DELIVERABLE 3.2: TRANSPORT ECONOMIC BACKGROUND SCENARIO USED FOR REFERENCE SCENARIO

CONFIDENTIAL

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1. Introduction

ECCONET assesses the effects of climate change on the transport network, taking inland waterways as a case study. Climate change is a long term phenomenon which may have different consequences in terms of precipitation and temperatures. In order to assess future effects of climate change for transport Ecconet applies a scenario approach. Different climate change scenarios are developed in workpackage 1 which include predictions on the weather conditions in the future (with 2050 as future year of study). These scenarios will have different consequences for water levels in the Rhine and Danube, which will affect inland navigation. Typically, lower water levels generally increase cost levels for shippers. The cost functions for inland waterways give the relationship between water levels and costs and are included in the transport model (NODUS). This model is used to assess the implications climate change might have for the transport sector in 2050.

In order to analyse the effects of climate change for the transport sector in 2050, we also need to define a future situation for transport. The transport sector will be affected by developments in the sector itself, but also by economic developments, demographic developments, spatial developments, etc. These developments together - without climate change and adaptation measures – make a scenario which is what ECCONET considers as the transport reference scenario (what may also be defined as the business as usual scenario). It is likely, for instance, that transport demand has changed in 2050 and that the infrastructural network has changed. The reference scenario is based on assumptions for 2050. NODUS uses real cost functions and transport OD (origin-destination) demands across countries, per mode and goods category. Ideally, the transport reference scenario provides information about the evolution of traffic per type of goods and mode (on national level) and the general assumptions behind this forecast (development of wages, taxes, etc.). This information has to be included into the NODUS model when analyzing the 2050 effects of climate change.

A transport reference scenario for 2050, accepted by the Commission, is then useful. This avoids discussion on the validity of any assumptions needed for transport projections. Unfortunately, such a commonly accepted reference scenario is not available. Many forecasting studies have been conducted in recent years of which some provide input to policy documents (among which is the recently launched new White paper from the Commission (European Commission, 2011). ECCONET has reviewed most of the forecasting studies and assesses the scenarios on the relevance for our project and use with NODUS.

This Deliverable 3.2 defines the transport reference scenario as used within ECCONET. We start with a review of different scenario studies that have been carried out in a European context. Various modeling and forecasting studies have defined a reference scenario with assumptions about the growth of transport for future years. The scenarios are explained and the relevance to ECCONET is assessed in chapter 2. The reference scenario for 2050 should not only provide details about transport demand. Chapter 3 outlines the 2050 infrastructure network which is part of the ECCONET reference scenario. Finally, chapter 4 describes how the 2050 freight flow matrices have been developed based on the assumptions from the selected scenario. These freight flow matrices are the necessary input for the NODUS model.

2. Long term scenario studies for inland waterways

In order to perform the assessment of the impact of the change in water levels in ECCONET a reference scenario for 2050 is needed. This scenario should provide information about transport flows in 2050 for different modes. In order to avoid discussions about the transport flows (which in fact could be regarded as being outside the scope of the study), it has been decided to base our scenario on results from available forecasting studies. Several scenario studies were identified as being potentially relevant, for which results have been compared and discussed. The following scenario studies/projects have been considered:

- Platina (2011)
- TEN-CONNECT (2011)
- White paper (2010)
- iTREN 2030 (2009)
- FREIGHTVISION (2010)
- HOP!, (2008)
- Medium and Long term perspectives of Inland waterway transport in the European Union, DG Move (2011)

Each of the above studies has briefly been assessed on their relevance to ECCONET. Aspects such as forecasting horizon, geographical scope and methodology are used as indicators. In the concluding section we motivate our preferred (and selected) reference scenario for ECCONET.

2.1 Platina project

The European Commission launched the PLATINA project to implement efficiently actions and measures promoting inland waterway transport. The main objective of PLATINA is to support the European Commission, Member States and third countries in the implementation of the NAIADES action programme. PLATINA brings together all the relevant actors in the inland waterway sector in a multi-disciplinary knowledge network. More information can be found at http://www.naiades.info/platina.

<u>Forecasting horizons:</u> 2025

<u>Geographical scope:</u> EU + Switzerland + Croatia + Serbia

<u>Objectives:</u> implementation of the NAIADES action program

<u>Methodology and models:</u>
Base year flows are collected at link level for the inland waterways. These flows have been validated by national experts. Forecasts have been made based on growth figures which are applied to these link flows.

<u>Relevance</u>
The study is relevant and contains reliable information at link level. However, the forecasting horizon is 2025. In addition to the short planning horizon, this is a project without approved results. This makes the scenarios not relevant to ECCONET.

2.2 TEN-CONNECT II

The TEN-CONNECT study has been performed for the redefinition of the TEN-T network. However, due to different circumstances, amongst which is the financial crisis, the results were not used for this purpose. A second round of calculations in TEN-CONNECT II has been done in 2011 where a new data collection process was performed and a new methodology was applied. The TransTools model is applied for producing forecasts for different scenarios of freight transport for 2030 (Tetraplan and partners, 2011).

Forecasting horizons: 2030

Geographical scope: EU

Objectives: Calibration of 2005 freight model, calculation of Baseline Forecast to 2030 and modelling of three infrastructure scenarios.

Methodology and models: A multi-modal modelling framework based on the STEMM concept was developed during the WORLDNET project in 2009. This methodology was used and has been calibrated and developed within the TEN-T Ports study in 2010. Growth assumptions come from the iTren study. The TransTools model has been used to produce forecast for the different scenarios.

Results

Table 2.1 shows the modal split outcomes for the base year and 2050.

Table 2.1: TEN-CONNECT II transport growth

EU27	2005	2030 Baseline (with priority projects)
road	177.5 bn truckkm	249.3 bn truckkm
rail	404 bn tonnekm	690 bn tonnekm
iww	167.6 bn tonnekm	280.6 bn tonnekm

Source: Tetraplan and partners, 2011

Relevance

Forecasting horizon is only until 2030 and no specific attention has been paid to inland waterway transport. The 2030 freight transport settings assume no change in policy and network for inland waterways.

