Final Report – Main Report

Medium and Long Term Perspectives of IWT in the European Union

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SUMMARY

Introduction

This summary presents the key findings and policy recommendations of the study '*Medium and Long Term Perspectives of Inland Waterway Transport in the European Union*', which was carried out by the consortium led by NEA with the partners Planco, via donau, CE Delft and MDS Transmodal. The study is funded by the European Commission Directorate-General MOVE and started in January 2011 and ended on 23rd of December 2011.

The summary starts with an explanation of the study objectives and subsequently sets the background of the study and the current position of Inland Waterway Transport (IWT). Next the assessment of the performance of the industry is presented, seen both from the demand side as well as from the supply side of the market. The results from the SWOT analysis provide the basis to identify the key problems and challenges for IWT for the coming decades. Additionally, 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. Based on the problem analyses and the outlook the policy objectives are presented and finally the conclusions and recommended policy packages and measures are presented. This provides the strategy for the inland waterway transport policy.

In addition to the broad and extensive expertise within the consortium, the basis for this study was provided through desk research, stakeholder consultations on the 5th of July and the 23rd of November 2011 and through a broad range of interviews with key users and operators in the inland waterway transport industry.

Study objectives

The 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.

The more specific objectives of the study were:

- to investigate and analyse the current situation of the EU inland waterway transport sector in the context of the economic crisis,
- to analyse the strengths and weaknesses of the sector,
- to explore the prospects and potential of inland waterway transport within the European transport system in the medium and long term, also taking into account the likely impacts of the economic crisis and the challenges and issues to be tackled in the future,
- to give concrete recommendations for policy measures with regard to inland waterway transport at EU level and comply with the priorities set out in the Transport White Paper,
- to make suggestions for the development of a medium and long term European strategy in support of inland waterway transport.

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).

Background

Transport policy

Transport is fundamental to our economy and society. However, when looking 40 years ahead, it is clear that transport cannot develop along the same path. Oil will become scarcer in the coming decades and will have to be sourced from increasingly uncertain supplies. Furthermore, congestion on the roads and climate change are major concerns, as well as the social costs of accidents and noise. In the recently published White Paper on Transport '*Roadmap to a single European Transport Area- Towards a competitive and resource efficient transport system*' (2011) ambitious goals have been set aimed at substantially reducing oil dependency and carbon emissions without sacrificing efficiency and the freedom of movement that transport offers. The main policy objectives in the White Paper are grouped around three general themes:

I. Developing and deploying new and sustainable fuels and propulsion systems.
II. Optimising the performance of multimodal logistic chains, including making greater use of more energy-efficient modes.
III. Increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives.

The first theme primarily contains goals for the automotive, airline and maritime shipping industry but it also applies to some extent to IWT. For example the use of Liquefied Natural Gas (LNG) as an alternative fuel and diesel-electric power trains can be mentioned. The second and third groups contain more direct goals for the IWT industry. IWT is an energy efficient mode and provides capacity on waterways and is therefore marked as one of the modes that should increase its modal share. In this respect achieving a modal shift is a separate goal within the second group: by 2030 a share of 30% of road freight over 300 km should be shifted to other modes (waterborne and rail) and by 2050 a share of 50% in this market should be transported by alternative modes.

In this respect it should be noted that IWT can also be competitive over shorter distances. Furthermore the core inland waterway networks will be incorporated and integrated within the networks of other transport modes. This core network integration is also one of the goals and should be achieved by 2050. The third theme is also relevant to the IWT sector. In particular the goals regarding modernisation of traffic management (for example through River Information Services), improving safety and security of transport and the further application of the 'polluter pays' principle could be mentioned in this respect. The White Paper announces that the European Commission shall examine mandatory application of internalisation charges on all inland waterways within EU territory. An approach shall be developed by 2020 for the internalisation of external costs in IWT. Last but not least the White paper has an explicit message regarding IWT '*Inland waterways, where unused potential exists, have to play an increasing role in particular in moving goods to the hinterland and in linking the European seas*.'

General characteristics and position of inland waterway transport

Inland waterway transport can contribute significantly to the White Paper objectives because IWT is characterised by the following intrinsic merits:

- very low direct movement costs,
- low energy consumption and low carbon footprint,
- low air pollution and noise levels,
- safe and secure services,
- spare capacity on the network, negligible congestion on the waterways, and
- high transport capacity and reliability.

It is clear that IWT already plays a very important role where high quality ports and waterway connections are available in combination with high transport demand and industrial activities (for example the Rhine delta). IWT is indispensable in the transport to and from major seaports in the Hamburg-Le Havre range and the Danube delta region, as IWT services are a key factor in the competitive position of these seaports and in the supply chains of users of those ports.

IWT has a very strong position in the transport of bulk commodities and containers on certain corridors linking the seaports to the hinterland over medium and long distances (above 50 km). The modal share of IWT in the EU27 is 25% to 30% for bulk commodities such as solid mineral fuels (coals), petroleum products (oil) and ores and metal waste. On some corridors and distance classes the modal share however exceeds 95%. Expressed in terms of volume in tonnes, the size of container transport by barge is still relatively small on a European scale. However, for the seaports Rotterdam and Antwerp, the contribution of container barge transport is quite substantial, with a modal share of 35% for IWT in the container hinterland transport.

The modal share of IWT in the EU27, compared with road and rail transport was 5.7% in 2010 with a transport performance of 129 billion tonne kilometres. On the Rhine however the share was 14.3%, North-South corridor 9.7%, Danube corridor 7.2% and on the East-West corridor it was 1.2%. It can therefore be concluded that the specific position and opportunities for IWT depend on whether the waterway network exists, and its quality as well as the level of industrial activity, welfare and population along these waterways, resulting in substantial transport demand. These circumstances however, vary quite a lot across Europe and have to be taken into consideration when defining the policies.

The following map shows the major waterways in Europe. The Rhine River, in particular the section between Rotterdam and Duisburg, is the most important part of the network in terms of cargo carried.

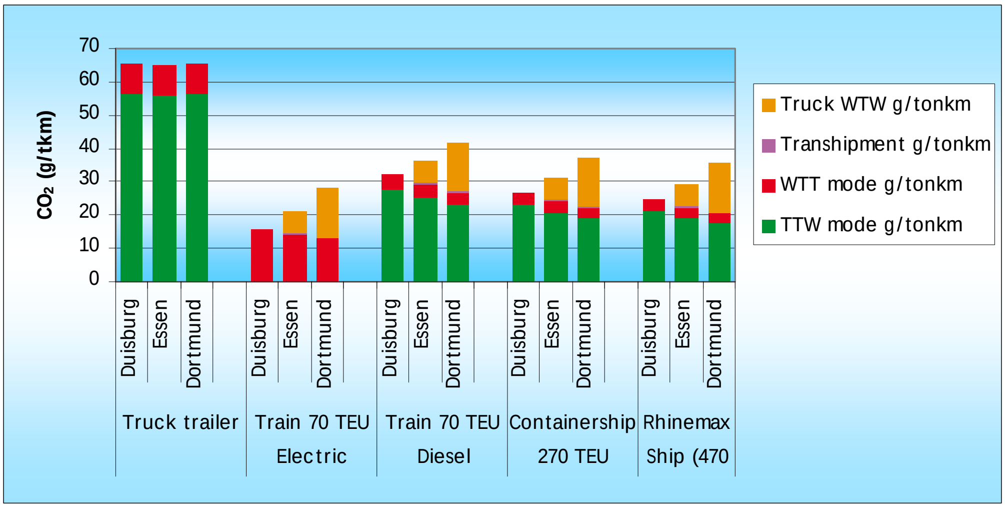
Figure 1 Transport volumes and waterways in Europe (2007)

Source: NEA, via donau, VNF, 2009 (Design streamlined by PLATINA)

Source: PLATINA Deliverable 5.5, 2010

Improving energy efficiency and reducing the emission of CO_2 are major items in the European (Transport) Policy. The higher energy efficiency of IWT compared to road haulage contributes to less fossil fuel consumption and therefore to less emission of CO_2. In cases where IWT can provide alternatives for road haulage operations it can contribute to a reduction of CO_2. The following figure presents the CO_2 emission for a typical main market in container transport where there is substantial competition between road haulage and IWT.

Figure 2 **CO_2 emission per tonnekms for container transport; case: Rotterdam-Duisburg (2009)**



Source: CE DELFT, 2011

This example shows that IWT can contribute to savings in CO_2 emission of 43% to 63% per tonne kilometre for a door-to-door chain, based on IWT for the main haul.

Currently, there are approximately 12,800 vessels and 9,325 companies active in the Inland Waterway transport market in the EU27. Transport carriers, brokers, trade associations, and transport logistic providers can be distinguished as type of companies active in the market parties. In total the companies have an annual turnover of 6 billion Euros and a direct annual contribution to the GDP of Europe of about 3 billion Euros. The added value and employment is mainly provided in Germany and the Netherlands.

The supply side of transport is rather fragmented in terms of the vessel owners, in Western Europe. On the other hand the demand side is much more concentrated as there are a limited number of larger industrial companies (for instance steel production industries, energy companies, chemical companies) and logistic companies (e.g. intercontinental container carriers) that provide work for the vessel owners. The work is however, generally not distributed through direct contracts between shippers and transport providers but mainly via intermediary organisations such as brokers and trade associations. A significant share of the executive work is acquired by individual transport providers active on the 'spot-market' that make price agreements for individual journeys.

On the Danube, however, the situation is different as there are a few (formerly state-owned) companies that serve the market.

Assessment of the present industry performance and challenges from the supply side and demand side of the market

In order to further develop and exploit all the intrinsic strengths of the industry some of the weak points of the IWT industry have to be looked at and a solution must be found to reduce the impacts of these weak points. In the following tables, which were derived from interviews and desk research with market parties, a balanced assessment is made of the strengths and weaknesses, as well as the opportunities and threats which the industry faces both on the supply as well as the demand side.

Table 1 SWOT for IWT as seen from the supply side of transport

	Strengths	*Weaknesses*
Internal origin	• Sufficient fleet capacity, in particular large vessels • Much spare capacity on waterways to foster a growth of traffic • High amount of flexible entrepreneurs in the market	• Long life-time of inland vessels and engines, resulting in high air pollutant emissions • Ageing human resources, lack of influx, shortage of qualified staff • Fragmented and atomised SME structure resulting in low co-operation and lack of ability to integrate IWT in door-to-door chains • Overcapacity and small profit margins • Limited use of ICT systems • Missing infrastructure links, limited fairway conditions and lack of transhipment areas and multimodal connectivity • Poor safety culture resulting in significant safety risks for workers
	Opportunities	*Threats*
External origin	• Funding programmes for funding of infrastructure • Stimulating policies to strengthen supply side of IWT • Internalising external costs: pricing of competing modes: road transport and rail	• Growing pressure on spatial planning (e.g. housing projects conflicting transhipment functions for IWT) • Conflicts with ecology (nature reserve) • Internalisation of infrastructure costs for IWT • Possible impact of climate change on water levels on long term

Table 2 SWOT of IWT activities in general as seen from the demand side

	Strengths	*Weaknesses*
Internal origin	• Low freight rates • Reliable transport operation • Low carbon footprint • Available transport capacity (vessels) • Available infrastructure capacity; growth potential • High market share in traditional sectors (captive markets for IWT such as coal, ore, oil) • Comparatively high safety levels; in particular external safety (risks for population or the environment)	• Not all origins and destinations are located in the proximity and necessitating the use of transhipment and other modes • High volumes needed (consolidation), dependence on a limited number of large customers and consolidation • Low operational speeds • Lack of visibility and poor image at potential clients • Varying water levels on certain corridors causing a low predictability of service levels and changing freight rates • High or low a water levels and accidents can block critical parts of the waterway network • Low level of awareness in IWT of broader supply chain developments (door-to-door) and limited knowledge of marketing and supply chain management • Industry fragmentation and reaction to external shocks (e.g. recent economic crisis).
	Opportunities	*Threats*
External origin	• Infrastructure expansion (e.g. Seine-Schelde, Rhine-Rhone) • Commercial co-operation and increase of scale in (multimodal) logistics • Growth of world trade resulting in steep growth of maritime container market • Congestion on motorways and lack of capacity in rail transport • Growing demand for low carbon transport solutions • Attracting new markets such as waste transport, bio fuels, LNG, pallets, continental containers • Increased awareness of safety and security problems • Growing number and position of inland container terminals	• Limited political support and funding resulting in poor condition of many waterways and inland ports • Loss of markets due to energy policy (e.g. coal and fossil fuel transports) • Impact of high-oil prices on various industries that are customers of IWT • Further liberalisation, efficiency and interoperability of rail transport markets • Possible introduction of Long and Heavy Vehicles for road haulage (e.g. 3 TEU truck) • Increased restriction of banks for investment as a consequence of the crisis

Many issues, as presented in the SWOT tables are concerns for the industry and shall in the first place be action fields for the industry itself. An example is the poor level of organisation and cooperation in the sector (between carriers, with other modes, with shippers) and the high level of fragmentation of the carriers in the market. This is seen as one of the major weaknesses.

For several reasons it is desirable that a further consolidation on the supply side of the market takes place. This could be in the form of expanding the size of companies or trade associations, resulting in better operational performance, more marketing power, more purchasing power and an increase in the quality of door-to-door services. Also logistic integrators should more extensively include the transport services of IWT and link IWT to other modes of transport in order to provide more intermodal door-to-door solutions using IWT to the market.

However, besides a strong need for action by the industry itself, IWT needs good infrastructure, as well as a good labour market and clear rules and regulations in order to use its full potential. There are several missing links in the waterway network, for example limited fairway depth and dimensions and problems with the reliability of fairways. Good maintenance of waterways, in particular dredging, is a key issue to ensure efficiency and reliability in this respect.

In general it can be concluded that there is a slow development and lack of attention for the required work on infrastructure. Poor maintenance of waterways by several Member States is a problem, in particular on the East-West and Danube corridors. In Western Europe the existing ports and terminal network is under pressure while along other corridors the density is insufficient (e.g. Danube). In particular for the container transport sector a high quality and efficient international container terminal network is required that is closely linked to factories and logistic areas and other modes of transport. Finally, more co-ordination is needed in the regulatory field on certain subjects such as the implementation of River Information Services.

Key problems and challenges for IWT

Basically there are two main longer term structural problems related to the present European policy framework (White Paper) with regard to the performance of inland waterway transport that need to be addressed:

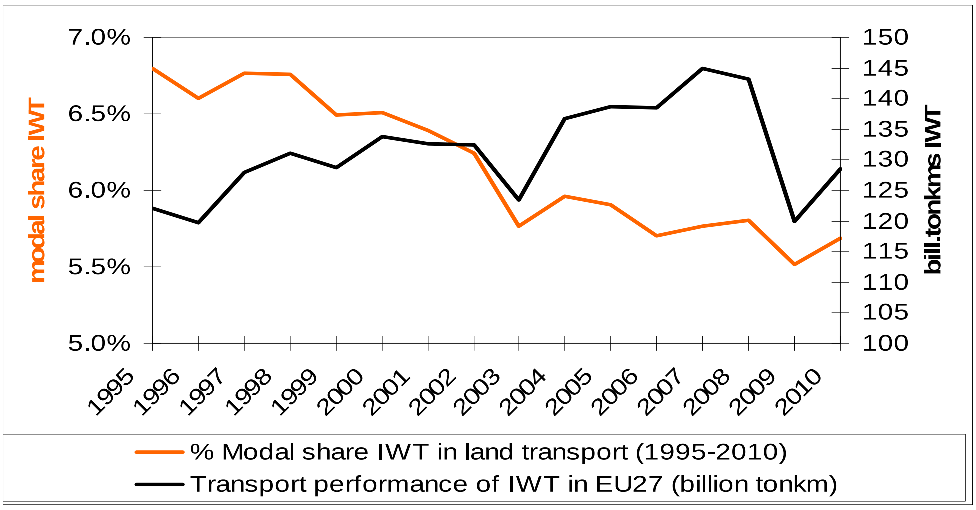
- The modal share of IWT is decreasing as opportunities are not exploited in new markets and the integration of IWT in door-to-door logistics.
- The environmental performance, opportunities for reducing air pollutant and GHG emissions from transport operations are currently not being exploited.

In addition, there are various more short and medium term problem areas, like *recovery from the impacts of the financial and economic crisis* and the present and medium-term *problems related to the phasing-out of mono hull tankers*. The study carried out by NEA in July 2010 for the European Commission on the impact of the financial economic crisis on the IWT industry concluded that these problems are expected to be solved, or largely solved, before 2020. The initial recovery seemed to be strong and on the upper boundary of the expected recovery path. Tax refunds from tax payments in previous years (2006, 2007 and 2008) did compensate, to a certain extent, the loss of revenues due to the crisis. Furthermore the long periods of low water levels on the Rhine (in the spring and autumn of 2011) resulted in low water surcharges and more trips were needed to carry the goods. The additional income for carriers brought some temporarily relief for the financial situation of carriers. However, the weakening European economy during the 2nd half of 2011 raises concerns again about the recovery of the sector and the financial stability for the next years. The expectations regarding transport demand in IWT for 2012 and 2013 have been lowered significantly.

It should also be highlighted that there are a few structural, industry specific problem areas, which are equally important. One of those concerns is *the structural shortage of staff in almost all segments of the market.* This problem, which was noticed years ago, has still not been solved and might become even more serious in the medium term due to the ageing workforce and lack of influx of new workers.

Declining modal share
An alarming observation is the decrease of the modal share of IWT compared to road and rail transport in the EU27.

Figure 3 Modal share and transport performance of IWT (btkm)



Source: NEA

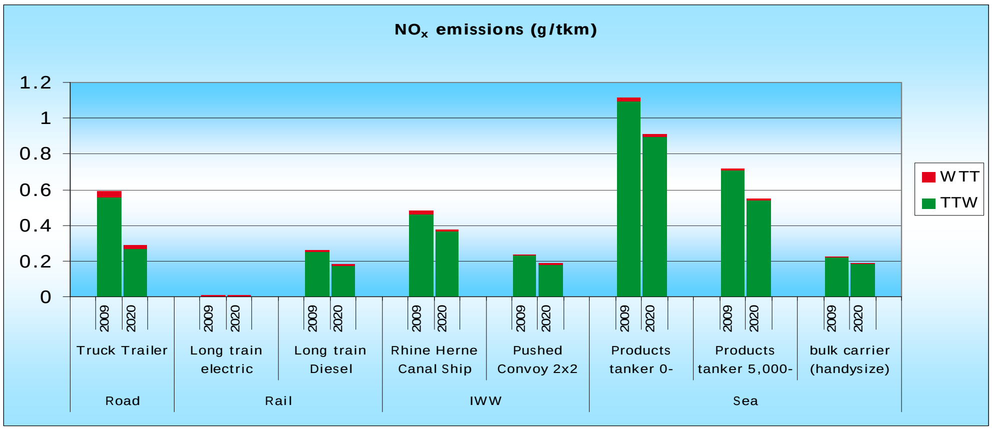
It can be concluded that the overall performance in tonne kilometres increased in the decade before 2009 and in particular during the years with high economic growth (2004 – 2008). The road freight transport industry in the EU27 was able to grow much faster due to various reasons (dense road network, smaller consignments, more time critical goods, uncomplicated organisation). Besides transport price, a key aspect in the competition with road haulage is the quality of the service that is offered. The longer transit time of barge transport, compared to road haulage can be a barrier despite the cost savings that can be achieved. Another issue is reliability of price and quality. Events such as low water or blocked waterways are problematic for shippers. Moreover freight forwarders and shippers are more interested in a one-stop-shop 'door-to-door' solution and do not want to be involved in the organisation of complex intermodal transport chains with multiple players and the necessity to bundle cargo with other parties.

Environmental performance
The CO_2 emission of IWT is still significantly lower than road transport. For example in door-to-door container transport between Rotterdam and Duisburg the estimates of the difference in CO_2 emission is approximately 50% in favour of an intermodal chain using a barge. Further efforts can be made to reduce CO_2 emissions in order to increase the advantage of IWT over road and to strengthen the contribution to this policy objective of the White Paper.

A major concern is the poor progress made on reducing the emission of air pollutants and in particular the emission of nitrogen oxides (NO_x) and particulate matter ($PM_{2.5}$). The trend towards 2020 shows an increasing gap between emission performance of engines in barges and trucks. Road freight transport already uses more modern and therefore cleaner engines. It is currently only due to the scale advantage of IWT versus road, that in many cases the emission per tonnekms does not exceed that of road transport. However, due to the quick modernisation of the fleet of trucks in Europe the emission per tonnekms will in many cases also be better for road haulage compared to IWT, particularly for smaller vessels and in suboptimal logistical circumstances for IWT.

The following figure shows the development:

Figure 4 Emission of NO_x in 2009 and 2020



Source: CE Delft, 2011

The emission of NO_x in road haulage will reduce by 50% in the 2009-2020 period while IWT (Rhine Herne Canal Ship) is expected to show a reduction of 20% to 30% (in a business as usual scenario). Only very large vessels, such as 5,000 tonne push convoys will still have a better emission profile in 2020 compared to road haulage.

Lack of staff, in particular boat masters

Although for some countries there is a lack of reliable data, the current estimate of the amount of workers in inland waterway transport (including passenger transport) in the EU27 is 43,300 workers. This figure includes the owner-operators and part-time and temporary employment. The majority (65%) of the workers is active in the Rhine corridor. A significant share of employment is in passenger transport.

In Germany the situation is alarming, with more than 40% of the employed aged 50 or above. This means that on average 200 workers have to be replaced annually and many of them are boat masters. However, only 120 graduates currently finish schools in Germany which leaves a net loss of 80 workers per year. The prospects in Belgium are similar with a net loss of about 15 workers per year. In France the situation is comparable with Belgium. In the Danube area the qualified nautical staff (captains, boat masters) is over aged (50+). It is expected that a large share of boat masters will leave the sector within the next 10 years which will leave a gap in the future. However, the Netherlands with a comparatively younger workforce is has not yet been adversely affected.

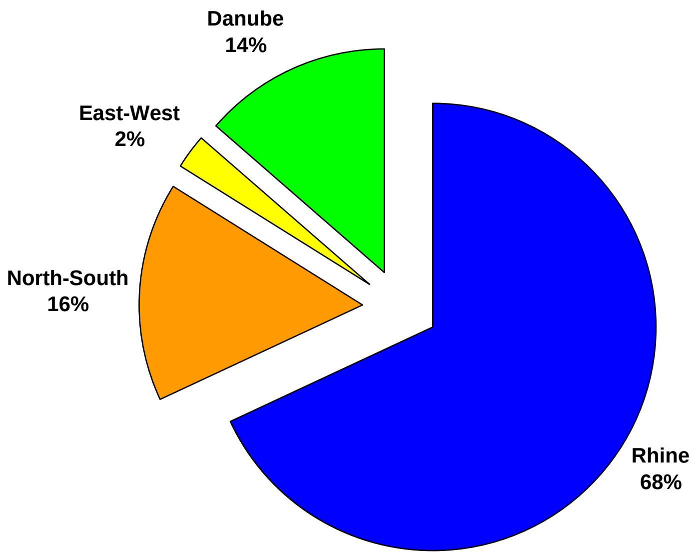
In addition to these troubling demographical issues, the transport demand is expected to increase. This results in more vessels needed to carry goods and passengers and therefore more staff needed to operate the fleet.

Model calculations were made to make an estimate for the EU27 area based on the expected freight transport demand in a low and high transport demand scenario. This analysis showed that at least 8% more staff (2020 low scenario) to 22% more staff (2020 high scenario) will be needed. This would result in an increase of approximately 3,800 to 10,500 more jobs in the IWT sector between 2007 and 2020. These figures mean that an annual increase of workers would be needed of between 300 to 800 people to cope with the growth of transport demand. Furthermore, the continuing trend towards larger vessels and a growing share of vessels in multi-shift operations will lead to an increase in the number of required workers. As a result in particular shortages occur with regard to highly qualified personnel such as boat masters. The figures reported by PLATINA in 2009 indicate a total number of approximately 5,500 students in Europe. Approximately one third of those students successfully finish their training each year, resulting in approximately 1,800 new workers per year. Given the ageing population and the transport demand growth, this supply of new workers will not be sufficient to cope with the demand.

Unbalanced development between corridors

Another familiar and long-term problem area concerns *the unbalanced development between the most important markets, i.e. Danube, North-South and East-West markets versus the Rhine market.* The Rhine market is still by far the most dominant market, as can be seen in the following diagram.

