely by Belarus with 35,8%. Other countries show a percentage in the vicinity of 30% of their total energy consumption.

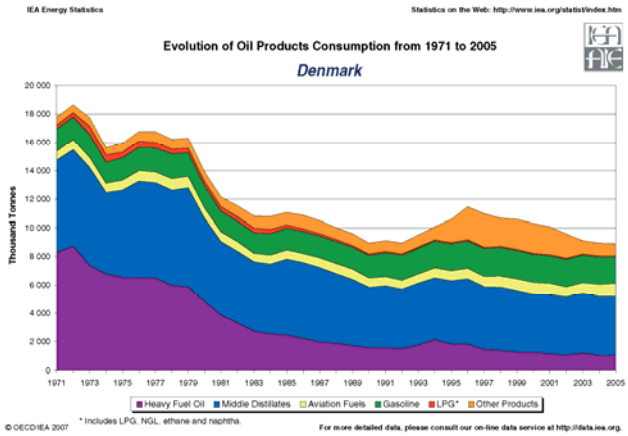
The distribution of the energy consumption by type of energy is especially interesting for oil and its related products. Indeed, as stated earlier, the consumption of these products is tightly related to the transport sector as well as some specific industries (chemical for instance), which is at the heart of the theme of accessibility, the topical focus of this present report. Moreover, as the use of petroleum products is believed to have played a significant role in global warming processes, the consumption of these products has extensive importance in the debates on policy responses to climate change.

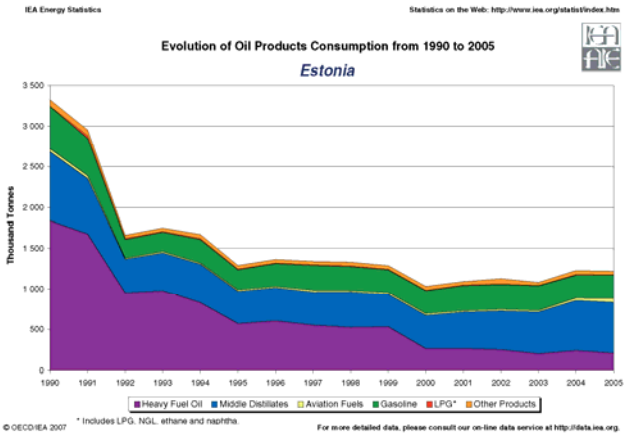
Almost all BSR countries have reduced their consumption of oil products in the recent decades. More precisely, for Russia, Latvia, Lithuania, Estonia and Belarus (all part of the former Soviet Union), the decrease took place between the years 1990 and 1995, since then, the decrease being rather mild. As for Denmark and Sweden, the decrease is quite significant since 1971 and for both the main effort was made between the seventies and early eighties. For Finland and Germany, the consumption has been rather stagnant over the 30 last years, although some variations took place in between. Poland and Norway are the only two countries for which the consumption of oil products has increased over the last decades: if the level of consumption in 2005 in Norway corresponds to 125% of the consumption level in 1971, it has doubled in the case of Poland.

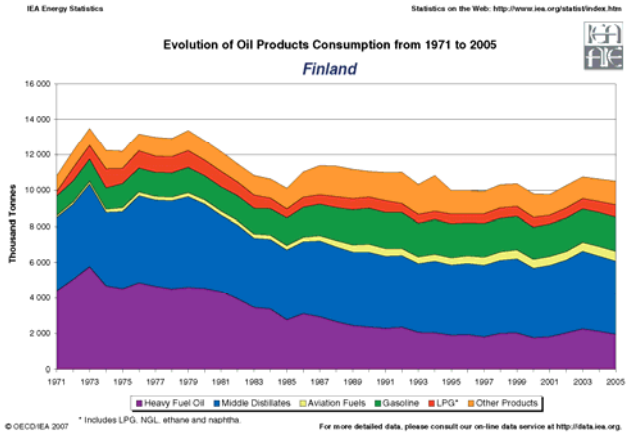
Figure 33: Evolution of oil product consumption in the BSR countries

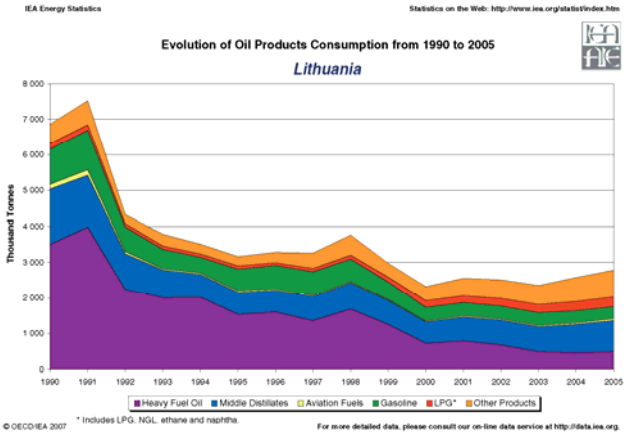






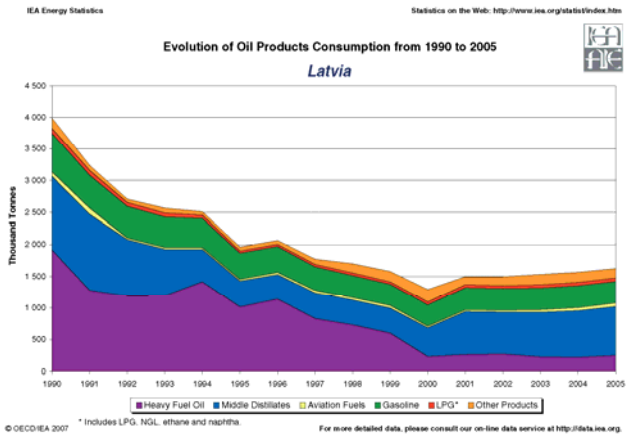


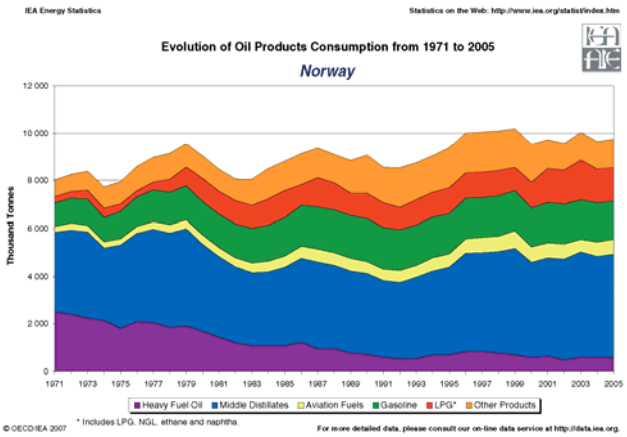


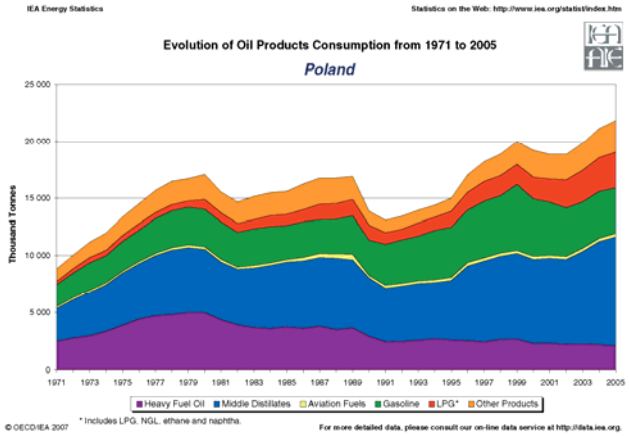


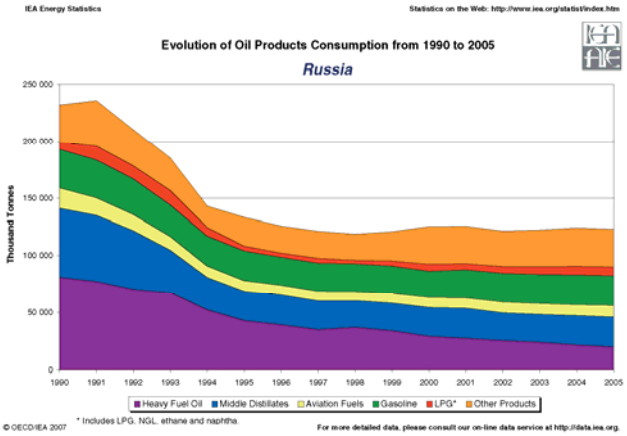
Source: International Energy Agency (2008)

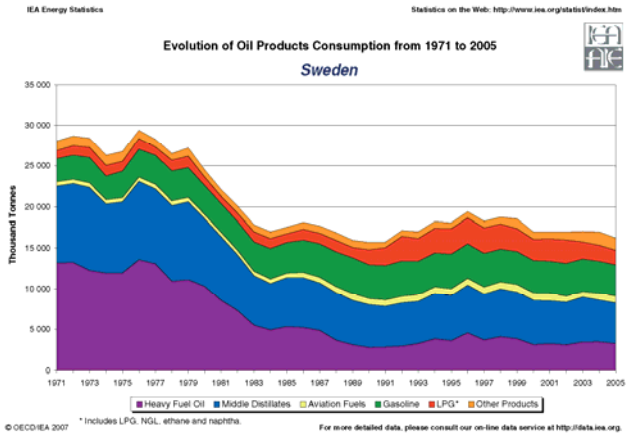
Figure 33: Evolution of oil product consumption in the BSR (cont.)