2.3 White Paper

The White paper has been published in March 2011 (EC, 2011). This policy document is accompanied by an impact assessment report that identifies the challenges that the transport system is likely to face in the future, based on an evaluation of policies and developments in the recent past and on an assessment of current trends (EC, 2011(a)). It defines a long-term strategy that would allow the transport sector to meet its goals with a 2050 horizon. The Commission has carried out an analysis of possible future developments in a scenario at unchanged policies, the so-called baseline scenario or reference scenario. This reference scenario is a projection of the future, which provides the benchmark for evaluating new policy measures. This scenario builds on a modelling framework including PRIMES, TRANSTOOLS, PRIMES-TREMOVE transport model, TREMOVE and GEM-E3 models (EC, 2011a). The projection is built on a set of assumptions related to population growth, macroeconomic projections, developments in oil price and technology improvement.

Forecasting horizons: 2030 and 2050

Geographical scope: EU

Objectives: study impacts of new EU policies accompanying/supporting White Paper.

Methodology and models: Results of different studies are combined. TRANS-TOOLS is generally used as main model up to 2030. For the forecast up to 2050, the PRIMES – TREMOVE models have been used.

Results level of detail: Aggregate indicators

Table 2.2: Freight transport projections (average growth rates per year)

	1990-2005	2005-2030	2030-2050
Road	3,6%	1,3%	0,5%
Rail	-1,5%	1,3%	0,8%
Iww	0,5%	0,8%	0,4%

Source: PRIMES-TREMOVE transport model (EC, 2011a)

Total freight transport volumes are expected to grow by about 38% by 2030, with road and rail growing at comparable rates. The developments in rail freight are sustained by a slower increase in fuel costs and the positive impacts of the opening of the rail markets. Road transport would maintain its dominant role in inland freight transport, contributing 73% in 2030, followed by rail (with 17%). Both road and rail slightly increase their shares between 2005 and 2030 to the expense of inland navigation, which is expected to grow at a lower pace. Beyond 2030 rail is expected to grow more than road and inland navigation.

Table 2.3: Modal split for freight transport

EU27	2005		2030		2050	
	Btkm	Modal Split	Btkm	Modal Split	Btkm	Modal Split
Total	2,495		3,438		3,863	
Road	1,800	72.17%	2,517	73.21%	2,840	73.52%
Rail	414	16.60%	579	16.83%	652	16.89%
Iww	280	11.23%	342	9.95%	371	9.59%

Source: data send by EC/JRC

Relevance

The reference scenario provides detailed forecasts for transport freight volumes, also for the ECCONET time horizon of 2050. However, the scenario is rather aggregate for inland navigation and lacks certain details which are needed for ECCONET. Details about the evolution of traffic per type of goods and mode (on national level), and the general assumptions behind this forecast (development of wages, taxes, etc.) are not available.

2.4 iTREN 2030

The basic objective of iTREN-2030 is to extend the forecasting and assessment capabilities of TRANS-TOOLS, which is the accepted tool for transport network analysis for the EU, to the new policy issues arising from the technology, environment and energy fields. The extension will draw on experiences from other projects such as TRIAS, TREMOVE II, REFIT and WorldNet. The tools and approaches developed for these projects will be connected with TRANS-TOOLS. The iTren 2030 project has developed a reference scenario until 2030 (for more details we refer to Fiorella et al., 2009). The Reference Scenario is the result of the integration and harmonisation of the four iTREN-2030 models that use common or comparable external assumptions (e.g. population growth rates) and consider a common set of policies. In particular, the Reference Scenario is based on the transport demand projections coming from the TRANS-TOOLS model. The TEN-T network will be constructed and road pricing is assumed to be implemented in the reference scenario.

Forecasting horizons: 2030

Geographical scope: EU

Objectives: Develop a modelling framework which can endogenise transport, energy , environment and economic policy.

Methodology and models:
The following models were interlinked with each other: TRANS-TOOLS, TREMOVE, POLES and ASTRA. Given some operational problems of TRANS-TOOLS at the time, several pragmatic changes to the methodology had to be made.

Results level of detail:
The published data contains a set of aggregate indicators by country (see Table 2.4).

Table 2.4: Key freight indicators for iTren 2030 reference scenario (EU 27)

Freight transport (billion tkm)	**2005**	**2030**	**Annual change (average, %)**
Road	2073	3056	1.6
Rail	447	798	2.3
Inland navigation	192	335	2.2
Maritime	4162	6004	1.5
Total	6875	10193	1.6

Source: Fiorella et al., 2009

Relevance:
This is a useful study, but results are rather aggregate and the time horizon is only until 2030.

2.5 FREIGHTVISION

"FREIGHTVISION - Freight Transport 2050 Foresight" was a project funded by the European Commission Directorate General MOVE to design a long term vision for European freight transport in 2050 and to identify actions and research to progress appropriate freight transport measures in Europe (see als Freightvision, at www.freightvision.eu). The research was carried out between 2008 and 2010 as a foresight process encompassing four conferences in which the project team identified and developed with the aid of more than 100 experts an action plan for securing long term freight transport in Europe.

Forecasting horizons: 2050

Geographical scope: EU

Objectives: Develop a long term vision and action plan for a sustainable European long distance freight transport system in 2050.

Methodology and models:

The methodology follows a combination of forecasting and modelling.