Figure 5 Share in total transport performance in EU27 in year 2007



Source: NEA

While a strong growth of transport volumes is expected as result of substantial infrastructural improvements on the North-South corridor (Seine-Schelde), on the Danube and East-West corridor (network: Mittellandkanal-Elbe-Odra) the shipping intensities are expected to remain modest in the foreseeable future.

Moreover the unbalanced development is also the result of different market situations between corridors. For example the Rhine and Danube waterways differ in terms of length, the population living close to the waterway as well as the size of the production industry and consumption by people along the waterway.

As a result of these differences, booming market segments on the Rhine, such as container transport, are still fairly underdeveloped on the Danube. Various attempts to stimulate these activities on the Danube have failed so far due to the lack of transport demand volume (critical mass), strong competition from road haulage as well as problems with the reliability of navigation conditions on the Danube waterway.

Prospects for 2020 and 2040 in a baseline scenario

In order to further investigate and substantiate the observations on trends in the market and market segments and to better appreciate the opportunities and threats identified in the SWOT tables, forecasts were made of the future IWT transport performance for the years 2020 (medium-term) and 2040 (long-term).

The baseline scenario incorporates all general White Paper (2011) policies and the most recent developments in supply chains. For example, modal split agreements in sea ports and changes in German energy policy were taken into account. However, it does not take into account additional specific policies and measures targeted towards the IWT industry. The 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, information on which was collected by desk research as well as interviews with large shippers, port authorities and large IWT operators. These parties were, amongst other things, asked to evaluate the medium-term growth perspectives in their markets segments. Using this approach, bandwidths bound by low and high growth for 2020 and subsequently also for 2040 were determined for various supply chains. The results of this exercise are presented in the following table for the EU27.

Table 3 EU27 average transport outlook baseline scenario, development of tonne kilometre performance, index 2007 = 100

Key business industry	*2007*	*2020 (min)*	*2040 (min)*	*2020 (max)*	*2040 (max)*
Containerised goods	100	142	262	175	442
Coal fired power plants	100	117	137	138	166
Steel industry	100	99	114	120	156
Petroleum and chemical	100	101	104	115	156
Agribulk	100	104	123	113	146
Construction industry	100	100	109	105	122
TOTAL	*100*	*107*	*132*	*123*	*181*

At first glance it can be concluded that the baseline market outlook for inland waterway transport seems positive. The outlook presents a growing market for IWT. There will be an increasing demand for IWT services in particular in container transport. Also due to rising concerns regarding nuclear power more demand is expected in coal transport for power plants.

However, it must also be taken into account that other modes of transport will also show an increase of their transport performance. Therefore, in order to reach a significant growth of modal share of IWT, additional efforts are needed to realise an increase of modal share compared to road and rail.

As the next table shows, the development of the IWT industry should be on the high growth boundary (the ‘max columns’ in the table above) to prevent a further decrease of the market share.

Table 4 Modal share development per corridor compared to road and rail, low and high baseline scenario for 2020 and 2040

Corridor	*Year 2007*	*Year 2020 (low, high)*	*Year 2040 (low, high)*
Rhine	14.3%	12.8%, 14.8%	14.1%, 16.4%
North-South	9.7%	8.9%, 9.9%	10.6%, 11.9%
Danube[1]	7.2%	6.8%	6.0%
East-west	1.2%	0.9%, 1.1%	0.8%, 0.9%

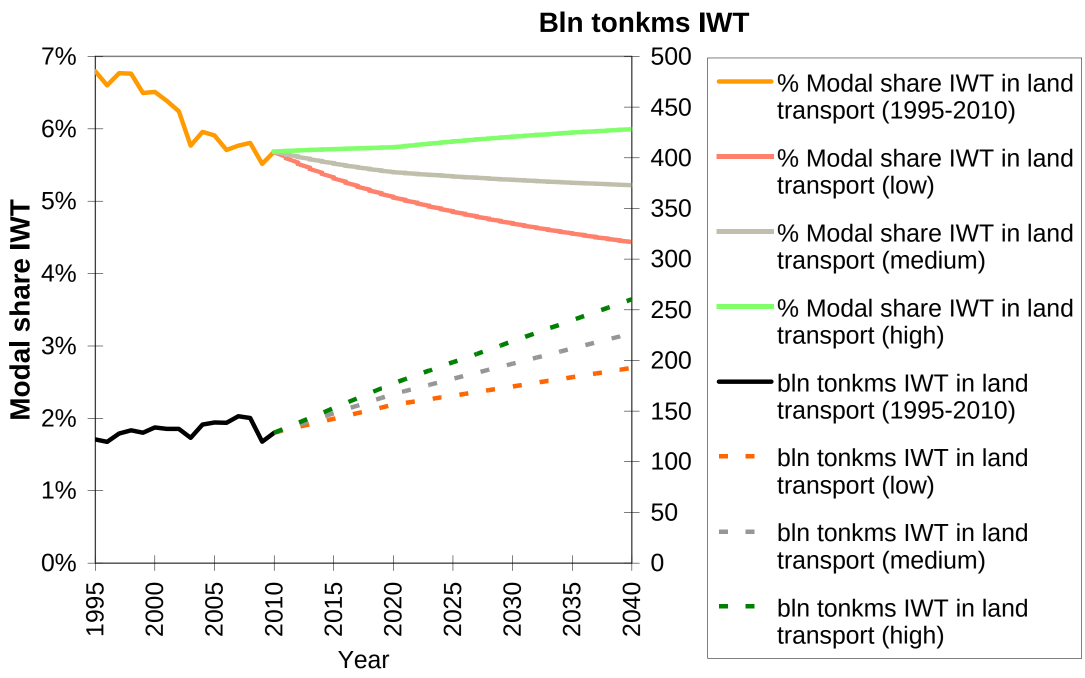
In table 4 the expected future IWT market shares are listed per corridor. The table shows that in the longer term, an unambiguous increase of the IWT market share is expected only in the North-South market. This is due to the substantial investment in the Seine-Schelde connection. In all other corridors the bandwidth (low versus high estimates) does not rule out the possibility of a decrease in market share.

In particular in the Danube market and East-West markets it is not expected that the modal share will increase under the baseline scenario. This is due to the limited port and fairway conditions, in combination with restructuring of supply chains and industries as well as high growth rates in the transport of final (consumer) products, a market segment dominated by road haulage.

[1] For the Danube instead of low and high scenario, an average forecast was provided. The forecast for the Danube is inline with the objectives of the Danube Region Strategy

The following figure presents the overall outlook on EU27 level.

Figure 6 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

To facilitate an increase of modal share, new markets need to be unlocked, for example in geographical terms by means of developing waterway connections (for instance Rhine-Rhone) but also through integration of IWT in door-to-door chains and by accommodating new types of cargo (e.g. palletised goods, perishable goods, bio fuels).

In general inland waterway transport needs to be able to provide intermodal alternatives to road haulage over shorter distances. In this respect spatial planning is a key issue for authorities to make sure that points of origin and destination of goods are consolidated, in close range of waterways and accessible through a dense network of terminals. This, however, requires a long-term approach.

Finally, through internalising external costs for inland waterways (planned after 2020) additional financial incentives will be provided to the market to exploit the most environmentally friendly modes of transport. In this respect it is important to reduce external costs of IWT significantly in this decade until 2020, in order to prepare IWT for this step. In particular, a drastic reduction of air pollutant emissions is needed. Moreover, infrastructure costs are only partly charged. As inland waterway transport is only one function of waterways and basins, it is necessary and fair to make clear what share of infrastructure costs are to be earmarked to IWT operations and what a fair and efficient pricing scheme for IWT should look like (user pays principle).

Policy objectives

From the results of the analyses it can be concluded that significant changes are required in order to meet the policy objectives of the Europe 2020 Strategy and the 2011 White Paper on Transport. Within this context, active support of inland waterway transport is required. For IWT two major policy objectives should be pursued, focused on the performance (output) of the sector:

1. **Raise the modal share of inland waterway transport, in particular through expanding the intermodal transport segment.**

2. **Reduce accidents, air pollutants and climate change impact of inland waterway operations.**

Both policy objectives are interrelated. Striving for an increase in modal share of IWT is justified by the societal benefits of inland waterway transport compared to other modes of transport. A further reduction of air pollutants, accidents and green house gas emissions is needed to safeguard and further strengthen and expand these social benefits. This will result in continued and growing public support to strive for an increase of modal share of IWT in transport policy. It is therefore of strategic importance to tackle the emissions of air pollutants, in particular as this is the main external cost factor for IWT, as other external cost factors are already quite low or insignificant. Moreover, the IWT sector should anticipate a possible internalisation of external costs in the future (after 2020) and therefore pay more attention to the reduction of air pollutant emissions.

Apart from factors that have a direct impact on the modal share or emission performance of IWT, factors also need to be addressed that indirectly determine the performance of IWT on these two policy objectives. These market conditions consist of:

- legal and administrative framework conditions,
- River Information Services (a major ICT platform for IWT and operational tool),
- labour markets, capital markets, equipment suppliers and shipyards,
- market information to support decision making,
- knowledge and know-how among users and stakeholders, and
- research and development on innovations for the future transport market.

These conditions are very important. Not resolving them would seriously limit the effectiveness of the two main policy objectives. Therefore, improving the market conditions supports and amplifies the two policy objectives that focus on the key performance indicators of the sector (modal share and external costs). The third policy objective therefore is:

3. Improve market conditions for operators and users of IWT

During the study problems were identified that belong to the market conditions. The limiting factors that were identified need to be addressed in order to ensure a smooth further development of IWT in Europe. For example a shortage of human resources would result in higher salaries resulting in higher transport prices and subsequently less market share. A shortage of qualified personnel could also result in longer working times which may cause safety risks. In the definition of 'market conditions' most of the required innovation efforts are also included. In general it can be concluded that research and development is needed in the following fields:

- *Technical innovations* in transhipment systems, cargo conditioning and load units, navigation aids, hull design, traffic management, infrastructure development and maintenance.
- *Organisational and management innovations* in cooperation models and cooperative transport planning, supply chain management, marketing, ship finance and exploitation models.

The next section explains the main determining factors behind modal share and external costs and also the interdependencies of the three specific policy objectives.

Policy package 1: Measures to raise modal share of inland waterway transport

The first policy package is geared directly towards the generation of a higher modal share for inland waterway transport in Europe. Over the past decades, IWT has been losing market share on all corridors. The analysis revealed a number of different reasons for this structural development: among others, in industrial restructuring, intermodal IWT does not offer competitive door-to-door transport costs, IWT is not sufficiently known among potential customers, the limited geographic coverage of the waterway network and infrastructure bottlenecks, IWT is not integrated enough in multimodal supply chains. The trend in the declining modal share shall be turned in the period to come.

Main determinants of modal share

The modal share of a transport mode is basically determined through simple market mechanisms, that is, a mix of cost/price and quality indicators, such as transport speed, on-time reliability, frequency of services and ease of use. Whereas some transport markets put a higher value on the transport price (for example construction materials), others have a relatively higher value of time (e.g. consumer products). Inland waterway transport is active on these different markets and therefore should be competitive in a variety of market circumstances.

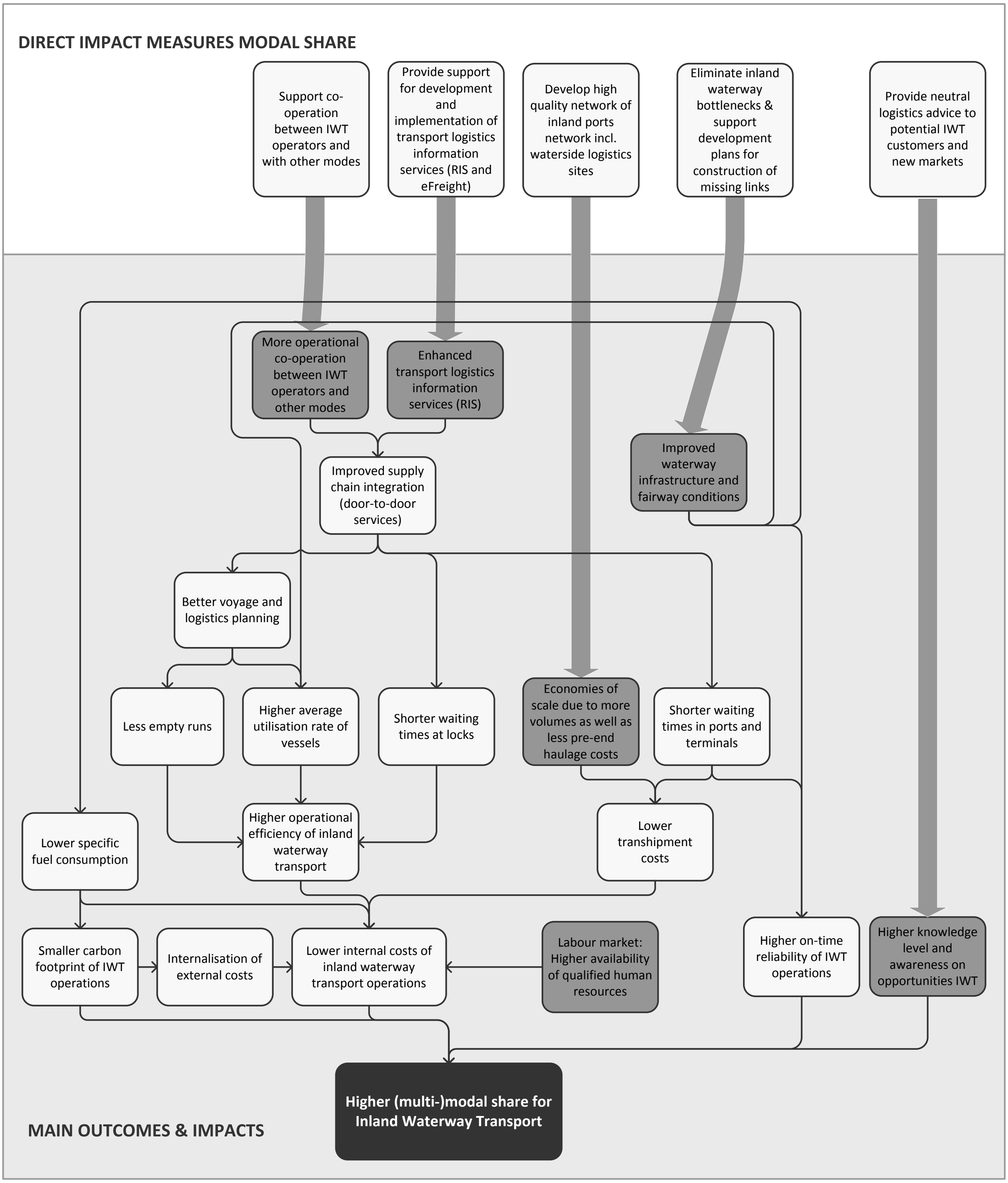
The main cost drivers in inland waterway transport consist of standby costs — personnel, depreciation/interest payments, insurance, and repair & maintenance costs and operational costs - mainly fuel costs. Most of these costs cannot be influenced by policy actions as they are largely determined by the market.

Average fuel consumption per vessel type basically depends on three factors: utilisation rates of vessels (due to loading restrictions), the parity of traffic (empty voyages) and the prevailing fairway depths (shallow water resistance). Moreover, in intermodal chains the costs of transhipment and pre- end haulage are very decisive for the competitiveness of intermodal IWT solutions. Finally, the utilisation of vessels (payload versus loading capacity and the share of empty sailing) influences the transport price per tonne.

The main non-market factors determining the cost and quality level of IWT operations, and which could be influenced via direct or indirect policy actions, are:

- **Waterway infrastructure quality**: The specific situation for inland waterway transport is that both cost and quality factors are strongly determined by the state of the infrastructure and fairway conditions. Fairway conditions and bottlenecks directly determine cost levels per unit (vessel utilisation, load factors), as well as level of service (transport speed, on-time reliability). Maintenance, such as dredging, is very important because the available depth determines the possible load rate as well as the reliability of transport and stability of freight prices.
- **Develop network quality of inland terminals and waterside logistics sites**: The competitiveness of multimodal supply chains often depends on the efficiency of port operations, as the costs for transhipment, pre- end haulage typically add up to more than 50% of the door-to-door transport costs. If the shipper or customer is located directly near the river or canal, pre- end haulage can be avoided, resulting in much lower door-to-door costs.
- **Level of supply chain integration and co-operation**: Apart from technical integration (e.g. harmonised transport or loading equipment); the application of intelligent information systems is a precondition for seamless multimodal logistics chains. More operational cooperation and seamless modal interfaces lead to higher operational efficiency (high utilisation and less empty trips), higher reliability of transport and consequently to more attractive transport and logistics services.
- **Level of awareness among potential customers**: Inland navigation is currently not sufficiently visible for third party logistics service providers and potential customers. IWT generally lacks the human resources and know-how to develop one-stop-shop multimodal logistic solutions. This is particularly the case for more complex and demanding door-to-door transport needs of those customers that are used to the flexibility and simplicity of road haulage. Although there are in fact larger organisations active in the market (e.g. large brokers, shipping lines in liquid cargo and container transport) these larger organisations mainly focus on serving the traditional markets. Only a few pioneers are investing in time-consuming modal shift projects.

Figure 7 Causal chains to directly intervene on modal share of IWT



Most effective policy measures to raise (multi-)modal share of IWT

Current EU policies (NAIADES) have mainly concentrated on raising the awareness and image of IWT. Although these are important determinants of the IWT modal share, they are not the only ones. In order to have a more significant and direct impact on the market, IWT policy should also influence operational factors such as transport price and quality of service. The paradox of such policy is however that those policy measures that would be most effective would entail directly influencing market forces, which often interferes with the basic principles of the internal market. While respecting the principles of the EU Treaty, effective policy measures to promote inland waterway transport need to move closer to the market.

For transport policies to have an impact on the market performance, the illustrated causal chain scheme offers different possible points of policy intervention. A policy package addressing the modal share of IWT should therefore consist of a mix of interconnected and complementary policy elements. Policies aiming at raising the modal share would primarily focus on reducing operational costs and raising quality aspects of IWT (i.e. reliability), thereby influencing modal choice behaviour. Considering the most important direct determinants of the modal share of inland waterway transport, the following policy actions are expected to have an effective and direct impact on modal share:

- **Eliminate inland waterway bottlenecks and support development plans and construction of missing links in European waterway network (e.g. Seine – Schelde, Rhine-Rhone, Sava River, Straubing-Vilshofen, other critical sections on the Danube, Elbe)**

- **Develop high quality network of inland ports including waterside logistics sites: funding for ports and transhipment sites**

- **Provide support for development and implementation transport logistics information services (RIS and its integration into eFreight; moving towards paperless transport and integration with eMaritime Single Window concept)**

- **Provide neutral logistics advice to potential IWT customers to raise knowledge level and awareness on opportunities of IWT**

- **Support cooperation between IWT operators and cooperation of IWT operators with operators using other modes**

Expected outcomes of modal share policy actions in IWT

- Better fairway conditions and a higher quality core waterway network leading **to scale advantages (larger vessels), improved vessel utilisation and lower specific fuel consumption** and consequently to **lower transport costs** per unit. A better state of the waterway infrastructure also leads to less delays and waiting times at locks and during operation as well as improved fairway depth throughout the year (less disruptions of navigation and loss of payload due to low water). On-time reliability of IWT operations will be improved. Both the reduction of transport costs and the **increase of reliability** make IWT more attractive within the transport market.
- A higher quality of the network of inland terminals and quays raising the level of service and intermediate transhipment opportunities. More efficient transhipment operations close to the client would **reduce the share of transhipment and operational costs in door-to-door chains** and would consequently allow for IWT to become more competitive also over shorter distances. In cases where pre- end haulage can be avoided, IWT can already be competitive on shorter distances (from 20 to 40 kilometres onwards). **Innovative spatial planning efforts** resulting in industries and logistic sites directly located along waterways could therefore be very successful to boost the modal share of IWT. In particular for new industries that have plants and distribution points to be located in the next years (e.g. production of bio fuels) such an approach would be highly effective.
- Further development of River Information Services and eFreight leading to an unbroken multimodal information chain, which is a prerequisite for the exchange of cargo between modes. This innovation will lead to more visibility and a **higher level of supply chain integration**. By reducing the frictions and increasing the interoperability between modes, IWT can play a larger role in multimodal transport chains.
- A network of neutral logistics advisors helping to raise **awareness on specific opportunities of IWT** in **new market segments** (e.g. biomass, bio fuels, waste transport, continental containers) and **identify new cargo flows for IWT and concrete modal shift potential and support implementation**. Equipped with a specific set of knowledge tools, a network of neutral logistics advisors should execute concrete and corridor-based modal shift projects. A policy initiative to set up a **pro-active neutral interface** between supply and demand would help overcome the reluctance and lack of awareness of market parties. Moreover it provides an answer to the lack of human resources and know-how in the IWT sector needed for such modal shift projects and it would **raise visibility of the sector** as well**.** By means of best practices and dissemination, the general know-how on logistics within the IWT sector would be raised resulting in growing interest and activity in door-to-door projects.
- Active support for innovative co-operation models within the IWT sector and between other transport modes will help overcome the negative side effects of the atomised supply side of the market. More operational co-operation will result in **better voyage and logistics planning** and consequently in **less empty runs** and **higher utilisation rates of vessels and more efficient transhipment and pre-end haulage operations**. This in turn translates into lower operational door-to-door costs and more competitive transport services (as well as into lower external costs).

Table 5 Summary of Policy package 1: Raise (multi-)modal share of IWT

Current situation
The modal share of IWT has decreased in the last decade; road transport shows higher absolute figures in growth compared to IWT. The IWT sector is mainly active in traditional bulk sectors. Besides maritime container flows in Western Europe, IWT still has a very limited role in multimodal supply chains for consumer goods. Possible new markets for IWT are palletised goods, biomass, bio-fuels, LNG and continental 'full truck loads' in containers. Moreover the quality of the existing waterway and inland port network is limited, in particular on the Danube, and IWT can only play its role on certain corridors in Europe. The Rhine corridor is the most important and mature but this corridor can also be characterised by some missed opportunities and weaknesses of the sector such as a lack of co-operation between operators and with other modes, limited awareness among potential customers as well as among responsible (regional) authorities.

Summary of problems related to performance on modal share	
Markets & Awareness	Lack of consolidation and cooperation within the sector, lack of one-stop-shop approach for door-to-door logistics, limited overview of available services and opportunities to use IWT, lack of visibility of IWT for shippers, limited co-operation with other modes, limited reinvestment and innovation capacity.
Fleet	Lack of funding for innovations, long lifetime of vessels, small research and innovation in vessel technology and transhipment techniques, shortage of smaller vessels, decreasing environmental performance versus other modes making IWT unattractive for shippers.
Employment & Education	Lack of qualified human resources, resulting in higher labour costs, IWT knowledge in transport logistics education, lack of logistics education in IWT courses, lack of 'door-to-door' thinking and awareness among IWT operators and skills to provide 'one-stop-shop' solutions
Infrastructure	Limited transhipment facilities, missing links in the network, poor fairway conditions and lack of appropriate maintenance, large impacts due to calamities, NIMBY problems at local level regarding transhipment facilities and industries along waterways (inland ports).
River Information Services	No integration with logistics, very limited RIS deployment resulting in sub-optimal efficiency of transport (higher costs)

Policy objectives 2020	Raise (multi-)modal share of inland waterway transport: Increase modal share of IWT contributing to lower transport costs for society, ensuring accessibility of Europe, reduction of congestion and increase of competitiveness and welfare in Europe.

Proposed policy measures IWT 2020 with a direct impact on modal share	
Description of priority measures	• Eliminate inland waterway bottlenecks and support development plans and construction of missing links in European waterway network
	• Develop high quality of inland ports network including waterside logistics sites: funding for ports and transhipment sites.
	• Provide support for development and implementation transport logistics information services (RIS and its integration with other modes through eFreight; moving towards paperless transport for inland waterways consistent with the eMaritime Single Window concept)
	• Provide neutral logistics advice to potential IWT customers to raise knowledge level and awareness on opportunities of IWT.
	• Support co-operation between IWT operators and with other modes.
Provisional time planning	**2014- 2020**

Vision 2040	Inland waterway transport plays a major role in more geographic areas, alternative energy markets and multimodal supply chains, including continental cargo such as palletised goods over shorter distances. IWT is fully integrated in the transport system with fruitful cooperation, professional management and seamless links to other modes, fully integrated transport planning systems, an efficient network of transhipment locations and consolidated industrial/logistic centres directly located at strategic positions along nodes of waterways. Successful business models are in place providing sustainable financial performance and a strong innovative mindset focussed on providing competitive door-to-door solutions.

