Bothnian Green Logistic Corridor

RBGC

STRATEGIC TRANSPORT NODES AND LINKS IN THE BALTIC SEA REGION

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Foreword

Lisätään myöhemmin!!

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1. Introduction

The aim is to develop the Bothnian Green Logistic Corridor (BGLC) as the most significant sustainable freight transport route in northern Europe, along which different modes of transport will reinforce each other and together serve as a well-functioning transport system. The objective of the Bothnian Green Logistic Corridor is to increase the integration between northern Scandinavia and the Barents Area with the industrial chain and end markets in the Baltic Sea Region and Central Europe.

The Rail Baltica Growth Corridor (RBGC) project works for fostering the competitiveness of the Baltic Sea Region by improving accessibility in the eastern part of the Baltic Sea Region. The Rail Baltica Growth Corridor addresses the problems of inadequate and underdeveloped transport connections in the Eastern Baltic Sea Region, especially in the north-south direction.

The main goal of the study is to identify the strategic transport nodes in the Baltic Sea area (BGLC and RBGC project area) using the nodes of the TEN-T Core Network as a starting point. The purpose of the study is to identify significant indicators for strategic nodes in passenger and freight transport. This is followed by the compilation and analysis of statistical data and creation of suitable methodology for creating the lower level strategic transport network in the Baltic Sea Region.

The study area area consists of the impact area of the Bothnian Corridor (Finland, Sweden) and the Rail Baltica Corridor (the Baltic Countries and northern Poland) and their extensions to neighbouring countries (Norway, Denmark, northern Germany).

2. Revision of the TEN-T guidelines

The TEN-T network is expected to contribute to a wide range of goals including the sustainable mobility of persons and goods and the enhancement of both the internal market and the global competitiveness of the Community. At the same time, the development of the TEN-T network will ensure territorial, economic and social cohesion, social welfare, safety and security for European citizens taking into account environmental aspects, such as climate change, pollution and protected areas.

In its Green Paper "TEN-T policy review – Towards a better integrated trans-European transport network at the service of the common transport policy", which was published in 2009, the Commission had proposed three planning options and emphasized the need to enhance the relevant financial and non-financial instruments to ensure effective and timely implementation of the TEN-T network.

The public consultations on the Green Paper and the positions of the EU institutions have supported the proposed dual layer planning approach, consisting of the Comprehensive Network and the Core Network. The fairly dense Comprehensive Network of rail, road, inland waterways, ports and airports, which constitutes of the significant parts of corresponding national networks, would be maintained as the basic layer of the TEN-T network. The Core Network, as a subset of the Comprehensive Network would overlay it and represent strategically the most important part of the trans-European transport network.

The Comprehensive Network would essentially result from an updating and adjustment of the current TEN-T network and directly reflect the relevant existing and planned infrastructure in the member states. On the other hand, the Core Network would be defined on the basis of a European planning methodology.

In this work, the TEN-T Core Network serves as a starting point for identifying the strategic nodes and links in the Baltic Sea region.

2.1 Description of the future TEN-T Core Network

The TEN-T Core Network represents a long-term target and shall be multimodal at the level of both nodes and corridors, facilitating intermodal transshipment and efficient and sustainable co-modal mobility and logistic chains. It should comprise those parts of the Comprehensive Network, which are of high strategic importance for the European Union.

The overall objective of the Core Network is to enhance the “European added value” of the TEN-T network. This is defined as a benefit, that goes beyond those achieved at national level and includes not only economic benefits, but also those derived in the cohesion, environmental and safety and security areas.

The Core Network should be conceived as a functional network reflecting the long-term needs of the Community. Therefore it should remain stable over a reasonably long period, to allow for investment needs and projects to be derived from European-wide perspective.

Accordingly, the Core Network should be developed on the basis of a methodology, which reflects, as far as possible, the state of the art in strategic infrastructure planning taking into account the various objectives laid down in the Treaty on internal market and global competitiveness, territorial cohesion, sustainable transport and de-carbonisation.

The Core Network will consist of two pillars: the geographical pillar and the conceptual pillar.

The geographical pillar of the Core Network will:

- span the entire EU in a coherent way, with the individual elements linking up to form continuous axes reflecting relevant existing or potential long-distance and/or border-crossing traffic flows, without giving automatic preference to any particular spatial orientation
- include the main gateway ports and airports
- connect the important nodes within the EU
- be linked to the corresponding infrastructure in neighbouring countries and regions, in order to connect the Union with the markets beyond its borders.

The Core Network will therefore be made up of nodes and links of high European strategic importance in the geographical sense. It will take into account the specific needs of different types of traffic, such as passenger and freight, along major long-distance and international corridors including traffic flows to points outside of the EU.

The conceptual pillar will comprise a methodological tool to allow for the inclusion of non-geographical technical or infrastructural attributes into the network. These attributes will enhance the efficiency of operation consistent with the objectives of EU transport or other relevant policies, such as de-carbonisation, interoperability, safety and security and sustainability. These attributes could include the necessary infrastructure components for efficient capacity management including innovative technologies and ITS applications.

2.2 Methodology for defining the TEN-T Core Network

Within the TEN-T policy review, the establishment of a scientifically-based, transparent planning methodology constitutes a first phase in identifying the elements of a sustainable, strategic, multimodal Core Network for the European Union. Such a methodology must be based on criteria which are consistent with the various relevant objectives.

The suggested criteria for nodes and links, which shape the TEN-T Core Network configuration include:

- geographical or spatial aspects (spatial integration and accessibility)
- external and global trade flows (large ports and airports and the major overland corridors to neighbouring countries will be the natural elements of the future Core Network)
- passenger and freight traffic flows and customers' needs (long-distance and/or border-crossing traffic volumes are relevant for the selection of the elements of the future Core Network)
- Inter-connectivity and multimodality of the network (the Core Network configuration should be coherent allowing direct interaction between the individual links within and between corridors and seamless inter-connectivity between the available modes at all major nodes)
- ecological issues (mitigation of greenhouse gas emissions or de-carbonisation is a major policy objective, which has relevance for all modes at all strategic planning levels).

The criteria for dimensioning and equipping elements of the TEN-T Core Network consist of:

- passenger and freight traffic demand, customers' needs
- removal of bottlenecks
- reduction of travel times and improvement in punctuality and reliability
- ecological issues
- traffic safety
- traffic management, logistics, co-modal services.

2.3 Identification of the main nodes in the Core Network

The main nodes are of the highest strategic importance in the EU and they are identified in the first step of the planning procedure. There are two classes of main nodes:

- primary nodes, which determine the overall network configuration
- secondary nodes, which are parts of primary nodes or result from shaping the network.

The nodes of the Core Network are identified in the following steps (nodes are primary unless otherwise indicated).

A. Main nodes for passenger and freight traffic (urban nodes)

1. The capital city of each EU Member State.
2. Every “MEtropolitan Growth Area” (nodes classified as MEGA in the ESPON Atlas 2006).
3. A conurbation or city cluster, which including the corresponding environs as defined by the corresponding LUZ (“Larger Urban Zones”, according to Urban Audit and EUROSTAT) exceeds one million inhabitants.
4. The main border crossing point of each available mode of transport, between each EU Member State and its non-EU neighbours. (in many cases, this will coincide with the points where the Major Axes specified in the Communication from the Commission “Extension of the major trans-European transport axes to the neighbouring countries - Guidelines for transport in Europe and neighbouring regions”, cross the external border of the EU.)

Urban nodes play an important role within the multimodal Core Network with regard to their infrastructure for both passenger and freight traffic. Apart from their wide range of economic, social and cultural functions, they are particularly relevant in the following respect:

- they connect network links – both of the Core and the Comprehensive Networks;
- they interconnect transport modes, and thus enhance multimodality;
- they connect long distance and/or international transport with regional and local transport (passengers and freight).

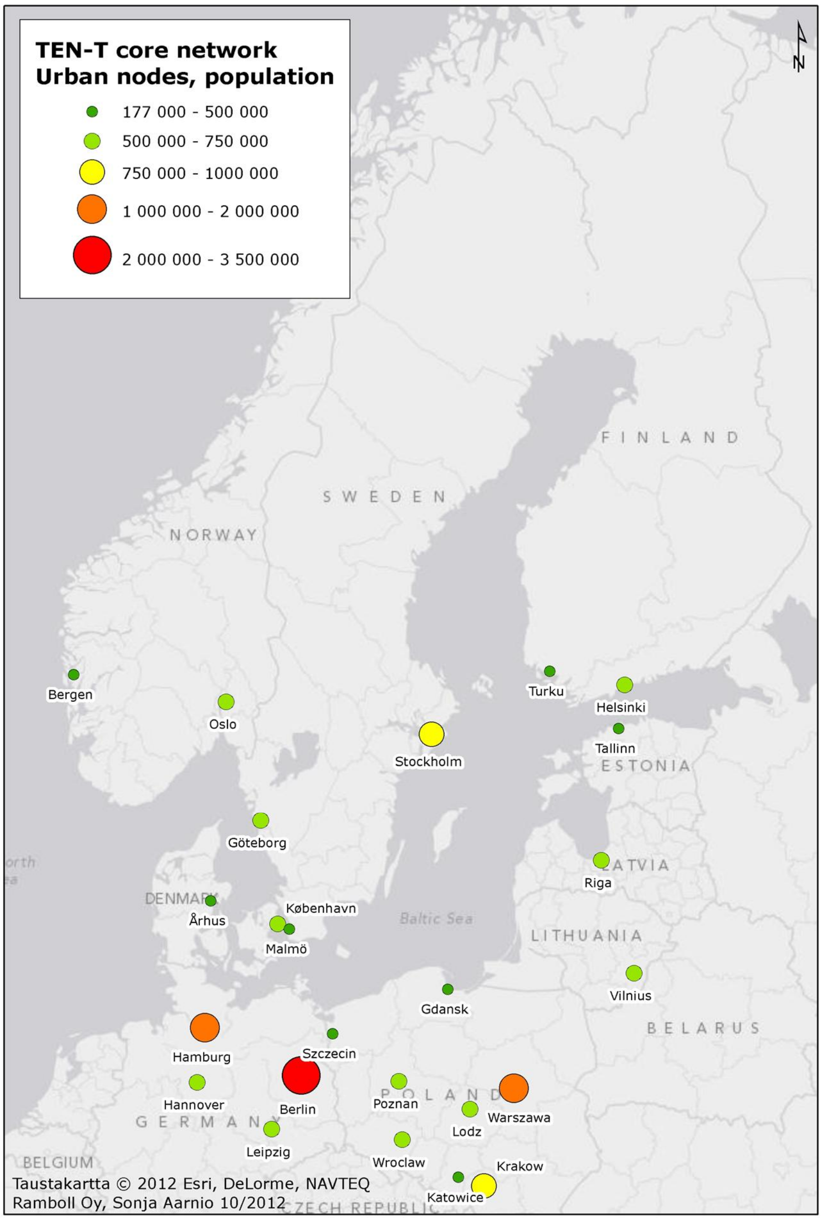

Figure 1. TEN-T Core Network main nodes for passenger and freight traffic (urban nodes) in the Baltic Sea Region.