Modelling for trend analysis of the key drivers and for the development of the forecast and scenario:

- TRANS-TOOLS for transport modelling
- PRIMES for energy modelling
- SYKE for GHG emission and fossil fuel share

Results, level of detail:
A book (Helmreich and Keller, 2011) and project deliverables (available through the Internet at www.freightvision.eu) provide information about the scenarios. Future uncertainty is addressed with three different forecasts for the future freight transport demand: a trend forecast (most likely development), a low forecast and a high forecast. The first scenario may be considered as a reference scenario for ECCONET purposes. Freightvision produces forecasts for freight transport demand, modal split and average load. Freight transport demand in the trend forecast scenario for total land transport in EU27 increases by 58% (2005-2050). It increases from 2315 billion tkm to more than 3600 billion tkm in 2050. Modal split changes slightly over time in favour of rail and inland waterways. This is based on certain assumptions, for instance on the development of load factors for trucks (in order to determine vehicle km's). These are projected to change from 9.8t in 2005 to 11.0t in 2050.

Relevance:
The study seems relevant because of the time horizon. However, the study does not provide the requested ECCONET level of detail for NSTR goods developments and inland waterways.

2.6 Port of Rotterdam forecasts

The port of Rotterdam has developed a vision for 2030 (Port of Rotterdam, 2011). This vision document presents four different scenarios that were used to forecast the potential cargo throughput in 2030. The most influential factors in forecasting cargo flows are economic growth, the volume of world trade, oil prices and environmental policy. Based on these factors, four different economic scenarios were selected to assess future developments in cargo handling. These scenarios were drawn up by the CPB Netherlands Bureau for Economic Policy Analysis and the European Commission conducted a study to support their vision for 2030. These scenarios may be relevant for ECCONET, as the focus is on inland navigation.

Forecasting horizons: 2030

Geographical scope: Hamburg – Le Havre Range, focus on Rotterdam

Objectives: Obtain insight in the future cargo throughput developments in Rotterdam and its competing ports.

Methodology and models: Combination of results from other studies. Dutch WLO scenarios are used and results from the HOP study. Both (scenario) studies are relatively old.

Results level of detail: Aggregate results available per commodity type for the four different scenarios.

Relevance:
This study does not give an EU wide overview, it focuses on the Rhine corridor and is based on Dutch scenarios. No information can be derived for the Danube and Po area. The information on commodity level is an advantage over the other studies. In conclusion, the Rotterdam port work has not the required scope for the ECCONET study.

2.7 Medium and long term perspectives of inland waterway transport in the European Union

The 2011 study '*Medium and Long Term Perspectives of Inland Waterway Transport in the European Union*' provides the European Commission with a comprehensive basis to define the inland waterway transport policy within the general transport policy for the medium and long term (NEA and partners, 2011). A quantitative forecast on the expected transport performance of IWT is given based on a business-as-usual (baseline) scenario for horizons 2020 and 2040. Particularly within the framework of rethinking and developing new transport policies, the study provides answers to the further positioning of IWT in the context of the new policy (for instance, the new White Paper on Transport, revised TEN-T Guidelines, EU 2020 agenda).

Forecasting horizons: 2020 and 2040

Geographical scope: EU 27

Methodology and models:
The basic forecasts that were used in the present study were derived from other already existing studies, in particular from the TEN CONNECT 2 study. This is a successor project to the 2009 TEN CONNECT study, regarding development of a transport network model and estimation of traffic growth at a European scale. For the horizon year 2030 transport developments in the entire EU were estimated, using a freight model.

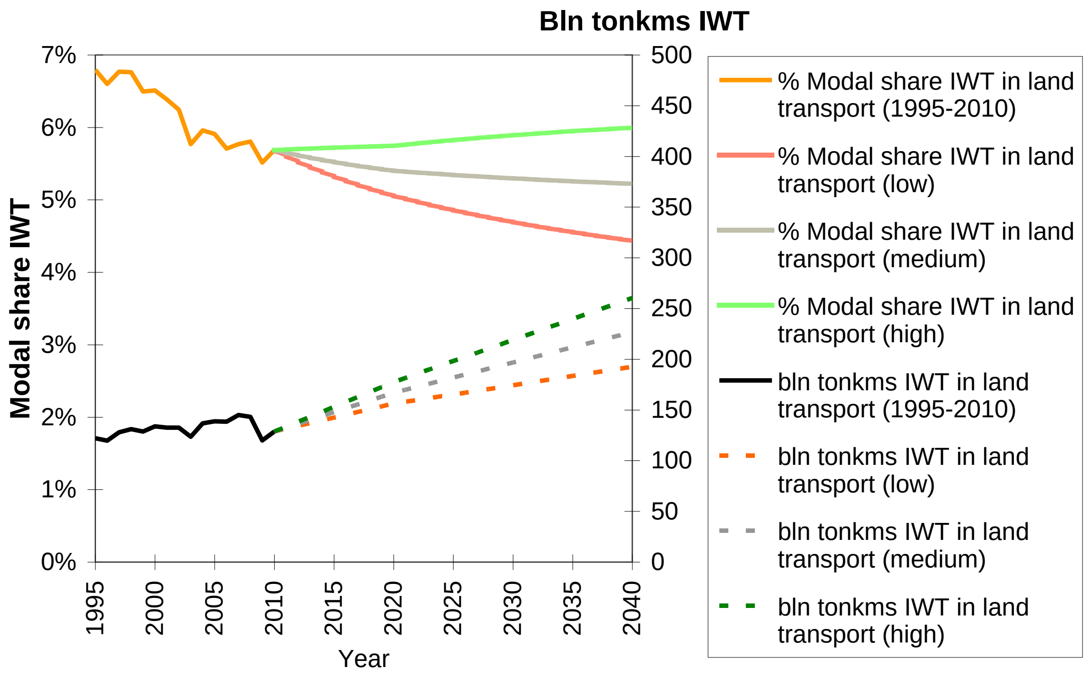
Data for the base year for the quantitative analyses were provided by ETIS/TRANSTOOLS data. The main reason for selecting 2007 as the base-year is that this is the most recent year for which the data on EU27 is available and considered as reliable. Another reason is that year 2007 was prior to the crisis that started in 2nd half of 2008 and caused substantial volatility in the observed freight flows. Furthermore, in the year 2007 the market situation was rather balanced in terms of supply and demand and there was no extreme water level situation in that year either.