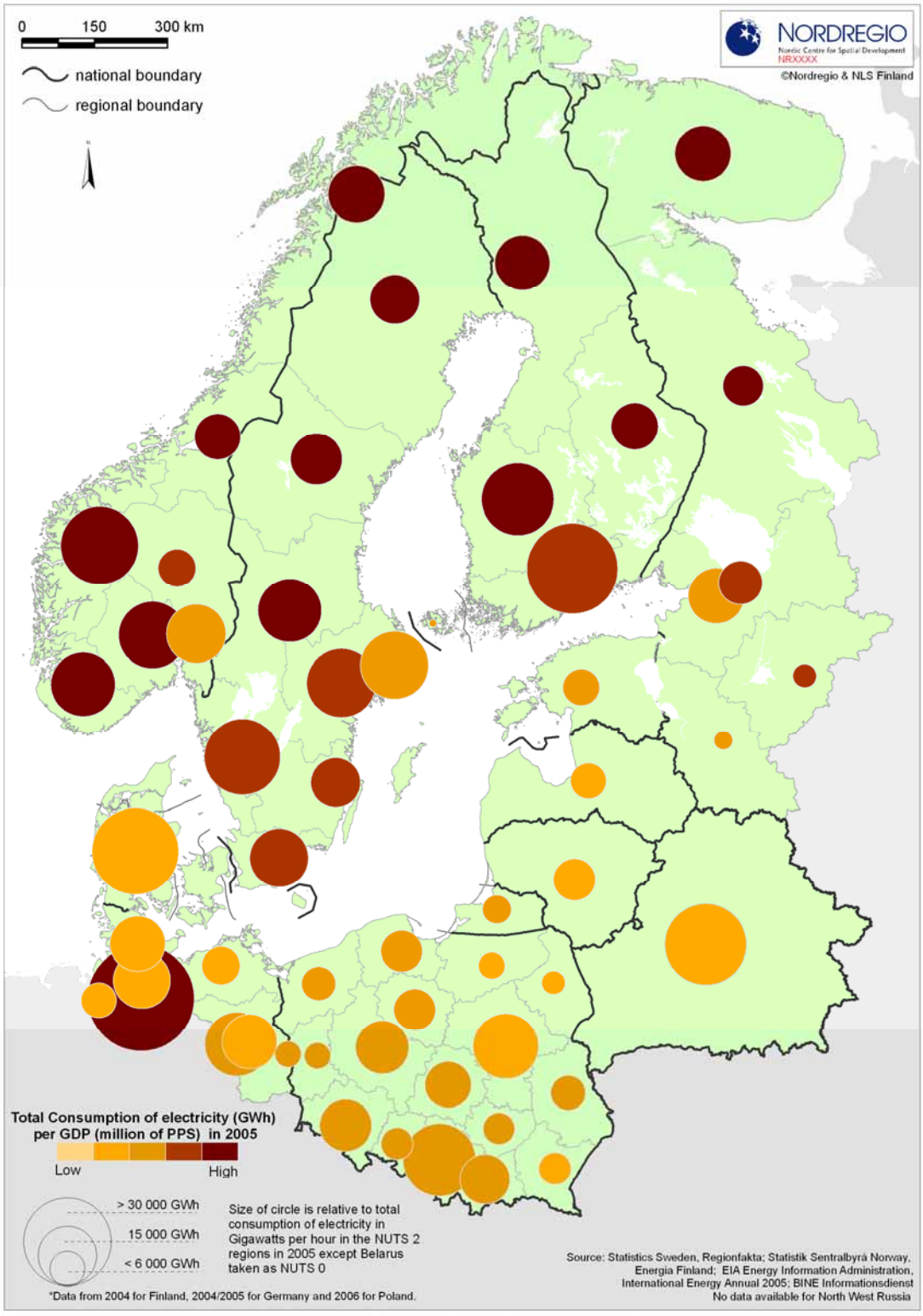
Source: International Energy Agency (2008)

The connection between the production and consumption of energy, as well as their impacts on the environment, tightly linked to the notion of energy efficiency. In concrete terms, this notion brings the idea that the consumption of energy should be adapted to the needs of the country or region, but with the aim of reducing at much as possible unnecessary losses or wastes. For the International Energy Agency, “improvements in energy efficiency can reduce the need for investment in energy infrastructure, cut fuel costs, increase competitiveness and improve consumer welfare” (IEA Homepage).

In the framework of this study, a way of measuring the energy efficiency of the different national or regional systems is to calculate the consumption of energy per point of GDP. Here, GDP is used as a proxy for the size of the regional economy. Figure 34 visualises such an attempt to measure it by indicating the ratio between the total regional consumption of electricity and the level of GDP at the NUTS 2 level (except Belarus at NUTS 0 level), as well as by visualising the total consumption of electricity (size of the balls) in each region.

As a stated earlier, electricity is a key type of energy as it is used in all types of sectors. The map provides a pertinent basis for benchmarking the electricity efficiency of the different regional economies. From the map, two main remarks can be drawn. First of all there is a strong difference between the western part of the BSR (Nordic countries and Germany) and the Eastern part (Poland, Russia, Belarus and the Baltic States). The regions in the former display much higher level of the calculated ratio. In concrete terms, this means that, proportionally, more electricity is consumed for producing one point of GDP (PPS) in those countries than in the ones belonging to the latter one. Second, there are some important variations within the countries, and especially in the Nordic countries between metropolitan regions and the other ones. Indeed, in general, metropolitan regions consume less electricity by point of GDP (PPS). This important difference is due to the structure of the regional economies: metropolitan economies are essentially based on low energy-demanding sectors such as the service one, while the economies in the northern parts of the Nordic countries are more specialised in manufacturing or industrial sectors. This specialisation in energy-demanding industries makes that the consumption of the regional economies is proportionally higher in those regions than in more service oriented ones.

Figure 34: Consumption of electricity per point of GDP, in 2005



4.4. Impact of increasing energy prices

As highlighted in the beginning of this chapter, access to energy is not only a question of infrastructure but also an issue of affordability. In that respect, the fluctuations of energy prices have a strong impact on the profitability of local businesses and impacts as well the available income of households. For businesses, increased energy prices mean an increase in their operation and transportation costs, and in turn a loss of competitive advantage to businesses located in other regions. For households, the increase of oil or electricity prices reduce their purchasing power as they have to spend more money on basic items rather than spending on other types of goods or local services. This has strong impact on regional economies.

Yet, energy prices are not, most of the time, decided neither at regional nor at national level. Energy prices are the result of supply and demand pattern on a global scale.

In a recent document produced by the Swedish company Vattenfall (2006) a thorough evaluation of the situation of electricity prices in Europe is made. They assess that recently the electricity prices have significantly risen through out Europe. For instance, in the Nordic countries, the system price on *Nord Pool* in early 2006 was approximately EUR 40-50/MWh (compared with EUR 25-30/MWh in 2005). This was mainly due to low water levels in hydro reservoirs, a very cold winter and the impact of the price of CO2 emission allowances.

Yet, beyond this statement, Vattenfall highlights that, within the EU, "electricity prices are converging to a higher degree between the various national and regional markets, due to an increase in international trading". Consequently, increased energy prices do not specifically disadvantage particular countries, but more Europe as a whole in a global perspective. Moreover, the impacts of the adoption of the protocol of Kyoto have been felt. The aim of emission allowances is to introduce market principles and thereby effectively reduce CO_2 emissions in the aim of achieving the EU's climate objectives under the Kyoto Protocol. Companies each receive a certain amount of emission allowances. If this level is inadequate, they must purchase additional emission allowances.