Outlook policy measures after 2020 with a direct impact on modal share	
Description of measures	• Implementation and realisation of new TEN-T projects (e.g. Rhine-Rhone connection).
	• Internalisation of external costs on an equal basis, pricing measures as a 'push factor' for improved modal share of IWT.
	• Expansion of port facilities and spatial planning policies aiming at creating clusters of industrial and logistic sites directly along waterways and well connected to other modes of transport

Policy Package 2: Measures aiming at reducing environmental, climate change and safety impacts

Without policy intervention in the year 2020 the average emission level of air pollutants of inland navigation ships will in many cases be higher than that of trucks. Without significant improvement, the gap will become even bigger in the period 2020-2040. A policy package providing push and pull measures to reduce the air pollutant emissions up to 2020 is needed to anticipate on the projected autonomous development. Reducing the external effects will guarantee public support for promoting and investing in IWT due to the social benefits and also to avoid a possible loss of market share in case of internalisation of external costs after 2020.

Main determinants

The main factors determining the declining environmental and safety situation in the IWT sector are:

- **Innovative power of IWT sector**: the state of the fleet and the level of innovation determine key factors such as specific fuel consumption, safety levels and emissions of air pollutants. The slow innovation rate is in turn largely caused by:
  - **Number of new engines in this market (approx. 200 per year).** The small size of the market as well as the fragmented structure of ship-owners hinders research due to lack of scale as risks increase and if research is done, the consequence is that the costs of innovations will be high.
  - **Economic and legislative incentives to modernise**: Whereas the size of the motorised fleet is approximately 8,500 vessels, according to the IVR database, only about 14% of these vessels (with engines younger than 2003) is compliant with stricter emission requirements (CCR phase 1 and 2 regulation). The large majority of vessels have older engines without regulations on the emission levels. Apart from legislative incentives, economic incentives to innovate are often also lacking. For instance, end-of-pipe treatment technologies which significantly reduce pollutant emissions are, even if subsidies are available, often not implemented as they add operational costs instead of adding value to the individual entrepreneur. Additional incentives are needed and will make it easier for the engine, equipment and shipbuilding industry to develop innovative solutions to reduce air pollutant and GHG emissions.
  - **Awareness of available innovations in the sector**: High fragmentation among vessel-owners within the IWT sector currently forms a barrier towards market entry of new technologies, including those which would help reduce fuel consumption and emission levels. Innovations are not disseminated and transferred as fast as would be possible.
  - **Access to capital and re-investment capacity**: another side effect of the SME character of the IWT sector is the low reinvestment capacity. Many companies are currently not in a position to provide convincing business cases for innovative investments to banks or financiers due to the scale of their operations and the generally low profit margins as a

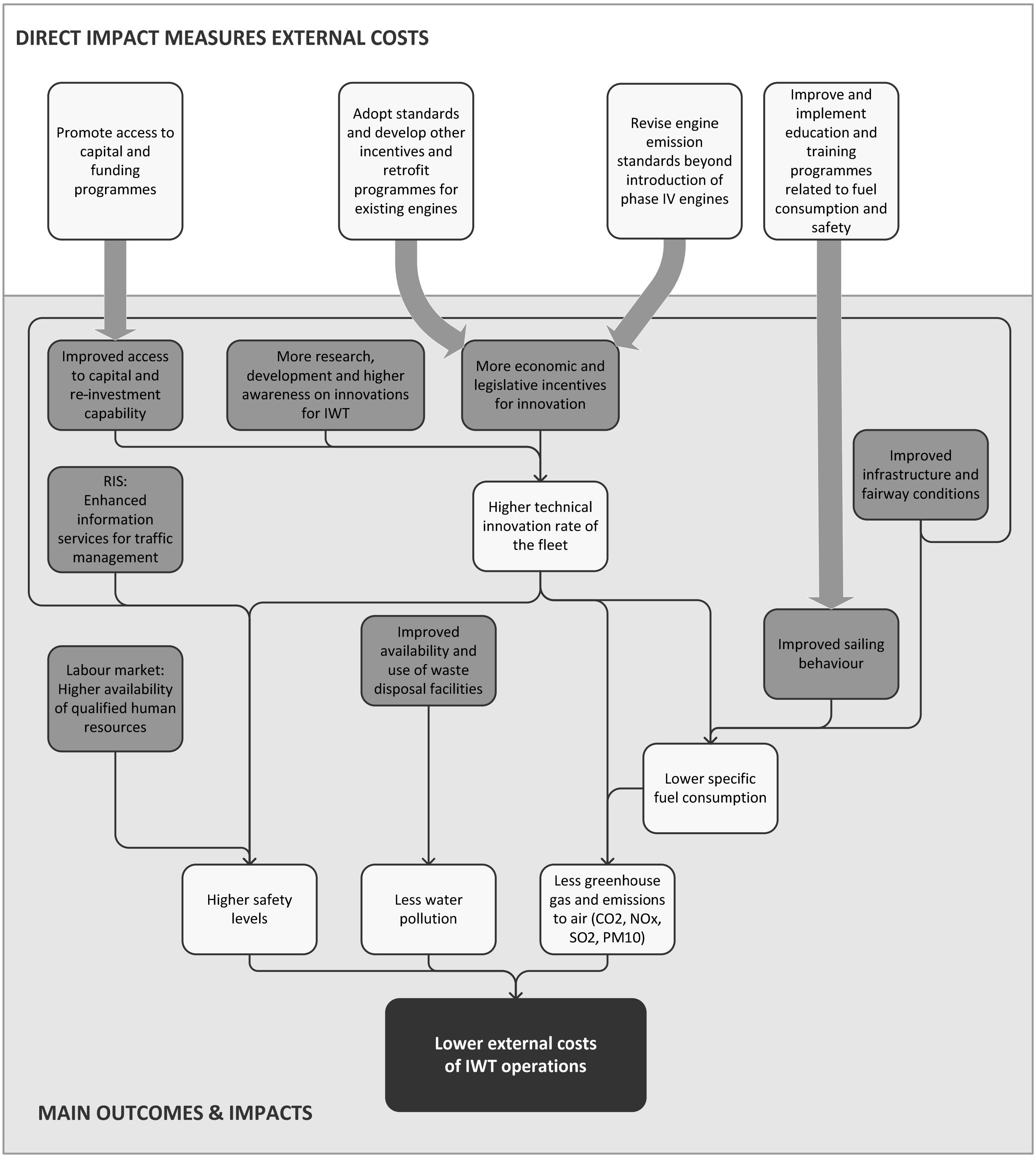
result of overcapacity and fierce competition between IWT operators and/or vessel-owners.

– **Continuous and dedicated research and development for IWT**: Continuous research and investment processes are important in order to provide the market with efficient, clean and safe technical solutions, practices and approaches. This is also needed to retain a competitive advantage in terms of GHG emissions and safety levels. Dedicated research and development is limited as a result of the relatively small home market for IWT applications.

- **Qualified human resources**: the optimal cruising speed of an inland vessel depends on a number of factors, such as engine capacity, stream velocity, to name a few. The marginal costs and additional fuel consumption of 1km/h speed increase are often disproportionately high. Demonstrations and experiences in the Netherlands have shown that significant reductions of fuel consumption and emission levels could be achieved by a combination of training, awareness measures and a technical decision support system. The human factor and the level of qualification is also a decisive factor in terms of safety.

- **Infrastructure conditions and availability of traffic management systems**: the state of waterway infrastructure has safety aspects as well impacting on transport efficiency (possible payload) and fuel consumption. Low water periods, possibly aggravated by lack of maintenance and the subsequent narrowing of the fairway can lead to more dangerous navigation situations and result in loss of transport efficiency due to loss of payload. The availability of supporting RIS services for traffic management can significantly raise safety levels.

Figure 8 Causal chains to directly intervene on external costs of IWT



Most effective policy measures to reduce external costs

For the transport sector in general, a higher modal share of IWT through providing a competitive alternative for road haulage would result in a reduction of external costs. However, also within the IWT sector the external costs need to be reduced, in particular the emissions to air of CO_2 and NO_x. Such policies aimed at reducing external costs could either be aimed at direct mitigation (directly reducing fuel consumption per tonne kilometre through technological or behavioural changes) or at the emission factors (reducing the emissions by using clean fuels or emission abatement technologies).

As a result of the long lifetime of vessels and engines and aggravated by the overcapacity, the amount of new engines to be installed will be quite limited and relatively small compared to the total number of engines in the European fleet. For a significant drop of the average air pollutant emission level of inland barge engines, not only measures to reduce the emissions of new engines are needed, but **also measures aimed at the reduction of the pollutant emissions from <u>existing ships and engines</u>.** Several measures could be implemented to lower the emission level of the existing fleet. The subsidy regimes applied in different countries over the last years, for example in the Netherlands and Germany, have shown limited effect, as the financial incentive for ship-owners was not sufficient to balance the additional investment and operational costs. Therefore, additional incentives would be needed to reduce the emissions of the existing fleet. Options for additional incentives to be considered could be the following:

- Mandatory standardisation,
- Environmental zoning,
- Emission taxation (cf. Norwegian NO_x tax and NO_x fund)
- Differentiation of port dues, clean vessels pay less, dirty vessels pay more,
- Voluntary standardisation and shipper incentives (e.g. current Green Award).

A mandatory standard will be most effective, although the overall costs of adapting the existing fleet may be very high if a stringent standard were to be imposed with short deadlines. A subsidy system is legally simple, but as a single instrument not effective and subsidies do not perform well in terms of cost effectiveness as a result of 'free rider behaviour'. Economic incentives, such as differentiation of port dues and taxing emissions are cost effective measures, as the market will find the most efficient solution to the incentive. However, the overall effectiveness depends upon the level of differentiation/taxation and the scale with which differentiation/taxation is applied. The deployment of a voluntary instrument (e.g. Green Award) is unlikely to result in significant further emission reductions. However, such an instrument is cost effective and does not face any legal constraints.

There is also a risk that there will be a scattered development of different environmental schemes (for example environmental access zones in ports, different type of port dues calculation). This is due to the fact that decision-making on that legislation is at the regional level. In order to ensure interoperability and uniformity, coordination and guidance by the European

Commission would be valuable to prevent a broad range of different schemes causing problems for operators to navigate across Europe.

To achieve a level of pollutant emissions comparable to that of road transport for new engines, a strengthening of emission limit values beyond phase-IV is needed. To foster technology development and cost reduction, a stimulus could be provided for the manufacturing industry through R&D and networking projects to speed up the development of clean and efficient techniques to reduce IWT emissions. They could be partially financed by governmental subsidies.

Greenhouse gas reduction in inland shipping can be guaranteed if a kind of standardisation or economic instrument (fuel tax) is implemented. The IMO has proposed ship efficiency indicators for seagoing ships in a complex international environment. Although this principle could also be used in inland shipping, less complex solutions may be more straightforward.

Because of the relatively small size, and the fragmented structure of fleet owners, active support from public bodies is desirable to provide coordination and to bring actors together in order to consolidate and create scale advantages and critical mass. The European Commission can offer support in this area by supporting networking and R&D projects. Knowledge of innovations in the field of inland navigation need to be disseminated and applied broadly with the support of innovation transfer clusters, enabling the fleet to be more competitive and sustainable. Also an intensive dialogue is needed between engine manufacturers, shipyards, equipment suppliers and fleet operators.

Even though mobile bilge water services have a successful history of more than 40 years in the Rhine region, implementation in the Upper Danube region faces obstacles. Certain differences — notably lower traffic frequencies, different administrative framework conditions — restrict the transferability to the Danube region. In the long run however, targeted development activities should also lead to the implementation of a harmonised system for the collection and treatment of oily and greasy ship waste. The establishment and maintenance of the necessary network of reception facilities is expensive. Therefore, a financing model will be necessary that should incorporate the ‘polluter pays’ principle, thus encouraging waste prevention, as well as the principle of indirect payment, thus discouraging an evasion of the deposit of waste on the Danube.

Fairway conditions are also a main determining factor of safety levels, for example narrower fairways will lead to higher risks, and fuel consumption (shallow water resistance), and consequently have an impact on the external costs of IWT operations. Measures in the field of fairway conditions have already been included in the first policy package (modal share) and will therefore not be duplicated.

Considering the most important determinants of the external costs of inland waterway transport operations, the following measures are expected to have an effective and direct impact on external costs:

- **Investigate and invest in the appropriate incentives and retrofit programmes to reduce pollutant emissions of existing engines.**
- **Revise engine emission standards beyond introduction of phase IV engines.**
- **Promote access to capital and funding programmes, and**
- **Improve and implement education and training programmes related to fuel-saving sailing behaviour and safety.**

Expected outcomes of external cost policies in IWT

- Innovative schemes providing economic incentives, serious investment support and retrofit investment programmes help to **overcome market barriers towards a greener fleet**. Bundling of expertise, knowledge and market parties resulting in a large scale innovation and investment programme helps to reduce required investment budgets. Given the long economic lifetime of typical main propulsion engines, more than half of the engines can gradually be replaced or technically adapted in the next decade if such a measure would be combined with other incentives.
- More stringent emission standards, also for existing engines shall be a trigger for the IWT sector to make a big step forwards towards a cleaner fleet. The long economic lifetime of vessels and their equipment currently however prevents a higher innovation rate. Policy measures that **create a more favourable investment climate** on the one hand and that set higher emission standards on the other will eventually lead to **shorter innovation cycles in the sector** and consequently to **lower emission levels**.
- **Improved maturity of phase-IV solutions** and reduction of the costs. Analysis has shown that achieving a phase-IV level for the whole fleet, the total investment costs (public and private) amounting roughly to €1 billion at current prices, and taking current cost estimates for SCR and DPF into account (CE Delft, 2011). An innovation atelier shall be constituted for the manufacturing industry that stimulates the development of clean and efficient techniques to reduce IWT emissions, accompanied by structural roll-out planning and subsidies covering parts of the investment costs. This would help to **raise the re-investment capacity** as well as facilitate a **faster implementation of innovations**.
- Further support for the harmonised development and implementation of River Information Services (especially traffic management systems) will significantly contribute to **more efficient transport and less fuel consumption** (optimal speed due to traffic management on corridors) **as well as higher safety levels in inland waterway transport operations**. Sophisticated and innovative RIS services, which offer up-to-date tactical traffic images and topical depth information will raise the safety of

navigation (less vessel-vessel collisions, less groundings) and therefore have an important preventative impact. In terms of calamity abatement and rescue management, traffic-related RIS services have an important function as individual ship movements can be traced almost unlimitedly (reconstruction of incidents and accidents; learning cases) and crucial cargo data can be exchanged more quickly between rescue forces in emergencies. This will have **significant positive effects on the number of casualties and water pollution levels**.

- The performance on GHG emissions not only depends on technological solutions, but also strongly on the human factor. As the safety and environmental performance of IWT depends to a large extent on sailing behaviour (and consequently on the availability of qualified personnel), measures to promote education standards and proper training will have a **positive effect on accident frequency, fuel consumption and GHG emissions**. Experiences from the Netherlands have for instance shown that proper training and use of innovative decision support systems have already led to a reduction of fuel consumption by 7% (€27 million fuel costs savings) since the start of the 'Smart Steaming' programme in 2007. A combination of training and technology support will therefore be effective in terms of carbon reduction targets.

Table 6 Summary of policy package to reduce environmental, climate change and safety impacts

Current situation
Inland Waterway Transport has lower external costs compared to road haulage as IWT has little or no costs for congestion, noise and accidents. As a result IWT is promoted in transport policies for instance through programmes aiming at modal shift, such as Marco Polo. The outlook for 2020 however, shows a growing gap in the air pollution performance between the average engine in road haulage and IWT if no action is undertaken. The performance on air pollutant emissions (PM, NO_x) of road vehicles is quickly improving due to the relatively short lifecycle of trucks and more strict emission standards and many more incentives (for example road pricing, environmental zones in urban areas) compared to the incentives in IWT. The current overcapacity on the IWT supply side is also slowing down innovation in this field, as there is a reduced need for new vessels in the short term. Moreover the market is small and the demand for new engines and technologies is fragmented. Other external cost factors show that there is a relatively high safety risk for IWT workers as well as water pollution (waste).

Summary of problems addressed	
Markets & Awareness	Small scale and highly fragmented supply side of the market results in poor buying power and low interest for manufacturers to invest in the development of clean techniques for inland vessels. The financial crisis has caused a decline in the financial strength of the sector and a reduced ability to invest in environmentally friendly solutions.
Fleet	The long lifetime of vessels and engines results in the slow implementation of innovations. There are limited push and pull factors for ship-owners and/or IWT operators in order to provide a sense of urgency to improve the environmental performance of existing vessels.
Employment & Education	Limited awareness among IWT workers regarding fuel consumption in relation to sailing behaviour. There is a poor safety culture for workers.
Infrastructure	Poor fairway conditions cause suboptimal load factors and therefore more fuel consumption and emissions per tonne and sometimes complicate the safety of

	navigation and reduce reliability. A limited inland ports network and sub-optimal spatial planning of logistic and industrial sites causes the need for pre- and end haulage by truck, causing higher external costs.
River Information Services	RIS is not fully implemented yet, while the full use of RIS would result in optimised route planning, resulting in less fuel consumption and fewer emissions. Transport logistics applications are however still in their infancy.

Policy objective 2020	Further reduce the external costs of inland waterway operations with a focus on air pollutant emissions. Create a significant improvement of the emission to air and fuel consumption (CO_2 emission) of inland waterway transport through push and pull measures. This results in a break of the trend of the increasing gap between the air pollution performance of road and inland waterways. Moreover, safety for workers is improved due to improved safety culture and awareness measures.

Proposed policy measures IWT 2020 with a direct impact on reduction of external effects	
Description of priority measures	• Investigate and invest in replacement and retrofit programmes to reduce pollutant emissions of existing engines.
	• Promote access to capital and funding programmes/create a business and investment friendly climate.
	• Revise engine emission standards beyond the introduction of phase IV engines.
	• Improve and implement education and training programmes related to fuel-saving sailing behaviour and safety.
Provisional time planning	**2014- 2020**
Vision 2040	Inland waterway transport makes use of the state-of-the-art techniques and is beyond doubt the most environmentally friendly mode of land transport. There are clear incentives and regulations in place to trigger continually shorter innovation cycles, such as direct financial incentives through internalised external costs. Co-ordinated research and technology development is continuing to further reduce external costs and develop new and updated techniques.

Outlook policy measures after 2020	
Description of measures	• Internalisation of external costs for all modes under equal conditions.
	• Strengthen policy instruments to reduce specific fuel consumption (e.g. fuel tax or design standard) and to promote the use of alternative fuels.

Policy Package 3: Measures aiming at improving market conditions for operators and users of IWT

In Policy Packages 1 and 2 only the measures that have a direct impact on the modal share or external costs have been included. There are however, also measures with an indirect impact on modal share and/or external effects which need to be implemented. Not resolving the problems which these measures address would seriously limit the effectiveness of the other two previous policy packages. Taking action would support and amplify the ultimate policy goals to increase the modal share of IWT and to reduce the external cost.

The following measures are proposed under Policy Package 3:

Sub-groups Policy Package 3

- **MARKET:**
  a) Improve general knowledge and information on IWT and the opportunities.
  b) Support the financial strength of the sector by preventing disruptions in the market due to overcapacity.

- **FLEET:**
  a) Support research, innovation & technology transfer as well as roll out planning.
  b) Support the development and use of waste collection systems.

- **EMPLOYMENT & EDUCATION:**
  a) Support solutions for lack of qualified staff.
  b) Improve and implement education and training programmes related to safety and logistics.

- **INFRASTRUCTURE:**
  a) Develop density and quality of inland ports network including waterside logistics sites.
  b) Provide support for improved waterway management and maintenance.
  c) Prepare for possible impacts of climate change.
  d) Prepare for discussion on internalisation of external costs.

- **RIS: Support and promote harmonised implementation of RIS**

The following figures show the relation of these measures through the causal chain with the objective to raise modal share as well as the objective to reduce the external costs of IWT.

Figure 9 Causal chains to intervene on modal share of IWT via market conditions

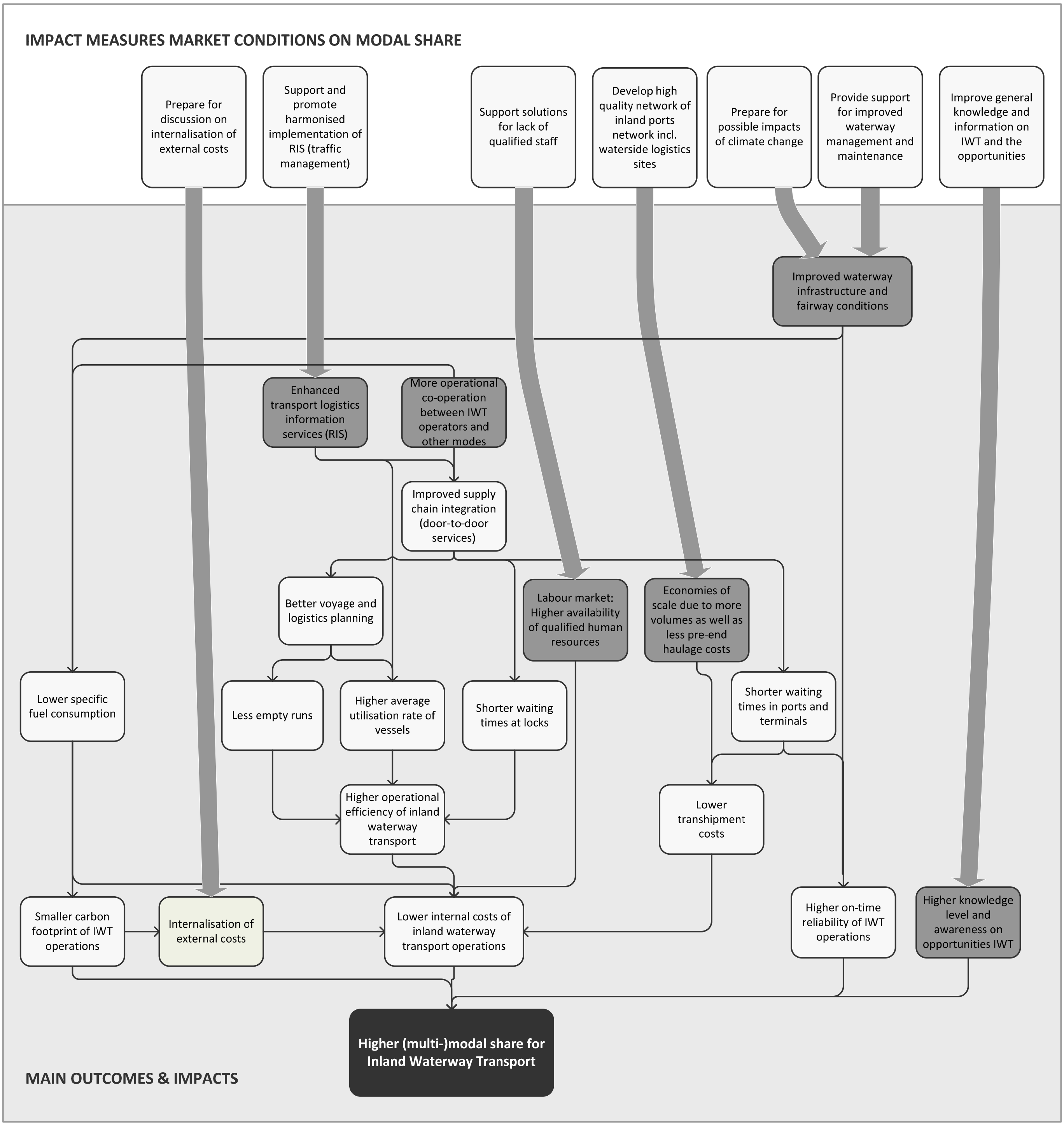
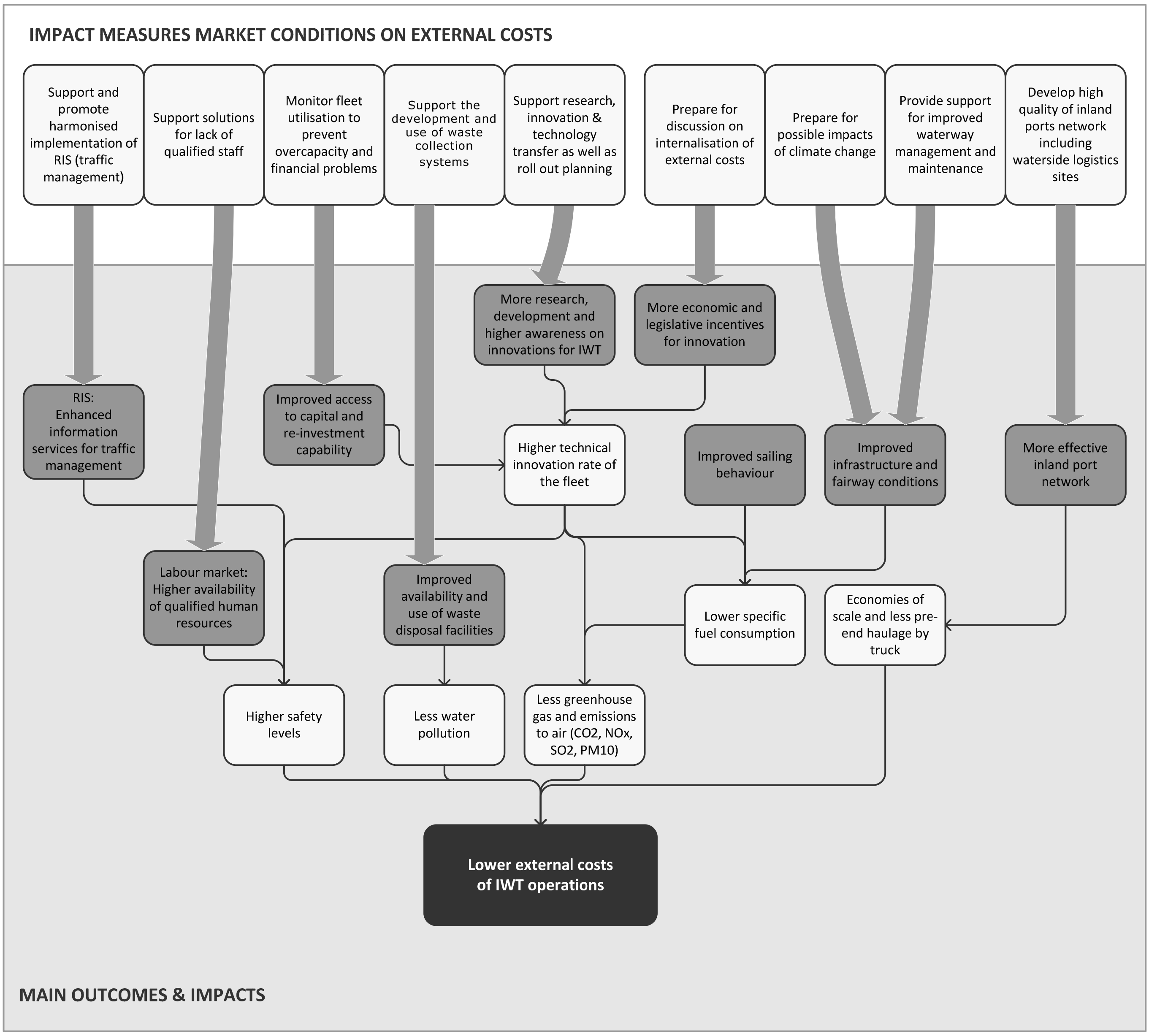