Results level of detail:
The baseline scenario incorporates all general White Paper (2011) policies and the most recent developments in supply chains. Starting point for developing the baseline forecast was transport demand data from the TEN CONNECT 2 study which was based on the iTREN 2030 integrated scenario. Subsequently specific growth factors were adjusted and corrected for inland waterway transport, based on specific IWT supply chain developments from desk research as well as interviews with large shippers, port authorities and large IWT operators. These parties were asked to evaluate the medium-term growth perspectives in their markets segments. Using this approach,

bandwidths bound by low, medium and high growth for 2020 and subsequently also for 2040 were determined for various supply chains.

The following figure presents the overall outlook on EU27 level.

Figure 2.1: IWT modal share and transport performance outlook (EU27)



Note: in the figure above the right hand Y-axis presents the overall performance in billion tonne kilometre while the left hand Y-axis presents the modal share of IWT versus road and rail transport.

Source: NEA and partners (2011)

In TEN CONNECT 2 (see Tetraplan and partners, 2011) the growth rates are also available for different types of goods, different countries and different geographic orientations (domestic, import, export, transit). This makes them very useful to ECCONET and NODUS application. In order to arrive also at basic forecast for 2040 the average annual growth rates in the models for the period 2020-2030 were extrapolated to the period 2030-2040.

Relevance

The results from this study are useful to ECCONET. It gives detailed results on freight flows at corridor level (by NSTR category and transport mode) for 2030 and 2040. Moreover, it provides forecasts at corridor level for inland waterway transport (for the Rhine and Danube corridor). However, ECCONET needs predictions for 2050 which makes an extrapolation needed.

2.8 Summary

We have reviewed different studies which has defined a reference scenario with assumptions about the future development of freight transport. The studies provide useful insights into the development, the policy relevance and application of reference scenarios, but only a few are relevant for the ECCONET project.

Since recent disaggregated data for specific goods types on corridor level for inland waterways is very useful to ECCONET, we have decided to use data from the Medium and Long term perspectives study. One drawback is that extrapolation is needed to develop the ECCONET reference scenario for 2050. More details about the final transport reference scenario will be presented in chapter 4.

3. Infrastructural network

The previous section covered the macro-economic conditions for future inland waterway transport in Europe and provided transport demand figures for 2050. NODUS also requires input for the infrastructural network. Since we focus on the analysis of the Rhine and Danube market, only flows which could possibly use these two rivers are of interest. This also affects the information that is needed for the infrastructural network. Many scenarios in the forecasting studies assume that all TEN-T projects have been realized by 2040 or 2050. Only a few of these projects are relevant to ECCONET and the particular Rhine/Danube market. We have made a selection of infrastructural (TEN-T) projects that will be added to the 2005 network. These projects are:

- Priority Project 18: Waterway axis Rhine/Meuse-Main-Danube
- Priority Project 30: Inland Waterway Seine-Scheldt

These projects are very likely to be completed by 2050 and will have a significant impact on IWT upon completion.

Moreover, we also introduced three other projects (two railway projects and one road project) supposed to be completed by 2050 and having a potential impact on the ECCONET transport task. These projects are:

- Priority Project 5: Betuwe line (railway, completed)
- Priority Project 7: Motorway project Igoumenitsa-Athina-Sofia-Budapest
- Priority Project 22: Railway axis Athina–Sofia–Budapest–Wien–Praha–Nürnberg/Dresden

Each of these five priority projects has a number of subprojects. These are presented in the next sections.

3.1 Priority Project 18: "Waterway axis Rhine/Meuse-Main-Danube" [1]

The subprojects are:

1. 2008-SK-92308-S
   Project Documentation and Modernisation of Bratislava old bridge
2. 2007-RO-92301-S
   D. A. N. U. B. E.: Danube Access Network – Unlocking Bottlenecks in Europe, by developing a high quality TEN-T ports infrastructure in Romania on optimal economic terms – Feasibility study phase
3. 2007-NL-18010-P
   Maasroute, Upgrade of inland waterways from class Va to class Vb specifications
4. 2007-HU-18090-S
   Improvement of the navigability on the Danube
5. 2007-DE-18050-S
   Independent variant research on the development of the Danube between Straubing and Vilshofen

[1] http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/priority_project_18/priority_project_18.htm

6. 2007-DE-18030-P
   New construction of the rail bridge above the Danube at Deggendorf
7. 2007-BE-18070-P
   Construction of a 225 x 25 m chamber navigation lock, its ancillary works and a pumping station / hydroelectric power plant on the Albert Canal, to the east of the existing lock complex at Lanaye
8. 2007-BE-18040-P
   Studies for the construction of a 225m x 25m (Class VIb) lock in Huy (Ampsin-Neuville) and the works of a 225m x 25m (classe VIb) lock in Flémalle (Ivoz-Ramet), both on the Meuse river
9. 2007-AT-18020-P
   Implementation integrated river engineering project Danube East of Vienna

The ones we suggest to include are 3, 5, 7 and 8, while 4 would be part of the WP2 measures. Following descriptions are from the official project leaflets on the TEN-T website.

- Project 3 concerns an <u>upgrade of the Meuse river between the Waal river near Nijmegen and the Belgian border at Lanaye</u> (near Liège).
  By upgrading the waterway from class Va to class Vb and increasing draught from 3.0 to 3.5 m, this important TEN waterway will be able to accommodate more inland shipping and thus achieve a substantial modal shift. Activities include:
  - raising of bridges at Weurt
  - construction of sluices at Heumen and at Limmel
  - enlargement of locks at Heel, Born, and Maasbracht
  - widening of the Juliana canal between Born and Stein, between Elsloo and Limmel and of a curve at Elsloo
  - raising the water level near Maasbracht – Born
  - widening a river curve at Steijl and Neer
  - widening and deepening a lock at Sambeek and Belfeld
  - deepening the Meuse near Venlo
  - construction of a traffic management centre at Maasbracht

- Project 4 involves the study of the elimination of fords and bottlenecks hindering navigation along the <u>Hungarian stretch of the Danube river</u> between the town of Szob and Hungary's southern border. It will contribute to meeting the requirements set for the Danube-Main-Rhine waterway (UNECE directives).
  Currently, the fairway does not meet UNECE VI B and C parameters for approximately half of the year. However, after the elimination of fords and bottlenecks, this limitation will happen only for 20 days as a maximum.