Table 11: Evolution of electricity prices for industries

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Industry - Ie (Annual consumption: 2 000 MWh; maximum demand: 500 kW; annual load: 4 000 hours)												
Denmark	0,0473	0,0467	0,0512	0,0485	0,0504	0,0558	0,0639	0,0697	0,0631	0,0646	0,0724	0,0638
Germany	0,0906	0,0845	0,0830	0,0791	0,0675	0,0669	0,0685	0,0697	0,0740	0,0780	0,0871	0,0946
Estonia	N/A	N/A	N/A	N/A	N/A	N/A	0,0465	0,0455	0,0455	0,0472	0,0511	0,0534
Latvia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0,0431	0,0409	0,0409	0,0443
Lithuania	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0,0550	0,0513	0,0498	0,0498	0,0548
Poland	N/A	N/A	N/A	N/A	N/A	0,0492	0,0585	0,0566	0,0446	0,0506	0,0543	0,0541
Finland	0,0481	0,0414	0,0401	0,0389	0,0377	0,0372	0,0401	0,0566	0,0543	0,0527	0,0517	0,0542
Sweden	0,0413	0,0430	0,0392	0,0348	0,0375	0,0313	0,0310	0,0666	0,0520	0,0462	0,0587	0,0626
Norway	0,0322	0,0442	0,0375	0,0344	0,0356	0,0344	0,0433	0,0560	0,0542	0,0528	0,0520	0,0724
Russia	N/A	N/A	N/A	N/A	N/A	0,0149	0,0170	0,0203	0,0213	0,0227	0,0255	N/A

This indicator presents electricity prices charged to final consumers, Electricity prices for industrial consumers are defined as follows: Price in Euro per kWh without taxes applicable on 1 January each year for annual consumption of 2 000 MWh (maximum demand of 500 kW and annual load of 4 000 hours), Electricity prices for household consumers are defined as follows: Price in Euro per kWh without taxes applicable on 1 January each year for annual consumption of 3 500 kWh in Euro per kWh,

Source: IEA; Eurostat

Table 11 provides evidence on the recent evolution of the electricity prices charged to the consumers, in this case the industries. All BSR countries have witnessed a steep increase in electricity prices since the beginning of the century.

If the fluctuations of electricity prices have a strong influence on the regional development perspectives through out the BSR, the increase of oil prices have a direct impact on accessibility issues. Indeed, as it has emphasised earlier in this report, the large share of oil consumed for transportation (cars, airplanes…) stresses the sensitivity of mobility patterns to changes in oil prices.

Table 12: Evolution of spot crude prices in different market places

US dollars per barrel	Dubai $/bbl *	Brent $/bbl †	Nigerian Forcados $/bbl	West Texas Intermdiate $/bbl ‡
1998	12,21	12,72	12,62	14,39
1999	17,25	17,97	18,00	19,31
2000	26,20	28,50	28,42	30,37
2001	22,81	24,44	24,23	25,93
2002	23,74	25,02	25,04	26,16
2003	26,78	28,83	28,66	31,07
2004	33,64	38,27	38,13	41,49
2005	49,35	54,52	55,69	56,59
2006	61,50	65,14	67,07	66,02
2007	68,19	72,39	74,48	72,20

Source: Platts.

* 1972 - 1985 Arabian Light, 1986 - 2007 Dubai dated.
† 1976 -1983 Forties, 1984 -2007 Brent dated.
‡ 1976 -1983 Posted WTI prices, 1984 -2007 Spot WTI (Cushing) prices.

Crude oil prices have soared since the turn of the century. From being around 13 dollars a barrel in 1998, it has reached around 70 dollars a barrel in 2007. Furthermore, prices have gone beyond the threshold of 150 dollars a barrel in 2008. A concrete consequence regarding transportation is that is becomes much more expensive to use a private car or a truck. Regions that are well equipped in local transportation services are less impacted than metropolises strongly dependent on private cars for commuting patterns. For smaller labour-markets, such as in the northern parts of the Nordic countries, the high oil prices reduce the possibilities for the development of large-scale labour-market as it becomes too expensive to travel from one region to the neighbouring one on a regular basis.

The increase of oil prices has also strong implications for the development of intra-BSR communications: the use of lorries for shipping goods throughout the region becomes too expensive, and air carriers have to face soaring kerosene prices implying a reduction of non-profitable lines.

In that light, the focus of European and national energy policies to develop locally-produced, renewable energies make sense. Less dependent on external energy sources BSR countries are more able to secure the supply of energy of regional economies. Yet, the issue of oil prices and their implication for transport pattern need to be dealt with in the coming years. The development of alternative energy sources for powering cars is, if not new, central to future transnational co-operation.

4.5. Renewable energies in the BSR

In the light of the debates on climate change and the related policy responses to adopt for its mitigation, renewable energies have become at the centre of the future energy strategies of both the European Union and its Member States.

But what is a renewable energy? Renewable energy is a generic term for a set of energy sources that can be regenerated either naturally or by human intervention. Consequently, a dozen of energy sources are to date considered as "renewable energies" (list not exhaustive): hydropower, wind power, municipal waste, biogas, primary solid biomass, solar photovoltaic, liquid biofuels, industrial wastes… Renewable energies are essentially used for producing electricity and heat.

For the European Commission, the future development of the production of renewable energies is important on three main accounts:

- *Renewable energy has an important role to play in reducing Carbon Dioxide (CO_2) emissions - a major Community objective.*
- *Increasing the share of renewable energy in the energy balance enhances sustainability. It also helps to improve the security of energy supply by reducing the Community's growing dependence on imported energy sources.*
- *Renewable energy sources are expected to be economically competitive with conventional energy sources in the medium to long term.*

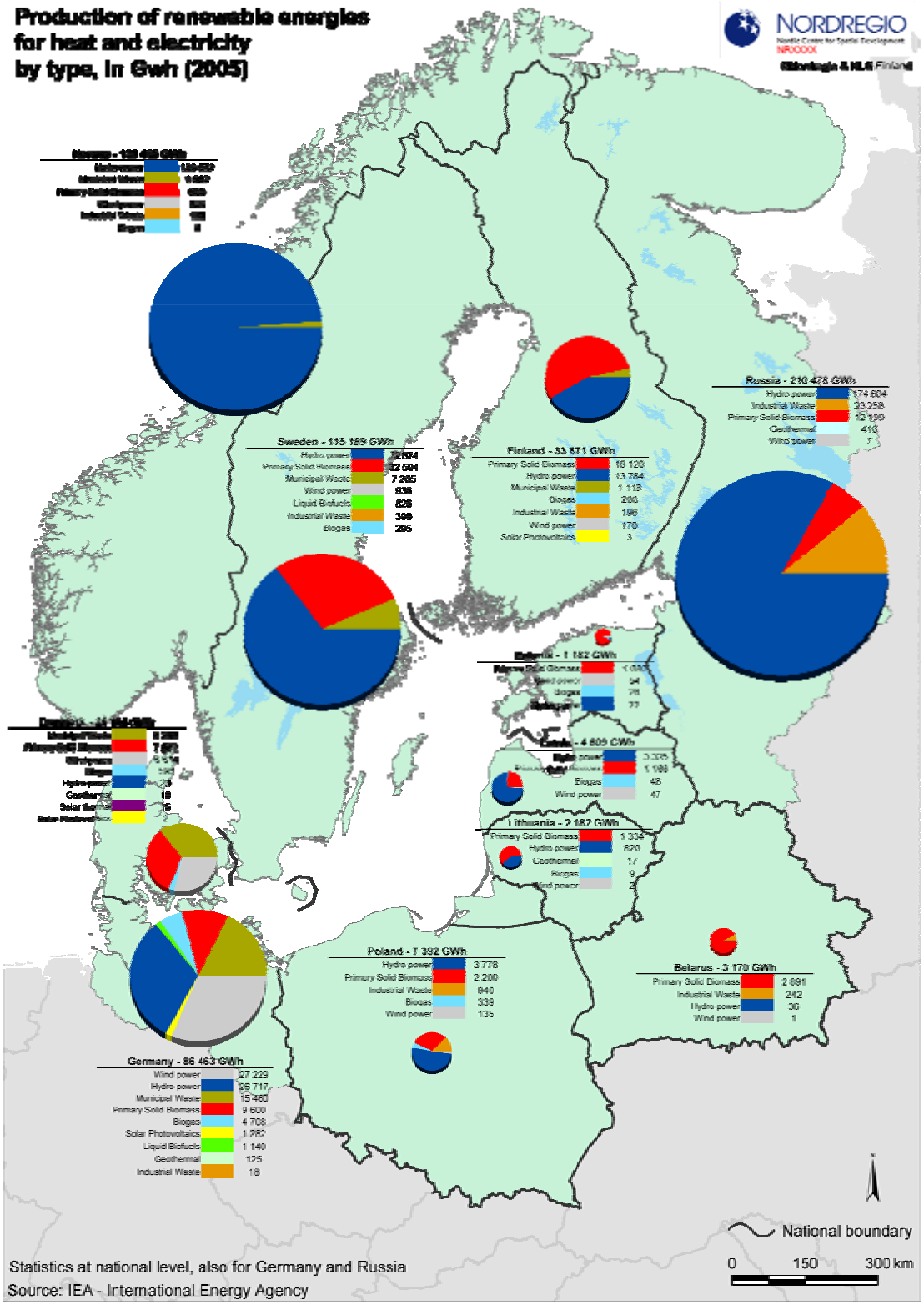
(European Commission homepage)

The importance of renewable energies can be summarized in 2 points. First, the production of locally based renewable energies aims at bolstering the energy independency of regions and countries by reducing the need for energy imports. The second point relates to the challenges linked to climate change: the production and consumption of renewable energies have lower impacts on the environment than carbon-based energies (coal, oil, gas…).