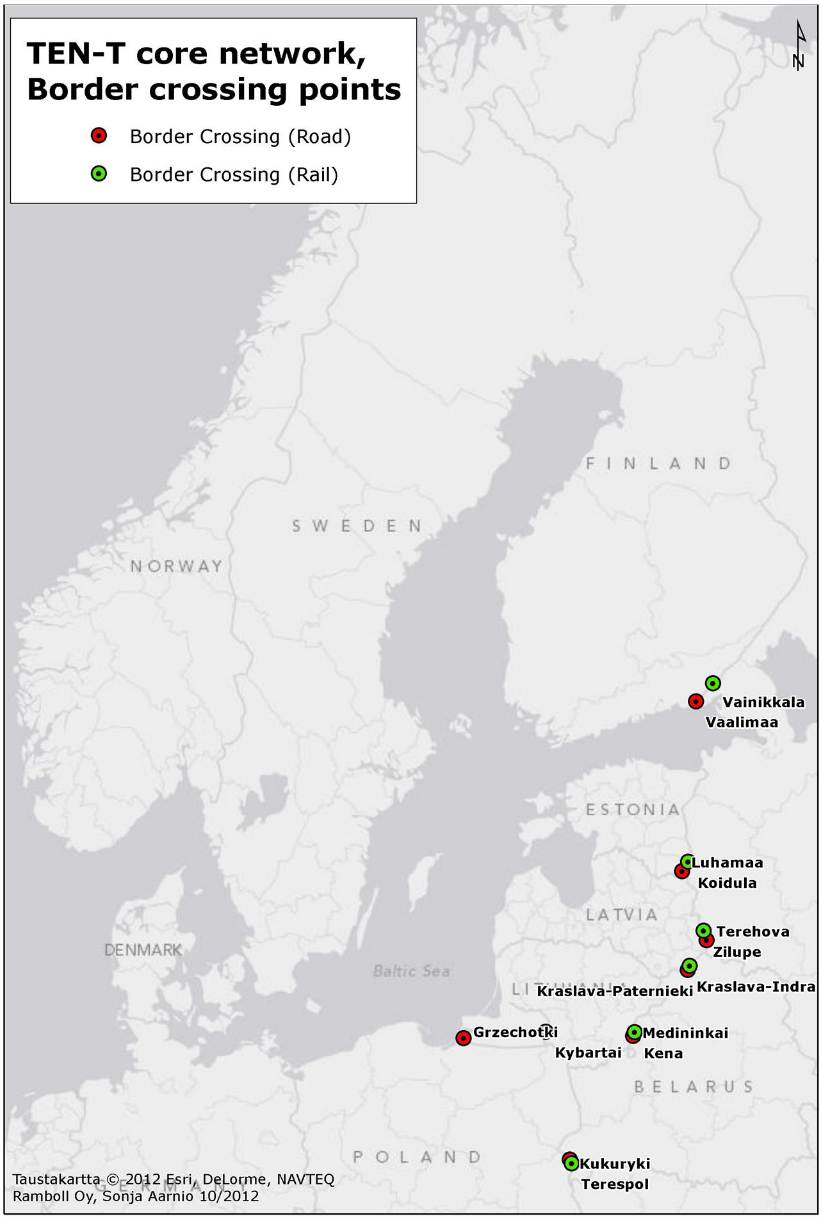

Figure 2. TEN-T Core Network border crossing points in the Baltic Sea Region.

B. Main nodes for freight traffic only

1. A sea or inland port or a road-rail terminal of an urban main node according to one of the criteria A.1–A.3.
2. A sea or inland port with an annual transshipment volume of at least 1 % of the total transshipment volume of all EU seaports, based on a linear interpolation between bulk and non-bulk.
3. In insular member states or NUTS 1 regions with access to the sea, where no ports are classified according to the criteria B.1 or B.2, as a general rule, along each continuous coastline only one seaport is classified as a main node. It shall be the largest such port, however taking into account also hinterland connectivity.
4. Ports on islands, which are not member states on their own, in general do not qualify as main nodes since their hinterland connections, if in the TEN-T at all, typically belong to the Comprehensive Network.
5. Inland ports, which have relevant interface function to Core Network rail links for freight, are classified as main nodes for freight traffic (secondary node).

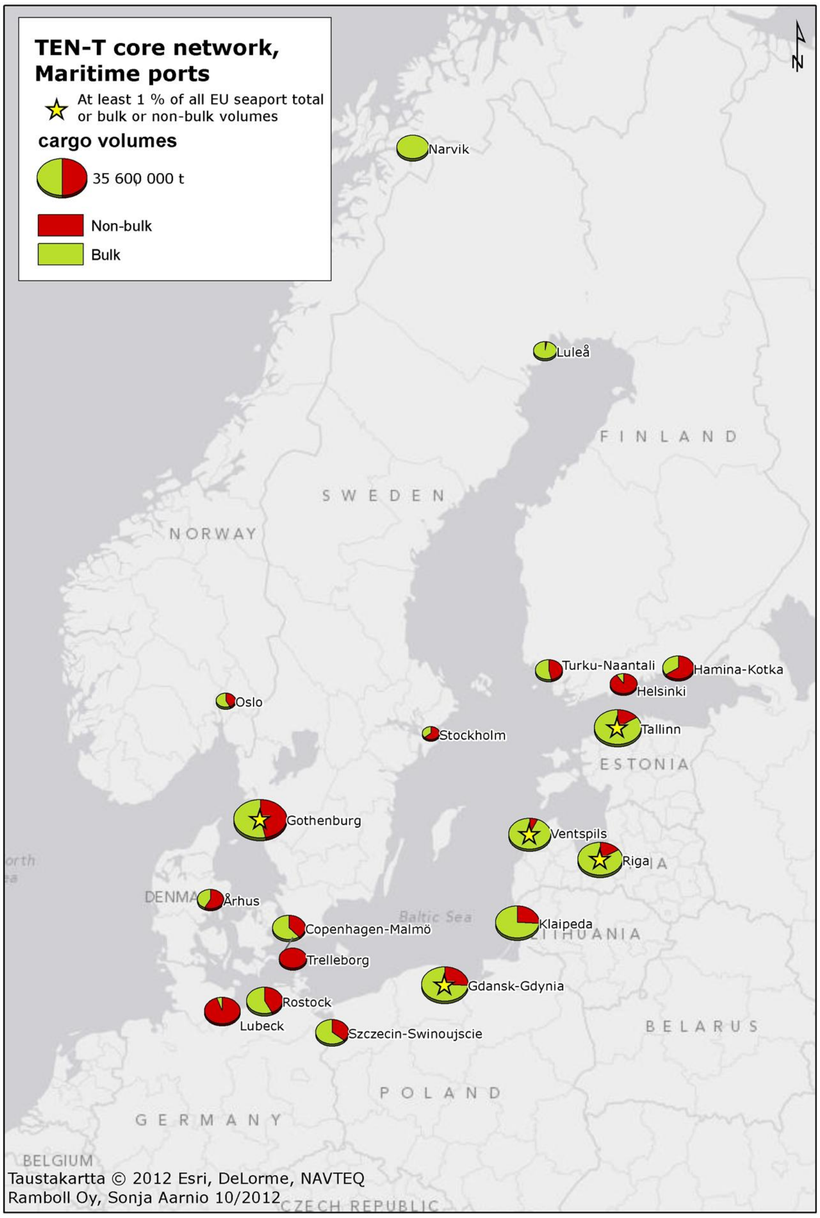

Figure 3. TEN-T Core Network main nodes for freight traffic only in the Baltic Sea Region.

C. Main nodes for passenger traffic only

1. The airports of urban main nodes according to A.1 – A.3. Among these airports, those which exceed 1 % of the total annual passenger volume within the EU have to be connected to the railway network, latest by end of 2050.
2. The cities relative to seaports qualified for the Core Network according to the criteria B.2 or B.3, if their population exceeds 200.000 inhabitants of the corresponding larger urban zone (LUZ).
3. Seaports qualified for the Core Network according to the criteria B.2 or B.3, if they show to have a bridgehead function for passenger ferry connections within maritime links of the Core Network (secondary node).

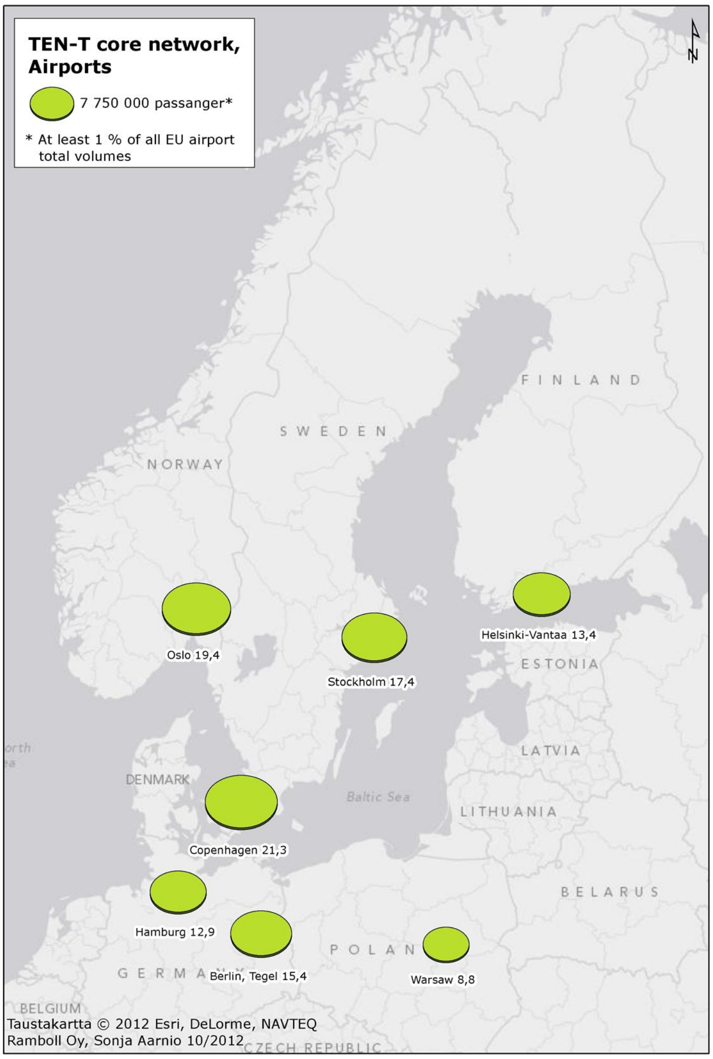

Figure 4. TEN-T Core Network main nodes for passenger traffic only in the Baltic Sea Region.

2.4 Identification of links in the Core Network

The land-based Core Network links (road, rail) will be complemented by the “Motorways of the Sea”, to give due access to insular Member States and to shortcut connections to/or between peninsulas. The Core Network links shall be of highest importance for long-distance traffic and play a strategic role for the development of the TEN-T network. Thereby, they contribute to a homogenous and balanced accessibility throughout the Union.

D. Links for passenger and freight traffic

1. Neighbouring urban main nodes according to A.1 – A.3 shall be connected with each other by road and rail. (Two main nodes are considered as “neighbouring”, if the corresponding relevant (existing and/or potential) traffic flows between them follow a direct line, not passing through a third main node located somewhere in between). More distant main nodes will thus be indirectly connected with each other, by which the network is formed.
2. Border crossing points according to A.4 are connected with their corresponding hinterland main nodes following the relevant traffic flows.

E. Links for freight traffic only

1. Seaports according to B.2 or B.3 shall be connected to only one hinterland main node each, corresponding to the most relevant traffic flows. Basically, connections between ports are not foreseen, but may result from the overall itinerary of a Core Network link. In countries where railways exist, hinterland connections of ports of the Core Network must include both road and rail.
2. The local links of sea and inland ports as well as road-rail terminals according to B.1 and B.4 ("last miles") are considered part of the Core Network.

F. Links for passenger traffic only

1. In member states, which have railways, airports have to be connected to the rail network by end of 2050, if their annual passenger volume exceeds 1% of the corresponding EU total.
2. Seaport cities according to C.2 and seaports with special importance for passenger ferries within the Core Network according to C.3 shall be connected with their corresponding hinterland urban node.

Omission of links

Core Network links according to D.1, D.2, E.1, E.2, F.1 or F.2 shall not be foreseen, if:

1. The link is not existing ("missing link"), but its implementation would not be justified by its function, e.g. within a potential trans-European transport corridor, or feasible by 2030;
2. The link exists, but does not comply with the requirements of its intended function within the Core Network and its upgrading would not be justified by its function, e.g. within a potential trans- European transport corridor, or feasible by 2030;
3. In particular, if the required measure would not be economically viable or environmentally sustainable. Applying these criteria for the modes individually, this will exceptionally allow for deviating from the principle of multimodality at the level of links. There may be links, which comprise only road or rail. The "Motorways of the Sea" will be a building block of the maritime dimension of the future TEN-T.

Criteria for the routing of the links

1. Only links of the Comprehensive Network may be selected for the Core Network.
2. Links should be as straight and direct as possible, to follow the relevant long-distance traffic flows, to enhance effectiveness and efficiency of transport, to support territorial cohesion and to contribute to the reduction of greenhouse gas and polluting emissions as well as to sustainable land use.
3. Detours would be justified to by-pass unavoidable obstacles and ecologically sensitive spaces (such as Natura 2000 sites) and to string additional smaller cities, airports, freight terminals, etc., if not too distant from the direct line and if the disadvantages due to additional detours do not exceed the benefits of improved regional or local accessibility.
4. The links should follow, as far as possible, already existing infrastructure, under construction or planned. Traffic flows shall be bundled wherever possible, taking into account topographical conditions, environmental impacts, users' needs and potential capacity constraints.
5. Rail links may be split into two different itineraries for passenger and freight transport, taking into account specific technical parameters (gradients, speed) and particular operational situations such as by-passes of areas with high passenger traffic.