Figure 10 Causal chains to directly intervene on external costs of IWT via market conditions



Implementation and monitoring

The main financial resources for the period 2014-2020 should come from the European Horizon 2020 programme as well as the Connecting Europe Facility. For the further elaboration (e.g. Impact Assessments) and the implementation of policy measures it is recommended to obtain active cooperation and support from the main stakeholders. These stakeholders are the River Commissions, Member States as well as the representative organisations from the inland navigation sector and representatives from the demand side (shippers, large logistic service providers). Financial and human resources should be consolidated (if possible) in order to strengthen the implementation capacity and to have a maximum efficiency and effectiveness on IWT policy. In order to raise the modal share of IWT an active dialogue is recommended with the key users of European inland waterway transport services as they regularly experience what measures would be most urgently required to develop the sector and to provide/shift more cargo to inland waterway transport.

Finally, in order to know whether the policy measures reach their goals, the European Commission needs to monitor the progress made on the score of key indicators. The installation of a policy measurement dashboard that presents the information on the developments of key indicators and as well actual forecasts based on trends and expectations on a regular basis is recommended.

1 Introduction

1.1 Objectives and Background of the Study

The European Commission's DG MOVE assigned a consortium led by Panteia B.V Business Unit NEA (NEA) NL) in cooperation with Via Donau (A), CE Delft (NL), Planco (D) and MDS Transport (UK) to carry out the project titled 'Medium *and Long Term Perspectives of Inland Waterway Transport in the EU*', No. MOVE C2/2010-331-1.

This study provides the Commission with a comprehensive basis for the definition of the inland waterway transport policy within the general transport policy for the medium and long term. According to the tender specifications, the objectives of the study were, more specifically, to:

- investigate and analyse the current situation of the EU inland waterway transport sector in the aftermath of the economic crisis,
- analyse the strengths and weaknesses of the sector,
- explore the prospects and potential of inland waterway transport within the European transport system in the medium and long term also taking into account the likely impacts of the economic crisis and the challenges and issues to be tackled in the future,
- give concrete recommendations for policy measures with regard to inland waterway transport at EU level and comply with the priorities set out in the Transport White Paper, and
- make suggestions for the development of a medium and long term European strategy in support of inland waterway transport.

In particular within the framework of rethinking and developing new transport policies, the study provides answers to the further positioning of IWT in these new policy environments (for instance the new White Paper on Transport, revised TEN-T Guidelines, pricing and external costs, EU 2020 agenda, modal merging, energy transition, CO2 emission targets and climate change). Moreover, this study provides a solid foundation for a focussed policy on IWT as an integrated part of the overall common European transport policy.

This document is the final report of the project and includes a comprehensive description of the main findings. The Annex Report provides more background information. The results are mainly presented in the core parts of the Main Report in chapters 3 to 7. Chapter 8 subsequently presents the recommended policy packages to reach the main policy objectives including the expected outcomes and the vision for 2040.

In chapter 2 the methodology is outlined while in this introductory chapter, in the next sections, a general overview of the current Inland Waterway Transport sector (section 1.2) and a brief discussion on the present policy framework (section 1.3) will be given.

1.2 The present situation and outlook for the IWT industry

1.2.1 Looking back at the developments in the past years

Historic reflection

In the 1990s the European IWT markets were almost completely liberalised. This was a significant historic achievement, given the fact that for centuries the industry had known price regulation schemes. In order to properly appreciate this milestone one has to be aware of the importance of tolling IWT activities along the Rhine River in the past. A reminder of this in the present landscape is the location of many ancient historic buildings and castles directly alongside rivers. In many cases, this was not done to enjoy the river scenery but to ensure effective and efficient collection of tolls by local parties. This situation ended in 1864 through the Act of Mannheim, resulting in free movement of goods over the Rhine. On the Danube a similar situation exists since the Belgrade convention of 1948.

In order to better accommodate the transition to the liberalised market several scrapping actions were launched in the 1990s to eliminate the structural overcapacity which existed in the regulated market since the 1980s. This scrapping programme, aimed at scrapping old vessels and tried at the same time to prevent new building activities from getting out of control (‘Old-for-new rule‘). The capacity regulating policy lasted the entire 1990s and was only ended in April 2003.

While experts had some concerns about the merits of liberalisation in the past, the experience of the past decade has taught us that the benefits are much higher than the costs. Customers of the industry and the final consumers have experienced a vastly better level of customer performance by the operators at very reasonable prices in the 1990s and 2000s. The prices, moreover, remained very low in the 1990s and only started to rise in real terms during the second half of the past decade (period 2004-2008) when the IWT freight volumes were growing at very high rates. The boom in this period led to a wave of new building activity and IWT vessels even became, for a time, objects for financial speculators. All this came to a grinding halt when as a consequence of the financial and economic crisis, in 2008 and 2009 freight volumes sharply decreased and ship financing became much more difficult.

Furthermore, the present IWT fleet and IWT companies are highly productive and, in many Member States, the fleet is currently much more well equipped and modern compared to the fleet situation a decade ago, thanks to the high level of competitiveness in the market and the policies leading to the market liberalisation in the 1990s in particular the ‘old-for-new’ rule.

Reflection on trends and developments since the PINE study

The European Commission decided in 2002 to launch a comprehensive study called 'Prospects of inland navigation within the enlarged Europe' on the current situation and future prospects of the IWT sector. This study was completed in 2004[2] and can be considered as a precursor of the present study. The situation at that time was however quite different. Back in 2003/2004 the financial-economic circumstances were much better and there was a focus on the enlarged European Union. It is worthwhile analysing the expected developments mentioned in the PINE study and comparing these with the actual development and the present situation and outlook for the industry.

Development of transport demand

First, with regard to the demand side of the market it must be said that even before the financial and economic crisis effected the market in 2008 and 2009 growth rates of freight volumes were much lower than expected for the past decade at the time of writing the report in 2004. However this was entirely due to an almost complete stand still in freight volumes for IWT in the period up to 2004. In contrast, in the period after that, from 2004 till 2007, average annual growth rates were very high (about 3.8% for the EU27). During the entire period 2000-2007 the transport performance in the New Member States grew at a much higher rate than in the old Member States.

In the second half of 2008, however, the industry faced a sharp decline in transport performance. Because of the financial and economic crisis, the IWT transport performance for the EU27 in 2009 fell back to the level of 1990 (source: EUROSTAT figures 2011). This, moreover, entirely wiped out the positive effects of the enlargement because the fall back to the level of 1990 also occurred in the group of new Member States separately.

Developments in the supply side

Looking at the supply side of the market it is very remarkable that the long period of capacity regulation and the old-for-new regulation — despite the many clear benefits they had — was not able to halt the increase of the average vessel size. On the contrary, in the entire period of EU capacity regulation the average vessel size increased at the same rate as before. It can be concluded from the fleet statistics that there even was a further increase in the time period after 2008 when many new much larger vessels were added to the fleet. Especially in the Rhine corridor this situation occurred because of the booming markets (2004-2008) and the phasing-out process of mono-hull tankers.

Regarding environmental performance, it can be concluded that some progress was made on the emission levels for new engines. Since 2007 new engines have to meet the criteria of emission stage III according to Directive 2004/26/EC. Another step was made by Directive 2009/30/EC regarding the quality of diesel fuel in inland waterway transport. Since January 2011 the fuel used in IWT contains also a maximum amount of sulphur of 10mg/kg fuel (EN590 specification) and therefore has the same specifications compared to road haulage, resulting in a strong reduction of the emission of SO_2 (sulphur dioxide).

[2] PINE- prospects of Inland Navigation within the enlarged Europe (March, 2004).

Another important supply side trend, noticed in the PINE study, was the structural shortage of demand in the labour market, both in Western as well as in Eastern European IWT markets. An achievement is the establishment of the Social Dialogue in the inland waterway transport sector that deals with issues such as working times, job profiles, harmonisation of manning requirements and working and living conditions for workers. Also the EDINNA network founded in February 2009 is seen as a positive development towards the harmonisation across Europe of education and training curricula and a further strengthening of the professional competences and more labour market mobility within Europe.

However, despite all efforts to find some relief, in particular from Eastern European countries, the lack of qualified workers is still obvious today and far from finding a solution. The situation constitutes a serious threat for IWT in the next decade, given the average age of staff in the industry. It can be concluded that substantial solutions and efforts are needed in order to prevent severe problems in many parts of the IWT activities.

Infrastructural developments

As regards the state of the waterway infrastructure, the last five years have shown progress in the elimination of bottlenecks, for example in the construction works on the Dutch Maas, the Magdeburg Elbe crossing and the preparations for the construction of the Seine-Nord canal (to be completed by 2017). The solution of the majority of most severe bottlenecks has however not yet materialised. There is a lack of maintenance on several waterways resulting in reduced fairway depth, reduced reliability and higher transport costs.

On the other hand infrastructure work often meets with environmental concerns. The required integrative approach towards environmentally sustainable waterway development generally requires more time and financial efforts than initially planned. In particular on the Danube (TEN-T priority project 18) the focus of the TEN-T coordinator — Karla Peijs, active since September 2007 —, has been on the mediation between economic and environmental interests.

The recent proposal by the European Commission for new TEN-T guidelines (October 2011)[3], and for the 'Connecting Europe Facility'[4] provide a new framework for investments on European level on the Trans European Network. It can be concluded that much more attention is paid to inland waterway infrastructure as well as ports compared to the previous framework. Due to the Corridor Development Plans there is room for the interests of inland waterway transport.

[3] COM(2011) 650/2 "Proposal for a regulation of the European Parliament and of the Council on Union guidelines for the development of the trans-European transport network", SEC(2011) 1212, 1213

[4] COM(2011) 665/3 "Proposal for a regulation of the European Parliament and of the Council establishing the Connecting Europe Facility", SEC (2011) 1262, 1263

Information and Communication Technology and River Information Services

During the past years a great deal of progress has been made in the field of information and communication technology. In particular the implementation of the River Information Services is a major development in inland waterway transport that supports the integration of IWT in the general ICT systems in logistics (e-Freight). The TEN-T multi-annual programme (2006-2013) has allocated a budget of 50 million euro for the deployment of River Information Services.

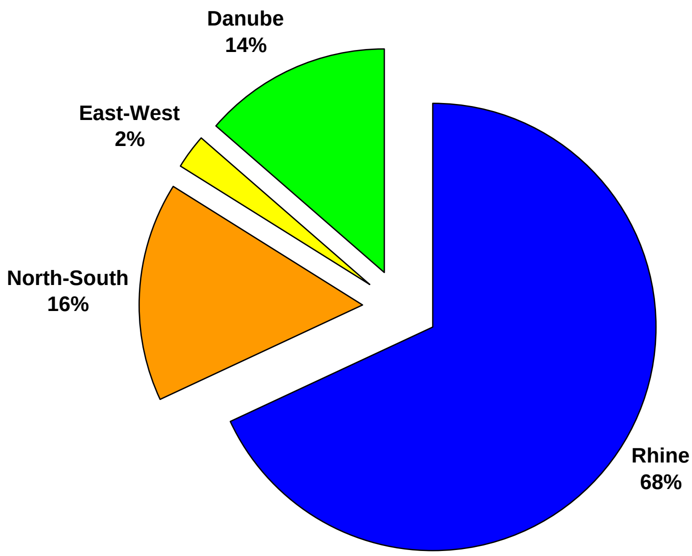
1.2.2 Modal share and important cargo flows for IWT

In the past years the modal share of inland waterway transport in the EU27 has slowly been declining. Compared to road and rail transport the share of transport performance of IWT was 6.8% in 1995 (122 billion tonne kms) and decreased to 5.5% in 2009 and picked up again to 5.7% in 2010 (129 billion tonne kms).

Within Europe there are, however, big differences in the position of IWT as result of varying quality and availability of inland waterways. For example IWT in the Netherlands has a modal share of almost 35%, while in Germany this is 12%, Austria 4%, France 3.5% and Poland 0.1%.

Due to the lack of availability of suitable inland waterways the opportunities to use inland waterways are limited to certain corridors and parts of the European transport network. The Rhine corridor is by far the most important corridor as almost 70% of the total cargo volume on inland waterways in the EU is transported along this particular corridor.

Figure 1.1. Breakdown per corridor (2007)



Source: EUROSTAT

IWT is highly important in the transport of large bulk transports. The modal share of IWT in the EU27 is 25% to 30% for commodities such as solid mineral fuels (coals), petroleum products (oil) and ores and metal wastes.

Expressed in terms of volume in tonnes transported by IWT, the share of container transport by barge is still relatively small on a European scale (11%). For the seaports Rotterdam and Antwerp in domestic markets and the Rhine corridor however, the contribution of container barge transport is quite substantial with a share of 35% for IWT in the container hinterland transport. This segment is rapidly growing.

In 2007, the most important products in terms of total volume transported by IWT were:

1) Sand and gravel with a share of 24%.
2) Liquid cargo representing 24% of the market.
3) Coal and ore with a share of 21%.
4) Various types of dry cargo represent 14%.
5) Agribulk sector represents 11.5%.
6) Transportation of metal products with approximately 5.5%.

The majority of the transports were carried out by vessels under the Dutch flag. These vessels performed 48% of the transport in Europe by barges. The German fleet has a share of 20% and the Belgian fleet has a share of 13%. Other countries have shares of 5% or lower.

One of the main reasons for the decrease of the modal share to 5.7% in 2010 is the changing economy of Europe. In particular in the Rhine area there is a decline in the size of heavy industries, less agriculture but more service industries and more transport of consumer goods. In particular, the crisis in 2009 also resulted in a much lower transport of heavy bulk products such as ores and coal for the steel industry.

More detailed information on the recent developments is presented in chapter 3 of this report. The forecast on the development of the transport performance of IWT as well as the estimated modal share of IWT in 2020 and 2040 are also presented in chapter 3 of this report (see section 3.1).

1.2.3 Production value and added value for society

According to EUROSTAT the total turnover of the IWT sector in the EU27 is estimated at 6.1 billion euro in the year 2007. The Netherlands and Germany have the biggest turnover (2.1 billion euro and 1.7 billion Euros) followed by France (618 million Euros) and Belgium (406 million Euros). The direct added value (jobs, profits) amounts to approximately 50% of the turnover, 3 billion euro in 2007. Moreover about 77% of the added value in EU27 comes from freight transport, while 23% originates from passenger transport and tourism.

Important additional benefits for society come from the low cost and the high transport capacity of inland waterway transport. These aspects have great benefits for industries. An example is the steel industry. These industries are competitive partly because of the availability of low transport costs of raw materials by IWT. On the other side, they depend on IWT to create turnover, employment and profits and give added value to other industries, for instance the automotive and construction industries. The indirect value added of IWT to Europe’s GDP is therefore quite substantial but not directly visible in official statistics.

1.2.4 Supply side environment: enterprises, fleet, capacity utilisation, prices and revenues

This section presents the general overview on the characteristics of the supply side of IWT. More information is presented in the chapters 4 (Fleet) and chapter 5 (Employment & Education).

Enterprises and human resources

During the year 2007 EUROSTAT counted a total of 9,324 companies in IWT in the EU27 providing jobs for 43,400 people in total (including passenger transport). So the average company provides work for approximately 4.5 persons.

The supply side structure of IWT in the Western part of Europe is dominated by small companies owning/operating one vessel. Larger companies and operators are predominant on the Danube. On the Danube single barge owners are still the exception. In contrast to the Danube, the majority of the dry cargo motor vessels in Western Europe are owned and operated by families, for example the husband and wife working together, self-employed, possibly with a hired boatman. Larger companies such as shipping lines also still exist in Western Europe and mainly operate larger vessels with hired staff such as push convoys, large container vessels and large motor tankers. In particular if vessels need to operate on a 24/7 basis, hired/employed staff is needed to comply with the staff and working time regulations.

Often these smaller companies get their assignments on a day-to-day basis via brokers or larger logistic service providers. The small companies therefore do not have commercial contacts themselves with the shipper. Generally the larger logistic service providers and brokers/middlemen have contracts with large shippers and they divide the work over a number of small associated IWT operators. A smaller part of these IWT operators cooperates in trade associations or works on the basis of long term contracts. In particular the operators working on shorter term contracts (spot market) were hit by the economic crisis in 2009.

In contrast to examples observed in other transport modes the IWT sector had very limited possibilities to (temporarily) reduce the supply of transport capacity in order to reduce costs and to rebalance supply and demand. It was due to the highly fragmented structure of the supply side of the sector as well as poor levels of cooperation and organisation that vessels were kept operational, causing financial problems for operators. Aggravated by the overcapacity on the market the individual IWT operator is often in a weak position to negotiate about freight prices as there is fierce competition between the individual IWT operators resulting in low prices and profit margins. Only during low water levels is there a temporary improvement of income for the IWT operator. The poor organisation is also demonstrated in the Netherlands by the failure to provide a collective labour agreement. Such structures are in conflict with the need for additional qualified personnel, in particular vessel operators and boat masters.

Fleet and capacity utilisation

The European fleet consists of approximately 12,800 units with a total load capacity of 16.4 million tonnes. The average year of construction of a dry cargo vessel is 1967 while in tanker transport the average year of construction is 1976.

In the last decades the fleet has substantially increased in scale. The new building wave of the past six years caused an overcapacity of larger ships that was clearly revealed in 2009 and 2010 when the economic crisis hit major parts of the IWT sector. In 2009 the freight flows declined significantly whereas the fleet was still expanding. This process could not be halted, due to new vessels being added to the market that were ordered a few years earlier (before the crisis).

In the tanker fleet, the replacement of single-hull by double-hull tankers is taking place in conformity with the provisions related to the transport of hazardous goods (ADN) which applies to a large share of the commodities carried by tanker vessels, amongst others gasoline. This process must be completed before 2019. The early anticipation of the supply side of the sector caused a ‘double fleet’ causing overcapacity possible for the period until 2019. This causes a significant pressure on freight rates and revenues.

Freight prices, revenues and financial reserves
In the period 2003 up until mid 2008 the revenues in the IWT sector were high and the outlook was bright, resulting in the confidence to invest earned and borrowed money in building new vessels with bigger capacity. A big drop in the freight prices was, however, observed by the end of 2008 and this low price period continued until mid 2010. Due to a temporarily prolonged low water situation in the spring and autumn of 2011 the IWT sector was able to increase somewhat the turnover of companies again. Also refunds on tax payments made in the booming years 2006-2008 were received in 2009, 2010 and 2011 and compensated to a certain extent the reduction of turnover. The present financial-economic situation (end 2011) is however still weak and far removed from a full recovery. The crisis caused a decrease in the value of vessels and forced the companies to consume own capital or to increase the share of loans to be able to survive in the short term.

As a result the financial resources available for new investments or improvements in existing vessels was substantially reduced causing worries about the ability to invest in new technologies including techniques to improve the environmental performance of IWT. Moreover, as financial risks have been made clear due to the crisis, banks tightened the procedures and increased thresholds for granting of new loans to IWT operators. The consequence of this situation is that it has become more difficult to come up with legislation that requires substantial private investments in the short term from vessel owners to meet emission standards for existing vessels, for instance by requiring investments in retrofitting with catalyst and filters.

1.3 European policy framework

1.3.1 EU 2020 Strategy

The future policy of the European Commission on Inland Waterway Transport will be in line with the overall objectives of the EU policy.

The **Europe 2020 strategy** is the most recent overall EU strategy for the coming decade. In a changing world, the EU wants to become a ***smart, sustainable and inclusive*** economy.

These three mutually reinforcing priorities shall help the EU and the Member States to deliver high levels of employment, productivity and social cohesion.

The main five policy targets as formulated in the EU 2020 strategy are:

1 **Employment:** 75% of the 20-64 year-olds to be employed.
2 **R&D / innovation:** 3% of the EU's GDP (public and private combined) to be invested in R&D/innovation.
3 **Climate change / energy:** greenhouse gas emissions reduction of 20% (or even 30%, if a satisfactory international agreement can be achieved to follow Kyoto) lower than 1990, 20% of energy from renewables, 20% increase in energy efficiency.

4 **Education:** Reducing school drop-out rates below 10%, at least 40% of 30-34–year-olds completing third level education (or equivalent).
5 **Poverty / social exclusion:** at least 20 million fewer people in or at risk of poverty and social exclusion.

Each Member State will adopt its own national targets in each of these areas. Concrete actions at EU and national levels will underpin the strategy.

In general the European Union is interested in increased welfare of the community. The level of welfare depends on the economic situation (GDP, employment, reducing poverty) as well as the quality of life of the inhabitants (mitigating climate change, energy security and air quality).

1.3.2 European Transport policy and IWT

With respect to the economic performance of the European Union, it is important to strengthen the competitiveness of the European economy in order to support the position of industries based in Europe. One of the items that determine competitiveness is the price and quality of transport and logistics. In this respect Inland Waterway Transport provides a significant contribution, through reliable and inexpensive transport. Furthermore, low transport costs will also be beneficial for the purchasing power of consumers.

Inland Waterway Transport is characterised as a mode with relatively low external costs, low congestion and low transport costs.