However, the capacity of regions and countries to produced renewable energies is not only a question of mastering related technologies, but also a question of the territorial energy capital. In concrete terms, the production of each type of renewable energies depends strongly, but not only, on the physical or geological specificities of each territory: for instance, the potential for developing hydropower is related to the availability of rivers.

Consequently, it is not surprising to find large disparities between countries when it comes to their specific mix of renewable energies production. Figure 35 synthesizes the figures of the production of renewable energies for electricity and heat, per country and per type of energy.

Figure 35: Production of renewable energies in the BSR in 2005



Russia is the largest BSR producer of electricity and heat originating from the exploitation of renewable energies with a production of more than 200,000 Gwh. However, this should be put into perspective: Russia is the largest country in the world and is as well as one of the biggest producer of energy; and the share of renewable energies in the Russia energy production mix is rather negligible. The largest producers of renewable energies after Russia are respectively Norway (139 466 Gwh), Sweden (115,189 Gwh) and Germany (86,463 Gwh). Other countries if the BSR have a much more limited production of renewable energies. The smallest producer of such energies is Estonia, with a production of 1,182 Gwh. However, an interesting feature displayed in figure 35 is the composition of the production mix of renewable energies in each country. In that regard, one can identify three main categories of countries.

What are those renewable energies?

Biofuel
Biofuels cover bioethanol, biodiesel, biomethanol, biodimethylether, biooil. Liquid biofuels are mainly biodiesel and bioethanol/ETBE used as transport fuels. They can be made from new or used vegetable oils and may be blended with or replace petroleum-based fuels. The natural plant feedstock includes soya, sunflower and oil seed rape oils. Under some circumstances, used vegetable oils may also be used as feedstock for the process.

Biogas
A gas composed principally of methane and carbon dioxide produced by anaerobic digestion of biomass, comprising:
- Landfill gas, formed by the digestion of landfilled wastes.
- Sewage sludge gas, produced from the anaerobic fermentation of sewage sludge.
- Other biogas, such as biogas produced from the anaerobic fermentation of animal slurries and of wastes in abattoirs, breweries and other agro-food industries.

Geothermal energy
Energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam. It is exploited at suitable sites:
- For electricity generation using dry steam or high enthalpy brine after flashing.
- Directly as heat for district heating, agriculture, etc.

Hydropower
Hydropower corresponds to the energy resulting in the production of electrical energy as a result of the natural accumulation of water in streams or reservoirs being channelled through water turbines.

Industrial Waste
Industrial waste consists of solid and liquid products combusted directly (usually in specialised plants, e.g. tyres) to produce heat and/or power.

Municipal Waste
Municipal waste consists of products that are combusted directly to produce heat and/or power and comprises wastes produced by the residential, commercial and public services sectors that are collected by local authorities for disposal in a central location. Hospital waste is included in this category.

Solid Biomass and Animal Products
Biomass is defined as any plant matter used directly as fuel or converted into other forms before combustion. Included are wood, vegetal waste (including wood waste and crops used for energy production), animal materials/wastes and sulphite lyes, also known as "black liquor" (an alkaline spent liquor from the digesters in the production of sulphate or soda pulp during the manufacture of paper where the energy content derives from the lignin removed from the wood pulp).

Solar photovoltaics
Solar Photovoltaic devices use semiconducting materials to convert sunlight directly into electricity.

Wind energy
Energy extracted from wind, traditionally in a windmill, but increasingly by more complicated designs including turbines, usually to produce electricity but also for water pumping.

Source: European Commission and EIA hompegaes

The first category comprises the countries that have hydropower as the dominant form of renewable energies. Norway, Russia, Sweden and Latvia belong to this category, making use of their extensive resources in river basins.

The second category consists of the countries where primary solid biomass is the dominant contributor to the production of renewable energies. As defined by the International Energy Agency, solid biomass is "defined as any plant

matter used directly as fuel or converted into other forms before combustion", including wood. Finland, Estonia, Lithuania and Belarus belong to this category. It is worth noting that Sweden has also a production of solid biomass mounting to one third of its total production of renewable energies.

The third category consists of the countries that have no dominant form of renewable energy, thus showing a more balanced production pattern. Germany, Denmark and Poland belong to this category. Interestingly, the three countries do not have the same profile when it comes to renewable energies production. The production of renewable energies for the generation of electricity and heating in Denmark originates from three, rather equivalent, sources: the combustion of municipal waste, the combustion of solid biomass and the conversion of wind energy; the two first ones essentially for heating purposes, and the latter exclusively for electricity. In Germany, two sources of renewable energies constitute more than 60% of the total national production: Wind energy and hydropower. In absolute terms, Germany is the largest producer of wind energy and as developed an extensive park of windmills, not the least on its North Sea coast. The combustion of municipal waste is also a quite developed source of energy production, constituting approximately 20% of the total national production. Finally, the Polish production of renewable energies originates mainly from hydropower (nearly 50%) and solid biomass. In absolute numbers, the total Polish production of renewable energies is much lower than the German and Danish ones.

5. The Baltic Sea Region at the forefront of ICT development

Information and Communication Technologies (ICT) have become an integrated part of the policy debates around the notion of accessibility. New technologies such as mobile telephony or internet and broadband connections give the opportunity to all 'wired' individuals and businesses to expand their contact networks, expand the market area for their products or just access more quickly and autonomously information that can be considered as 'universal knowledge'.

As in the case of transport and energy, the ICT relates to the notion of 'accessibility' not only in terms of available infrastructure, but also in terms of how these infrastructures are actually used by either individuals or businesses.

Many countries of the BSR are at the forefront of the EU when it comes to ICT: Sweden and Finland, due to the presence of Ericsson and Nokia, have acted as world leaders in the production of ICT related material; Norway, Denmark and Germany, as advanced economies, have rapidly developed adequate 'hard' (networks…) and 'soft' (education, telecom operators…) infrastructure in order for their respective economies, to take advantage of these new developments. On the Eastern shore of the BSR, the development of ICT infrastructure and management has emerged later due to the economic restructuring towards market economies. However, if a gap exists between some groupings of countries in the BSR, there are many encouraging signs that this gap is reducing over the years. As an example, the fact that some countries on the eastern shore, principally Estonia and Poland, have developed e-Government systems equivalent to the ones found in the Nordic countries (Nordic Council of Ministers, 2005) supports this idea of a reduction of disparities between countries in a medium-term perspective.

The idea behind the present chapter is to put the development of ICT in the BSR in different perspectives. Unfortunately, due to the limited availability of comparable data for all BSR regions, the analysis will focus on the national level. 3 main perspectives are to be developed hereafter: (1) how is the BSR countries positioned compared to the rest of the EU or OECD countries, (2) to which extent is there a 'digital divide' between the BSR countries, and finally (3) to which extent there is a 'digital divide' between different territories or users within these countries.