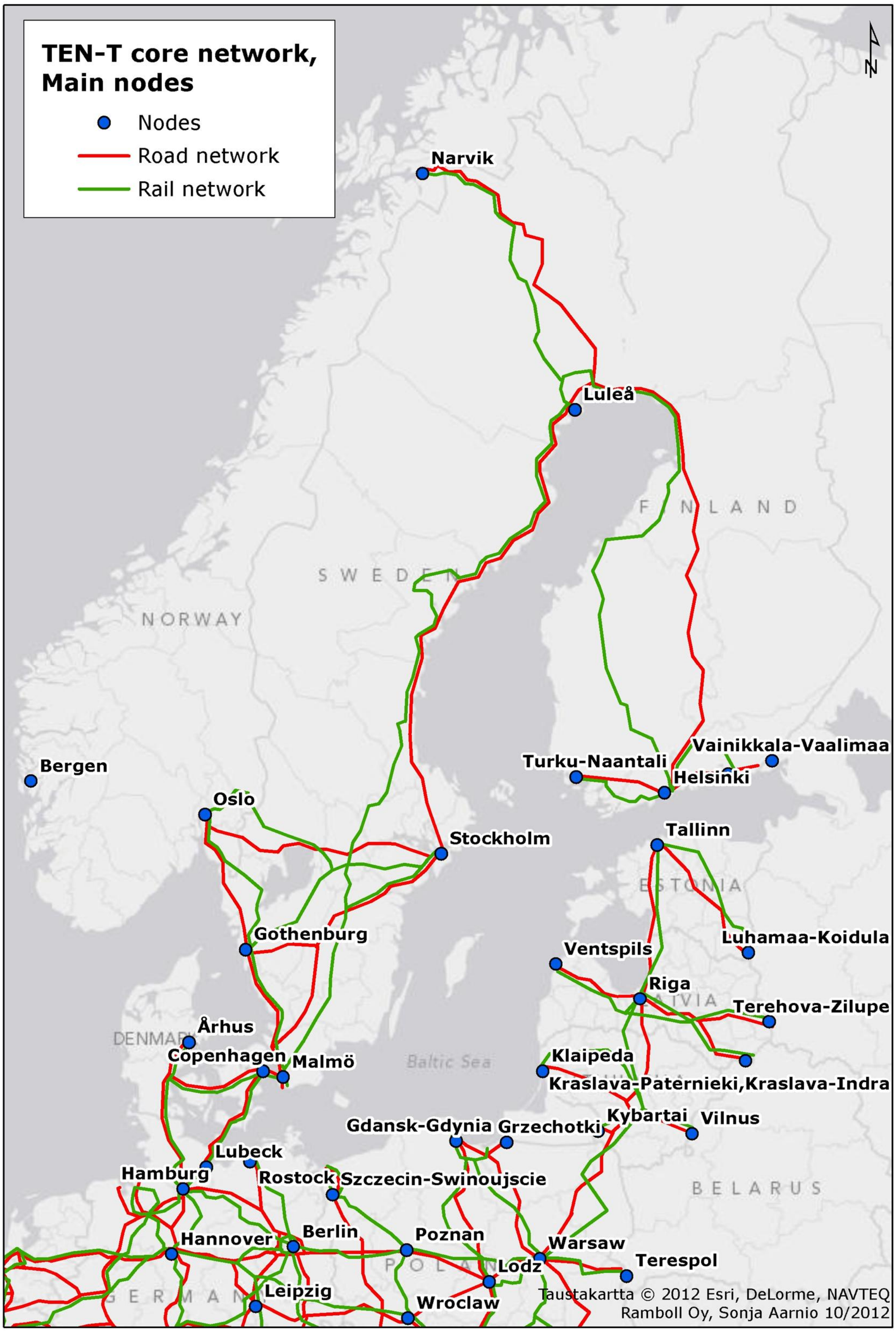

Figure 5. TEN-T Core Network main nodes and links in the Baltic Sea Region.

2.5 Description of the ongoing revision process of the TEN-T guidelines

The TEN-T transport networks of the EU are regulated by the guideline decision and the financial regulation approved by the EU Council and Parliament. The existing guideline decision was made in the year 1996. The first revision of the decision was made in the year 2004 taking into account the EU enlargement and the expected changes in traffic flows. The appendix of the guideline decision included a list of 30 priority projects, which are preferred in the allocation of EU financing. The High Level Group also made a decision in the year 2005 on the extension of the major trans-European transport axes to neighbouring countries and regions. In this context, the Commission was put under obligation to make a proposal on necessary revisions in the year 2010.

The European Commission started the preparation of the revision of the TEN-guidelines by publishing the Green Paper in 2009, in which it sought answers for the foundation of the future development of the trans-European transport network. The Green Paper proposed three network planning options (dual structure with the wide TEN-T "Comprehensive Network" and updated Priority Projects; Priority Projects only; a new dual layer structure comprising the "Comprehensive Network" and a "Core Network"). The content of the Green Paper was analyzed with the Member States during the year 2009, and in the interest of clarity, the European Parliament and the Council adopted a recast of the TEN-T Guidelines in the year 2010.

In February 2011, the Commission presented a staff working document to the Council and European Parliament, which further developed the methodology, planning and implementation scenarios.

As a follow up of the EU 2020 Strategy, the Commission adopted the White Paper, towards a competitive and resource efficient transport system in March 2011. This strategy sets out to remove major barriers and bottlenecks in many key areas across the fields of transport infrastructure and investment, innovation and the internal market. The aim is to create a Single European Transport Area with more competition and a fully integrated transport network, which links the different modes and allows for a profound shift in transport patterns for passengers and freight. The White Paper aims at dramatically cutting carbon emissions in transport by 60% by the year 2050.

In December 2011, the Commission adopted a proposal for the regulation of the European Parliament and of the Council on Union guidelines for the development of the trans-European transport network. The goal of the proposal is to transform the existing patchwork of European roads, railways, airports and canals into a unified transport network (TEN-T). The new Core Network will remove bottlenecks, upgrade infrastructure and streamline cross-border transport operations for passengers and businesses throughout the EU. It will improve connections between different modes of transport and contribute to the climate change objectives of the EU.

This proposal has been discussed in the Working Group of the European Council and a general view of the proposal was obtained from the Council in March 2012. The proposal has been revised to be more flexible and functional with regard to the demands for the transport networks and deadlines for implementation.

Discussions and hearings on the proposal will be held in the European Parliament in the autumn of 2012. The final proposal is expected to be presented for approval in the spring/summer of 2013 and the ultimate goal is to adopt the revised TEN-T guidelines in the beginning of the year 2014. It is planned that the revision of the TEN-T Core Network will be conducted in the year 2023.

3. Significant nodes in the Baltic Sea Region

Even if the geographical setting of each city varies considerably, the urban form and its spatial structure are articulated by two structural elements: nodes and links. Nodes are reflected in the centrality of urban activities, which can be related to the spatial accumulation of economic activities or to the accessibility to the transport system. Terminals, such as ports, train stations and airports, are important nodes around which activities agglomerate at the local or regional level. Nodes have a hierarchy related to their importance and contribution to urban functions, with higher order nodes, such as management and retailing, and lower order nodes, such as production and distribution. (ESPON 2007).

3.1 Identification of significant nodes in passenger traffic

The significance of a node in passenger traffic can be determined by the generation and attraction of passenger trips using different modes of transport. Passenger traffic volumes are related to the size of the node (for example measured by population and employment) and location of the node (for example measured by accessibility).

Trips in passenger traffic can be classified by trip purpose into the following common categories:

- work trips (trips between home and work places/production sites)
- business trips (trips to different public and private services)
- shopping trips (trips to retail units and shopping centres)
- educational trips (trips to schools, universities and research institutes)
- leisure trips (trips to tourist attractions)
- social trips (trips to visit friends and relatives).

In order to assess the significance of various nodes, a set of indicators is identified for the purpose of this study. The goal is that the identified indicators would reflect the different categories of trip purposes in passenger traffic, and thus comprehensively indicate the significance of a particular node.

The criteria and methodology used in the ESPON study (ESPON 2007) for the characterization of functional urban areas were applied to a certain extent in this study. However, unlike in the European-wide ESPON study, the study area here was confined to the Baltic Sea Region, which caused for adjustments and revisions in classifying and interpreting the results of each indicator.

Some of the smaller cities located in the metropolitan areas of national capital cities (for example Helsinki, Stockholm, Oslo, Copenhagen and Berlin) have been integrated to one major city in data collection and analysis.

3.1.1 Criteria and indicators for significant nodes in passenger traffic

The following criteria have been used in evaluating the significance of nodes in passenger traffic:

- population & regional economy
- administration & central location
- education & knowledge
- culture & tourism.

For each criterion, 2-3 indicators have been identified and corresponding data has been compiled to measure the role and significance of each node (figure 6). Multi-criteria analysis has been used to make comparative assessment between different measures. An indicator-specific index has been calculated for each indicator and a total index has been estimated for each group of criteria as a result of indicator-specific indexes.

A hierarchical weighting approach has been applied, in which relative weights have been determined for each indicator and then for each group of criteria depending on their estimated contribution to the significance of nodes in passenger traffic. The maximum score is 10 within each group of indicators and within each group of criteria.

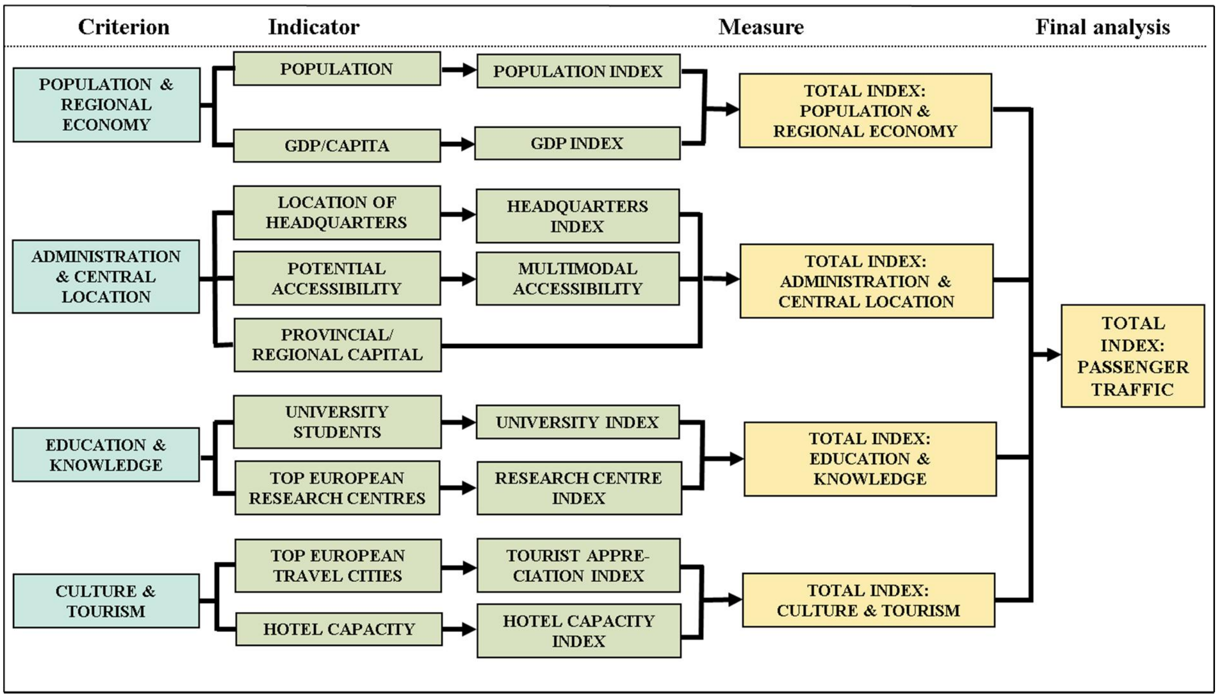

Figure 6. Criteria and indicators for determining strategic nodes in passenger traffic.

Population & regional economy

Two indicators were identified for the criterion "population & regional economy": population and GDP/capita. Population describes the size of the node, and thus reflects the passenger traffic volumes within urban areas. Gross domestic product/capita can be justified as an indicator to reflect the spatial accumulation of economic activities within urban areas.

With regard to the trip purpose categories, population and GDP/capita reflect the number of work trips between home and work places/production areas within the urban areas.

The main sources of data for these indicators include the EUROSTAT data base and national data bases.

Population has a maximum score of 6 and GDP/capita has a maximum score of 4 in defining the total index for this group of criteria. The weighting coefficient of the criterion "population & regional economy" is 5 among all groups of criteria in final analysis. The ranking of nodes according to the criterion "population & regional economy:" is presented in Appendix 1.

As the population of cities has a higher weight than GDP/capita, large cities, for example, in continental Europe tend to have higher position in overall ranking. However, GDP/capita is higher in the Nordic countries than, for example, in the Baltic countries and Poland, and thus has a balancing effect between different regions. GDP/capita also varies between cities in each country and therefore also reflects national distinctions.