- Project 5 concerns the <u>main bottleneck in the entire Rhine-Main-Danube waterway, which is from Straubing to Vilshofen</u>. While the rest of the waterway has been adapted to 2.5 m water depth in recent years, the Straubing-Vilshofen section's water depth only reaches 1.6 m at low water levels. A water depth of 2.50 m can be reached only 165 days a year on average. While the TEN-T project only concerns an exploratory study, ECCONET will assume the extra depth is actually achieved by 2050.

- Project 7 concerns the <u>construction of the fourth lock at Lanaye</u>, the key lock along the Albert Canal at the Belgian-Dutch border. This lock connects maritime and inland ports along the Rhine-Main-Danube (from Rotterdam to Constanza) and along the Seine-

Scheldt (from Le Havre to Antwerp) and constitutes an essential point of passage for the European inland waterway network. The existing lock is highly congested, causing considerable delays (21,000 merchant ships / 11.5 million tons in 2006).The fourth lock at Lanaye will be 225 m x 25 m, so as to bring the lock's capacity to more than 50,000 vessels per year (with a merchant fleet composition similar to the current one). The project also includes a pumping station to offset the increase in water consumption, and a hydroelectric power plant to capitalise on the available fall of water.

- Project 8 aims to increase the lock capacity of the Meuse river to reach class VIb, or the traffic of boats carrying 9,000 tonnes. The locks located in Ivoz-Ramet and in Ampsin-Neuville are two of the most important in the Walloon region, counting 11,490,000 and 8,880,000 tonnes respectively in 2007. The project plans to build a new lock at Ivoz-Ramet and, for the section Ampsin-Neuville, it will develop the detailed studies, including hydraulic, navigation, socio-economic and environmental analysis.

3.2 Priority Project 30: "Inland Waterway Seine-Scheldt"[2]

The subprojects of this PP are:

1. 2010-FR-91118-S
   Etudes pour la mise au gabarit Vb de l'Oise entre Compiegne et Creil
2. 2009-FR-90910-P
   Rebuilding of the dams in Boran and Venette on the river Oise
3. 2009-FR-90909-P
   Upgrade of Deûle river size to 3,000 tonnes between Sequedin and Deûlémont
4. 2009-BE-90200-S
   Study of the navigability of the 'Upper-Seascheldt' and the 'Southern Ghent Ring Canal' for class Va motor vessels (1500-3000 tonnage)
5. 2007-FR-91207-S
   Extension of the Grand Canal du Havre
6. 2007-EU-30010-P
   The Seine-Scheldt inland waterway network - cross-border section between Compiègne and Ghent

All of these are deemed relevant to ECCONET and will be included in the projected infrastructure network for 2050.

- Project 1 covers an upgrade the Oise river (between Compiègne and Creil) to navigation class Vb. The Oise River is navigable for 103 km, from the intersection with the Seine to Compiègne (Janville). It links the Seine basin to the waterway network of the Nord-Pas de Calais and, further, to the Benelux, as well as to the Champagne-Ardenne network and the Mosel and Rhine basins. The fairway upgrade of the Oise river up to Class Vb will allow vessels between 3,200 and 6,000 tonnes and of maximum 185m length. It will also enhance the use of two intermodal terminals (road/rail/water freight transhipping).

- Project 2 is located on the canal from Compiegne to Conflans Sainte- Honorine on the River Oise which is in direct and immediate continuity with the planned large gauge Seine-

[2] http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/priority_project_30/priority_project_30.htm

North Europe Canal link. It is essential for achieving the inland waterway transport development and anticipated inter-modal transfer objectives. The Action aims at reconstructing the Boran and Venette dams, which are technically and functionally obsolete, as well as equipping these sites with fish passes, in order to:

- enable navigation in periods of high water levels in the structure's two main channels, the dam then being covered
- improve safety
- relieve the maximum hydraulic passage in the event of a flood
- maintain the upstream man-made lake for navigation purposes by ensuring anchorage, and thus secure water transport and increase the growth dynamic of this mode of transport
- re-establish the fish-farming continuity of the Oise

- Project 3 has the objective to upgrade the River Deûle between Sequedin and Deûlémont from Class IV to Class V in order to allow the navigation of ships of up to 3,000 tonnes. Up to now this stretch had a cross section that allowed freight traffic up to 1,350 tonnes only. In addition, stretch's width was reduced at two different points in the proximity of Lille. This bottleneck requires a light system to be used which delays the traffic. The Global Project seeks to eliminate this bottleneck at the cross border section. This Action promotes inland waterways transport by giving access to the Nord-Pas-de-Calais network to additional European shipments. A 70% increase in the traffic flow is foreseen by 2015, which corresponds to a traffic of 13.5 million tonnes instead of the initial 8 million tonnes currently. This increase in the inland waterway traffic represents an estimated reduction of 300,000 trucks per year on the road in the region.

- Project 4 aims at improving the link between the Seine and Scheldt rivers to allow class Va vessels to complete the route between Paris and Ghent. The main objectives of the Action is the completion of an exploratory study, which will provide a better understanding of the possibility and of the effects of upgrading the Upper-Seascheldt and the Southern Ghent Ring Canal to a class Va waterway. The study will investigate which bottlenecks prevent this waterway from allowing class Va vessels to navigate it and how these bottlenecks can be resolved. As for project 5 of PP18, this subproject only consists of exploratory studies to prepare an infrastructural change. ECCONET will assume that the targeted water depth is achieved to allow passage of class Va vessels.