5.1. The BSR in international comparison

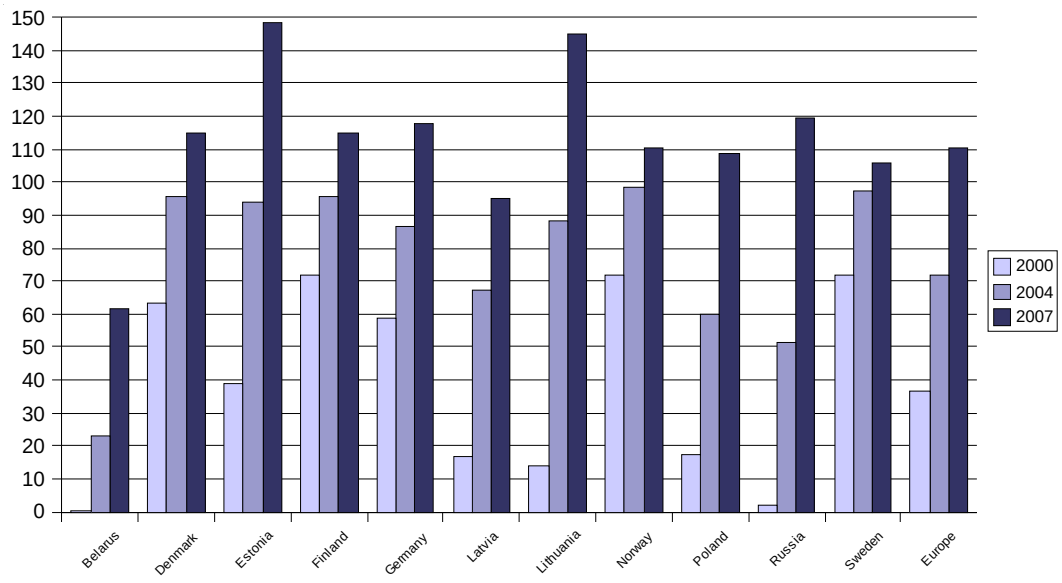
Recent statistics published by the international organisation OECD provide interesting insights on the relative position of the BSR countries in the international context regarding the development of ICT.

As it has been highlighted throughout this report, individuals and businesses are at the heart of the issues of accessibility, whether connected to transport, energy, or, as it is in this present chapter, Information and Communication Technologies (ICT). If even 5 years ago the development of ICT was measured in terms of access to fixed or mobile telephone lines, the rising importance of

the internet as a way of expanding social interactions and business opportunities puts this technology at the heart of ICT development. As for fixed and mobile telephony, the current penetration rates show that the technology has matured in the recent years and that the large differences that existed at the beginning of the century are now more or less marginal.

Consequently, the main challenges ahead regarding ICT development relates to the capacity for both types of identified users, i.e. individuals and enterprises, to 'access' the internet is determinant for enabling these groups to be part of economic and cultural globalisation processes. Until the next technology emerges...

Figure 35: Mobile phones subscribers per 100 inhabitants



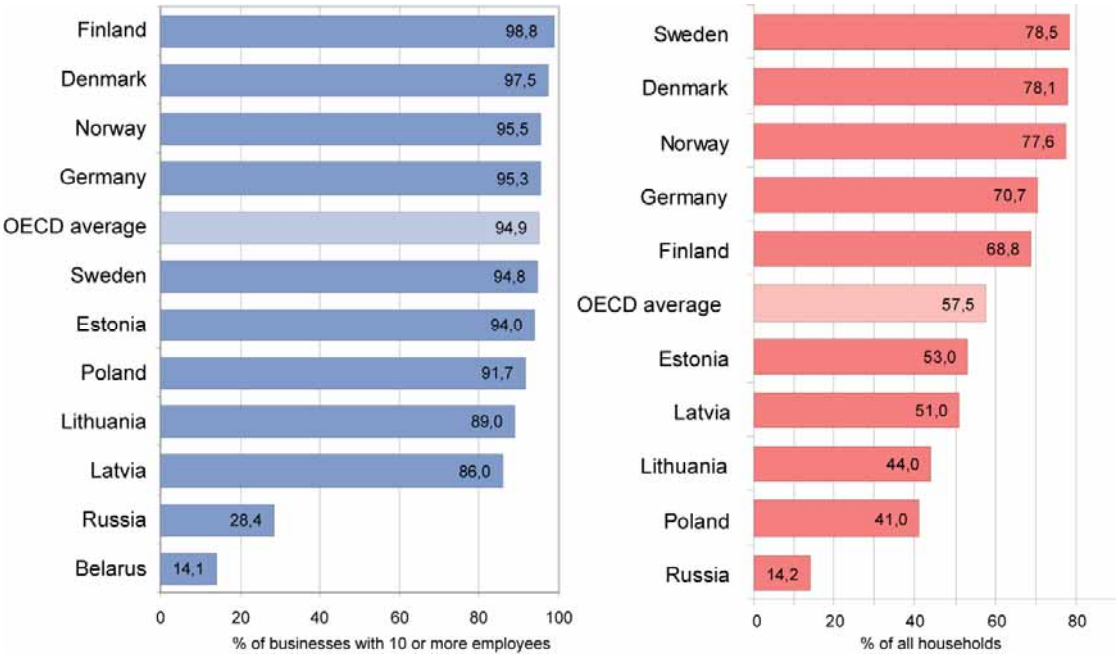
Source: WTI (2008)

Figure 35 illustrates the recent development trends regarding ICT in BSR countries. In 2000, the gap in mobile phone subscribers between the block constituted of the Nordic countries and Germany and the rest of the BSR was important. In 2007, this gap does not exist any more: Lithuania and Estonia have the highest number of subs per 100 inhabitants. To date, only Belarus lags currently behind (only 60 subscription per 100 inhabitants), but the development from 2000 to 2007 shows that the catching up of Belarus will occur in the coming few years.

Yet, the main challenge of ICT is not more to use 'old' but to catalyse and anticipate the development of 'new' technologies. Indeed, ICT are developing in waves: while one technology is maturing and getting mainstreamed, a new 'edge' technology appears and sets the new standard. Consequently, the focus should not only be put on the use of ICT, which will even out eventually over 3 to 5 years, but on the capacity of the different countries to be part of the pioneers for each wave and to anticipate the impacts that the new technology will have on the society and the economy.

In that respect, the Nordic countries and Germany have shown an outstanding capacity to be part of the pioneer countries in almost all ICT, as the importance of the ICT industry in their economy puts them in an upstream position when it comes to adapting to new technologies. The disparities between countries for different types of technologies will be highlighted in the next section of this chapter dedicated to ICT.

Figure 36: Access to internet for households and enterprises (more than 10 employees) in 2007



Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in households and by individuals, January 2008; Community Survey on ICT usage in enterprises, January 2008; NewCronos database, January 2008; UNCTAD, e-business database; and OECD, based on national sources.

Figure 36 above brings the BSR countries in a wider international comparison, here with the OECD. Despite the fact that many of the BSR countries (Russia, Belarus, Estonia, Latvia and Lithuania) are not part of this international grouping of country, the benchmarking of each BSR country to this standard is of high interest as it provides a worldwide benchmark to the most advanced economies. Here, two main remarks can be made. First of all, the Nordic countries and Germany are the only countries of the BSR that lie above the OECD average for internet usage for both households and for enterprises. Second, the disparities between countries and OECD average are lesser when it comes to businesses than to households. Indeed, the Baltic States and Poland are much closer to the OECD average in the case of enterprises than in the case of households. Consequently, the 'digital divide' that is said to exist between the Western and Eastern shores of the BSR is much more a question of access of ICT to individuals rather than to businesses. One possible interpretation could be that market forces and trade prospects pushes the economic actors to adapt to the existing technologies and take advantage of them. This aspect is of outmost importance when one takes the perspective of trade development within the BSR.

Table 13: E-readiness rankings, Top-15 and BSR countries (2008)

2008 E-readiness rank	2007 rank	Country*	Score 2008
1	2	United States	8,95
2	4	Hong Kong	8,91
3	2	Sweden	8,85
4	9	Australia	8,83
5	1	Denmark	8,83
6	6	Singapore	8,74
7	8	Netherlands	8,74
8	7	United Kingdom	8,68
9	5	Switzerland	8,67
10	11	Austria	8,63
11	12	Norway	8,60
12	13	Canada	8,49
13	10	Finland	8,42
14	19	Germany	8,39
15	16	South Korea	8,34
...	...	...	...
28	28	Estonia	7,10
37	37	Latvia	6,03
41	40	Poland	5,83
38	41	Lithuania	6,03
59	57	Russia	4,42

** Belarus not ranked*
Source: The economist (2008)

Finally, the annual survey performed by the economic journal *The Economist*, namely the E-readiness rankings, provides an additional source of comparison between the BSR countries and the rest of Europe and the world. The main aim for calculating such an E-readiness index is to assess the world's largest economies on their ability to absorb information and communication technology and use it for economic and social benefit" (The Economist, 2008). Although the results cannot be taken as scientific evidence as such, they nonetheless provide an interesting insight on the positioning of the BSR countries in the worldwide information society.

First of all, 5 BSR countries belong to the worldwide top-15: Sweden, Denmark, Norway, Finland and Germany. Out of the five, only Germany and Norway have improved their overall ranking as well as their score between 2007 and 2008. Denmark, who was number one last year, is now in fifth position and the former second, Sweden, is now third, while Finland came down from the tenth to the thirteenth position.