It should also be noted that GDP/capita is a better indicator to demonstrate economic activity within an urban area than, for example, employment, which has a high degree of correlation with population.

Administration & central location

Three indicators were identified for the criterion “administration & central location”: number of headquarters among the 2000 largest companies in the world, or among the 500 largest companies in Europe, administrative functions of a city (provincial or regional capital) and potential multimodal accessibility

The headquarters of the largest companies are listed by composite scores based on their rankings for sales, profits, assets and market value. The location of headquarters in a particular city describes the internal functions and concentration of decision making functions. With regard to the trip purpose categories, the number of large company headquarters reflects the number of business trips to private services. The main sources of data for the headquarters of the largest companies include the Forbes listing of the 2000 largest companies in the world (2011) and the Financial Times listing of the top 500 companies in Europe (2010).

The administrative functions of cities at different regional levels are reflected by their role as a provincial or regional capital. The classification of cities by their administrative functions is based on the hierarchical NUTS classification for dividing up the economic territory of the EU as follows[1]:

- provincial capital city (NUTS 2 level)
- regional capital city (NUTS 3 level).

It should be noted that the national capital cities have significant administrative functions. However, national capitals are excluded from the analysis due to the fact that they also usually have the administrative functions of provincial and/or regional capitals.

Accessibility of a node is indirectly a measure for the potential for activities and enterprises in the region to reach markets and activities in other regions. Potential multimodal accessibility is calculated by integrating the accessibility by road, rail and air traffic into one indicator. Potential multimodal accessibility reflects the central location of a node in the European context. Multimodal accessibility of regions has also been used for investigating relationships between accessibility and economic development. The values and indexes for potential multimodal accessibility have been obtained from the ESPON study (ESPON, 2007).

With regard to the trip purpose categories, the number of home-based and non-home-based business trips is reflected by the location of public and private services. The significance of these services is measured by the location of headquarters of large companies and the number of administrative functions in cities. Furthermore, services tend to locate in central and accessible location, which is described by potential multimodal accessibility.

[1] In Germany and Poland provincial capital cities include the capital cities of NUTS 1 regions and regional capital cities include the capital of NUTS 2 regions.

Number of headquarters of the largest companies has a combined maximum score of 3, potential multimodal accessibility has a maximum score of 4 and the administrative function of cities has a maximum score of 3 in defining the total index for this group of criteria. The weighting coefficient of the criterion “decision making & central location” is 1,5 among all groups of criteria in final analysis.

The ranking of nodes according to the criterion “decision making & central location” is presented in Appendix 2.

Headquarters of major companies are likely to locate in large cities with central location, although headquarters of some older companies have stayed at original sites in smaller cities. Administrative functions are usually concentrated in cities which have a central location which often have a long tradition of administration.

Accessibility is recognized as an important factor in the development of territories, regions and cities and a key factor in improving the territorial balance. The potential multimodal accessibility levels are still varying widely across the regions and cities in the Baltic Sea Region. In general, the best accessibility can be found in the core area of Europe, while the level of accessibility decreases towards northern and eastern parts of the Region. The main territorial structure built up over history is still visible in the core-periphery dichotomy. However, potential multimodal accessibility index shows that the accessibility pattern is basically more polycentric than a traditional core-periphery picture. This is due to the influence of more polycentric patterns created by rail and air traffic, in which larger cities and capital cities enjoy high accessibility levels.

Education & knowledge

Two indicators were identified for the criterion “education & knowledge”: the number of university students and the location of top European research centres. These indicators describe the role and significance of a city with regard to the higher education and know-how. With regard to the trip purpose categories, the number of university students and location of top research centres reflect the number of educational trips.

The main sources of data for the number of university students are the “University World” data base and national data bases. The data source for top European research centres is the “Webometrics” data base.

The number of university students has a maximum score of 8 and location of top European research centres has maximum score of 2 in defining the total index for this group of criteria. The weighting coefficient of the criterion “knowledge” is 1,5 among all groups of criteria in final analysis.

Ranking of nodes according to the criterion “education & knowledge” is presented in Appendix 3.

Major research centres are usually concentrated on the largest cities. The largest cities also have several significant universities and thus attract a large number of students. Smaller universities are usually located in regional centres, which promote their attractiveness as educational nodes. Finally, a few specific respected “university cities” can be identified in the study area (for example Uppsala and Lund), which emphasize the significance of these cities as educational nodes.

Culture & Tourism

Two indicators were identified for the criterion “culture & tourism”: top European travel destinations and hotel capacity. Ranking among the top European travel destinations reflects the volume of attracted leisure trips to a particular city. Hotel capacity measured by the available bed-places reflects the potential for tourist activities.

The main source of data for the top European travel cities is the data base in the social networking site “Travbuddy”. Hotel capacity measured by the number of bed-places has been obtained from Eurostat at NUTS 3 level.

Tourist appreciation has a maximum score of 6 and hotel capacity has a maximum score of 4 in defining the total index for this group of criteria. The weighting coefficient of the criterion “culture & tourism” is 2 among all groups of criteria in final analysis. Ranking of nodes according to the criterion “culture & tourism” is presented in Appendix 4.

3.1.2 Strategic nodes in passenger traffic

The final selection of strategic nodes in passenger traffic was done by calculating the total index as a sum of the individual indexes in each group of criteria. Based on the ranking of nodes by the total index, a preference threshold was determined for the selection the strategic nodes in passenger traffic.

Based on the applied methodology, a total of 60 nodes were selected as strategic nodes in passenger traffic in the Baltic Sea Region. This represents approximately the half-way point between the number of nodes in the TEN-T Core network and in the TEN-T Comprehensive network. The ranking and total indexes of the strategic nodes in passenger traffic are presented in table 1.

The selected 60 strategic nodes include 22 nodes, which are already included as main nodes for passenger traffic (urban nodes) in the TEN-T Core Network. In addition, 38 other nodes are identified as strategic nodes in passenger traffic based on the methodology applied in this study (figure 7).

There are only a few urban nodes in Finland and Sweden, which are included in the TEN-T Core Network and which are located in the southern parts of these countries. Based on this study, several additional strategic nodes in passenger traffic have been identified in the central and northern parts of Finland and Sweden, which serve major geographical areas with low population density.

In Denmark, several new strategic nodes have been identified in Jutland in addition to the two largest cities, which are included in the TEN-T Core Network. Similar to Denmark, the two largest cities in Norway are part of the TEN-T Core Network, while a few additional strategic nodes were identified.

The capital cities of the Baltic countries are included in the TEN-T Core Network. Only a couple of additional strategic nodes were identified in these countries. The largest cities in northern and central Poland are already part of the TEN-T Core network. A few additional middle-sized cities were qualified as strategic nodes in passenger traffic, which are mainly located in the eastern part of the country.

Similar to Poland, the largest cities in northern Germany are included in the TEN-T Core Network. However, several new strategic nodes were identified, which are either located on the Baltic coastline or in the central parts of northern Germany.

Table 1. Ranking of selected strategic nodes in passenger traffic.

Rank	Strategic node	Total index	Rank	Strategic node	Total index
1.	Copenhagen	88,0	31.	Magdeburg	44,6
2.	Stockholm	87,3	32.	Kaunas	43,5
3.	Berlin	86,0	33.	Halle	42,2
4.	Helsinki	85,9	34.	Karlstad	41,0
5.	Hamburg	79,7	35.	Åbenrå	40,8
6.	Oslo	78,6	36.	Gdynia	40,5
7.	Warsaw	74,7	37.	Linköping	40,5
8.	Göteborg	70,5	38.	Braunschweig	39,5
9.	Hannover	69,7	39.	Wolfsburg	39,0
10.	Poznan	65,0	40.	Umeå	39,0
11.	Bergen	64,9	41.	Jönköping	38,3
12.	Leipzig	64,2	42.	Vejle	38,0
13.	Riga	63,9	43.	Bialystok	37,5
14.	Vilnius	60,7	44.	Jyväskylä	37,0
15.	Århus	58,6	45.	Lund	36,5
16.	Tallinn	57,7	46.	Salzgitter	36,3
17.	Wroclaw	57,1	47.	Oulu	36,0
18.	Tampere	56,4	48.	Vaasa	36,0
19.	Ålborg	55,8	49.	Tartu	35,3
20.	Trondheim	55,7	50.	Bydgoszcz	35,1
21.	Malmö	55,1	51.	Olsztyn	34,5
22.	Lodz	54,2	52.	Pori	34,5
23.	Gdansk	50,3	53.	Luleå	34,5
24.	Kiel	50,1	54.	Klaipeda	34,3
25.	Uppsala	49,8	55.	Kristiansand	34,3
26.	Rostock	49,6	56.	Cottbus	34,0
27.	Turku	49,1	57.	Viborg	34,0
28.	Lübeck	48,8	58.	Szczecin	33,5
29.	Odense	48,6	59.	Skien	33,5
30.	Örebro	47,6	60.	Västerås	33,0

Future outlook for passenger traffic

Based on the Baltic Transport Outlook study (BTO 2011), the increase in international passenger car transport, in terms of vehicle kilometres, is estimated to be 23 %, or 1.1% per year in the Baltic Sea Region between the years 2010 and 2030. About one-third of the total growth is expected to occur in Poland, followed by Sweden, Germany and Lithuania. The largest relative growth of 50 % is expected to occur in Estonia.

A growth of 120% or 4.2% per year is estimated in international railway passenger traffic by the year 2030. The largest growth is expected to occur in Sweden due to improvements in the domestic inter-urban high speed train system as well as significant infrastructure investments, such as the Fehmarn Belt between Denmark and Germany. Significant growth in international railway passenger traffic is also expected in Poland and Germany.

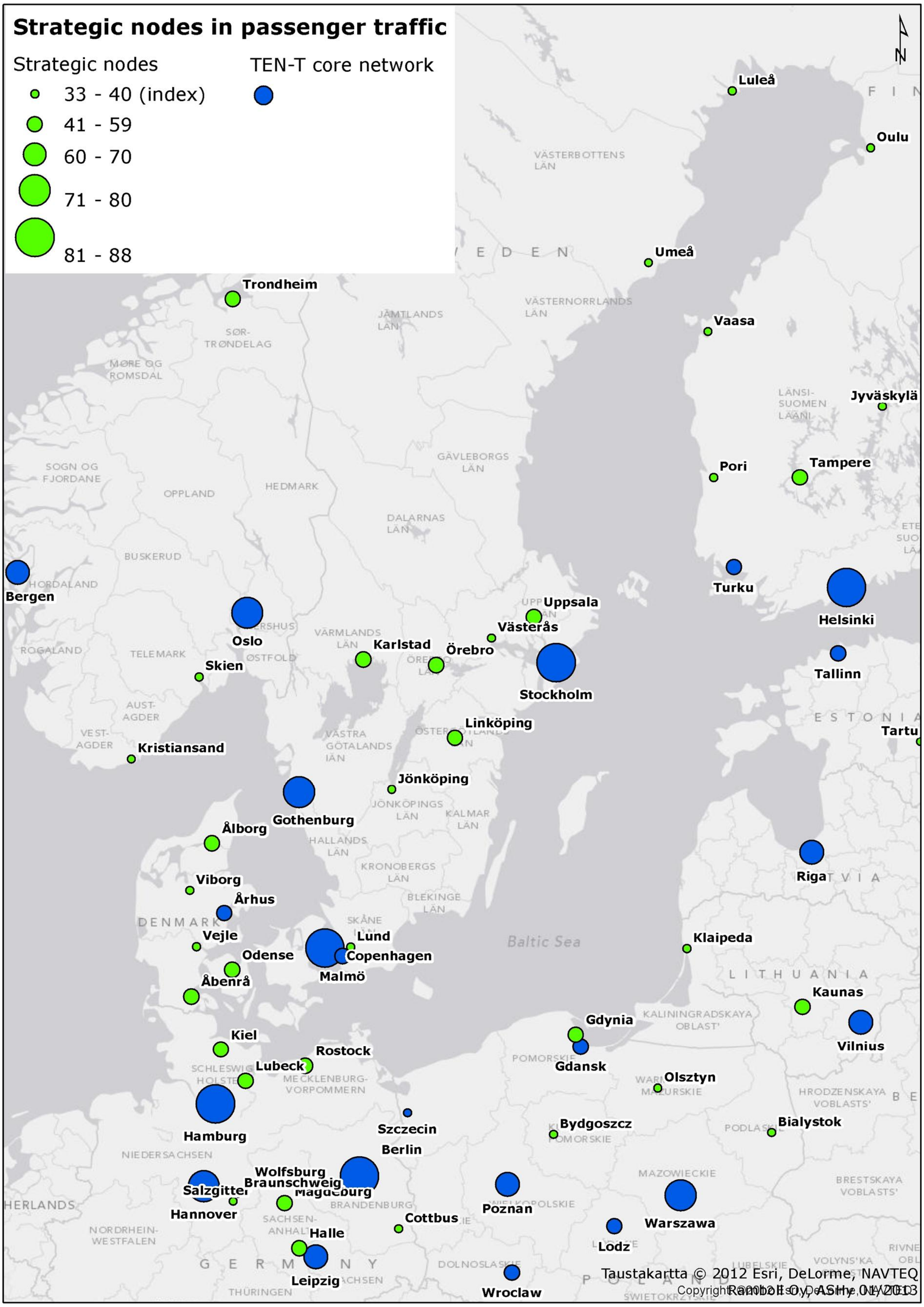

Figure 7. *Selected strategic nodes in passenger traffic.*

3.2 Identification of significant nodes in freight transport

Main nodes in freight transport include ports, which serve as connecting points between maritime transport and road/rail transport, and land-based intermodal terminals which serve as connecting points between road and rail transport.