Given the expected growth of freight flows and congestion on other modes of transport, one of the options is to make more use of inland waterway infrastructure since it has substantial spare capacity to accommodate additional freight flows. In particular the further development of intermodal transport is believed to be a solution to support the further development of smart and sustainable transport in the EU.

In the recently published White Paper on Transport '*Roadmap to a single European Transport Area- Towards a competitive and resource efficient transport system*' (2011) ambitious goals are set, aimed at substantially reducing oil dependency and carbon emissions without sacrificing efficiency and the freedom of movement that transport offers. The main policy objectives in the White Paper are grouped around three general themes:

1 Developing and deploying new and sustainable fuels and propulsion systems.

2 Optimising the performance of multimodal logistic chains, including making greater use of more energy-efficient modes.

3 Increasing the efficiency of transport and of infrastructure use with information systems and market based incentives.

Although the first category primarily contains goals for the automotive, airline and maritime shipping industry it also applies to IWT (e.g. LNG and diesel-electric propulsion). The second and third groups contain more direct goals for the IWT industry. IWT is an energy efficient mode and is therefore seen as the mode with the potential to increase its modal share. In this respect modal shift is a separate goal within the second group: by 2030 a share of 30% of road freight over 300 km should be shifted to other modes (waterborne and rail) and by 2050 a share of 50% in this market should be transported. Under certain conditions IWT can also be competitive on shorter distances. Furthermore, the core inland waterway networks shall be incorporated and integrated within the networks of other transport modes. This core network integration is also one of the goals and this should be achieved by 2050. The third group of goals is also relevant to the IWT sector. In particular the goals regarding modernisation of traffic management (e.g. through River Information Services), improving safety and security of transport and the further application of the polluter pays principle could be mentioned in this respect.

Last but not least the White paper has an explicit message regarding IWT: '*Inland waterways, where unused potential exists, have to play an increasing role in particular in moving goods to the hinterland and in linking the European seas*'.

The White Paper has as its overarching objective the decarbonisation of transport. The ultimate goal is to reduce transport greenhouse gases emissions by 60% in 2050 (compared to 1990 levels).

Some selected goals — with relevance to IWT — to achieve this emission target are:

- **Modal shift**: 30% of road freight above 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050.
- **Transport management systems**: full deployment of waterborne transport management systems including River Information Services.
- **Multimodal network**: ensure that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system. A fully functional and EU-wide intermodal TEN-T core network by 2030, with a high quality and capacity network by 2050.

Moreover, there are (internal) problems and bottlenecks that need to be addressed in inland waterway transport in order to unleash the full potential of IWT. Several of these problems, bottlenecks and opportunities for IWT are already addressed in existing EU policy programmes, such as NAIADES I, Marco Polo and TEN-T as well as in national policies on inland waterway transport.

1.3.3 NAIADES action programme 2006-2013

An important milestone in Europe's efforts to promote inland waterway transport was the launch of the multi-annual European Action Programme for Inland Waterway Transport (NAIADES) in January 2006. The NAIADES action programme is aimed at enhancing the use of inland navigation in order to ensure a sustainable, competitive and environmentally friendly European transport network, and includes recommendations for actions to be taken in the period between 2006 and 2013.

Several Member States have pursued an active approach towards promoting inland waterway transport. Apart from the general company start-up support services, which are offered in almost all Member States, some countries offer grants, aid schemes and subsidies to support the creation of new market initiatives, such as combined transport and container liner services. In addition, national funding programmes exist for investments in intermodal and port facilities in order to facilitate new market initiatives. Consolidated and comprehensive national action plans to promote inland waterway transport have however emerged only in a minority of Member States. For a large part, this can be attributed to the limited and fragmented administrative resources available driven by a poor political attention and awareness concerning the opportunities of inland waterway transport.

In order to facilitate the coordinated implementation of the NAIADES programme, the Commission called upon support from a platform of all interested inland waterway transport stakeholders, Member States, river commissions and industry representatives. PLATINA (Platform for the implementation of NAIADES), is an RTD FP7 coordination action for inland waterway transport, which brings together 23 partners from 9 European countries. It is funded with 8, 35 million euro from the Commission and continues to assist with the implementation of the NAIADES action programme since June 2008. The project has developed effective support in the five strategic areas of the NAIADES programme: markets, fleet, jobs & skills, image and infrastructure.

The NAIADES action programme is achieving significant results through the PLATINA project, for instance by improving access to funding for innovations, developing education and training standards, defining strategic research needs, bundling and disseminating innovative ideas and concepts, creating general awareness programmes, addressing administrative and regulatory barriers, sharing of good practices and by defining guidelines for sustainable waterway planning.

In April 2011 the European Commission published the Mid-term progress report, a staff-working document (SEC (2011) 453).

The creation of the NAIADES Action Programme and the setup of a European implementation platform have strengthened the political perception of inland waterway transport not only at EU level, but also in the Member States and shipping industry.

1.3.4 REGINA: Reflection group on inland navigation

In spring 2010 an informal reflection expert group on inland navigation (‘REGINA’) documented the main activities and tasks which are required at the European level in order to strengthen inland waterway transport[5].

[5] www.naiades.info

The focus was mainly on the administrative and institutional actions and measures needed. The reflection group concluded the following:

- Much closer co-operation and co-ordination is needed between all stakeholders, the European Commission, the River Commissions, and the Member States.
- There is a need for a permanent European IWT policy (follow-up NAIADES after 2013)
- More financial and human resources for implementation of policy actions in particular at European Community level.
- Seamless transition needed since PLATINA project will end in May 2012.

According to REGINA the implementation of a European-wide action programme to promote inland waterway transport should be comprehensive, inclusive and be based on structural co-operation between all actors involved. The benefits of a truly European action programme to support inland waterway transport can only be achieved through co-ordinated action and reciprocal commitment between EU, Member States, river commissions, river protection commissions and the inland waterway transport industry. In order to overcome the identified shortcomings intensified co-operation between all stakeholders is required. The limited administrative resources must be mobilised and exploited more efficiently and effectively. For this, the visibility of European programmes must be improved and potential beneficiaries must be better motivated to engage in joint projects aiming at promoting inland waterway transport in Europe. REGINA made clear that there is a need for improved general framework conditions for efficient and sustainable IWT operations.
On this basis a consolidated 'inventory of tasks' was elaborated, structured along the five existing thematic action pillars of NAIADES. The inventory contains more than 60 IWT-related activities and tasks that need to be taken up and co-ordinated at a transnational level.

The inventory was made regarding the objectives, horizontal issues and tasks and was useful for this study (Medium and Long term perspectives of IWT in the EU) and used as one of the references for possible measures to overcome the identified problems and challenges.

1.3.5 Danube Region Strategy

The EU Strategy for the Danube Region (EUSDR)[6] is a macro-regional strategy adopted by the European Commission in December 2010 and endorsed by the European Council in 2011. The Strategy was jointly developed by the Commission, with the Danube Region countries and stakeholders, in order to address common challenges together. The Strategy seeks to create synergies and coordination between existing policies and initiatives taking place across the Danube Region.

[6] SEC (2010) 1489, European Union Strategy for the Danube Region, Brussels.

The targets for the implementation of the Danube Region Strategy's priority area on inland waterways are as follows:

- Increase cargo transport on the river by 20 % by 2020 compared to 2010.
- Solve obstacles to navigability, taking into account the specific characteristics of each section of the Danube and its navigable tributaries and establish effective waterway infrastructure management by 2015.
- Develop efficient multimodal terminals at river ports along the Danube and its navigable tributaries to connect inland waterways with rail and road transport by 2020.
- Implement harmonised River Information Services (RIS) on the Danube and its navigable tributaries and ensure the international exchange of RIS data preferably by 2015.
- Solve the shortage of qualified personnel and harmonise education standards in inland navigation in the Danube region by 2020, duly taking into account the social dimension of the respective measures

In October 2011, the Steering Group for Priority Area 1a – To improve mobility and multimodality: inland waterways set the course for the implementation of the Strategy in this Priority Area.

2 Approach

2.1 General considerations

The study will investigate and analyse:

- the situation of the EU inland waterway sector in the context of the economic crisis,
- the strengths and weaknesses of the sector, and
- the prospects and potential of inland waterway transports in the European transport system in the medium (2020) and long term (2040).

The study will take into account the impacts of the financial economic crisis and will address the challenges and issues to be tackled in the future such as growing transport demand, congestion problems, sustainability and environmental constraints and the impacts of climate change.

The investigations and analyses should result in **concrete recommendations for policy measures**. These policy measures will have to fit closely to priorities as set out in the Transport White Paper and will present a detailed view on specific strategies in the medium and long term for inland waterway transport.

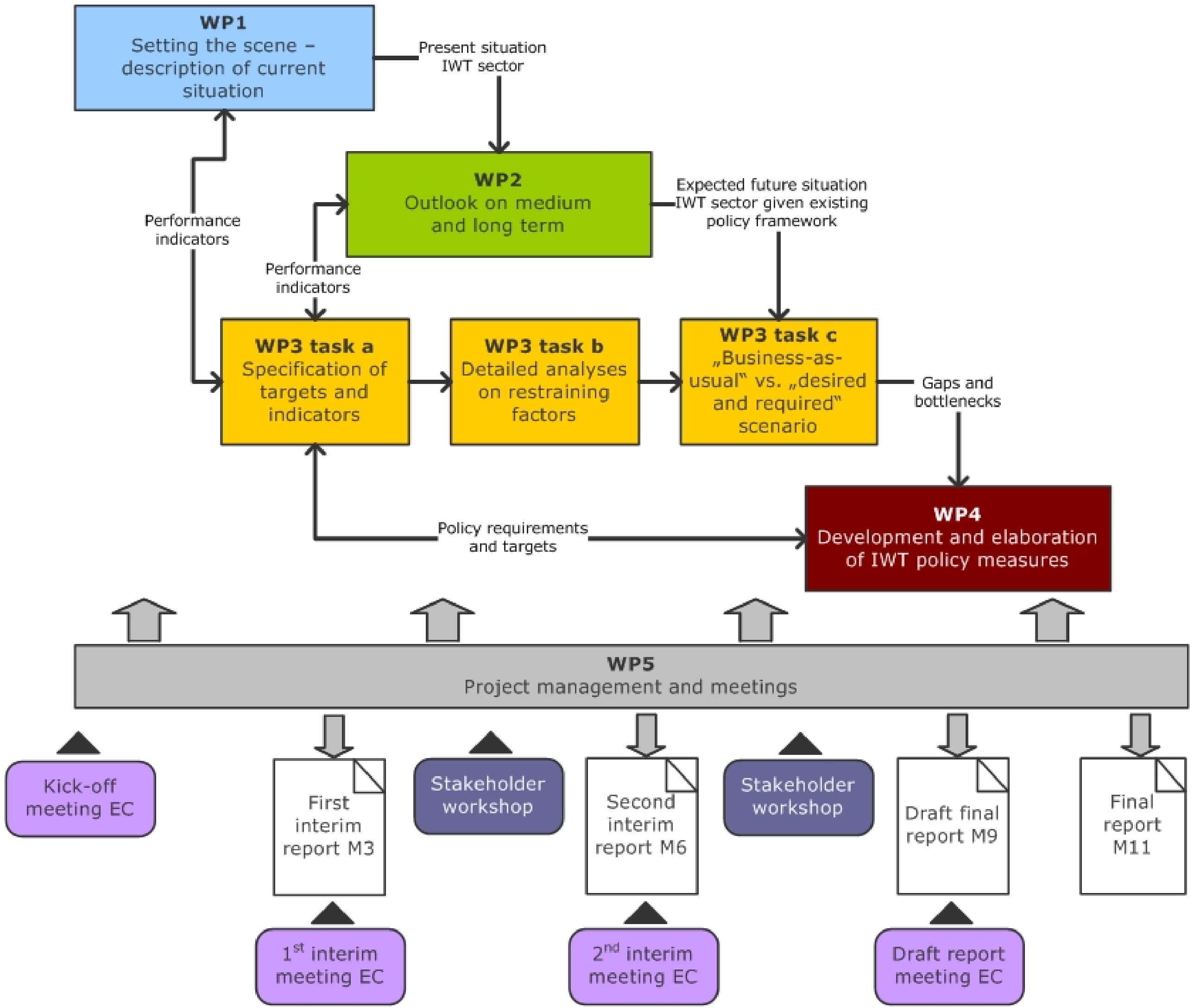
2.1.1 Chosen project structure

In order to structure the required work and provide a clear insight into the necessary project activities and to be able to allocate responsibilities amongst consortium members, the proposed project was broken down into five main work packages:

- WP 1: Setting the scene – description of current situation
- WP 2: Outlook on medium and long term
- WP 3: Specification of targets and indicators
- WP 4: Development and elaboration of IWT policy measures
- WP 5: Project management and meetings

Figure 2.1 on the next page presents the schematic breakdown of the project into the five work packages. The deliverables as well as the external communication are highlighted. The figure and the subsequent concise textual explanation also clarify the general interdependencies between the tasks.

Figure 2.1 Work package structure of the project



Short Explanation of the Work Package Structure

Step 1: Description of the current situation
The project started by describing the current characteristics and market position of the IWT industry 'setting the scene' (WP1). This was carried out by developing a concise description of the current situation, presenting details on the demand side, supply side, intermodality and IWT, the environmental performance, external costs and the current policy framework.

Step 2: Outlook on medium and long term
The second major step was to present an outlook on the development of the industry on medium and longer term. Based a 'business as usual' or 'autonomous development' scenario: what will happen if no additional or new initiatives or policy measures are initiated?

Step 3: Specification of targets and indicators
In the third work package the 'autonomous development scenario' as derived in WP2 was confronted with a 'desired and required development scenario' of the IWT sector as seen by relevant stakeholders from industry and public administrations. SWOT analyses were used to structure and describe the results of this confrontation. As a result, a list of gaps and bottlenecks for each of the thematic areas were obtained.

Step 4: Development and elaboration of IWT policy measures
The list of remaining issues or 'gaps' as derived from WP3 was the main input for the work in work package 4. This work package focused on the development of well-founded policy recommendations for the medium and long term. Based on the preceding analyses in WP1 to WP3, the consortium a proposal for a set of policy measures aimed at bridging the gap between the envisaged development of the industry and the desired development

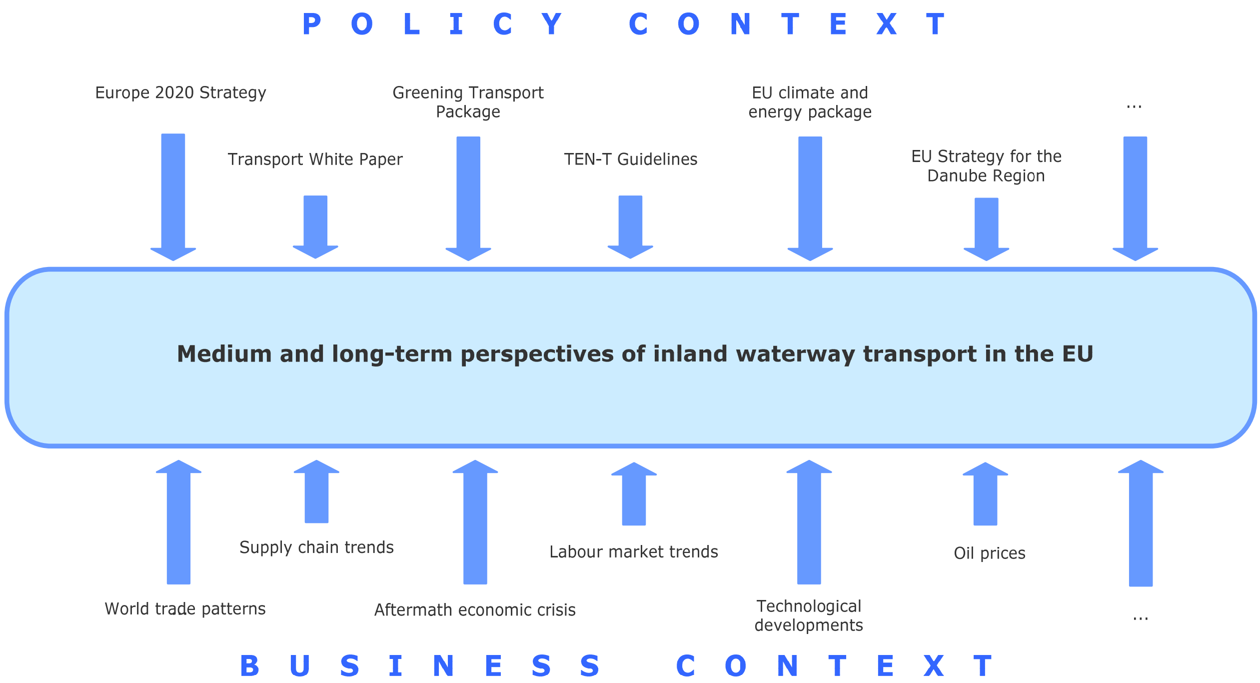
Viewpoints and objectives of three different stakeholder groups were taken into account at various times in the course of the project. Moreover the findings of the stakeholder analyses were used to structure the work and to identify the issues and indicators that were important to study. The results of the stakeholder analyses are presented in this chapter.

The main relevant stakeholder groups distinguished are:

- Shippers,
- Inland Waterway Transport operators, and
- Society as a whole.

Within the framework of the study the term 'Policy measures' does not only refer to policies by the EC or policies at European level. Policy measures could be policies of other authorities as well: Member States, River Commissions or regional or local authorities. In some cases the term could even refer to policies taken or yet to be taken by the industry itself. Figure 2.2 presents the interrelationship between the study, the markets and the (policy making) market environment.

Figure 2.2 Schematic view on policy and business context



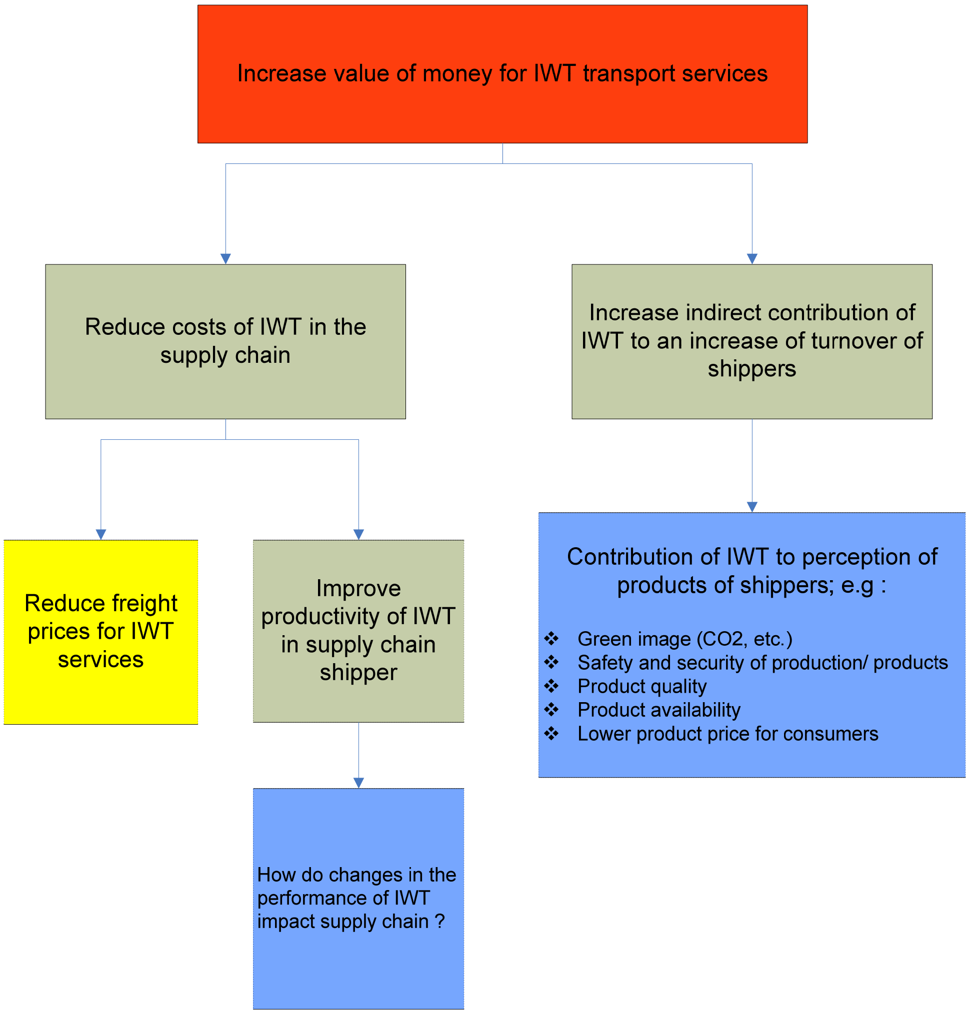
In order to structure the relationship for each stakeholder group, objective trees were made which illustrate the objectives and the relation to secondary objectives that determine the extent to which objectives are reached. These trees are shown on the next pages (figures 2.3-2.5).

In these graphs the red cells represent the primary objective of the stakeholder. A purple cell indicates that this objective is further analysed in a separate objectives tree. The yellow cells indicate that the objective has an overlap with objectives of other stakeholders. The blue cells present indicators that are not further analysed in the scheme.

SHIPPERS

The shippers and industries using inland waterway transport focus on increasing the value for money for IWT transport services. Shippers will pursue a low price and high quality. A low price can provide a competitive advantage. Besides price there quality aspects are also important, such as the reliability and flexibility of transport (product availability) and the risk of damage and theft (product quality, security). Furthermore the 'green image' is becoming more and more important for shippers. Consumers are increasingly demanding products with a low carbon footprint and manufacturers are paying more attention to their corporate social responsibility (CSR). In this respect inland waterway transport can contribute to the image of shipper's products and services.

Figure 2.3 Objectives from viewpoint: Shippers



INLAND WATERWAY TRANSPORT COMPANIES

The inland waterway transport companies have the main objective to continue and expand their business and to increase profitability. This can be realised in two ways: by increasing turnover or by reducing costs.

The productivity of the operation is quite important as well as the cost of resources. Productivity is influenced by factors such as the load factor, the number of operational hours, the share of empty journeys, waiting times, infrastructure quality and transport speeds.

An increase of turnover can be realised by increasing the transport performance (e.g. more trips, longer distances, higher payloads) as well as higher freight rates and/or by means of providing value added services (for instance ICT, storage management).

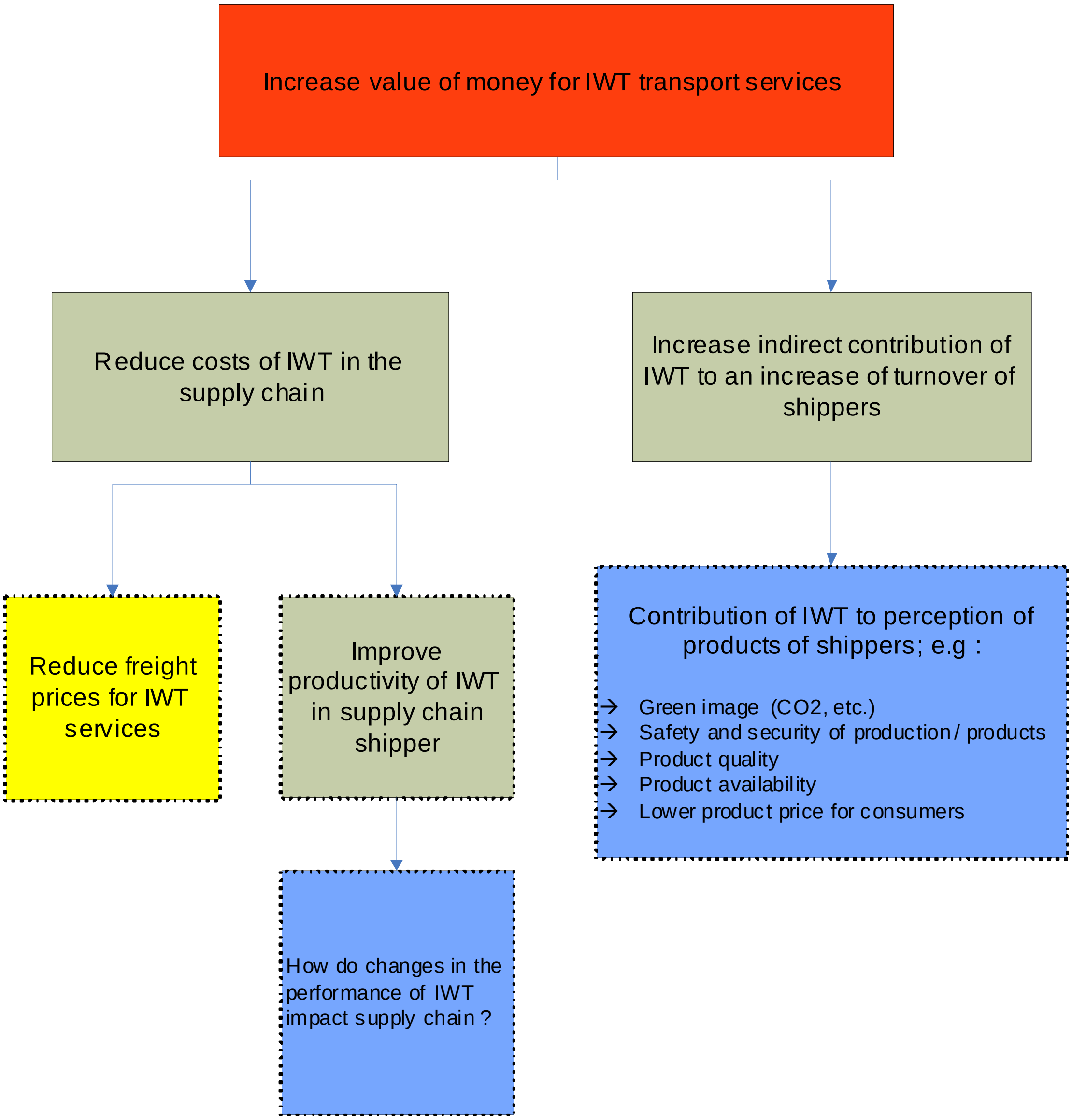
Innovation is needed to cope with shippers' demands. For example investments are needed to invest in clean engines and fuel saving techniques or to develop new logistic concepts using new vessel types. The level of innovation depends to a large extent on the available financial resources through the profits made in the past. If there is no profit, there is no money available to invest and innovation processes slow down.