Other BSR countries are situated lower on the overall standings and had the following positions: Estonia (28th), Latvia (37th), Lithuania (38th), Poland (41st) and Russia (59th). Belarus was not included in the survey and was thus not ranked. If Latvia, Lithuania and Poland are rather close, Estonia seems to develop faster than its neighbours the capacity to adopt ICT. An interesting remark is that all the above mentioned countries have improved their score

between 2007 and 2008, even if it is not always reflected in an improvement of their overall ranking.

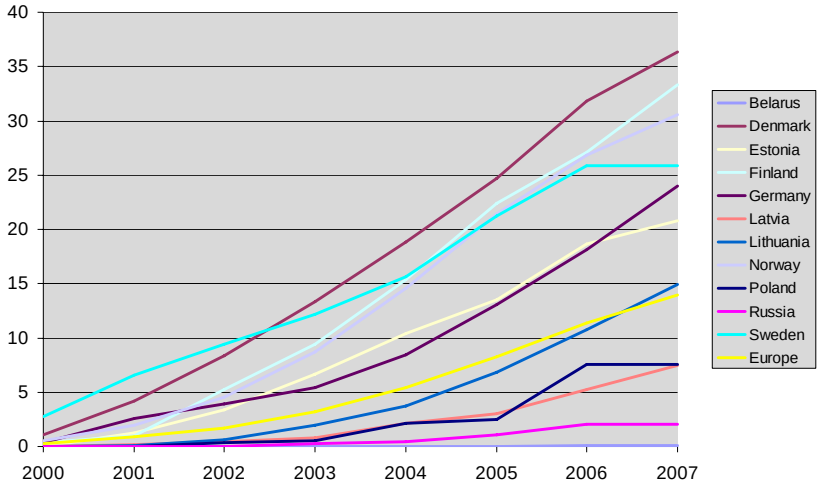
The previous figures have highlighted the fact that the 'digital divide' in the BSR is essentially an issue of access of Information and Communication Technologies to individuals as well as the capacity of regional and national economies to benefit from the adoption of ICT. As a matter of consequence, the following sections will explore the extent of this divide first between the BSR countries, and then within them.

5.2. Disparities in access to ICT between BSR countries: the case of broadband connection

The previous section has given us an overview of the current position of BSR countries in an international context. Moreover, it has enabled us to identify the two main dimensions that should be focused on in order to highlight disparities in terms of ICT access between countries: it should be focused on individuals rather than on enterprises, and it should take into consideration rather new or 'edge technologies rather than more mature ones, e.g. mobile phones. Stemming from the assumption that disparities between countries are sharper in the context of emerging technologies, the present section will focus on the access to broadband networks for both enterprises and households across the BSR.

Indeed, broadband has been identified by the OECD as the current technology has a 'tremendous potential" (OECD, 2008). Especially, broadband technologies are able to expand the use of internet, as it enables faster access and greater connection capacity (OECD, 2008). The following figure aims at illustrating the development of broadband technology in the BSR countries by measuring the number of subscribers to broadband connections per 100 inhabitants.

Figure 37: Change in the number of broadband subscribers per 100 inhabitants between 2000 and 2007



Source: WTI (2008)

In 2000, the use of broadband technology was marginal not only in the BSR countries, but also in the rest of Europe. However, since then, the use of the technology, which enables a faster and larger capacity for the user to access the internet, has expanded significantly. Yet, not only countries around the Baltic Sea have been able to keep up the same pace. Not surprisingly, the Nordic countries and Germany have displayed a greater capacity to adopt this new technology and are now at the forefront of Europe regarding broadband connections. The disparity between those five countries and the rest of the BSR countries is the most obvious one, but it shouldn't conceal other blatant disparities.

Indeed, Estonia and Lithuania can be said to belong to a group of close followers to the 5 most advanced countries. Estonia has reached a level that is close to the one of Germany, whereas Lithuania lies above the European average. Poland and Latvia belong to a third group of countries. The main reason for them to be lagging behind other countries is the relative late start of the broadband catching-up process. Indeed, whereas the rate of broadband connection started to expand in Estonia and Lithuania already in 2002, it only did so in Poland and Latvia in 2004. The relative late start of broadband expansion explains the relative lagging of these countries compared to their Baltic counterparts. Finally, Russia and Belarus belong to the fourth and last grouping of countries, where the state of broadband connections is still at its infancy.

The example of evolution of subscription to broadband in the different BSR countries highlights a rather common pattern when it comes to access to ICT: first, for a given technology, disparities between countries are shrinking rather quickly and can thus be qualified more as temporary disparities rather than persistent ones; second, the extent of disparities between countries at a given time depends essentially on the degree of maturity of the technology and the degree of advancement of the national economy, as more advanced economies will tend to adopt new technologies more rapidly.

Table 14: Category scores at the E-readiness index 2008

	Overall score	Thematic categories					
		Connectivity	Business environment	Social and cultural environment	Legal environment	Government policy and vision	Consumer and business adoption
Category weight	*100%*	*20%*	*15%*	*15%*	*10%*	*15%*	*25%*
Sweden	8,85	8,80	8,52	8,60	8,60	9,35	9,05
Denmark	8,83	8,70	8,65	8,67	8,60	9,85	8,60
Norway	8,60	8,20	8,01	8,27	8,30	9,35	9,15
Finland	8,42	7,70	8,62	8,40	8,30	9,00	8,60
Germany	8,39	8,20	8,36	8,00	8,30	8,20	8,95
Estonia	7,10	6,50	7,81	6,73	7,80	6,25	7,60
Latvia	6,03	5,60	7,10	6,20	6,90	4,70	6,10
Lithuania	6,03	5,00	7,09	6,33	7,20	4,70	6,35
Poland	5,83	5,05	7,16	6,20	6,60	4,70	5,80
Russia	4,42	4,10	6,19	5,33	4,20	2,85	4,10

Source: The Economist (2008)

In the previous section, the E-readiness index designed by The Economist provided an innovative way to benchmark BSR countries against the other European and world nations. Table 14 gives a more in-depth insight on the issue by detailing the scores of each BSR country for each of the 6 categories investigated, namely connectivity, business environment, social and cultural

environment, legal environment, government policy and vision and, finally, consumer and business adoption. The interest for having this table in the context of this present study is that it is able to highlight the respective strengths and weaknesses of each country when it comes to the Information Society.

Here are, in brief, the dimensions that each category highlights:

- Connectivity: physical communication infrastructure and share of the population accessing this infrastructure;
- Business environment: capacity to promote and facilitate electronic business;
- Social and cultural environment: degree of 'internet-literacy' and development of adapted education structure for improving knowledge and usage of ICT;
- Legal environment: assess the legal structure supporting firms' ability to transact business online;
- Government policy and vision: assess the dedication of governments to develop infrastructure networks and ensure fair competition for operators;
- Consumer and business adoption: measure the public spending on ICT and the penetration of ICT for businesses and individuals

(The Economist ,2008)

Although describing the results of table 14 for each country would be too detailed, it is nonetheless interesting to highlight some of the most instructive ones. For instance, one of the main drivers behind the high ranking of the Nordic countries appears to be the strong commitment of national authorities, as their score on the "Government policy and vision" indicator belongs to the world's highest. On the other hand, in Germany, it is the score on "consumer and business adoption" that pulls Germany in the world's top 15. In Estonia, the business and legal environments seems to be decisive in putting the Baltic State in the first half of the ranking. The same pattern is also perceived in Latvia and Lithuania, although to a lesser extent. Finally, in Poland and Russia, the business environment seems to be the indicator that lifts up their national overall score, while the relative weakness of the 'governmental' component tends to lower it.

5.3. Understanding the territorial dimension of ICT: Intra-national disparities

The previous sections have highlighted the processes leading to disparities between countries in terms of penetration of different information and communication technologies. As stated earlier, the disparities are the result of both hard (infrastructure) and soft (education) matters. However, these disparities are not dependent on the territorial settings of the different countries. Indeed, peripherality, when understood as long distance to the largest markets, does not play an important role in that process, as their in the field of ICT shows it.