- Project 5 intends to extend the existing Grand Canal du Havre to connect it to the Canal de Tancarville (the main link between the Port du Havre's internal waterways and the Seine River) and allow a two-way circulation inside the port. Like the previous project, ECCONET will assume this extension to be built in full.

- Project 6 is designed to connect the Seine and Scheldt river basins, and, to a broader extent, the entire Rhine-Scheldt delta and the Rhine basin. It will not only help alleviate serious road congestion which affects the north-south economic axis, but also open up a new European freight corridor between Le Havre, Paris, Dunkerque, Antwerp, Liege and Rotterdam/Amsterdam. Along this corridor, the project will allow the concentration of freight in push-tows carrying up to 4,400 tonnes. At the same time it will provide high-capacity access to the northern seaports - and a catchment market of more than 60 million people. The project investments will be aimed at eliminating the main bottlenecks, and will concern the following three sections:
    - Seine-Ghent

- Conde-Pommeroeul to Sambre
- Upper Scheldt

3.3 Priority Project 5: "Betuwe line"[3]

The subprojects of this PP are:

1. 2007-NL-60380-P
   Retrofit of 90 Siemens ES64F4 E-locomotives with Alstom ETCS L2 equipment for usage on EU freight corridors and various conventional networks
2. 2007-NL-05020-P
   Works for replacement of legacy systems by 15/25 kVAC on two remaining sections in the Netherlands of the railway corridor Rotterdam-Genoa

All of these are deemed relevant to ECCONET and will be included in the projected infrastructure network for 2050.

- Project 1 covers the retrofit and new build of a given number of locomotives of a specific type to implement the European Rail Traffic Management System (ERTMS), designed to gradually replace the existing incompatible national systems throughout Europe.
- Project 2 aims to ensure coherent technical conditions along the axis Lyon/Genova-Basel-Duisburg-Rotterdam/Antwerpen between Rotterdam and Genoa.by adapting the two remaining "islands" of 1500 VDC power supply to 15/25 kVAC supply. The particular sections concerned are a 12 km section from Zevenaar to the Dutch-German border and 50 km on the Kijfhoek marshalling yard.

3.4 Priority project 7: "Motorway axis Igoumenitsa-Athina-Sofia-Budapest"[4]

This motorway project aims to provide significant improvements to the road network of southeastern Europe by linking the main cities of the region. It will also connect the ports of Patras, Igoumenitsa, Athens (Piraeus), Thessaloniki and Constanta to the heart of the enlarged European Union. The initial plan for this axis involved the construction of two new motorways across Greece. Extensions to this axis were adopted in 2004, adding connections from the north of Greece towards the neighbouring countries, and from there towards Central Europe. The first branch of these extensions runs along the former pan-European corridor IV from the Greek-Bulgarian border at Promahon to Nadlac on the Romanian-Hungarian border, linking Thessaloniki to Sofia and to Budapest. The other branch runs from the Romanian-Hungarian border in the direction of the port of Constanta, via Bucharest.

This last branch is relevant to ECCONET as it provides an alternative to inland waterway transport on the Danube corridor and railway transport. We assume that this improvement in road infrastructure is ready by 2050.

[3] http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/priority_project_5/priority_project_5.htm

[4] http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/priority_project_7/priority_project_7.htm

3.5 Priority Project 22: "railway axis Athina-Sofia-Budapest-Wien-Praha-Nürnberg/Dresden"[5]

The subprojects of this PP are:

1. 2009-CZ-90503-S
   Modernisation of railway section Veseli and Luznici-Tábor-II part, Veseli and Luznici-Doubi u Tábora-detailed design
2. 2009-CZ-90502-S
   Modernisation of the Tábor-Sudoměřice u Tábora line - detailed design
3. 2009-CZ-90500-S
   Modernisation of the Nemanice-Sevetin railway section - preliminary design
4. 2008-CZ-23466-S
   Optimisation of Railway section Prague Hostivar - Prague main railway station detailed design
5. 2007-HU-22020-S
   Preparation of design for approval for the railway line section Biatorbagy (incl.)-Tata (excl.)
6. 2007-EU-22070-S
   Studies for the development of the Railway Priority Project 22
7. 2007-CZ-90503-S
   Reconstruction of the Olomouc Railway Station
8. 2007-CZ-22090-S
   Geotechnical and design studies for the construction of new rail connection Praha-Beroun

All of these are deemed relevant to ECCONET and will be included in the projected infrastructure network for 2050.

- Project 1 aims to modernise and double the track of the railway section Veselí nad Lužnicí-Doubí u Tábora, of the IV Transit railway corridor of Priority Project 22 Athens-Sofia-Budapest-Prague-Nuremberg/Dresden. The project will include modern electronic signaling and communication devices, modifications of railway stops and stations, anti-noise measures. The existing track will be doubled on the section Veselí nad Lužnicí-Sobìslav, while two new tracks will be designed for the section Sobislav-Doubí u Tábora, partly in parallel with motorway D3.
- Project 2 aims to provide the technical design for the construction of the second track of the section Sudoměřice u Tábora-Tábor, of the IV Transit railway corridor of Priority Project 22, railway axis Athens-Sofia-Budapest-Vienna-Prague-Nuremberg/Dresden. The section Tábor-Chotoviny follows the position of the main track of the line, while two direction relocations will be designed for the section Chotoviny-Sudoměřice u Tábora. The first one will include the development of an elevated track bridge, with an approximate length of 456 m including a 90 m bridge over the future D3 motorway. The other section will include a two-track tunnel of approximately 430 m.
- Project 3 aims to prepare the preliminary design for the modernisation of the section Nemanice I-Ševetín located on the IV transit railway corridor on Priority Project 22, railway axis Athens-Sofia-Budapest-Vienna-Prague-Nuremberg/Dresden. When completed, the project should improve the connection between the IV Transit railway corridor and the Prague railway junction, at the crossing of several trans-European axes. In

[5] http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/priority_project_22/priority_project_22.htm

compliance with the current development plan of the city of České Budějovice, the entire double-track railway will be renewed along the eastern boundary of the village of Hrdějovice and will further run in two tunnels to the villages of Ševětín and Dobřejovice.