The objective to make money by means of higher freight rates is contradictory to the objective of shippers. The height of freight rates mainly depends on the ratio between supply and demand (available vessels vs. cargo flows). Big fluctuations in the freight rates are seen during the year on corridors sensitive to water levels. During low water periods, the supply of transport capacity reduces due to lack of available fairway depths. As result of the changed ratio between supply and demand, the prices increase. On the other side the fall of freight demand by end 2008 and 2009 resulted in high overcapacity of vessels resulting in low freight rates in 2009.

Secondly the structure of the market influences the freight rates. The supply side of the market is characterised by fragmentation and is dominated by small companies. On the demand side there are mainly large companies. This difference between supply and demand in terms of market structure is believed to result in less negotiation power for inland waterway transport companies leading to lower freight rates.

A commonality with the transport policy objective is the increase of modal share. With respect to productivity also the infrastructure managers are relevant and therefore the role of public authorities. For example, the productivity and the price of transport are influenced by the dimensions of waterways as well as the 24h operation of locks and bridges. An increase of productivity generally results in lower transport costs and therefore increases the competitiveness compared to other modes and results in a higher modal share for IWT.

Figure 2.4 Objectives from viewpoint: Inland waterway transport operators



WIDER SOCIETY

The primary objective is to increase the contribution of IWT to the welfare of society. This translates to increasing the value added to GDP (direct and indirect contributions through employment, profits) as well as by savings on external cost of transport. The latter can be split into:

- increase the modal share of IWT
- reduce the external costs of IWT

In section 1.3 of this report the policy framework for IWT was already highlighted which also includes the objectives for the wider society. In the next section the specific objectives are described addressing the increase of modal share and the reduction of external costs.

Increase modal share of IWT

The NAIADES Communication (2006) made clear that the EU has committed itself to pursuing the goal of shifting transport to less energy-intensive, cleaner and safer transport modes. Inland waterway transport is an obvious choice to play a more prominent role in reaching these policy targets. Concrete policy actions are needed to fully exploit the market potential of inland navigation and to make its use more attractive. Given that inland navigation is often a cross-border transport mode, action at both national and Community level is required. This was also highlighted in the White Paper and by the REGINA group (see section 1.3 of this report).

Reduce external effects of IWT

Inland Waterway Transport provides a lower external cost to society compared to road haulage[7]. Hence, policies should promote Inland Waterway Transport and focus on an increase of its modal share. On the other hand, the external costs of Inland Waterway Transport need further reduction.

The policy objective to reduce external costs is clearly set out in the recent European Commission policy documents such as:

- The White Paper on Transport 2011 'Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system', March 2011 (see also section 1.3 in this report).
- The Greening transport package (July 2008).
- The Future of Transport (2009).

In this respect the Inland Waterway Transport mode should be able to maintain a competitive advantage compared to other modes and road transport in particular. Savings on the external costs provide the arguments and support for policies in favour of a higher modal share of Inland Waterway Transport. Moreover, sooner or later it is expected that these external costs will be internalised in transport prices by means of charges. In order to ensure that the impact is small, it is important to reduce the external costs of IWT. Figure 2.6 shows the further objectives and elements of the external costs.

Also the reduction of green-house gas emissions (CO_2) will be an important challenge for the future. Transport did not significantly reduce its GHG intensity by switching to cleaner energy sources and still depends for 97% on fossil fuels. This also has negative implications for the security of energy supply. Measures to improve fuel quality and a binding target of 10% share of renewable energy sources in transport by 2020 were adopted recently as part of the Climate and Energy package. The EU has recently adopted the Climate and Energy package that sets a target of reducing GHG emission in the EU by 20% compared with 1990. Transport plays a key role in achieving this goal and an inversion of some of the current trends will be necessary. Moreover, the 2008 TERM Report of the European Environment Agency, which provides indicators tracking transport and environment in the EU, shows that many Europeans still remain exposed to dangerously high levels of air and noise pollution. In particular, the concentration of PM_{10}, of which transport is the second most important source,

[7] See also figures 4.17 and 4.18 in section 4.1.5 of this report

exceeds the 2005 limit value at many hotspots where the combination of different sources contributes to the transgression of the limit values. Also pollution from shipping emissions of NO_x and SO_x needs to be addressed.

Transport itself will suffer from the effects of climate change and will necessitate adaptation measures. Global warming, resulting in a rising sea level will amplify the vulnerability of coastal infrastructures, including ports. Extreme weather events, would affect the safety of all modes. According to first studies (KLIWAS, ECCONET) regarding the impacts on inland waterway transport droughts and floods are likely to pose problems for inland waterways after 2050.

The White Paper on Transport 2011 also indicates that in the coming decades, oil and other fossil fuels are expected to become more expensive as demand increases and low-cost sources dry up. The negative impact on the environment will be greater, as conventional sources are replaced by more polluting supplies. At the same time, the need to move to a low-carbon economy and the growing concerns about energy security will bring about a greater supply of renewable energy, made much cheaper by technological progress and mass production.

The shift in relative prices will make investments in alternative energy sources more attractive, in spite of the high variability of those prices. The need to establish supporting infrastructures and the long life span of vehicles will delay the transition process. The immediate consequence of such a transformation will be the reduction in the need to transport fossil fuels, which currently represent around half of the volume of international shipping. A large amount of these commodities (oil, coal) are also transported by IWT (modal share figures for these commodities will be presented in chapter 3 of this report).

Figure 2.5 Objectives from viewpoint: welfare EU, society as a whole

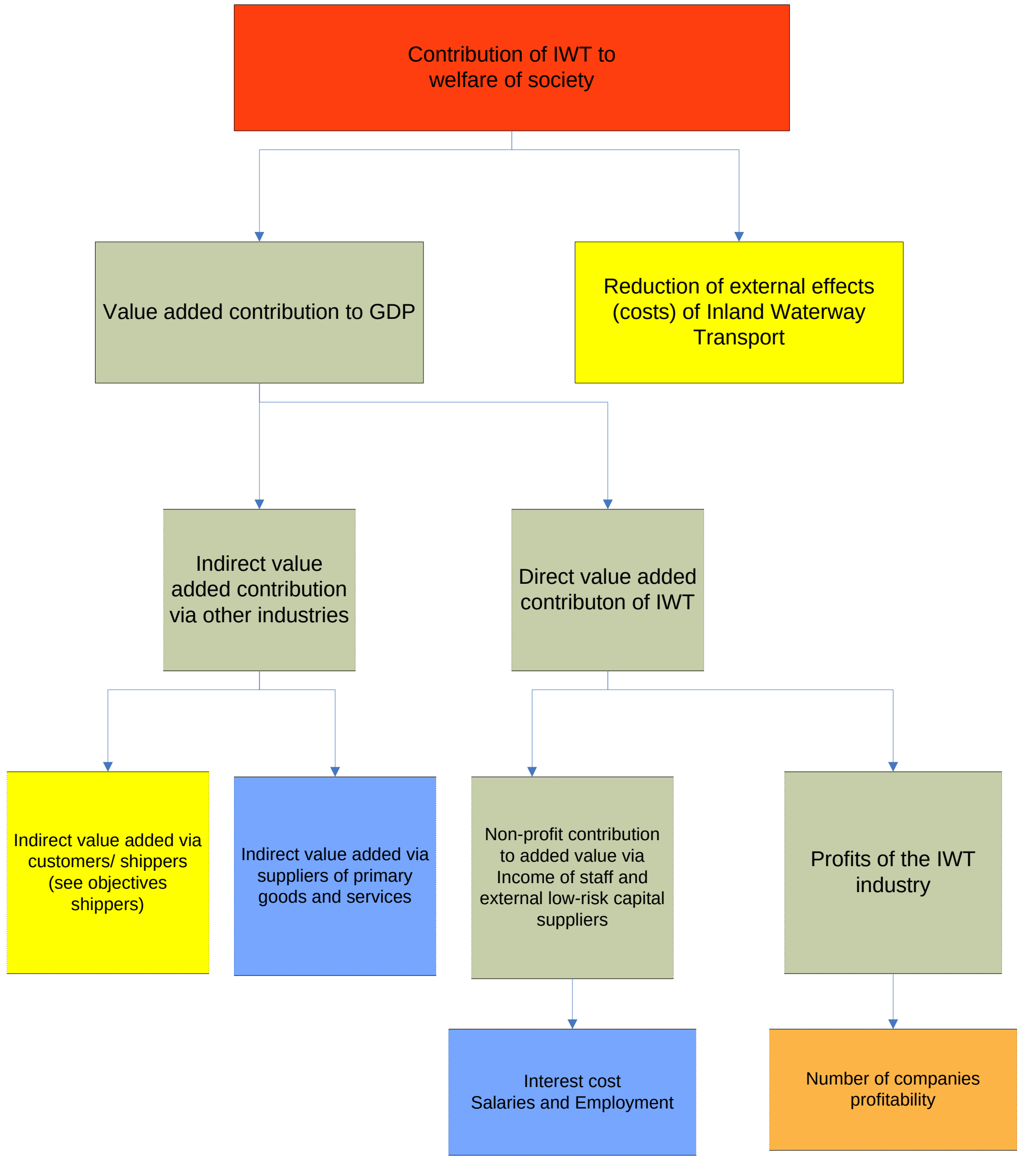


Figure 2.6 Transport Policy - reduce external costs of IWT

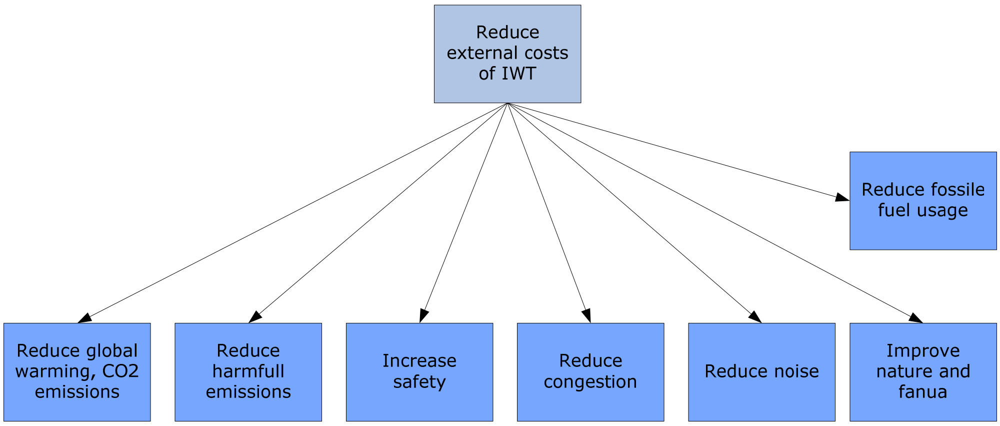
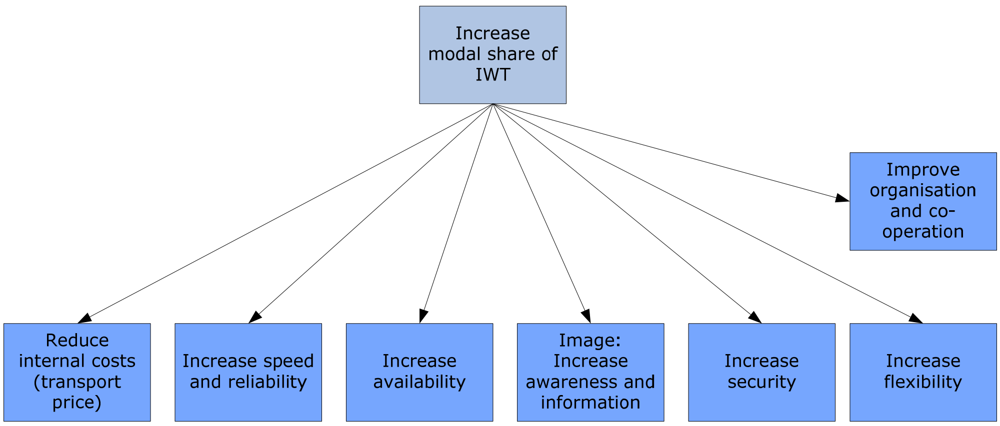


Figure2.7 Transport Policy - increase modal share of IWT



2.2 Systematic policy analysis framework

The following horizontal system elements were distinguished for the policy analysis framework, which are vital to the strength and success of inland waterway transport:

I. Markets & Awareness
II. Fleet
III. Employment & Education
IV. Infrastructure
V. River Information Services (RIS)

The markets and awareness field focuses mainly on transport demand and the users of inland waterway transport. As the IWT market is characterised by a high market power from the demand side, the needs of users are highly important to take into account as well as raising the awareness about the potential of IWT.

The categories Fleet, Employment & Education and Infrastructure and RIS are four different areas focussing on the crucial production elements that are essential for IWT to provide services. Basically a vessel, workers and a waterway is needed to provide transport services. Each component in this production system is of vital importance for the quality and quantity of the performance.

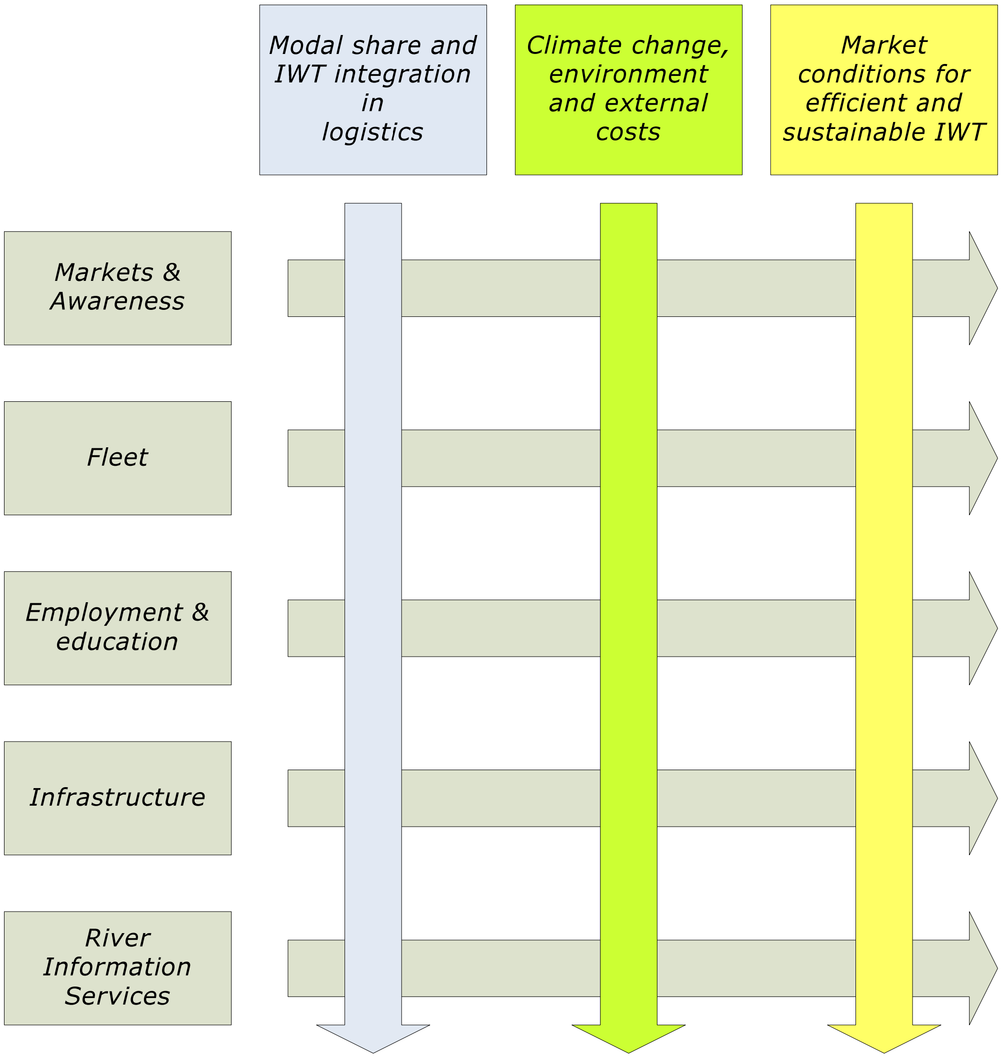
Last but not least River Information Services are of growing importance due to the overall need in logistics for efficient integrated solutions. By using ICT efficiency can be improved as well as the integration of IWT in logistics (e.g. tracking and tracing, eFreight). ICT and in particular RIS therefore play an important role in the development of the performance of Inland Waterway Transport.

The analytical approach largely follows the NAIADES action fields which have also proven suitable for the present purpose. In addition, three vertical dimensions were added to the areas. In each of these fields one could look at the various types of policy objectives (see figure 2.4), namely outputs on:

- **Multimodality and logistics:** Improve logistics supply chain integration and increase (multi-) modal share of IWT.
- **Environment, climate change and safety:** Reduce external costs and carbon footprint of IWT operations.
- **General market conditions:** Improving the general framework conditions for efficient and sustainable IWT operations.

This structure is the analytical framework to structure the policy measures of the study.

Figure 2.8 Policy analysis framework



The theme '**Multimodality & logistics**' is important for IWT as this is the 'key' to integrating inland waterway transport in door-to-door supply chains. It is therefore essential to focus on the current situation in intermodal transport by barge and to make an outlook on how this market is developing, what new opportunities there are and what policy actions are needed to ensure that the potential of IWT can be exploited. Attention is paid to intermodality and logistics in each of the horizontal fields.

For instance when looking at 'Markets & Awareness', it can be noted that container transport is still the market segment with the steepest growth rates, additionally boosted by intercontinental trade patterns (such as Asia-Europe) and major expansions in seaports for container handling capacity. For example the expansions on Maasvlakte II area in Rotterdam points towards a massive increase of container transport by barge and also an increase of modal split (currently 35% with a target of 45% in 2030). Such a great challenge and growth potential requires also that the IWT mode is prepared for such a transport demand in terms of fleet capacity, education of staff as well as the necessary inland port connections to serve the clients in the hinterland. Moreover there are possible opportunities in 'new' markets such as door-to-door multimodal transport.

Specific attention is paid to the '**Environment, climate change & safety**' aspects, in particular to air pollution, energy consumption and alternative fuels. The environment is one of the key areas in which action must be taken for the next decades, given the problems with fossil fuel dependency, climate change and air quality concerns. With respect to air quality, inland shipping had an excellent position in the past, but with the fast renewal of trucks — in contrast to IWT — and more stringent emission standards every 3-4 years, additional action in the field of IWT is required. The specific technical characteristics of inland vessels (e.g. long lifetimes of engines and the limited market for replacing engines) ask for a targeted approach. Finally, both the European climate change strategy and efforts towards the internalisation of external costs will impact the IWT sector. Therefore efforts should be aimed at a further reduction of external costs (air pollution, emissions of greenhouse gases, safety).

Not all policy measures that will be needed to strengthen IWT can be directly subsumed in one of the two output categories distinguished so far. These apply in particular to all type of measures that are needed the improve the market conditions of IWT (e.g. providing general information and statistics on various issues, level playing field, harmonised regulations, well functioning labour market). All these types of measures are categorised as measures aiming at **'Improving market conditions'**.

Another more general structuring dimension of the study is related to typical market segments of the industry. The study distinguishes various types of industry supply chains / segments, for example:

- Coal fired power plants
- Steel industry
- Petroleum and chemical industry
- Containerised goods
- Agribulk
- Construction industry, and
- Sea River transport

Also the main four corridors relevant for inland waterway transport in the European Union have been distinguished:

- Rhine corridor
- North-South corridor
- East-West corridor
- Danube corridor

The analysis of the current situation as well as the forecast for the medium and long-term was carried out according to the above analysis framework.

2.3 Baseline Scenario

As can be seen in section 2.1 the study provided a Baseline scenario for the years 2020 and 2040. These years are the chosen time horizon years for the development in the medium term (2020) and long term (2040). In the Annex report (Annex 2) a more detailed description is presented on the methodology and assumptions.

The Baseline scenario is firstly based on a number of key assumptions regarding developments on macro level:

1. The development of the world and the EU economy.
2. Depletion of resources of raw materials, world market prices for resources.
3. Demographic, social, technological and cultural developments.
4. 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[8]. 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[9]. 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.

However, 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 qualitative

[8] ITREN2030, ISI Fraunhofer and partners, European Commission, 2009.
[9] TEN CONNECT2, Tetraplan and partners, European Commission, June 2011.

and quantitative results of this exercise will be presented later on in this report (see sections 3.1.8 till 3.1.10).

2.4 Reporting the results

In this report the following five chapters correspond to main policy fields that were identified:

- Markets & Awareness – Chapter 3
- Fleet – Chapter 4
- Employment & Education – Chapter 5
- Infrastructure – Chapter 6
- River Information Services – Chapter 7

Each of these 5 chapters consists of 3 sections. The first section describes the present situation and the 'business as usual' outlook for 2020 and 2040 (Baseline scenario). The second section contains the problems based on desk research, interviews and the SWOT analyses of the various supply chains. The third section in each chapter presents a number of possible measures to address the identified problems.

More detailed policy measure descriptions in a standardised format are included in the Annex Report (Annex 8).

The final chapter, chapter 8 subsequently presents the summary for each of the 3 policy objectives: the current situation, policy objective, suggested measures and the vision for 2040. This final chapter of the report presents the recommendations on the policy strategy and the measures needed to 'curb' the development of the industry into the 'desired' direction. Finally it provides recommendations on implementation and monitoring.

3 Field 1: Markets & Awareness

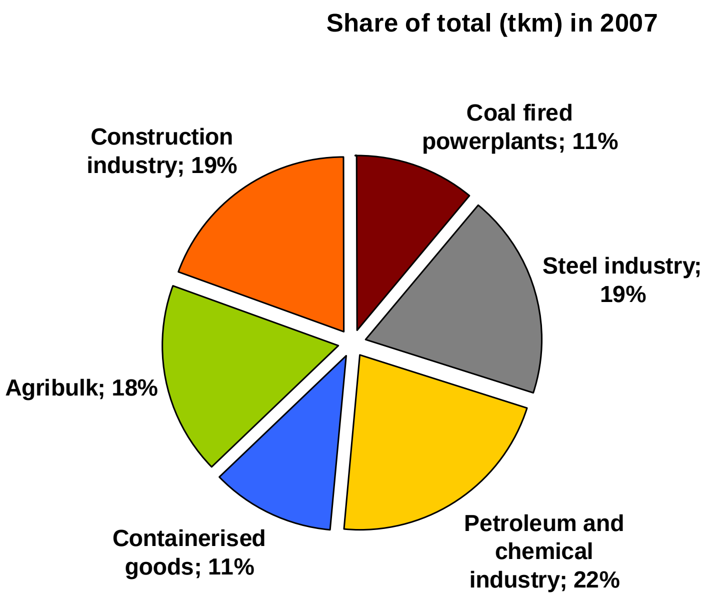
3.1 Overview present situation and outlook 2020 and 2040

In this section the supply chains in the market and the expected development of the market in the medium and long term in a so called "Baseline" scenario will be presented and briefly discussed. The quantitative analyses are based on available databases for the year 2007 on freight flows across Europe by means of EUROSTAT 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.