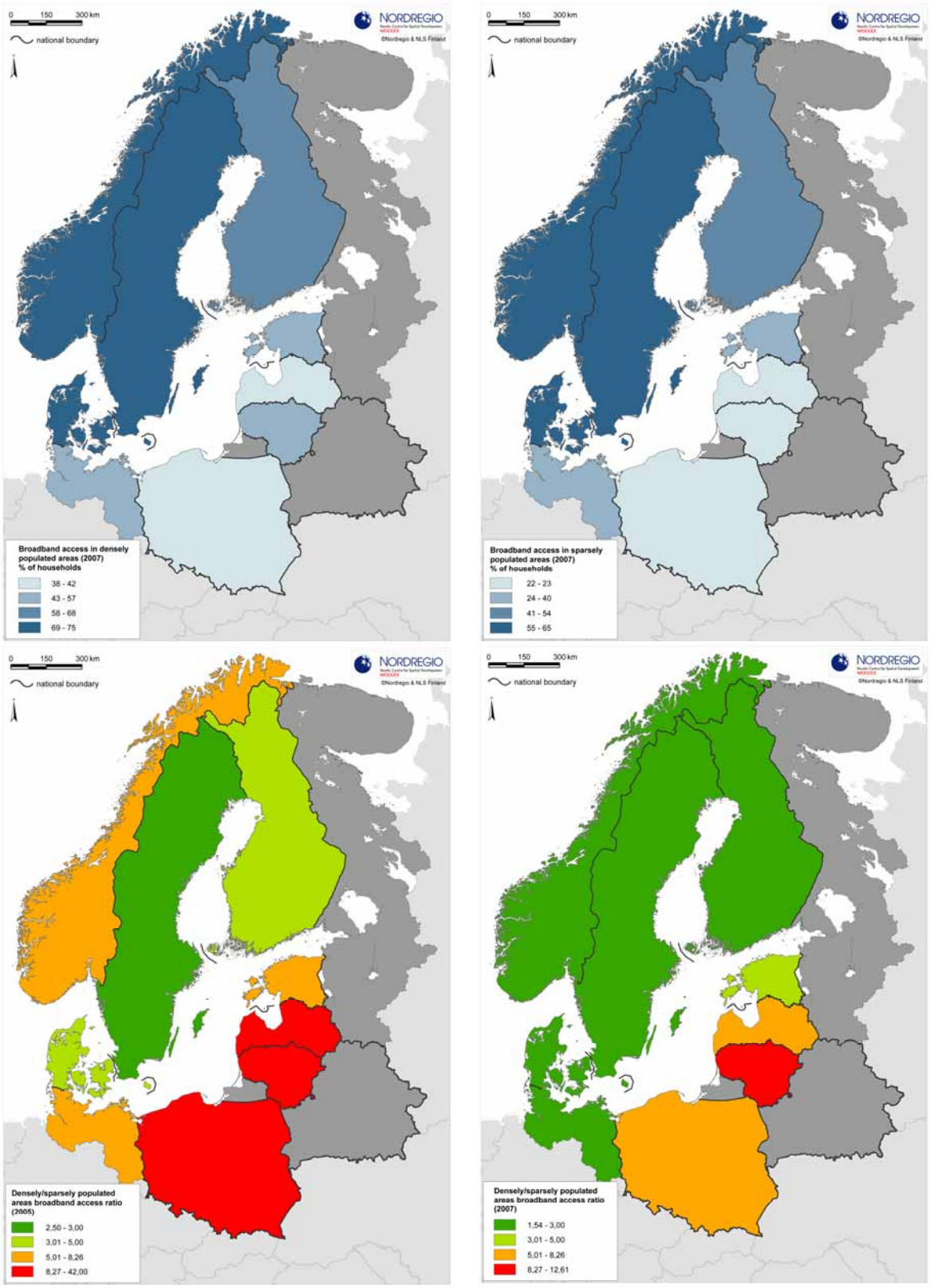
As the components of the E-readiness index show it, the capacity of nations to be not only involved, but also acting as drivers, of the information society depends strongly on the business, societal and policy environments. Yet,

enhanced disparities within countries reveal the territorial dimension of the ICT.

Indeed, the access of individuals to ICT services is still strongly influenced by the place where these individuals live. In concrete terms, this territorial dimension of ICT is expressed by the fact that access to broadband connections is more advanced in densely populated areas (more than 500 inh/km^2) than in sparsely populated ones (below 100 inh/ km^2). This assumption appears to be correct for all BSR countries.

Figure 38 hereafter illustrates this territorial dimension by measuring the usage of broadband connections in the two types of territories previously mentioned for 2007, as well as calculating the evolution of the ratio (densely/sparsely) between 2005 and 2007.

Figure 38: Share of households using broadband connection in densely and sparsely populated areas of the BSR



Source: Eurostat; Data not available for Russia and Belarus

When benchmarking (once again) BSR countries against each other for the broadband usage indicator in both territorial contexts, the picture reveals the same structure: Nordic countries are more advanced, followed by Germany and Estonia, and finally by Latvia, Lithuania and Poland. However, the calculation of the ratio densely/sparsely broadband usage, another picture appears.

Indeed, in 2005, the BSR could be divided into few categories depending on the extent of the disparities between densely and sparsely populated regions: Sweden belonged to the top category (i.e. with the smallest disparities in terms of broadband usage between densely populated and sparsely populated regions); Finland and Denmark to the second one; Norway, Germany and Estonia to the third one; and finally Latvia, Lithuania and Poland to the last one.

As for the 2007 ratio, we have used the same threshold for each category in order to better identify the countries that have moved from one category to another. And the conclusions are stunning: Sweden has been joined by Norway, Finland, Denmark and Germany in the top category; Estonia has moved to the second category; Poland and Latvia to the third category; while Lithuania was still belonging to the last category, although its ratio has been reduced by half.

In concrete terms, it shows that in the time span of only two years, all BSR countries have significantly reduced the disparities between the usage of broadband connections by households in densely and sparsely populated regions. Consequently, the 'digital divide', at least when it comes to broadband technology within the countries has been reduced.

6. Looking forward: Concluding discussion on accessibility

The aim of the present report was to provide an overview of the recent trends regarding transport, energy and Information and Communication Technologies in the Baltic Sea Region. The purpose of such a paper was to serve as an input for discussion for the future VASAB Long Term Perspective (LTP) process. Consequently, the thought end-users are the members of Committee on Spatial Development of the BSR as well as the member of the Working Group 2 (Accessibility) set up in the framework of the TACIS East West Window project.

Regarding the issue of accessibility, the aim of the report was to go beyond the traditional focus on transport infrastructure. Consequently, it has developed a wider focus by:

- integrating energy and ICT issues as fully-integrated components of accessibility strategies;
- highlighting the implications of accessibility, and essentially transport, challenges from the global to the local levels;
- benchmarking the challenges for different types of regions or countries in the BSR, and especially between metropolitan and sparsely populated (including islands) areas;
- emphasizing the necessity to view the needs for infrastructure improvements in the light of specific needs for regional development, e.g. mobility between regions.

The following recommendations will aim at reflecting these different aspects and provide guidance for the coming LTP-making process.

Transport - External accessibility

Our analysis has highlighted the necessity to increase the range and intensity of air connections from the main BSR airports of Copenhagen, Stockholm, Berlin, Warsaw and Saint-Petersburg, acting as BSR-gateways to global destinations in North America, Middle East and Asia. Moreover, in order to improve the capacity for flight-transfers to global destinations, it would be advisable to increase the intensity of air connections between these airports. Specific partnerships between regional authorities and main national carriers would be needed in order to achieve this. The rapid expansion of passenger and cargo transportation in the main BSR hubs puts a lot of pressure on the existing infrastructure. An assessment of the potential for expanding the capacity of these airports would provide important information for the potential for these airports to serve as the backbone of global air transportation in the BSR. Other airports of BSR dimension should develop air connections more targeted to European destinations and develop complementary profiles regarding reached destinations (Mediterranean, North West, Central, and Caucasian Europe).

The study has stressed the important role of seaports as connecting points of the BSR and its regions to distant markets (North America, China, India, and Japan). Currently, seaports on the Eastern shore of the BSR are the ones that have increased most significantly the volumes of transited cargo. The BSR should have a range of 5 to 10 seaports that are (1) equipped with modern

loading equipments, (2) endowed with direct connections to the road and rail systems and (3) able to handle a wide range of products such as containers, raw material, natural resources or manufactured goods. These seaports would act as the main gateways for long-haul shipment, i.e. able to connect their hinterland and neighbouring regions with faraway destinations.

Our study has shown, once again, the crucial importance of the railway network for improving the external accessibility of the BSR. Saint Petersburg is, in particular, of outmost importance for connecting the Asian (central Asia, China, Eastern Russia) and European railway system, enabling the transportation of freight on long distances. The delay of the completion of the TEN-T Rail Baltica project is the missing link with the most serious consequences for the whole region. This section of the TEN-T network should be highly prioritised for rapid completion as it is the backbone for the integration of railway systems in the East BSR. In addition, plans for upgrading the Tallinn-Saint Petersburg section are needed in order to secure a good connection between the TEN-T and Russian networks. To date, this section is the busiest in Europe regarding cargo transportation. Besides this essential north-south axis, the completion of alternative East-West routes may play an interface role between the natural resources-rich regions of North Russia to the large markets of North America. Projects such as Barents line and North East Cargo Link should be further supported.