- Project 4 looks at studies to solve the connection of IV railway corridor to the Prague railway junction, the crossing of several trans-European arteries. The project deals with the reconstruction of three railway stations (Prague Hostivaø, Prague Zahradní Mìsto, Prague Vršovice) and the improvement of double track lines between these stations (in the section Prague Zahradní Mìsto-Prague Vršovice). The studies include proposing a solution for the optimum scope of railway infrastructure (including changes from railway to public transport), preparing the design documentation and resulting public discussion. The project aims to eventually modernise the railway lines and the related buildings up to European standards, in order to achieve higher speed on the line and increase transport capacity and railway safety.
- Project 5 aims at upgrading the Biatorbagy to Tata railway section, part of Priority Project 22(railway axis Athina-Sofia-Budapest-Wien-Praha-Nürnberg-Dresden) in order to cut the journey times between Budapest and Vienna from the current 2h45 to 2h. It includes reconstructing the stations and the signalling system to enable higher track capacity and enhanced safety standards for passengers.
  The project encompasses the following activities:
  - Geodetic and geotechnical survey
  - Preparation of design for approval of track, signalling system, telecommunication and structures
  - Environmental impact asssestment

  These activities will ensure that all the required documents are available in order to obtain the building and environmental permission to implement the scheme.
- Project 6 concerns the section Thessaloniki-Promachon-Kulata-Sofia-Vidin-Calafat-Craiova-Timisoara-Curtici-Lokoshaza-Budapest-Gyor-Hegyeshalom. Part of the project involves an assessment study for the entire length of section (Phase A) to establish common standards. The phase A study will suggest the technical and operational characteristics in compliance with the Interoperability Technical Standards (TSI). It will be followed by phase B technical studies for the sub-sections Thessaloniki-Strymon-Promachon (Greece); Radomir-Kulata (Bulgaria); Craiova-Timisoara-Arad (Romania) and Lokoshaza-Budapest-Hegyeshalom (Hungary).
- Project 7 focuses on the modernisation of the Olomouc station and railway junction, part of the Czech National Transit Railway Corridor connecting the Czech Republic with Slovakia and Germany. The activities encompass a study that will prepare the detailed technical design and building permits, an assessment of transportation and operational technologies, as well as proposals for an optimal scope of railway infrastructure. It also includes the necessary operational, technical and financial documents for the construction phase. Supplemental geodetic measurements, geotechnical and civil engineering research, environmental impact research will be undertaken to propose technical solutions and determine the final budget.
- Project 8 focuses on the preparatory study for the construction of the new rail connection Praha (Prague)-Beroun. The study includes a geotechnical survey and the subsequent project design documentation for the construction of the first Czech railway network built to high-speed specifications.

4. The ECCONET reference scenario: freight flow matrices

ECCONET uses the NODUS model to determine the effects of climate change for inland waterways in 2050. This model needs input by means of a transport reference scenario. This scenario is based on certain assumptions and should provide information about transport flows and infrastructural network to allow analyses of the Rhine and Danube market. Chapter 2 has explained the forecasting study which has been chosen as starting point for ECCONET to define the future traffic flows, and chapter 3 has identified the infrastructure network. The Medium and Long Term Perspectives study provides us with information about growth factors, but only until 2040. The next step is then to extrapolate this information to obtain 2050 figures, and apply these to the freight flow data (O/D matrices). The matrices are input to NODUS, together with the adjusted infrastructural network, and used to obtain the calibrated 2050 situation: the transport reference scenario. We will now explain how the freight flow matrices for 2050 have been developed starting from the scenario input of the Medium and Long term perspectives study.

4.1 Creating freight flow matrices 2050

The Medium and Long term perspectives study provided a baseline scenario for the future years 2020 and 2040. These years are the chosen time horizon years for development in the medium term (2020) and long term (2040). The baseline scenario is based on a number of key assumptions regarding developments on macro level:

- the development of the world and the EU economy;
- depletion of resources of raw materials, world market prices for resources;
- demographic, social, technological and cultural developments;
- economic and transport policy environment in the EU.

The main basic assumptions of the scenarios that were constructed for the present study were taken from the EU iTREN-2030 integrated scenario. The latter scenario was developed by the iTREN-2030 project for the European Commission (Fiorello and others, 2009). The integrated scenario also addressed the effects of the financial and economic crisis in their projections for the future. The starting point for developing the business as usual forecast was the transport demand data from the recently finished TEN CONNECT 2 study (Tetraplan and others, 2011). The assumptions and forecast data for modes road, rail and IWT in TEN CONNECT 2 were based on the iTREN 2030 integrated scenario.

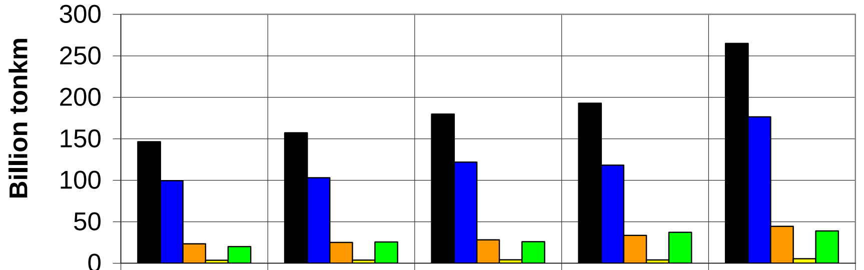
The scenario could be described as a 'Baseline' scenario in the sense that it incorporates all general White Paper (2011) policies and the most recent developments regarding the market environment of supply chain. For example modal split agreements in sea ports and changes in German energy policy were taken into account. However, it does not look at additional specific policies for the IWT industry.