In figure 3.1 a breakdown is given of the Inland waterways Transport sector in 2007, in term of tonne kilometres, in various sub segments of the market.

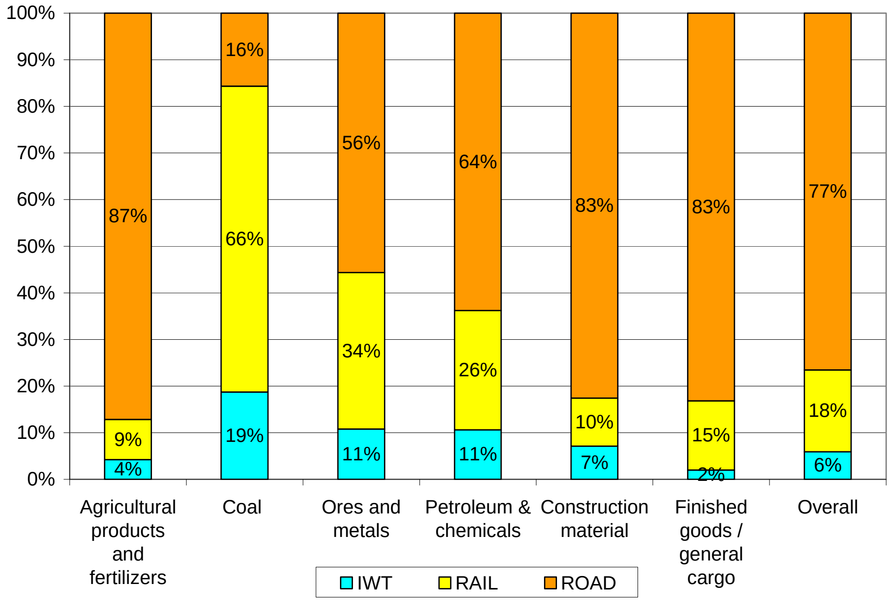
The figure displays in particular:
- Bulk transport to coal fired power plants
- Bulk and general cargo (non-containerised) transport to and from the steel industry
- Bulk transport to and from the petroleum and chemical industry
- Transport of containerised goods for various industries
- Transport of (non-containerised products to/ from) the agribulk and food industry
- Transport (non-containerised) to and from the construction industry

Figure 3.1 Market segments distinguished



The modal share of IWT in EU 27 in the different market segments is shown in figure 3.2. With a range between 2% and 19% shares differ from the average share of 5.9%.

Figure 3.2 IWT Modal Share by market segments (EU27, 2007)



Moreover, the strength of IWT varies geographically between corridors.

Table 3.1 Modal share IWT per corridor compared to road and rail

Corridor	*Share IWT in year 2007*
Rhine	14.3%
North-South	9.7%
Danube	7.2%
East-west	1.2%

Source: NEA

In this study, "Intermodal Sea River Transport" was added to the various IWT sub-segments that were considered. However, it will be concluded in this chapter that this market is very small and therefore has not been taken into account in further descriptions and analyses in the coming chapters.

The medium and long term perspectives of the market segments are dependent on the outlook for the various supply chains and industries. For each business industry an outlook is presented in the next subsection. Finally, a quantitative overview is provided on the outlook on freight demand in the various inland waterway transport corridors in Europe.

3.1.1 Coal fired power plants

Coal fired power plants:

- **Size in 2007 in EU27: 16,286 million tonne kms**
- **This market segment accounts for 11% of the total IWT market**
- **IWT modal share is 19%**
- **Energy policies and closing of mines in Europe are important drivers**
- **Transport is mainly carried out by push barge convoys or large motorvessels**
- **Sources seaports or mining regions to destination often located directly along waterways**

Characteristics

Power generation requires in particular reliable coal delivery from seaports. Therefore, often coal shuttles with dedicated vessels are operated. They continuously supply large coal volumes from seaports and directly return without payload for the next coal shipment. The decision to choose IWT for coal transport is cost-driven, so that shippers have an incentive to use large dry bulk ship configurations realising significant economies of scale. Large push convoys consisting of a push boat and up to six barges, carry coal from seaports to destinations along the Rhine such as Duisburg. These convoys provide capacities of up to 18,000 tonne and allow an extensive decrease of transport cost. Smaller trains with two barges supply power plants within domestic markets. Push convoys with vessels and up to 2 pushed barges as well as large self-propelled vessels are other alternatives.

Decreasing waterway dimensions and fairway depth between seaports and plants limit the size and load of ships for direct delivery. Transhipment and use of adjusted ships and loads may be an option. Larger ship configurations on sections with more favourable waterway dimensions allow more extensive cost reductions. For instance, in the German canal network adjacent to the Rhine maximal small pushed trains with two barges or consisting of one vessel and one barge are allowed. However, power generators usually choose direct deliveries from seaports with smaller ships. Barge-barge transhipment often applies jointly with interim coal storage in inland terminals. Coal is mostly transhipped to rail in these terminals for plants without suitable waterway access.

Supply chain organisation

Coal logistic concepts of currently constructed plants along the German canal network show the relevance of customised solutions with respect to local conditions. Long term agreements/contracts between plant operators, such as shippers and shipping lines are required to allow investments in adjusted ships. Logistic concepts include direct deliveries and avoid transhipments. Some customers, who choose to organise the supply chains themselves, use the spot market to attract vessel capacity. However, in most cases vessels operate under long term contracts, which are concluded between the customer on the one side and groupings of operators or large forwarders on the other side of the market.

Push convoys deliver to one plant. Low transport costs are an important factor for decisions on plant location and ship configuration. Furthermore, dedicated storage facilities in seaports and ships running continuously ensure reliable coal supply.

Developments

Power generation supply chains are heavily influenced by the energy policy and the closure of Western and Central European coal mines. Since China has an ever higher demand for coal resources and India will presumably be supplied to a large extent by South African coal pits, the European market will be served mainly by coal pits in Russia as well as North and South America (e.g. USA, Columbia).

This trend will have a positive impact on coal import volumes via seaports and corresponding hinterland transport by barge. Via the ports of Amsterdam, Rotterdam and Antwerp as well as the port of Constanta and the sea-river ports on the Lower Danube, the Rhine-Main-Danube corridor provides access to both markets for raw materials. Developments in power generation with respect to energy policy are more ambiguous. Drivers for a continuous large share of coal fired power generation are the likely substitution of oil due to rising prices and the ceasing of nuclear power generation. The latter may be accelerated due to the impact of the recent earthquake and nuclear accident in Japan.

IWT has a strong position in coal transport and in particular along the Rhine corridor with large transport volumes. There, IWT achieves a market share of 53%. Power plants in the vicinity of the Rhine and adjacent waterways are supplied with import coals from seaports. Although IWT accounts for significant shares along the North-South and Danube corridors, the total volume is lower due to less coal fired power plants. IWT share is far below average along the East-West corridor due to insufficient waterway infrastructure to supply most of the power plants. Accommodation of large coal volumes requires the employment of the mass transportation modes IWT and railway. A decisive factor for IWT is its low cost level. As supply is scheduled a longer transit time along the waterway is no issue, however, reliability of inland navigation is required.

While average forecasts for coal transport related to power generation expect a moderate growth due to the expected shift to other energy resources, the growth along the Rhine could be superior due to additional coal-fired power generation capacity in Germany.

Considering the current construction and planning of power plants in Germany coal volumes related to power generation on the Rhine corridor could increase to up to 50 million tonnes in 2030. Danube ports will presumably also have an increasing importance as attractive sites for new coal power plants. This would go hand in hand with increased transport volumes on the River Danube. Along the East-West corridor the maximum development will be less dynamic. In the longer term after 2030, volumes will decrease due to further growing CO_2-concerns yielding lower growth between 2020 and 2040.

Table 3.2 Coal transport demand; performance by IWT

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	16	19	22	22	27
Index (2007)	100	117	138	137	166

Medium term (2020): the industry suffered a modest decrease because of the general slowdown of economic activity. Full recovery and further expansion of freight volumes will occur before 2020. The main challenge in the medium term will be to head off competition by rail freight transport and improve turnover and profitability of operators. The financial performance of operators in this segment is still poor because of the overcapacity in the segment of large dry cargo vessels and the high rate of empty voyages in this market segment. Given the large scale of transport of coal the larger vessels require sufficient fairway depth. In this respect fairway conditions are quite important in order to have low transport costs. Maintenance of fairways is therefore a crucial aspect for the reliability as well as the costs and ultimately the modal share of IWT in coal transport.

Long term (2040): In the long run the prospects in this market segment are presently considered to be quite favourable. The peak-oil point is expected to occur by 2015. It is forecasted that the use of crude oil will quickly diminish and all other fuel types will be required to fill the energy demand. Given recent political decisions in Germany and other countries on the future supply and use of energy the prospects of using coal have recently become much better. However, this also points out that the prospects of coal in the long term, how favourable they may look at the moment, are uncertain because a reversal of political decisions at some date in the future is possible.

As it now appears coping with the increase of freight volumes in the market might be the biggest challenge in the long term. New market volumes might be gained on the Danube because the origin of many of the present cargo flows may shift to Eastern Europe.

3.1.2 Steel industry

Steel industry:

- **Size 2007 in EU27: 27,446 million tonne kms**
- **This market segment accounts for 19% of the total IWT market**
- **IWT modal share is 11%**
- **Strongly affected by economic crisis**
- **Pressure on the competitiveness of the industry in Europe**
- **Shifts in raw material sourcing to Eastern Europe and other continents may occur**
- **More imports via seaports of semi-finished steel products**
- **Import of raw materials from Ukraine and Russia likely to grow**
- **Transport of raw material is carried out by push barge convoys or large motor vessels primarily from sea ports or (to a lesser extent) mining areas to sites of steel plants**
- **Transport of semi-finished products form steel plans also go to seaport or to companies in the European manufacturing industry (cars, trains or shipbuilding) or to the construction industry**

Characteristics

Regular barge transports supply steel plants with raw materials. Often dedicated vessels run shuttle operations to ensure reliable supply. Large ships carry bulky commodities to achieve low transport costs per unit. The largest ships operate along the Rhine between ZARA-ports and Duisburg. Push convoys with six barges carry up to 17,000 tonnes of iron ore. Waterway capabilities limit ship size and load on other sections of the waterway network. Depending on conditions smaller pushed trains with about a 4,000 tonne capacity and self-propelled vessels with about a 2,500 tonne capacity are used on waterways adjacent to the Rhine.
Self-propelled vessels dominate the transport of break-bulk products. Ship size varies depending on size of consignments and waterway conditions. Small-sized vessels transport a significant share of steel industry products carried on inland waterways to customers at lower class waterways.

Supply chain organisation

Shippers use facilities in seaports and inland ports to store raw materials. Steel producers hold additional buffers on site at plants. In general, the strategic transport decisions depend on the location of steel plants and on the input source. Multimodal hinterland chains with transhipment from inland navigation to railway are an option and often such transhipments are connected with buffering raw materials in inland ports.
Steel producers are central actors in the supply chain and they decide on sourcing of inputs. A plant supply of inputs is already considered when planning. The organisation of chains depends on their sourcing strategy. If purchasing inputs directly at the source the producers are usually involved in transport decisions. In contrast, traders might organise shipments of commodities. Apart from that, steel producers may outsource transport decisions.

In any case, the requirements of steel producers determine the modal choice. Customised logistic concepts are developed for regular standardised shipments of raw materials. Logistic concepts include sources, modes, frequency and shipment size as well as storage of raw materials.
As in other industries the reliability of input flows is very important in the steel industry. A reliable input flow including buffers is one condition to avoid costly production stops. Among modes with sufficient reliability, cost dominates decisions on transport of inputs. As outlined regarding the coal supply of power plants, waterway conditions determine reliability and cost of IWT. IWT is very well positioned for input flows of the steel industry due to affinity of bulk commodities. Good links and direct waterway access of steel plants contribute to cost-efficiency of IWT. Plants without access to waterways and weakening waterway conditions distant to seaports give rise to integration of IWT in intermodal chains.
The cost position of IWT relative to rail transport varies from case to case. While transport costs between Rotterdam and Duisburg are lower compared to railway transport, IWT of iron ore with smaller ships from Rotterdam to Dillingen on the Saar is more expensive than railway transport. Despite higher costs, IWT accounts for a large share on this connection. Depending on the size of the ships IWT realises a cost advantage compared to railway transport regarding coal transports from Hamburg to Salzgitter for the steel industry.[10]

Developments

The European steel industry was heavily affected by the economic downturn in 2009. Meanwhile, a recovery has been noticed in the business cycle of the European steel production. However, the recovery will be rather slow compared to the strong decline during the downturn. For 2012 a lower production is expected in the steel industry compared to 2011. Future perspectives of the industry depend on development and worldwide distribution of steel consumption. Another factor is the cost structure of European steel production. There are concerns regarding the competitiveness of the European steel industry. In the future an increasing movement of production and processing capacities to South-Eastern Europe as well as to other continents is expected to take place. The consequence would be that in Western Europe a substitution of steel production by imports would occur, whereas in South-Eastern Europe the opposite picture could be observed. This provides opportunities for inland navigation on the Danube corridor. Apart from the movement of complete plants, production in Europe could be limited to the finalisation of semi-finished products. Moreover, the shift from raw materials to semi-finished products would be beneficial due to rising oil prices.

In particular, transport of raw materials is a large market for IWT. Transport volumes are related to production volumes of plants supplied by waterways. The market share with respect to ores and metal waste is 21%. In competition with railways, low cost is a factor to choose IWT provided reliable waterway connection and access in the vicinity of the plant. Among modes IWT is the best and most able to accommodate the large bulk volumes. A reduction of steel

[10] PLANCO/BFG, Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways, 2007

related IWT of raw materials is likely related to a shift of production to non-European plants. Supply of raw materials from Ukraine and Russia are expected to gain importance. In many instances this type of IWT activity is strongly connected to the (planning of) infrastructure projects. IWT has a lower share of 6% in transport of steel products. Due to usually smaller batches and many destinations distant to waterways these transports have a lower affinity to IWT. Rail transport is therefore mainly used for the distribution over Europe of heavy steel products (e.g. coils). For locations that are in the vicinity of waterways however, the heavy weight and oversize of goods could be a reason to choose IWT.

The share of IWT differs among corridors depending on the location of steel plants with respect to waterways and seaports. Along the Rhine corridor IWT accounts for 23% of the total transport. Related to the location of steel production in the vicinity of waterways, the Danube and North-South corridors show significant IWT shares.

Medium term forecasts are uncertain while the long term outlook is negative for IWT for Western Europe in the low baseline scenario. For the Danube region substantially higher growth rates are expected. However, in the long term the competitive pressure for European plants might rise.

Table 3.3 Transport demand for ores and metal; performance by IWT

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	27	27	33	31	43
Index (2007)	100	99	120	114	156

Medium term (2020): the steel industry suffered a substantial reduction of output in the recent financial and economic crisis. Especially the significant decrease in the automobile industry and construction industry in the EU meant that the volumes of raw materials, semi-finished and finished steel products transported declined sharply in 2008 an 2009. In 2010 there was clearly some recovery in this market but until 2014 freight volumes are not expected to return to levels prior to the crisis.

Long term (2040): In the long term the survival of the European steel industry is a big problem. Restructuring of the steel industry will be necessary to improve the competitiveness on the world market and this restructuring will lower production levels. High fossil fuel prices will also be an important factor that may adversely affect the competitive position of the industry.

In Western Europe a substitution of own EU steel production to other countries and steel import flows is expected to occur. This new cargo flow may compensate for the loss of dry bulk cargo volumes of raw materials in the Western European IWT market. In correspondence to this one would expect a change in type of vessels used by IWT: less raw material flows in large push barges and the use of more dry cargo motor vessels. However, the competitive position of rail transport will be much stronger in the new market segments.

The long term growth perspectives in Middle and Eastern Europe are better in this market than in Western Europe. Increasing movement of production and processing capacities to South-Eastern Europe will provide opportunities for IWT on the Danube. In addition, supply of raw materials from Ukraine and Russia will gain importance. On the Danube existing infrastructural bottlenecks currently put IWT at a disadvantage compared to rail transport on certain corridors. Removal of those bottlenecks will create good prospects for IWT.

3.1.3 Petroleum and chemical industry

Petroleum and chemical industry:

- **Size 2007 in EU27: 31,502 million tonne km**
- **This market segment accounts for 22% of the total IWT market**
- **IWT modal share is 11%**
- **Main drivers: oil price, efficiency and the availability of alternative fuels**
- **Industry and consumption in Europe for chemical industry**
- **Outlook for the tanker transport sector is fairly stable**
- **Industry experts think that the increase in alternative fuels and chemical cargo flows will not fully compensate the decrease of transport of mineral fuels**
- **Transport is carried out primarily by tankers**
- **A replacement process of single-hull by double-hull vessels is ongoing and is expected to be complete in 2019**
- **This market segment is heavily seaport oriented**

Characteristics

IWT related to mineral oil products and chemical industry is mostly the regular transport of raw materials. Shippers usually contract capacities in the long term. Logistic concepts often include dedicated ships for regular supply of particular commodities. Cost intensive cleaning of tanks often required before carrying other commodities is a reason for commodity-specific ships. IWT is adjusted to conditions such as the volumes required and the storage available. Shuttles from seaports or between plants without return freight dominate. However, depending on supply chain characteristics return freight may be available and ship routing is adjusted to these freight flows. An example is a circle routing with subsequent transports.

Tank ships dominate in the chemical industry with its large share of liquid bulks. Large tank ships are used for bulk commodities shipped in large volumes such as mineral oil products. Along the main corridors with corresponding capabilities capacities above 3,500 tonnes ensure low costs per unit. On other waterways, smaller units adjusted to local capabilities are used. In general, shippers require ships with less capacity for smaller consignments. Ships with separate small-sized tanks for different commodities are an alternative. Furthermore, special tanks may be required due to the characteristics of the commodities. This applies in particular to gases, which account for a large share of IWT in the chemical industry. The prohibitive cleaning costs of tanks before carrying different commodities, tends to be dedicated to smaller tanks.

Double-hull tank ships are required for the transport of chemicals on waterways. An additional hull reduces the tank capacity of ships. Tank ships of a larger size are required to suit capacity requirements and allow comparable levels of cost reduction.

Supply chain organisation

Petroleum and chemical industry supply chains are interrelated and both include large and in particular, liquid bulk flows. In the petroleum industry, crude oil imports arrive in seaports and are transported to refineries. Refineries either supply large consumers such as chemical plants or depots for further distribution with mineral oil products. A share of crude oil supplies is transported by pipeline. IWT accounts for a large share of other bulk transports depending on the location of the refinery and destination. Commodities have an affinity to IWT and plants within the petroleum and chemical industry are often located near water. Smaller mineral oil consumers are usually supplied from depots by road transport. Several plants within the chemical industry are large consumers supplied directly with mineral oil.
The chemical industry includes producers of base chemicals and special chemicals. They use mineral oil and chemical raw materials in production. Furthermore, semi-finished products are used as inputs to produce high-value chemicals. The interdependency of chemical production is one reason for the emergence of large chemical plants including different productions. A large share of raw materials is imported via seaports. Pipelines transport a significant volume of bulk. IWT accounts in particular on wet connections for a large share of remaining bulk transports. While raw materials tend to be shipped in large volumes suitable for IWT the batch size usually decreases along the supply chain towards finished products. The batch size of base chemicals is larger compared to special chemicals. Overall, products including a wide range of commodities and different degrees of vertical integration within the chemical industry make supply chains and related transports rather individual. However, all plants require the regular supply of large volumes of raw materials.

The most relevant actors for supply chain decisions are mineral oil product suppliers, producers in the chemical industry and end users of chemicals. They decide on product flows in production and distribution and corresponding transports. Decisions are determined by the requirements of production processes in the chemical and related industries. Relevant requirements arise on the supply and demand side of commodities. Furthermore, traders of mineral oil products and other chemicals decide on transport. Shippers’ requirements are binding for forwarders and logistic service providers, who are assigned to organise transport along supply chains. The chemical industry outsources a large share of logistic activities to external providers.

The organisation of supply chains in the complex chemical industry is a challenging task. Producers require reliable transport of raw materials and semi-finished products to ensure continuous production. Frequent navigational restrictions could reduce reliability of IWT below acceptable levels. Storage along the chain and on site at plants reduces adverse impacts of transport delays. However, emerging floating storage concepts tend to decrease a plant’s reserves. They are implemented as conditional on the reliability of IWT.

Sufficient reliability provided, cost is the most important factor in transport decisions within the chemical industry. This applies in particular to large volumes of inputs. Relevance of inland navigation for particular transport flows depends on waterway access at origins and destinations as well as waterway connections. Corresponding to product flows connections with seaports and between plants are important. Availability of product pipelines negatively affects the share of IWT on particular liquid bulk routes. If pipeline connection is available, it is superior to inland navigation for corresponding liquid bulk transports. IWT is regarded as reliable despite restrictions such as changing water levels of rivers. Although changing water levels of rivers may limit payload, IWT of liquid bulk commodities achieves in particular on wet connections cost advantages compared to railway and road transport. Furthermore, fairway depth and bridge clearance may limit ship size and cost advantage of IWT. The cost advantage is, depending on tank ship capacity, up to 50% on a typical liquid bulk route between Antwerp and Ludwigshafen.[11]

Restrictions for the transport of dangerous goods by railway and road are another reason to choose IWT as a large share of goods in the chemical industry is classified as dangerous.

The relevance of speed for transport decisions increases with the finishing of products along the supply chain. Packed chemicals account for a larger share among finished products. Furthermore, increasing volumes of chemicals are shipped in containers. Road and railway transport dominate transport of packed chemicals, while IWT accounts for a small share of volumes.

Developments

After the downturn in 2009 the IWT volumes of petrochemicals and chemicals have recovered fast. The suitability to accommodate extensive volumes of liquid bulk commodities in the hinterland of seaports with reliable waterway connections is a factor to choose IWT. Hence, IWT achieves a market share of 23% along the Rhine corridor and 16% along the North-South corridor. Tank shipping is less developed along the Danube and East-West corridors. In general, railway and pipeline transport are alternatives for the transport of large volumes. Lower costs are an advantage of IWT. Moreover, safety with respect to rather low external risks of dangerous goods contributes to the choice of IWT. Road transport dominates the large volume of small batches shipped to disperse destinations.

Future development of oil consumption and related transport will be influenced by oil price, efficiency and the availability of alternative fuels and energies. Political developments in oil producing countries will increasingly become a factor as well. Growing scarcity of oil will increase the efforts to improve efficiency and find alternatives suitable for large scale use.

Related to the growing wealth an increase of the demand for chemical products is likely. The European chemical industry expects an average growth of 2% per annum until 2020. However, European plants increasingly have to compete with plants in the Middle East and Asia. The large market is a reason for the industry to keep production in Europe at the current level, but there might be a further increasing focus on more specialized chemicals, which would reduce massive bulk flows and increase the share of chemicals carried in containers.

[11] PLANCO/BFG, Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways, 2007

Cutbacks in the oil supply and growth in the chemical industry are expected in Europe with a corresponding impact on IWT volumes. The availability of alternative fuels and a more serious oil scarcity would lead to a stronger reduction of volumes in the lower scenario for the Rhine and East-West corridors. Lower bound expectations include an increasing cutback of IWT volumes after 2020.

It is expected that the increase in alternative fuels and chemical cargo flows will not fully compensate the decrease of transport of mineral fuels. Therefore, the outlook for the tanker transport sector is fairly stable. The situation however, highly depends on the possibility of inland waterway transport to have a role in the transport of alternative fuels. This possibility depends to a large extent on the type of supply chains and the geographic location of import, generation and distribution points for alternative fuels (e.g. bio fuel plants and distribution). In case such points are located directly along inland waterways (or seaports connected to inland waterways) IWT can play an important role, similar to the current role in the transportation of mineral fuels.