Ports have the most significant role in the intermodal system. All ports have local, regional, national or international importance in their specific hinterlands. However, all ports in the Baltic Sea Region cannot serve as strategic ports and the strategic port network has to be defined from the international/national perspectives, which usually extend beyond local or regional features.

Furthermore, the size (volume) of a port is an important factor, but not the only indicator for describing the significance of a port. Cargo structure is also an important indicator and has to be considered when determining the significance of a port.

Besides the international significance, the national or corridor-specific significance of ports should also be considered. Moreover, the future potential of ports should also be assessed either based on their normal development or induced potential as a result of new industrial development (for example new mining industry in the North).

For assessing the significance of various ports in the Baltic Sea Region, a set of indicators were identified for the purpose of this study. The goal is that the identified indicators would not only reflect the volume of the ports, but also the cargo structure, location, connectivity and multi-functionality of the ports.

The criteria and methodology used in the Baltic Transport Outlook study (BTO 2011) for identifying the most significant ports were mostly applied in this study. The port data used in this analysis was updated and the methodology was adjusted for the purposes of this study.

3.2.1 Criteria and indicators for significant ports in freight transport

The following three steps can be defined in identifying the significant ports in freight transport (figure 8):

Step 1: First selection of ports based on their size (first screening).

Step 2: Multi-criteria analysis based on the location, connectivity and volume of ports as well as on the multi-functionality of ports.

Step 3: Qualitative analysis with economic aspects.

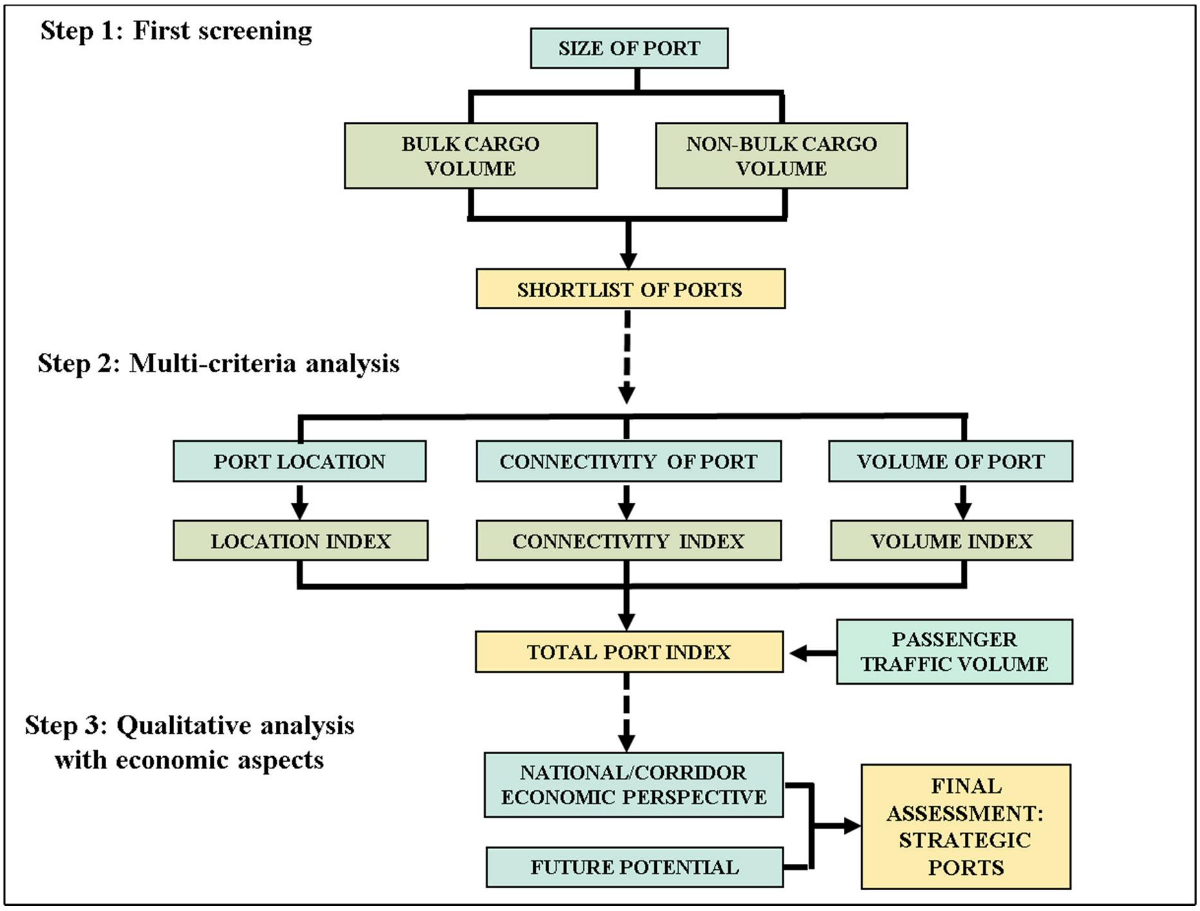

Figure 8. Criteria and indicators for determining strategic ports in freight transport.

First selection of ports based on their size

The first step in the selection process includes the first screening of the ports based only on their size (handled volume). The aim is to identify the primary group of the largest ports in the Baltic Sea Region by shortlisting ports that qualify based on the defined volume criteria.

As ports have different cargo volumes and cargo structure, different volume criteria has been applied for bulk cargo and non-bulk cargo. Following the volume criteria, ports have been considered in both categories. In order to be shortlisted from the first screening, a port must meet the volume criteria in one of the two categories: either in bulk cargo or non-bulk cargo. Consequently, two shortlists have been prepared for the multi-criteria analysis in step 2.

The data for port volumes in bulk and non-bulk categories are obtained from the Eurostat data base, data bases of local port associations and other national data bases. The base year for the data is 2011. Two or more ports, which are closely located to form a natural port-pair, have been considered as one port entity in the analysis.

The volume criterion for bulk cargo was set to 7 million tonnes and the volume criterion for non-bulk cargo was set to 2 million tonnes to select the most significant ports in the Baltic Sea Region. A total of 38 ports were qualified for the shortlist. It should be noted that 10 ports were qualified in both categories for further analysis. Qualified ports have been presented in table 2.

Table 2. Qualified ports after first screening in bulk and non-bulk categories.

Port	Bulk cargo volume (1000 tonnes)	Port	Non-bulk cargo volume (1000 tonnes)
Bergen	50 000	Göteborg	20 800
Tallinn	27 900	Lubeck	18 000
Riga	27 500	Rostock	13 500
Ventsplis	26 200	Klaipeida	12 400
Klaipeida	23 700	Hamina-Kotka	12 200
Sköldvik	22 100	Trelleborg	10 700
Göteborg	20 500	Helsinki	9 700
Brofjorden Preemraff	19 900	Gdynia	9 600
Narvik	17 600	Gdansk	7 300
Gdansk	16 200	Helsingborg	6 500
Swinoujscie-Szczecin	11 700	Riga	6 500
Fredericia	10 900	Rödby	6 100
Tonsberg	10 200	Tallinn	5 600
Grenland	9 300	Århus	5 400
Luleå	9 000	Copenhagen-Malmö	5 300
Butinge	8 900	Rauma-Pori	5 100
Rostock	8 700	Kiel	5 100
Copenhagen-Malmö	8 500	Turku-Naantali	4 800
Kokkola	7 200	Puttgarden	4 300
		Helsingör	4 000
		Hanko	3 700
		Ystad	2 900
		Swinoujscie-Szczecin	2 800
		Stockholm	2 700
		Karlshamn-Karlskrona	2 600
		Oslo	2 300
		Ventspils	2 300
		Frederikshavn	2 200
		Bergen	2 000

Multi-criteria analysis based on the location, connectivity, volume and multi-functionality of ports

Step 2 in the selection process includes the multi-criteria analysis of the qualified and shortlisted ports from the first screening (step 1). The significance of ports was assessed separately for qualified bulk ports and non-bulk ports according to three indicators: location, connectivity, volume of a port.

Similar to nodes in passenger traffic, a hierarchical weighting approach has been applied, in which relative weights have been determined for these indicators depending on their estimated contribution to the significance of ports. The maximum score is 10 within each group of indicators.

Location of a port

The location of a port was evaluated according to its position or distance from the TEN transport network. The international role and significance of a port is reflected by its integration and relevance to European-wide road and railway networks. The qualified ports will get a score (location index) of 0-4 depending on the port's location as part of the TEN-T axis or proximity to the TEN-T axis (table 3). The Bothnian Corridor is considered as part of the TEN-T Core Network.

The weighting coefficient of the location index is 5 for bulk ports and 4 for non-bulk ports in calculating the total index.

Table 3. Ranking of qualified bulk and non-bulk ports based on the location index.

Rank	Bulk port	Location index	Rank	Non-bulk port	Location index
1.	Tallinn	4	1.	Göteborg	4
2.	Riga	4	2.	Lübeck	4
3.	Klaipeda	4	3.	Klaipeda	4
4.	Göteborg	4	4.	Hamina-Kotka	4
5.	Brofjorden Preemraff	4	5.	Trelleborg	4
6.	Narvik	4	6.	Helsinki	4
7.	Gdansk	4	7.	Gdynia	4
8.	Copenhagen-Malmö	4	8.	Gdansk	4
9.	Kokkola	4	9.	Helsingborg	4
10.	Ventspils	4	10.	Riga	4
11.	Luleå	4	11.	Rödby	4
12.	Sköldvik	3	12.	Tallinn	4
13.	Swinoujscie-Szczecin	3	13.	Copenhagen-Malmö	4
14.	Fredericia	3	14.	Turku-Naantali	4
15.	Tonsberg	3	15.	Puttgarden	4
16.	Rostock	3	16.	Hanko	4
17.	Butinge	2	17.	Stockholm	4
18.	Bergen	1	18.	Oslo	4
19.	Grenland	1	19.	Karlshamn-Karlskona	3,5
			20.	Rostock	3
			21.	Århus	3
			22.	Rauma-Pori	3
			23.	Kiel	3
			24.	Helsingör	3
			25.	Ystad	3
			26.	Swinoujscie-Szczecin	3
			27.	Ventspils	3
			28.	Frederikshavn	3
			29.	Bergen	1

Connectivity of a port

The connectivity of a port was evaluated according to the number of countries or foreign ports served by RoRo/container line operators and by the frequency of international services. Connectivity analysis was conducted only for non-bulk ports and it reflects the role of a port in connecting countries and regions within Europe and the Baltic Sea Region.

The qualified ports will get a score (connectivity index) of 0-4 depending on the port's connectivity to foreign countries and ports as well as on the number of international departures (table 4).

The weighting coefficient of the connectivity index is 2 for non-bulk ports in calculating the total index.

Table 4. Ranking of qualified non-bulk ports based on the connectivity index.

Rank	Non-bulk port	Connectivity index
1.	Lübeck	3
2.	Klaipeda	3
3.	Hamina-Kotka	3
4.	Helsinki	3
5.	Gdynia	3
6.	Århus	3
7.	Rauma-Pori	3
8.	Göteborg	2
9.	Rostock	2
10.	Trelleborg	2
11.	Gdansk	2
12.	Helsingborg	2
13.	Rödby	2
14.	Tallinn	2
15.	Copenhagen-Malmö	2
16.	Kiel	2
17.	Turku-Naantali	2
18.	Puttgarden	2
19.	Helsingör	2
20.	Hanko	2
21.	Swinoujscie-Szczecin	2
22.	Stockholm	2
23.	Oslo	2
24.	Karlshamn-Karlskona	2
25.	Riga	1
26.	Ystad	1
27.	Ventspils	1
28.	Frederikshavn	1
29.	Bergen	1

Cargo volume of a port

The cargo volume indicator of a port was evaluated according to the absolute volume level of cargo throughput by cargo type. The total volume index is divided into four different sub-indexes according to four different cargo types: liquid bulk, dry bulk, containers and RoRo cargo & other dry cargo. The analysis of different cargo types reflects the cargo structure of a port and different types of cargo have different impacts on the economy.