Transport – Internal accessibility

The work performed for the WG2 has highlighted the main challenges concerning accessibility issues within the BSR. It has been highlighted that the primary road network, i.e. the network of motorways and highways, is still very fragmented in the BSR. In most countries, motorways only exist for connecting metropolitan regions to their close hinterland but do not continue much further. From a transnational point of view, the radial shape of national motorway systems do not enable to connect capital and metropolitan regions in neighbouring countries with high capacity road infrastructure. The lack of integration of the national road systems is especially felt at the local, cross-border level where bottlenecks and/or missing links prevent the good integration of regional economies and local labour-markets. It is thus necessary to improve the state of the road infrastructure in some key cross-border regions: Szczecin (Germany-Poland), Narva (Estonia-Russia), Kaliningrad-Gdansk, Vyborg-Imatra, Kirkenes-Murmansk (Norway-Russia). This is as well the case along most the Finnish-Russian border (East Finland – Republic of Karelia). In addition to these technical improvements, it is necessary to tackle the problem of long waiting times at the Russian and Belarus borders, which can amount to several hours for trucks and buses. The ease of administrative formalities is an important prerequisite for fostering greater interactions between the Schengen area and Russia-Belarus.

The study has highlighted the main issues concerning the integration of railway networks in the BSR: differing technical standards (1520mm for Russia, Belarus, Baltics, Finland and parts of Poland; 1435mm for other regions), different degree of modernism of infrastructure (electrification), different capacity on sections of the same line (single or double track). Because of its very technical character, the integration of BSR railway networks necessitate a strong transnational co-operation enabling to set up objectives for upgrading

jointly and simultaneously sections belonging to the same line. This is especially the case between North West Russia and the three Baltic States, but as well between Germany and Poland and Poland and Lithuania. The integration of the two gauge systems should be made via the use of new generations of trains (locomotives and wagons). The upgrade of the Tallinn-Saint Petersburg line from the 1520mm to the 1435mm gauge would enhanced the integration of Saint Petersburg with its East BSR neighbours and beyond to the rest of the EU. The development of East-West through North West Russia and the Nordic countries should be promoted.

Maritime transportation has been flagged as of outmost importance by the project findings. Maritime routes are essential for connecting cities and regions on each side of the Baltic Sea. It enables not only East-West connections (Stockholm-Riga, Stockholm-Helsinki, Gdynia-Karlskrona) but also long-haul North-South connections (Travemunde-Helsinki, Rostock-Liepaja). These connections are very important for tourism exchanges and passage of lorries from one shore to another. There is a strong potential to further develop such "motorways of the sea", especially when it comes to connections from Kaliningrad and Saint Petersburg. Yet, maritime routes may play an important role in integrating regional communities separated with a strip of water. This is for instance the case between Helsingor (DK) and Helsingborg (SE), between Tallinn and Helsinki and between Puttgarden (DE) and Rødby (DK), where these short-haul maritime connections are essential for the integration of local labour-markets. Some neighbouring areas in the BSR have the potential to develop such integrated 'cross-water' regions: Kaliningrad-Gdansk, Saint-Petersburg-Tallinn, Tammuna-Ventspils… Inland waterways in Finland, Poland and Lithuania play a significant role for connecting the inland to the coastal areas. The capacity of these waterways should be maintained and developed in order to foster a balanced development throughout the BSR and not only localised on the coastal areas.

Finally, air transportation has been shown to have a significant role for bridging the Baltic Sea. Dense networks exist between airports of the Nordic metropolitan areas. Another cluster integrating Helsinki with the Baltic States and Poland has emerged recently. These clusters enable to highlight the privileged relationships between BSR countries. To date, North West Russia and Belarus are not significantly inserted in those networks. More air connections from and to Saint Petersburg would boost the possibility for interactions for individuals and businesses. Increased flexibility for the approval of visa would have positive effects as well. The development of more transnational connections from Murmansk to cities in Northern Fenno-Scandia would foster its integration with its neighbouring regions. Finally, the development of more connections from the German cities of Hamburg and Berlin would provide better possibilities for individuals and businesses in the BSR to be connected to Northern Germany.

Energy – Networks

The study has pictured the current state of the main energy infrastructure in the BSR. In a historical perspective, countries around the BSR have adopted different standards when it comes to electricity transmission grids. The variety of voltages used on the different lines increase the difficulty of created a fully integrated BSR transmission grid. To date, there are few connections between

the transmission grid systems of the Western and Eastern shore of the BSR. This low number of trans-BSR connections increases the vulnerability of the whole system to possible temporary disruptions at specific nodes. The possibility for completing more East-West connections should be investigated and promoted. This could be achieved under the supervision of an inter-BSR body, on the same type as the Nordic co-operation Nordel, able to coordinate separate national actions and aiming at integrating technical standards across the BSR. The possibility to complete more underwater line, connecting the Baltic States and Poland to Sweden should be investigated as well.

The study has shown that there is a dense network of pipelines from Russia to the Baltic States and Poland. Some of these pipelines are no more in use, and it would be necessary to define common actions for refurbishing or removing these pipelines depending on their foreseen usage in the future. This could be mediated by the CSD in co-operation with national ministries responsible for energy.

Energy – Production and consumption

One of the objectives of the study was to map and analyse the patterns of energy production and consumption in the BSR. These patterns enable to highlight possible energy flows between large energy producer regions and large energy consumer ones. In that respect, metropolitan areas have shown to be strongly dependent on other regions for their energy supply: the lack of space and the lack of underground resources imply that their endogenous production is low, while the need of combined needs of their households and businesses is huge. Consequently, for individual countries, the concern of securing the energy supply to the 'engine' of their respective national economy need drastic measures outside of these areas. First of all, it is necessary to better exploit the territorial energy capital of each region, and especially regarding renewable energies. The coasts of Poland and the Baltic States are still lacking major investments in wind power stations. In that regard, a closer partnership between these countries and Germany and Denmark, which are European leaders in the field, is advisable. More over, the Baltic States do not use at all the potential of municipal and industrial wastes to produce energy: developing such systems would ensure less energy dependency and better environmental conditions. In Sweden and Finland, the development of further energy production such as wind power and geothermal energy should be promoted, taking advantage of the large open spaces available in those countries.

When it comes to energy consumption, the most urgent to further reduce the consumption of oil products, both in the light of the issues of energy dependency and climate change. It has been shown that many countries have reduced their consumption of oil products. Yet, it has also been shown that traffic on BSR roads has steadily increased over the last decade: transport is one of the largest sectors consuming oil products. A reduction of oil-products consumption should mainly be tackled at the level of the transport system. This should be tackled by (1) reducing the need for car travel around the largest metropolitan regions, where most of the traffic takes place, this can be done by fostering the development of local/regional transportation systems and best practices through joint projects (Interreg for instance), (2) developing oil-friendly (rail) pan-BSR corridors connecting the main BSR metropolises and (3)

promoting piggy back solutions for the transportation of freight between metropolises on trains rather than on lorries.

ICT – Infrastructure and usage

The results of the study have shown that the main disparities in terms of ICT usage are to be found on relatively emerging technologies, such as broadband, both between countries and between metropolises and more peripheral areas. Although these disparities have been shown to be rather temporary, they nevertheless represent a temporary competitive advantage for some countries and regions (e.g. Stockholm or Helsinki). This pattern is repeated over time for the different waves of ICT development. It is pressing to develop a sustained collaboration at different levels of governance in the BSR. At the national levels, it is necessary for BSR countries, and especially between EU/EEA countries and Russia-Belarus, to develop joint regulations fostering the integration of the ICT networks with regards to both physical infrastructures (e.g. fibre optics cables) and software applications, facilitating flows of large volumes of data between countries. The national levels should as well ensure that different national operators have the possibility to develop services in other BSR countries. Development of joint ventures between national operators is a possible solution.

At the regional level, it is necessary for regional authorities to develop strong partnerships with national and local/regional operators in order to secure a good coverage of the population. The target of 100% of the local population covered by mobile phone, internet and broadband services should be set as the norm. In the case of cross-border regions, there would be a strong gain in promoting the integration of local/regional networks, thus reducing the coast for infrastructure investment and increasing the size of potential consumers and thus increasing the profitability of the operations for private companies. The development of such cross-border services should be facilitated by the setting up of Interreg IVA projects on that particular topic. The CSD could provide advice to local and regional communities for setting such projects.

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