These 'top-down' model based growth forecasts were modified and, where required, corrected by using 'bottom-up' practical information from specific sector studies and key supply chain experts which were approached by project team members in a number of in-depth interviews. The expected development paths of the supply chains were discussed with these experts, and the interviews specifically focussed on the way in which inland waterway transport activities might develop in the future, based on current industry trends and policies.

This quantitative and qualitative information was supplied amongst others by major shippers, port authorities and large IWT operators. These parties were, among other things, asked to evaluate the medium term growth perspectives in their markets segments. Using this approach, for various supply chains bandwidths, regions bound by low and high growth paths, for the freight volumes for IWT in 2020 and subsequently also for 2040 were determined. The developments for road and railways were taken from the other studies.

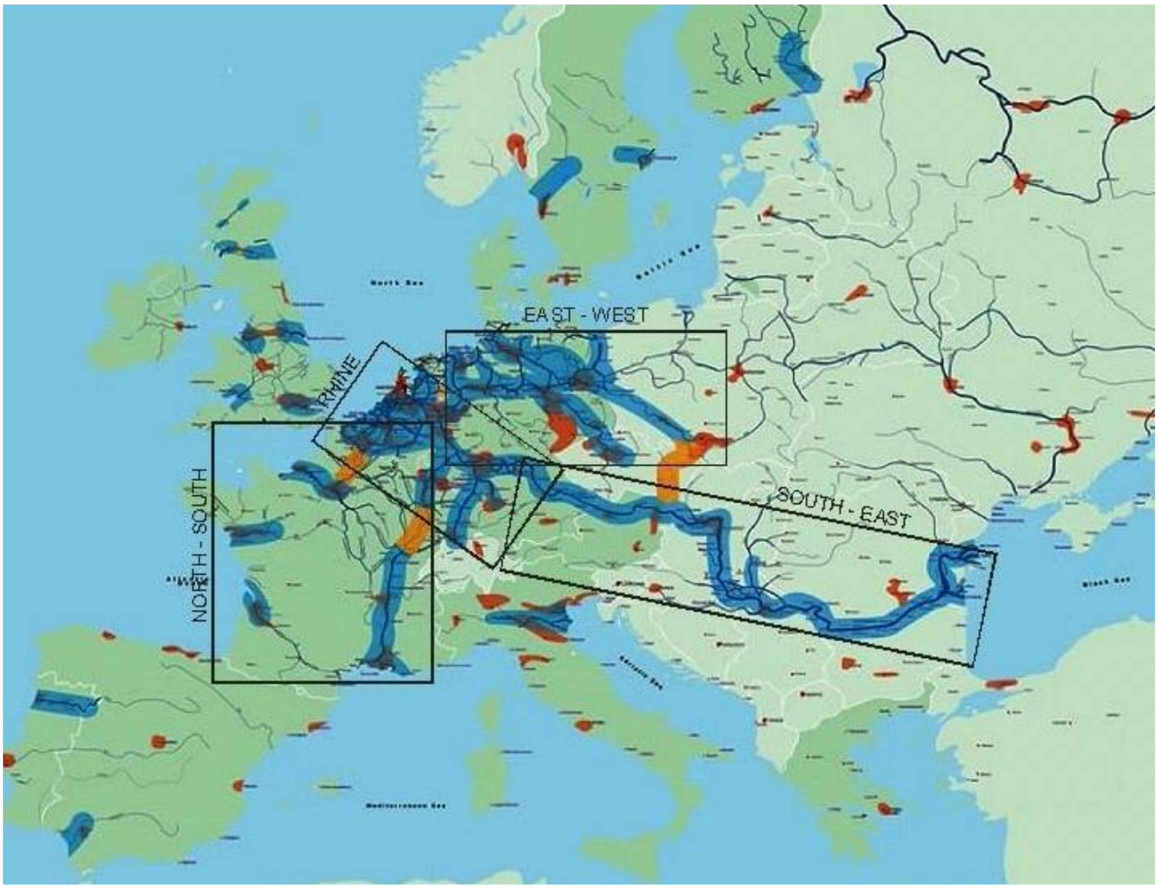
Figure 2.1 already provided an overview of the modal split developments for the different scenarios (low, medium and high). It can be seen that the overall transport performance of IWT is expected to grow. However, in the low and medium scenario, the expected growth of IWT is smaller compared with the expected growth of rail and road. Only in a high growth scenario will the modal share not decline further and will end up at approximately 6.0% in 2040. The study also provides developments on corridor level and commodity type. Based on the specific growth expectations for each type of commodity for each corridor, the overall expectation for each corridor was estimated as well as the total development for the EU27 area. The following figure (figure 4.1) presents the differentiation for each corridor, with corridors as depicted in Figure 4.2. The assumed growth prospects on the Danube are in line with the objectives as stipulated in the Action Plan for the EU Danube Region Strategy (20% growth of cargo volume by 2020). For more details about methodology, assumptions and growth factors we refer to NEA et al., 2011).

Figure 4.1: Transport performance outlook per corridor



	2007	2020 min	2020 max	2040 min	2040 max
EU27	146	157	180	193	265
Rhine	99	103	122	118	176
North-South	23	25	28	34	44
East-West	4	4	4	4	5
Danube	20	25	26	37	39

Figure 4.2: Overview of corridors



This scenario input has been used to determine the 2050 freight flow matrix. This been done through extrapolation of the 2020 and 2040 growth factor information. For ECCONET we have taken the 2020-2040 growth factors for the medium scenario for all modes (at corridor and commodity level, when available). The average values for these 20 years have been determined and used to obtain a proxy for the trend in the next 10 years until 2050. The 2005-2050 growth values that are now known have been applied to the 2005 base year O-D matrix as developed earlier in the project. Averages have been determined for flows that use multiple corridors.

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