The qualified ports will get a score of 0-4 depending on the volume of each cargo type. Ports in the bulk port category are given index values for dry and liquid bulk cargo, and ports in non-bulk category for container and RoRo & other dry cargo. The total volume index is calculated as a sum of sub-indexes divided by two. Thus, the score of the total volume index can vary between 0,5-4 (table 5).

The weighting coefficient of the volume index is 5 for bulk ports and 4 for non-bulk ports in calculating the total index.

Table 5. Ranking of qualified bulk and non-bulk ports based on the volume index.

Rank	Bulk port	Volume index	Rank	Non-bulk port	Volume index
1.	Bergen	2,5	1.	Göteborg	3,5
2.	Riga	2,5	2.	Lübeck	3
3.	Ventspils	2,5	3.	Klaipeda	2,5
4.	Tallinn	2	4.	Hamina-Kotka	2,5
5.	Klaipeda	2	5.	Rostock	2
6.	Narvik	2	6.	Trelleborg	2
7.	Gdansk	2	7.	Helsinki	2
8.	Kokkola	2	8.	Gdansk	2
9.	Sköldvik	1,5	9.	Riga	2
10.	Göteborg	1,5	10.	Århus	2
11.	Swinoujscie-Szczecin	1,5	11.	Rauma-Pori	2
12.	Grenland	1,5	12.	Gdynia	1,5
13.	Luleå	1,5	13.	Helsingborg	1,5
14.	Rostock	1,5	14.	Rödby	1,5
15.	Fredericia	1	15.	Kiel	1,5
16.	Tonsberg	1	16.	Turku-Naantali	1,5
17.	Copenhagen-Malmö	1	17.	Helsingör	1,5
18.	Brofjorden Preemraff	1	18.	Hanko	1,5
19.	Butinge	0,5	19.	Swinoujscie-Szczecin	1,5
			20.	Stockholm	1,5
			21.	Tallinn	1
			22.	Copenhagen-Malmö	1
			23.	Puttgarden	1
			24.	Ystad	1
			25.	Oslo	1
			26.	Ventspils	1
			27.	Frederikshavn	1
			28.	Karlshamn-Karlskona	1
			29.	Bergen	0,5

Multi-functionality of a port

Some of the qualified ports after the first screening are specialized only on handling bulk or non-bulk cargo, while some of the ports also have significant passenger traffic volumes. Table 6 shows the multi-functional ports in the study area and their cargo/passenger traffic volumes.

The multi-functionality of qualified ports has been evaluated as follows:

- total index after multi-criteria analysis has been multiplied by 1,5, if the qualified port has significant volumes of either bulk and non-bulk cargo and passenger traffic volumes of 0,5-1 million passengers/year
- total index after multi-criteria analysis has been multiplied by 2, if the qualified port has significant volumes of both bulk and non-bulk cargo or either bulk or non-bulk cargo and passenger traffic volumes of over one million passengers/year.
- total index after multi-criteria analysis has been multiplied by 2,5, if the qualified port has significant volumes of both bulk and non-bulk cargo and passenger traffic volumes of 0,5-1 million passengers/year

- the total index after multi-criteria analysis has been multiplied by 3, if the port has significant volumes of both bulk and non-bulk cargo and passenger traffic volumes over 1 million passengers/year.

Table 6. Qualified multi-functional ports and their cargo/passenger volumes.

Port	Bulk cargo volume (million tonnes)	Non-bulk cargo volume (million tonnes)	Passenger volume (million passengers)
Bergen	50,0	2,0	0,09
Tallinn	27,9	5,6	7,5
Riga	27,5	6,5	0,6
Ventspils	26,2	2,3	-
Göteborg	20,5	20,8	1,7
Klaipeda	23,7	12,4	-
Gdansk	16,2	7,3	-
Swinoujscie-Szczecin	11,7	2,8	0,9
Rostock	8,7	13,5	2,0
Copenhagen-Malmö	8,5	5,3	0,9
Helsinki	1,5 (*)	9,7	9,8
Helsingborg	1,6 (*)	6,5	8,5
Århus	4,0 (*)	5,4	1,3
Kiel	1,2 (*)	5,1	1,6
Turku-Naantali	6,0 (*)	4,8	3,7
Helsingör	-	4,0	8,5
Stockholm	1,8 (*)	2,7	9,1
Oslo	3,4 (*)	2,3	2,3
Frederikshavn	-	2,2	2,0

(*) port not qualified in the first screening in the bulk category

According to the multi-functionality analysis of ports, there are only three qualified ports, which have significant volumes of both bulk and non-bulk cargo as well as high passenger volumes (Tallinn, Göteborg and Rostock). Ports with smaller volumes of bulk cargo, significant volumes of non-bulk cargo and high passenger traffic volumes include Helsinki, Helsingborg, Turku–Naantali, Stockholm and Oslo.

3.2.2 Strategic ports in the Baltic Sea Region

The final selection of strategic ports was done by calculating the total index of qualified ports based on the multi-criteria analysis as a sum of their location, connectivity and volume indexes. After this, the multi-functionality of ports was assessed by applying the methodology described in the previous chapter. Finally, a total index was calculated to describe the significance of each port in freight transport. Based on the ranking of nodes by the total index, a preference threshold was determined for the selection the strategic ports.

Based on the applied methodology, a total of 30 ports were selected as strategic ports in the Baltic Sea Region. The ranking and total indexes of the strategic ports are presented in table 7.

As emphasized in the description of the applied port selection methodology, the strategic ports in the Baltic Sea region cannot be defined based only on their volume, but also considering their role as serving the region's existing needs and connecting the different countries and regions to each other as well as providing access to markets. The strategic network of ports should also secure connectivity to the neighbouring countries outside the Baltic Sea Region.

Table 7. Ranking of selected strategic ports in freight transport.

Rank	Strategic port	Total index	Rank	Strategic port	Total index
1.	Göteborg	92	16.	Kiel	44
2.	Tallinn	81	17.	Helsingör	44
3.	Riga	73	18.	Gdynia	42
4.	Rostock	70	19.	Frederikshavn	36
5.	Klaipeda	62	20.	Lübeck	34
6.	Copenhagen-Malmö	61	21.	Hamina-Kotka	32
7.	Helsinki	60	22.	Narvik	30
8.	Gdansk	58	23.	Kokkola	30
9.	Swinoujscie-Szczecin	56	24.	Trelleborg	28
10.	Helsingborg	52	25.	Luleå	28
11.	Århus	52	26.	Bergen	26
12.	Turku-Naantali	52	27.	Rödby	26
13.	Stockholm	52	28.	Rauma-Pori	26
14.	Oslo	48	29.	Hanko	26
15.	Ventspils	46	30.	Brofjorden Preemraff	25

The top ports in overall ranking are quite evenly spread between the countries in the Baltic Sea Region. The overall network of strategic ports shown in table 7 and figure X includes all 18 ports in the TEN-T Core network. Furthermore, the strategic port network includes 12 additional ports, which are located in Denmark, southern Sweden and also in southern Finland. However, a regional imbalance can be seen in the area around the Gulf of Bothnia, where only two ports (Luleå, Kokkola) are ranked among the strategic ports. Both of these ports already have significant transport volumes of mining products. These ports play an important role for the industry in the northern regions and their importance will become even more significant as the mining industry in the north will expand and contributes to new mining sites and growing cargo volumes in forthcoming years.

Qualitative analysis with economic aspects

The opening of new mines and the expansion of existing mining activities will result in a significant increase in shipping volumes in the northern part of the Gulf of Bothnia. Today, the annual transport volumes of the metal ores are about 30 million tonnes in northern Sweden and about 2–3 million tonnes in northern Finland. The potential transport volumes by the end of this decade will be about 70 million tonnes/year in northern Sweden and almost 10 million tonnes/year in northern Finland. The final routing of these cargo volumes is yet unknown.

In Sweden the volume will probably be directed to the port of Narvik, but partly also to the port of Luleå. The situation is more complex in Finland. Volumes from mines may be directed for further processing to the existing or new refineries in western Finland or via one or few ports to Europe or other international markets. Any subsequent concentration of traffic to Finnish ports would in any case promote new port/ports to the shortlist (bulk port list) and change the basic setting of this analysis.

Furthermore, the transit cargo traffic from North-East Russia via northern Finland has been growing and is today about 3 million tonnes/year. In the future, these volumes will probably concentrate to the port of Kokkola like today, but this situation might also change. Somehow, the expansion in northern mining activities and transit traffic also has to be considered in the final assessment. Therefore, based on volumes and the connectivity of the strategic network, the port pair of Kemi–Oulu was included in the list of strategic freight transport nodes. (Liikennevirasto 2012).

Future outlook for maritime transport

Based on the Baltic Transport Outlook study (BTO 2011), the total cargo throughput of the ports in the Baltic Sea Region is estimated to increase by 228 million tonnes or by 30% between the years 2010 and 2030. The average annual growth rate is approximately 1.3%, indicating that the experienced fast growth of maritime transport volumes in the Baltic Sea Region is notably slowing down, but there are large differences between the different segments. If the liquid bulk volumes are excluded, the average annual growth is estimated to be 2.2%, corresponding to an increase by 56% till 2030.

Besides the Russian ports (St. Petersburg and Kaliningrad regions), the largest growth rates of over 80 % in cargo volumes is estimated for the Gdansk-Gdynia region by the year 2030 (figure 9). The second largest growth category can be identified in southernmost Sweden and in the Stockholm region, where the estimated growth rates will be in the range of 60-80 %. Moderate growth rates of 40-60 % are estimated for most of the other coastal areas with the exception of the Gulf of Bothnia and southern coast of Norway.

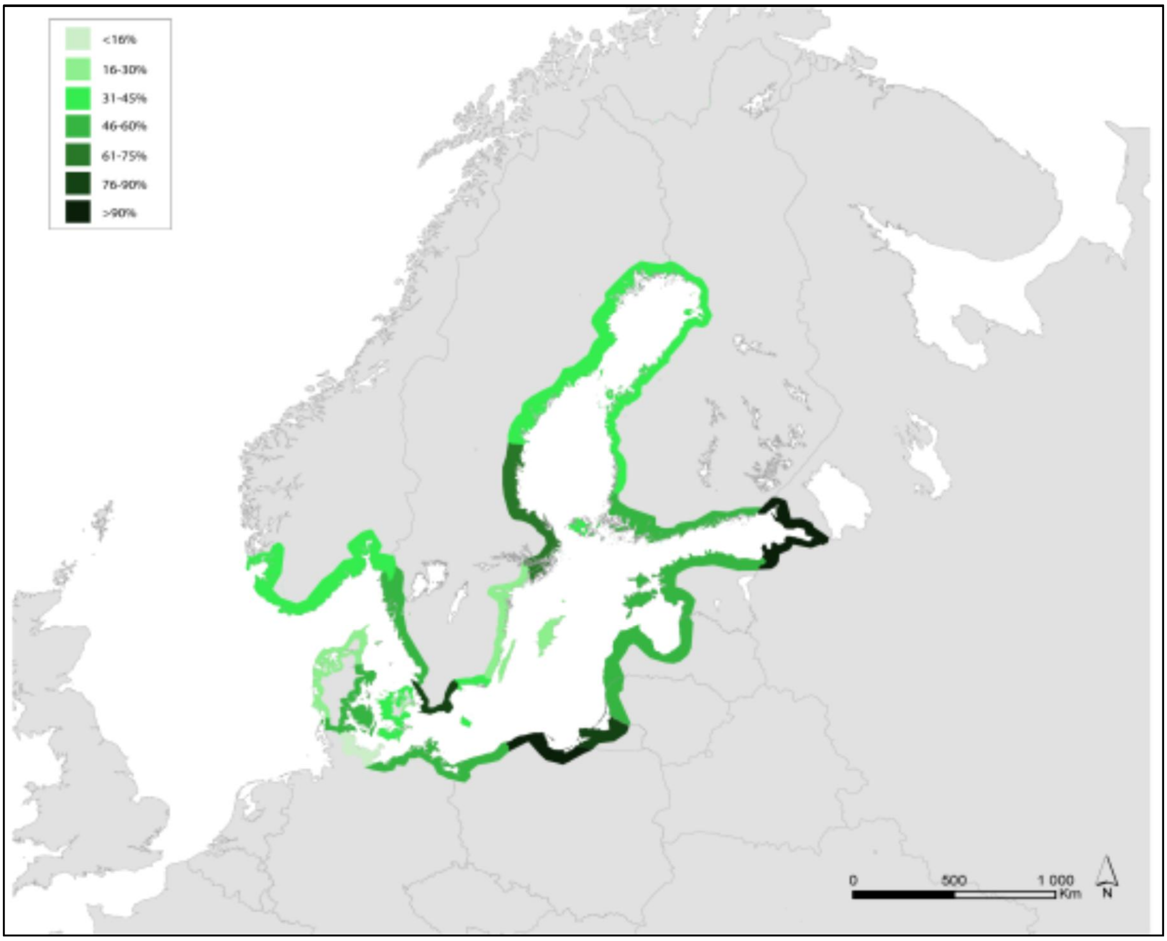

Figure 9. Relative changes in cargo volumes by the year 2030 in the coastal areas of the Baltic Sea Region (excluding liquid bulk cargo) (source: BTO forecast 2030).

3.2.3 Land-based intermodal terminals

In order to connect the important parts of the different infrastructure networks – road, rail, ferries and short sea shipping, intermodal terminals play a vital role. Intermodal terminals include ports and land-based terminals, in which easy and swift interchange between the different transport modes is performed. With the focus on multimodality, efficient intermodal terminals will have a very important role in the future.

Presently, intermodal terminals (road/rail) need a certain basic volume in order to be efficient. Large-scale transport chains are important in securing operational efficiency between the modes. Efficient terminals are essential, both for being transfer points between modes, but also for providing flexibility between the different networks.

There are a number of intermodal terminals throughout the Baltic Sea Region. The efficiency regarding interchange between the different modes of transport needs to be strengthened in most of them in order for the networks to excel (Trans Baltic 2011).

It is very difficult to obtain information regarding intermodal terminal operations, as there are no official statistical sources on terminal turnover and efficiency. The only available information is based on interviews and discussions with different terminal owners. As intermodal terminals will play a vital role in connecting different modes in the future European transport system, it is vital that systematic data collection would be of great importance in the future.

Table 8 shows the major intermodal terminals in the Baltic Sea Region (excluding Finland, Estonia, Latvia and Lithuania) in the year 2010. This table is based on interviews and consultations in the Trans Baltic study and shows terminals which handle cargo load of over 40 000 TEU/year. This level has been chosen after discussion with terminal operators based on the fact that 40 000 TEU/year will keep the daily operations at a necessary performance level, and this level is justified as a significant node in freight transport.

Table 8. Major intermodal terminals in the Baltic Sea Region in 2010 (terminals of over 40 000 TEU/year) (source: Trans Baltic study, 2011).

Country	City	Remarks
Sweden	Stockholm (Årsta)	81 000 TEU (2005)
Sweden	Gävle	30 000 TEU (2005)
Sweden	Karlstad	62 000 TEU (2005)
Sweden	Malmö	75 000 TEU (2011)
Sweden	Gothenburg	94 000 TEU (2005)
Sweden	Örebro (Hallsberg)	65 000 TEU (2005)
Sweden	Älmhult	76 000 TEU (2005)
Sweden	Umeå	31 000 TEU (2005)
Norway	Oslo (Alnabru)	62 000 TEU (2006)
Norway	Trondheim	
Denmark	Copenhagen (Höje Taastrup)	75 000 TEU (2011)
Denmark	Fredericia (Taulov)	60 000 TEU (2011)
Germany	Hamburg	
Germany	Lubeck	115 000 TEU (forecast 2015)
Germany	Rostock	
Germany	Berlin-Brandenburg	
Poland	Warsaw (Praga)	
Poland	Warsaw (Pruszkow)	90 000 TEU (forecast 2015)
Poland	Poznan (Gadki)	60 000 TEU (forecast 2015)
Poland	Lodz (Olechow)	
Poland	Wroclaw	

With the exception of the small city of Älmhult in Sweden and middle-sized city of Fredericia in Denmark, all other land-based intermodal terminal nodes of over 40 000 TEU presented in table 8 are identified as strategic nodes in this study and are also connected to the strategic road and railway network. Fredericia in Denmark is not classified as a strategic node, but can be considered as a significant land-based intermodal terminal and therefore should be included as a strategic intermodal node in the freight transport network.

In Finland, the ports mostly handle the intermodal operations. There are a number of smaller intermodal terminals, but their throughput is less than 40 000 TEU/year. The volume of intermodal transport by rail in Finland was about 30 000 TEU in 2010. This volume has decreased by 12 000 TEU during the years 2005-2010.

In Lithuania, the new potential land-based intermodal terminals are estimated to be developed in Kaunas and Vilnius (BTO 2011). These nodes are identified as strategic nodes in this study and are also connected to the strategic road and railway network.

No data has been obtained for Estonia and Latvia, but it is obvious that the ports play a vital role in the intermodal system of these countries. Main intermodal operations are concentrated in Tallinn and Riga, which are identified as strategic nodes in this study and are also connected to the strategic road and railway network.

The final selection of strategic nodes in freight transport is presented in figure 10.

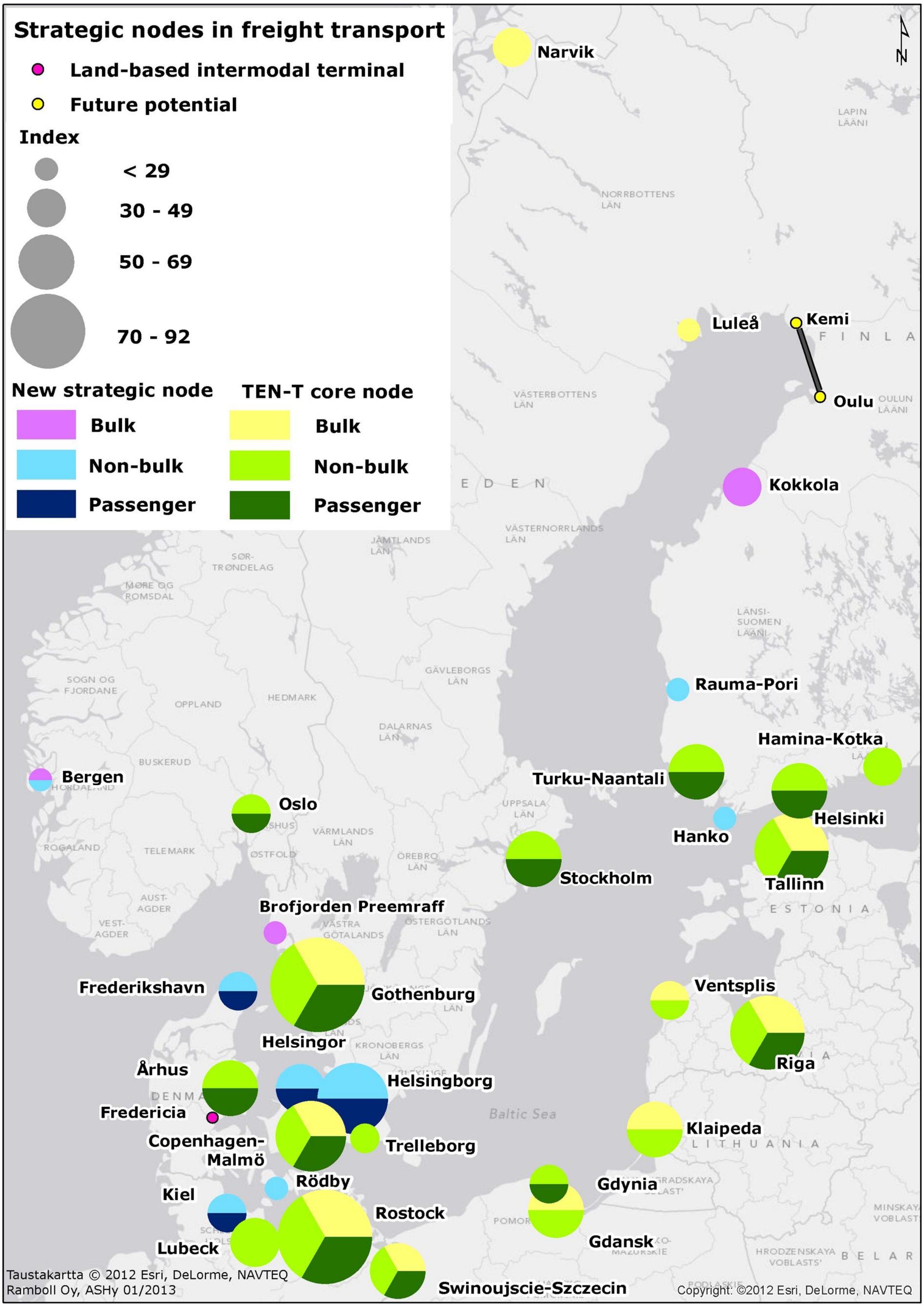

Figure 10. Selected strategic nodes in freight transport.

Future outlook for land-based freight transport

Based on the Baltic Transport Outlook study (BTO 2011), the largest land-based growth (road & rail transport) will occur in Poland, where an increase of about 400 million tonnes (52 %) is estimated by the year 2030 (figure 11). This is due to estimated economic development and road & railway infrastructure development. In northern Germany and Sweden the expected growth in land-based freight transport volumes will be about 200 million tonnes, while in other Baltic countries the growth is estimated to be less than 100 million tonnes by the year 2030.

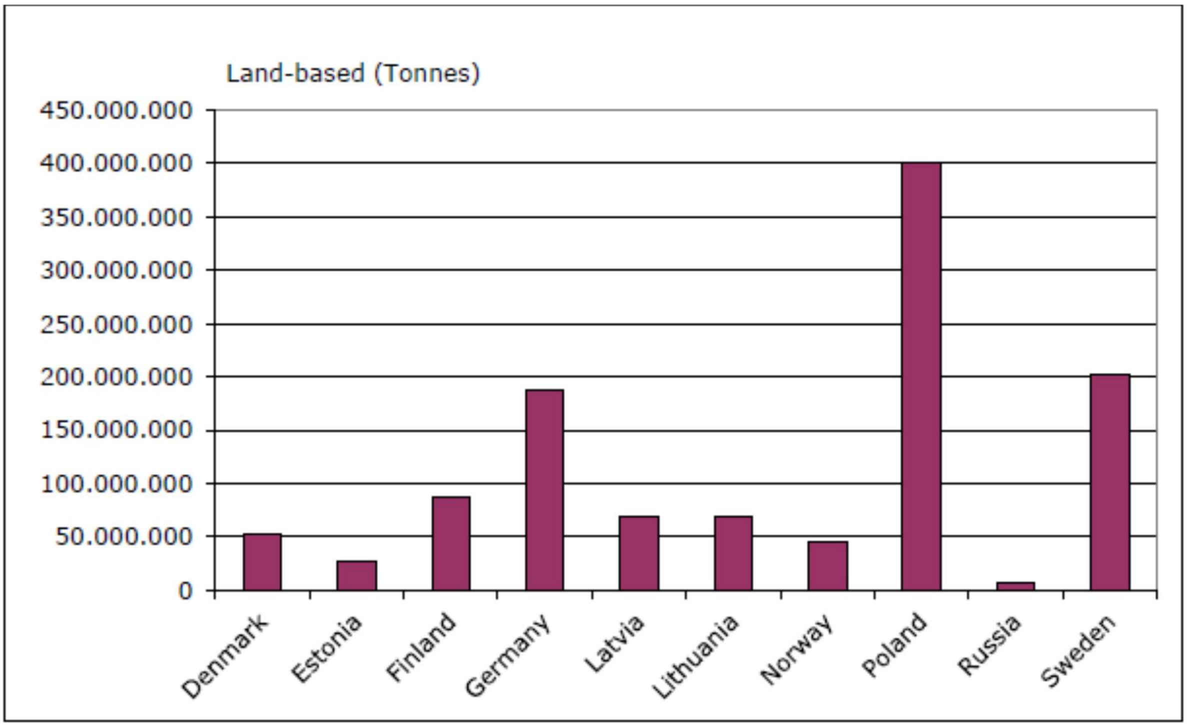

Figure 11. Estimated growth in land-based freight transport volumes by the year 2030 (source: BTO forecast 2030).

4. Strategic transport network in the Baltic Sea Region

The strategic transport network should promote connectivity between transport modes, unhindered movements across borders and connectivity within networks outside of the Baltic Sea Region. The strategic network should also provide access points to minor transport networks especially in more peripheral areas. In densely populated areas the transport system should serve both long-distance and international traffic, but also the traffic related to the major urban areas. In freight transport, the strategic network should provide efficient connections between production sites and consumption areas, and also ensure significant import and export connections to the regions and countries within and outside of the Baltic Sea Region.

In this study, the strategic transport network in the Baltic Sea Region has been created by connecting the strategic nodes in passenger or freight traffic by relevant links. According to the basic principle in the configuration of the network, the strategic nodes in freight transport have been connected to the national network at least by a railway link. Similarly, strategic nodes in passenger traffic have been connected to the national network at least by a road link. However, the major nodes in passenger and freight traffic have both road and rail connections (figure 12).

The starting point for the strategic transport network configuration has been the TEN-T Core road and railway network. This Core network is quite dense in northern Poland and Germany and also in the Baltic countries. New strategic nodes in these areas are already mostly located along the TEN-T Core network, and thus based on this study, the number of new strategic links is fairly low.

The situation is somewhat different in the Nordic countries and especially in Finland, Norway and Denmark. There are only a few TEN-T Core nodes in these countries and the TEN-T Core network is also very scattered. In this case, quite a few new strategic nodes have been identified, which have been connected to the national network by new strategic road and railway links.

As a conclusion, it can be noted that the number of TEN-T Core nodes is fairly small in the Baltic Sea Region. Consequently, several new strategic nodes can be identified in different countries based on the methodology applied in this study. On the other, the TEN-T Core Network is quite comprehensive in the Baltic Sea Region with the exception of the most peripheral areas. The TEN-T Core network also provides connections to the main border crossing points to Russia and Eastern Europe. This means that most of the new strategic nodes are located along the existing TEN-T Core network and significant extensions to the existing network are not necessary.

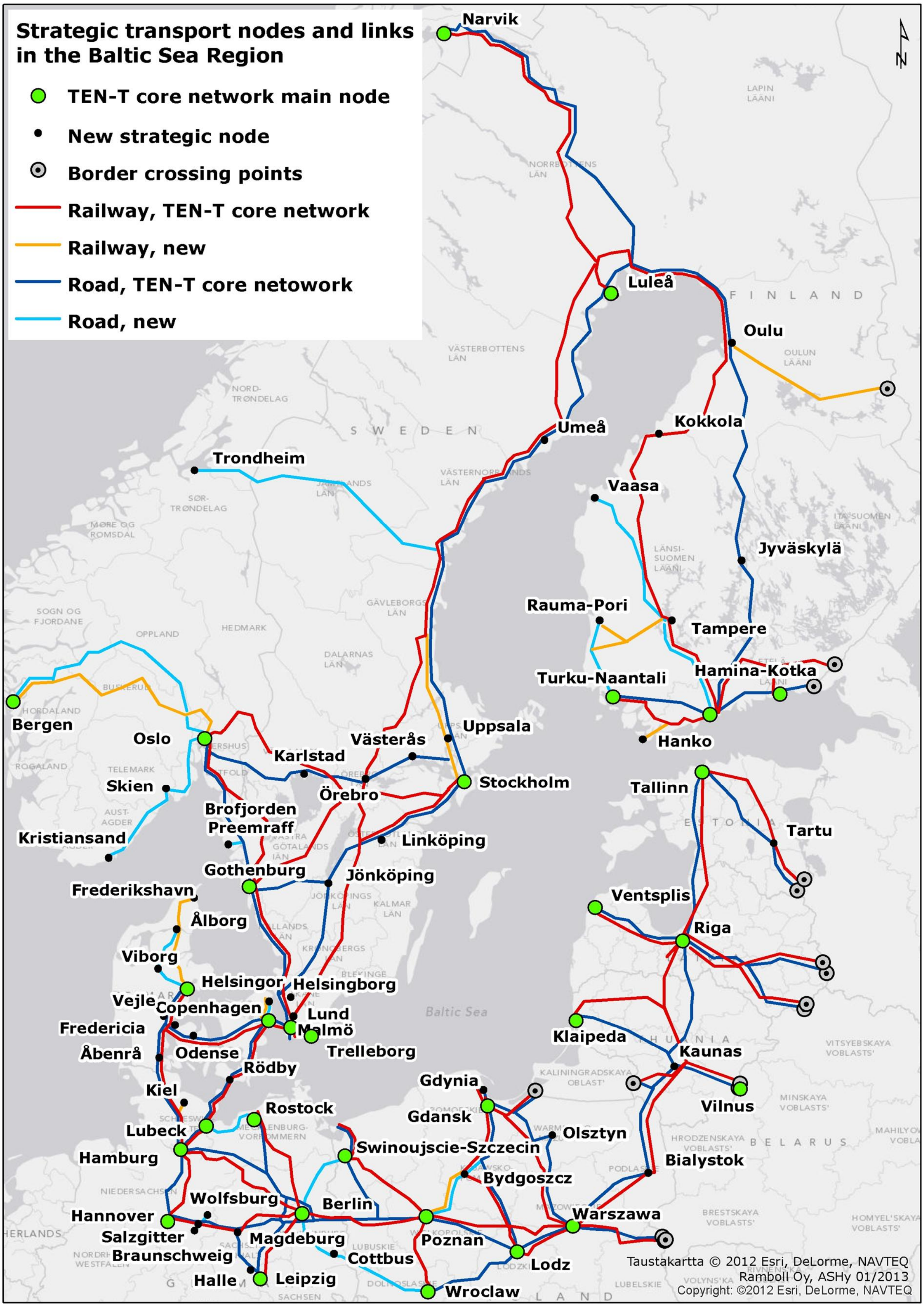

Figure 12. Strategic nodes and links in the Baltic Sea Region.

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Appendices

Appendix 1. Ranking of nodes based on the criterion "Population and regional development".

1.	Copenhagen	51.	Kaunas
2.	Stockholm	52.	Białystok
3.	Helsinki	53.	Gdynia
4.	Berlin	54.	Toruń
5.	Hamburg	55.	Potsdam
6.	Oslo	56.	Oulu
7.	Warsaw	57.	Göttingen
8.	Gothenburg	58.	Västerås
9.	Hannover	59.	Linköping
10.	Bergen	60.	Legnica
11.	Ålborg	61.	Lahti
12.	Riga	62.	Cottbus
13.	Poznan	63.	Helsingborg
14.	Leipzig	64.	Randers
15.	Vilnius	65.	Kolding
16.	Århus	66.	Jönköping
17.	Malmö	67.	Silkeborg
18.	Tampere	68.	Kouvola
19.	Odense	69.	Norrköping
20.	Stavanger	70.	Kristiansand
21.	Trondheim	71.	Horsens
22.	Örebro	72.	Lund
23.	Lodz	73.	Naestved
24.	Wroclaw	74.	Umeå
25.	Tallinn	75.	Sonderborg
26.	Braunschweig	76.	Lappeenranta
27.	Kiel	77.	Holbaek
28.	Halle	78.	Borås
29.	Magdeburg	79.	Hjorring
30.	Lubeck	80.	Södertälje
31.	Rostock	81.	Helsingör
32.	Turku	82.	Frederikshavn
33.	Uppsala	83.	Växjö
34.	Jyväskylä	84.	Svendborg
35.	Fredrikstad	85.	Haderslev
36.	Wolfsburg	86.	Salo
37.	Vejle	87.	Skien
38.	Salzgitter	88.	Sundsvall
39.	Viborg	89.	Arendal
40.	Herning	90.	Olsztyn
41.	Pori	91.	Klaipeda
42.	Slagelse	92.	Elbląg
43.	Tromsö	93.	Płock
44.	Karlstad	94.	Gorzów Wielkopolski
45.	Vaasa	95.	Zielona Góra
46.	Aabenraa	96.	Włocławek
47.	Fredericia	97.	Koszalin
48.	Gdansk	98.	Siauliai
49.	Szczecin	99.	Kalisz
50.	Bydgoszcz	100.	Tartu

Appendix 2. Ranking of nodes based on the criterion “Administration & central location”.

1.	Copenhagen	36.	Borås
2.	Helsinki	37.	Schwerin
3.	Stockholm	38.	Cottbus
4.	Warsaw	39.	Wismar
5.	Oslo	40.	Gdynia
6.	Hamburg	41.	Uppsala
7.	Berlin	42.	Vilnius
8.	Hannover	43.	Wittenberg
9.	Lund	44.	Linköping
10.	Wolfsburg	45.	Rostock
11.	Salzgitter	46.	Halle
12.	Gothenburg	47.	Ålborg
13.	Helsingör	48.	Frederikshavn
14.	Århus	49.	Hjorring
15.	Potsdam	50.	Viborg
16.	Celle	51.	Haderslev
17.	Leipzig	52.	Kolding
18.	Malmö	53.	Sonderborg
19.	Luneburg	54.	Vejle
20.	Kiel	55.	Riga
21.	Lubeck	56.	Eskilstuna
22.	Neumunster	57.	Västerås
23.	Braunschweig	58.	Fredericia
24.	Flensburg	59.	Herning
25.	Brandenburg	60.	Horsens
26.	Göttingen	61.	Randers
27.	Holbaek	62.	Silkeborg
28.	Naestved	63.	Neubrandenburg
29.	Slagelse	64.	Tampere
30.	Dessau	65.	Nyköping
31.	Magdeburg	66.	Wroclaw
32.	Frankfurt Oder	67.	Tallinn
33.	Jönköping	68.	Karlstad
34.	Aabenraa	69.	Szczecin
35.	Plock	70.	Gdansk

Appendix 3. Ranking of nodes based on the criterion "Education & knowledge".

1.	Berlin	31.	Hannover
2.	Warsaw	32.	Bergen
3.	Copenhagen	33.	Halle
4.	Stockholm	34.	Örebro
5.	Poznan	35.	Kiel
6.	Helsinki	36.	Ålborg
7.	Hamburg	37.	Luleå
8.	Oslo	38.	Oulu
9.	Uppsala	39.	Östersund
10.	Lodz	40.	Borås
11.	Wroclaw	41.	Joensuu
12.	Vilnius	42.	Jyväskylä
13.	Gothenburg	43.	Rostock
14.	Lund	44.	Gävle
15.	Århus	45.	Magdeburg
16.	Tallinn	46.	Kaunas
17.	Leipzig	47.	Greifswald
18.	Umeå	48.	Jönköping
19.	Bialystok	49.	Odense
20.	Gdansk	50.	Karlstad
21.	Olsztyn	51.	Halmstad
22.	Torun	52.	Cottbus
23.	Turku	53.	Frankfurt Oder
24.	Linköping	54.	Rovaniemi
25.	Riga	55.	Klaipeda
26.	Tampere	56.	Jelgava
27.	Trondheim	57.	Siauliau
28.	Potsdam	58.	Szczecin
29.	Göttingen	59.	Lappeenranta
30.	Tartu	60.	Vaasa

Appendix 4. Ranking of nodes based on the criterion “Culture and tourism”.

1.	Berlin	46.	Celle
2.	Stockholm	47.	Magdeburg
3.	Copenhagen	48.	Szczecin
4.	Warsaw	49.	Falun
5.	Hamburg	50.	Östersund
6.	Oslo	51.	Oulu
7.	Riga	52.	Karlstad
8.	Tallinn	53.	Linköping
9.	Vilnius	54.	Umeå
10.	Helsinki	55.	Jönköping
11.	Poznan	56.	Koszalin
12.	Hannover	57.	Kuopio
13.	Bergen	58.	Halmstad
14.	Gothenburg	59.	Sundsvall
15.	Leipzig	60.	Wismar
16.	Gdansk	61.	Mikkeli
17.	Wroclaw	62.	Gävle
18.	Malmö	63.	Kajaani
19.	Trondheim	64.	Örebro
20.	Kaunas	65.	Vejle
21.	Lodz	66.	Göttingen
22.	Potsdam	67.	Konin
23.	Pärnu	68.	Lahti
24.	Lubeck	69.	Elblag
25.	Gdynia	70.	Västerås
26.	Rostock	71.	Bialystok
27.	Jurmala	72.	Naestved
28.	Tampere	73.	Zielona Gora
29.	Klaipeda	74.	Växjö
30.	Turku	75.	Gorzów Wielkopolski
31.	Århus	76.	Świnoujście
32.	Kiel	77.	Seinäjoki
33.	Rovaniemi	78.	Braunschweig
34.	Tartu	79.	Joensuu
35.	Kristiansand	80.	Liepaja
36.	Uppsala	81.	Slupsk
37.	Odense	82.	Lappeenranta
38.	Bydgoszcz	83.	Leszno
39.	Taurage	84.	Luneburg
40.	Skien	85.	Piotrkow Trybunalski
41.	Arendal	86.	Hamar
42.	Olsztyn	87.	Helsingborg
43.	Aabenraa	88.	Jyväskylä
44.	Luleå	89.	Torun
45.	Ålborg	90.	Stralsund