Table 3.4 Petroleum and chemical industry

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	32	32	36	33	49
Index (2007)	100	101	115	104	156

Medium term (2020): At first the *liquid cargo* sector did not suffer as much as the dry cargo market from the external shock of the financial and economic crisis. At least until the beginning of 2009 the transported volumes of liquid cargo even significantly increased in the second half of 2008 and the first quarter of 2009, due to the dramatic drop in the oil price in the summer of 2008. This induced a wave of speculative demand and associated transport. However, later on in 2009 the transport of liquid cargo by IWT totally collapsed. The negative impact of the decline in the market was further aggravated by a large increase in the capacity of the fleet. The increase in the fleet, moreover, proved very difficult to halt because of the (regulatory required) process of replacement of single-hull vessels by double-hull vessels to be completed by 2019.
Despite of the fact that part of the market volumes (chemical transport) in 2010 quickly showed some signs of recovery the entire supply / demand situation will remain very unbalanced until 2019 and a large overcapacity of the fleet is expected for the next years to come.

Long term (2040): After 2020 the productivity of the IWT tanker fleet will diminish somewhat, because the opportunities to take advantage of economies of scale will be reduced, because of the double-hull tankers. So there will be a loss of competitiveness vis-à-vis other transport modes. In addition, it is expected that a gradual reduction of volumes and demand for fossil oils and crude oil might take place in the next years. An increase of the oil prices may accelerate the decline in demand for transport of fossil fuels. Although the demand for chemical products will continue to grow, the market position of the European chemical industry may deteriorate and there might be a possible transfer of activities to e.g. Asia and the Middle-East. Increased investments related to safety requirements for vessels and loading / unloading of vessels might be imposed on operators although an increase of safety is expected due to the use of double-hull vessels.

Additional new cargo volumes may emerge e.g. by the increase use of new types of fuel (e.g. bio-fuels, LNG). Because of the energy transition it is expected that industries will be developing and will be requiring new transport demand. However, since these new energy carriers will also be bulk commodities, probably imported from overseas, the inland waterway transport mode could be a favourable mode for hinterland transport of those materials. A critical issue is however the location of plants and distribution points: along waterways well connected with seaports. Moreover, from biomass also biogas or ethanol could be produced. The distribution of those products from new plants could be done as well by barges and this could also require new types of vessels. Finally, fuel transport on the Danube could still increase when storage capacities are increased and improved.

3.1.4 Containers

Containerised goods:

- **Size 2007 in EU27: 16,477 million tonne km**
- **This market segment accounts for 11% of the total IWT market**
- **IWT modal share is 3%**
- **Quick recovery after crisis in 2009 and promising growth perspectives in the next decades**
- **Increase of cargo carried in containers in stead of break-bulk**
- **World trade and consumption (population) are main drivers**
- **Important incentives come from seaports, e.g. 45% modal split target Rotterdam for IWT for "Maasvlakte II" terminals**
- **The present EU transport market almost exclusively consists of transport on the river Rhine and transport on the North-South axis between Belgium and the Netherlands; IWT in the hinterland of other seaports (e.g. Hamburg, Le Havre) shows positive development, but volumes are on a far lower level.**
- **Most transport is carried out by specific container vessels although conventional dry cargo vessels are used as well and occasionally even push barges**

Characteristics

The position of IWT along corridors depends on corresponding seaports as well as waterway conditions and inland terminal density in their hinterland. Strong seaports, good waterway links and a high quality network of inland terminals lead to above average IWT shares in the hinterland of Western seaports.

Liner services usually carry container on inland waterway and in particular between seaports and hinterland terminals shipping lines operate regularly scheduled services. These services carry containers from different shippers. Large ships allow cost regression and make IWT more competitive. However, waterway capabilities and sufficient demand are required for the operation of large ships. Waterway dimensions and in particular bridge clearance determines capacity. With respect to cost regression usually three-tier container transport on waterways is required to achieve cost levels competitive with railway and road transport. However, some two-tier container services are in operation. The Rhine corridor accommodates high capacity container transport. Depending on the section up to six tiers are permitted. The largest inland container ships belonging to the JOWI-class operate along the Rhine corridor. These ships carry container on five tiers achieving a capacity of 470 TEU. Pushed trains are an alternative to large self-propelled vessels.

Apart from large ships small vessels adjusted to limiting waterway dimensions and bridge clearances are required. These ships either operate direct services from the seaport or are used as feeders from inland terminals. Direct services of medium-sized ships avoid additional transhipment in the hinterland. This saves time and transhipment costs, which may compensate higher shipping cost along the waterway. Typical capacity of such direct services along the Rhine is about 200 TEU. Smaller ships with capacities below 50 TEU are operated from the

ZARA-seaports to short-distance destinations in the Netherlands and Belgium and carry containers along the German canal network adjacent to the Rhine.
Along the Danube pushed trains with four barges are regarded as optimum for future container transport. Three tiers yield a capacity of 576 TEU. In the hinterland of the Constanta port four tiers are theoretically possible for transports to Belgrade. The number of maximum container levels decreases to three on the Danube further to the West e.g. in Austria and Bavaria.

Supply chain organisation

Overseas containers are, especially along the River Rhine, transported by IWT into the hinterland. Containers are predominantly loaded with small sized consumer goods imported or destined for export. In the origin region either single shippers with sufficient volumes dispatch loaded containers or logistic enterprises consolidate LCL. In destination regions, containers are usually deconsolidated by wholesalers and large retailers receiving FCL. Apart from that, logistic providers deconsolidate container shipments and distribute consumer goods. With the growing logistic efficiency of IWT, container transport increases continuously on waterways in seaports in the hinterland. However, road and railway transport still dominate in this market segment. A major share of container transport on inland waterways is a component of long intermodal transport chains passing terminals e.g. inland ports. Container transport accounts for a large share of sea-river transport. Sea transport directly from and to inland ports avoids transhipments of containers in seaports.

A wide range of actors such as suppliers, importers and retailers determine global shipping decisions. Shippers dispatch a different number of individual consignments with a limited batch size. In particular shippers with few shipments outsource transport organisation to forwarders and logistic service providers. In general, third parties have a strong influence on global supply chains of consumer goods. They operate global container networks and provide door-to-door transport. A large number of different shippers use such networks for disperse shipments. In the seaport hinterland transport maritime shipping lines have a strong influence (e.g. APM-Maersk, CMA CGM, MSC). They decide on what containers are shipped under carrier’s haulage. Costs are less relevant for modal choice in container transport, as costs are very low in relation to the high value of consumer goods. However, hinterland transport accounts for a large share of cost in the door-to-door intercontinental container transport. Therefore, cost of IWT and related transhipments are an important factor. This applies in particular to maritime shipping lines deciding on container hinterland transport in carrier’s haulage. This intercontinental container cargo by IWT is generally not time-critical. Many import goods from Asia stay for example for a few weeks on deep sea vessels (e.g. transport from Shanghai to Rotterdam takes approximately 28 days).

Container capacity of ships determines competitiveness of IWT in terms of cost. Capacity of particular ships depends on number of container levels possible. Bridge clearance is a limiting factor. Low clearance reduces tiers and may lead to non-competitive cost levels per container.

IWT has a significant cost advantage on typical container routes. IWT is more than 40% cheaper compared to other modes between Rotterdam and Duisburg employing high capacity ships of Jowi-class. The cost advantage declines on other typical routes with smaller ships such as between Rotterdam and Basel. However, IWT remains cost leader.[12]

Quality aspects are becoming more and more important in container transport. Relevant criteria in this respect are reliability, speed and flexibility of modes. Relevance of reliability becomes apparent, as container shippers often back transports by other modes to ensure in-time delivery. Container transport on waterways is very reliable. Congestion is no issue on waterways and changing waterway levels are usually not that critical for container ships. However, in 2007 and 2008 there was congestion in the seaports, causing additional costs due to the increase of waiting times for vessels for loading/unloading. This resulted in a loss of modal share for barge in container transport.[13]

In particular in the continental cargo market the limited speed of IWT may increase time to market of goods above acceptable levels as these chains are used to the speeds of road haulage and rail. However, unloaded containers are usually not that time critical and they have an affinity to IWT. The waterway network limits spatial flexibility of IWT. Flexibility in terms of time is provided with regular liner services connecting seaports and inland ports. A growing inland terminal network and more frequencies of container lines improve flexibility for container shippers using IWT. In particular container transport demands the implementation of information and communication technologies in IWT in order to optimise port processes and load rates of vessels. Technologies such as River Information System (RIS) and port community systems facilitate the integration of IWT to intermodal container chains as well as the optimisation of terminal and transport planning. These technologies also fit the "Single Window" developments.[14]

Developments

Global population and income growth will stimulate intercontinental container shipping and corresponding hinterland transports in the future. Also in the next decades the majority of containers will be shipped along the Rhine corridor. North-South corridor volumes benefit from the positive development in the hinterland of French seaports (e.g. Le Havre). Less favourable waterway conditions limit IWT volumes in the hinterland of German seaports along the East-West corridor. Container IWT along the Danube River leaves scope for some additional development as well although the circumstances are rather different compared to the Rhine corridor (longer distances, less volume, smaller economy).

[12] PLANCO/BFG, Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways, 2007

[13] NEA goederenvervoermonitor 2011, Ministry of Infrastructure and Environment (Rijkswaterstaat, Dienst Verkeer Scheepvaart), 2011

[14] http://ec.europa.eu/taxation_customs/customs/policy_issues/electronic_customs_initiative/it_projects/index_en.htm

However, the slow transport speed will remain weak point of IWT for transport over larger hinterland distances from ports and particularly in continental transport. Railway and in particular road transport, allows lower transit times and road transport also saves transhipment handlings.

New terminal capacities in seaports will accommodate the expected increase in container trade. The relevance of capacity in hinterland transport will further increase, so that IWT with its spare capacity might expand its market share. Moreover, seaports defined modal split targets to ensure performance of the intermodal chain. For example, the Port of Rotterdam aims to increase the modal share of IWT from 37% to 45% between 2008 and 2035 resulting in an absolute increase of inland container barging from this port by **500**% over this time period. Container volumes are therefore expected to grow strongly with for example 4.8% p.a. in the medium term along the Rhine corridor. This contributes to the growth of container IWT along the Rhine and North-South corridor. In the longer term between 2020 and 2040 the growth is expected to slightly decrease.

Initiatives of German seaports to strengthen IWT in hinterland transport are less ambitious corresponding to the weaker competitive position of IWT. Modal share developments in German seaports are the main growth driver of container IWT along East-West corridor.

In the Danube region the focus in the years to come, will be on developing reliable and cost-effective container liner services. The constantly increasing containerisation rate in combination with a growing export volume for containerised goods in South Eastern Europe is expected to provide a sufficient critical mass of customers to support this process. Since 2005, several intermodal transport liner services have emerged on the Danube. There are services from Constanta via Giurgiu and Rousse to Belgrade, as well as Constanta to Galati or Svishtov. Since August 2010 a weekly service is offered between Constanta - Belgrade - Budapest. Typical container barge can carry 144 at a time. Container vessels such as those used on the Rhine (JOWI-class with 470 TEU) cannot be operated efficiently on the Main-Danube corridor due to limited bridge dimensions. On the Danube, therefore, pushed convoys are used which provide the additional advantage of being more flexible in scheduling the loading capacity.

More uniquely in Europe, Roll-On-Roll-Off (RoRo) services are being mainly operated on the Danube with a few on the Rhine River as well. On the Danube tractor-trailers and semi-trailers are transported between Passau (Germany) and Vidin (Bulgaria). The scheduled service is like a “floating motorway”, making it possible to circumvent the at times poorly maintained roadways and ports in South-Eastern Europe and thereby considerably improving transport safety and security. Most RoRo shipments are carried out using specially constructed catamarans. Catamarans are vessels with a double-hull, both of which are connected by the loading deck. The vessels are 144m in length, 22.8m in width and 3 to 3.3m in height, with a maximum draught of 1.65m. The loading deck for trucks measures 2,500m2 and can hold up to 49 vehicles. On the Rhine River this type of transport is applied on a small scale as well for the transportation of new cars and agricultural machinery.

Table 3.5 Transport demand containerised goods; performance by IWT

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	16	23	29	43	73
Index (2007)	100	142	175	262	442

Medium term (2020): The growth in the transport of containerised cargo in inland waterways fell back sharply (a decline of 13%) in 2009 compared to 2008. The transport of containers which grew on average by 10% per year between 1985 and 2007 came to a rather abrupt halt when the level of international trade declined. However, figures of transhipment show that there was a significant bounce back of the volumes in 2010. Continuing with the present growth rates, the volume levels of 2008 will already be reached again already in the year 2012. It is expected that that from then onwards a strong growth rate of approximately 5% per annum may prevail.

Long term (2040): After 2020 the high growth rates continue to be predicted for the container market. A significant driving force are the modal split commitments made by various sea port authorities (Rotterdam in particular) for the future transport to/ from the port. In addition the container transport on the Seine-Schelde connection can be further developed as well as the transport of containers on the Danube. The latter should be seen in combination with a growing export volume for containerised goods in South-Eastern Europe. Coping with the high growth rates will be an important challenge in this market. Another challenge is the development of transport services for continental containerised goods. This may lead to:

- A further increase of extended gateways and "container transferia" to consolidate flows, enlarge scale of transport and to reduce congestion in seaports
- A further increase of the scale of operations on main waterways, which could further decrease costs
- possible expansion of market shares, e.g. in hazardous goods transport, perishables, waste transport
- new infrastructure projects (e.g. Seine-Escaut) will almost certainly create additional market volumes
- port infrastructure projects need to increase capacity in ports and may decrease waiting times

3.1.5 Agribulk

Agribulk and food industry:

- **Size 2007 in EU27: 26,105 million tonne kms**
- **This market segment accounts for 18% of the total IWT market**
- **IWT modal share is 4%**
- **Main products transported are dry bulk products: grains, animal fodder and fertilizers.**
- **There is a negative outlook for IWT demand in this sector but perhaps there are opportunities for supply to bio-fuel plants**
- **Fertilizer production is expected to gradually decline**
- **Transport demand depends on world market prices and weather as well as size of live-stock and population in Europe**
- **The fleet to transport this type of cargo consists mainly of small- and medium sized dry cargo vessels**
- **The sources of the cargo flows consists of a mixture of seaport and agricultural areas located in the EU**
- **Destinations are the food processing industry, agricultural co-operatives and seaports (for overseas export)**

Characteristics

Mainly dry cargo motor vessels are used to transport the products in the agribulk-market but occasionally push barges may also be used. Generally it is the smaller and medium-sized motor cargo vessels that specialise in the agribulk supply chains. The vessels, therefore, often do not require the maximal dimensions of the waterways.

Most of the IWT services are demanded via spot markets although some cargo flows are transported under longer term contracts.

In general transport volume developments in this sector are rather stable and are not really influenced by the economic climate. Often more important drivers are the weather, which influences the size of the harvest (e.g. grain), the size of the livestock and changes in the size of the population.

In the future it can also be expected that more and more agricultural bulk products will be used for the production of energy and bio fuels to replace fossil fuels. This is expected to create a gradually, increasing transport demand for IWT and will, in contrast to the present situation, increase the dependence of this sector on development in the general economy. This type of product will then be transported by liquid cargo motor vessels.

Supply chain organisation

Looking at the composition of animal bulk products transported one could distinguish four distinct supply chains/ sub-segments in the market:

- Animal feed
- Grains/ Wheat
- Fertilizers
- Oil seeds

Animal feed customers are often large co-operations of farmers and the final consumer is here of course cattle breeding farms. IWT is primarily used in the transport from seaports to large agricultural co-operations. The animal feed generally does not originate in seaport areas but is shipped to these from overseas. The final distribution in the supply to cattle breeding farms is usually done by road freight transport companies.

The final consumers in the supply chains of grains are both farmers (cattle feed) and the food processing industry. As can be seen, sourcing within the continent is more important in this supply chain than the animal feed market.
Fertilizers are produced by the agro-chemical industry. Raw materials (e.g. phosphates) are shipped to these companies by sea. Plants are frequently located in a seaport or close to seaports. IWT is being used to ship fertilizer to agricultural co-operations from where farms are being supplied. The type of farmer is of course the crop growing farms.
Oil seeds are used by some chemical plants and to a lesser extent the food processing industry. Many vegetable oils are used to make soaps or other skin products, candles, perfumes and other cosmetic products. This is also a flow which is strongly related to seaports

Developments

The agribulk sector experienced a comparatively modest impact from the financial and economic crisis. Only in the transport of fertilizers was there a noticeable decline in Western Europe. In general, the decisive factor to use IWT in agribulk industries is the low cost of massive bulk transport. This applies particularly to seaport related flows with sufficient size. The modal share of IWT in this segment is below average due to the dispersed structure of transport flows. Origins/destinations distant to waterways limit the potential for IWT. Road transport is best suitable for small batch sizes. Due to the strength of seaports and corresponding waterway links the Rhine corridor accounts for the largest IWT share in this segment. Along the Danube IWT the modal share is also above average.

Production sites for fertilizers in South-Eastern Europe might be closed down, once stricter environmental regulations are applied. Due to a constant high demand in this region, additional volumes will have to be imported (partly by inland waterway transport).

Fertilizers are produced by the agro-chemical industry. Raw materials (e.g. phosphates) are shipped to these companies by sea. Plants are frequently located in a seaport or close to seaports. IWT is being used to ship fertilizer to

agricultural co-operations from where farms are being supplied. The production of fertilizers is energy intensive and has a significant negative impact on the environment. It is believed that this type of cargo will show a significant decline in the medium and long term. Other agribulk commodities transported by IWT are animal feed, grain and oil seeds. These specific markets depend on the development of the European population, the stocks of cattle and world food market prices. It is expected that the first two drivers will cause the cargo flows to gradually decrease in the medium (2020) and long term (2040). The third factor may result in an increase of exports in the future and accompanying cargo flows. It is expected, however that the first two drivers will be stronger than the third so that the net result will be negative development for animal feed, grain and oil seeds. However, the pace in which the flows will decrease will be much more modest than the pace in the fertilizer market segment.

The agricultural goods carried on the Danube primarily include rapeseed, grain, sunflowers and soy. With regards to foodstuffs and animal feed, large quantities are transported from Romania and Bulgaria mainly to Austria. Although France, Germany and Poland are the largest rapeseed producers in the European Union, Romania, Hungary and Slovakia also have large areas under rapeseed cultivation. Within the Danube region, grain products are mainly produced in Germany, Ukraine, Hungary and Romania. Sunflowers are primarily cultivated in Hungary, Romania, Bulgaria and Ukraine.

A positive trend is expected in the growing role of IWT to supply bio fuel plants with raw materials. This provides an opportunity for Danube navigation as large growing areas are situated along the Danube e.g. in Hungary, Romania, Bulgaria and the Ukraine. In addition, the transport of by-products such as rape meal or sugar beet slices shows high potential for inland waterway transport.

The following table presents the overall expected transport performance by IWT for the agribulk markets. It can be observed that the trend is positive.

Table 3.6 Transport demand agribulk; performance by IWT

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	26	27	29	32	38
Index (2007)	100	104	113	123	146

Medium term (2020): The *agribulk sector* (cereals, seeds, fertilizers, ingredients for feed, etc.) was not as badly affected by the crisis as many of the other dry cargo market segments. The transported volume of agricultural products by inland navigation in Western Europe 'only' decreased in 2009 by 1.3% compared to 2008. This sector is rather stable and is not really influenced by the economic climate. More important is the weather which influences the size of the harvest (e.g. grain). Until 2020 a (very) modest growth of transport volumes is expected in this market. The transportation by barge will have to meet with increasing requirements regarding food-security concerns (e.g. GMP).

Long term (2040): Relevant to the demand volume for longer term are the size of the livestock industry and the size of the population. Neither of these factors shows a strong growth expectation in the years after 2020. On the contrary, the size of the population in Europe is expected to decrease. Moreover, irrespective of this decline, fertilizer volumes will decrease because of environmental restrictions.

While the general trend is strongly negative for this market segment, it is expected that more and more agricultural bulk products will be used for the production of energy and bio fuels to replace fossil fuels. This trend is expected to generate an increasing transport demand for IWT, which more than compensates the overall picture of a strongly declining market. In case IWT succeeds in having a prominent role in the transportation of biomass, strong overall growth is expected of the transport performance in the agribulk segment.

In addition to the potential for transporting biomass, there is the potential of the Danube (in particular for the export of products) as this corridor is not yet fully exploited and may offer a brighter perspective. The trend towards the use of renewable resources (e.g. biodiesel, biomass, lignocelluloses feedstock, cereal and whole crop feedstock, sugar and starch, oilseed) can be favourable for the perspectives of IWT, especially in areas with large agricultural resources. Waterways in Europe connecting European regions with high biomass potentials and locations with bio-based industries constitute transnational transport axis which would be ideal for the reliable supply of industries with renewable resources. A fundamental difference with other bulk transport generating industries (e.g. steel industry) is that the sources of transport volume are more dispersed, which could be favourable for IWT provided that the network of logistics transhipment sites is enhanced. This trend would also make IWT less dependent on maritime cargo.

3.1.6 Construction industry

Construction industry:

- **Size 2007 in EU27: 28,529 million tonne km**
- **The market segment accounts for 19% of the total IWT market**
- **IWT modal share is 7%**
- **Heavily affected by crisis, the impacts will take long to recover**
- **Drivers are the demographics and policies on gravel mining along waterways, shift towards mining from sea or sources abroad**
- **Increase in use of recycled materials**
- **The market consists of two main sub segments:**
  - **the transport of sand and gravel to large infrastructure and building projects where it is directly used**
  - **bulk transport to building material manufacturing plants where it serves as raw material in the production**
- **In the first market sub segment special vessels may be used that also help in the mining of gravel (e.g. mining of river gravel or sea gravel), otherwise the fleet consists of medium- and large sized dry cargo bulk vessels**
- **The EU market in this segment is dominated by the domestic markets**

Characteristics

For the transport of raw materials to construction industry plants usually rather large vessels may be used. This will be particularly possible when the plants are located along rivers or in ports accessible to those large vessels and when gravel and/or sand from river locations is the source of those cargo flows.

In the transport to / from large infrastructure projects both small and medium-sized motor vessels are used with the occasional push barge. Because the locations of construction sites vary in the course of time, different vessel types might be useful in different projects.

In the market segment of transport of river or see sand, however, a substantial number of specific IWT vessels operate that are also used in the process of mining / pumping up the sand. Those vessels, which are active primarily in the Netherlands and Belgium, are characteristic for this particular IWT market segment.

Generally this type of transport is not time-critical and could be planned and scheduled.

Supply chain organisation

The supply chains of material (mainly gravel) from mining / win locations to production plants which manufacture specific materials for construction are comparatively simple and the geographic patterns are fixed.

Most plants are located close to waterways and the market share of IWT in this supply chain is very significant in countries with a dense waterway network (e.g. the Netherlands). The IWT services required in this particular market segment are frequently contracted via the spot market although a sizeable part of the transport volumes is also channelled through the term market. Some of the raw material trading and production companies have their own fleet of vessels to ensure transport capacity.

The supply chain of sand to infrastructure projects or large housing projects is more complex because those projects will not necessarily be located close to waterways. Although the destinations for the time being are fixed in the longer term this market does not know fixed destinations. In many instances this type of IWT activity is strongly connected to the (planning of the) infrastructure project itself and therefore, the marketing and pricing of the transport flows is primarily done in the form of long term contracts with the contractor of the infrastructure project or the builder of the project.

Developments

The construction industry is still heavily affected by the financial and economic crisis. Currently (end of 2011) cargo flows transported by IWT are about 15%-20% below the levels observed in 2007 in Western Europe. IWT is primarily employed for large shipments of sand, gravel and other bulk commodities due to transport cost advantages. Apart from minimum transport volumes the vicinity of waterway access is required to achieve competitive cost levels. Large shipments arise in particular between mines and locations with extensive consumption of raw materials. Despite less seaport related transport patterns the density of the waterway network contributes to high IWT shares on the Rhine and North-South corridors. Railway is an alternative for transport of larger volumes with origin / destination distant to waterway. Road transport is favourable for shipments with smaller volumes.

The crisis may have a much more lasting and structural impact on this particular market segment due to more restrictive financing requirements and cuts in government expenditures on infrastructure projects.

It is therefore expected that the impact of the crisis will be felt in the medium term as well. It is questionable whether in 2020 the size of cargo flows will have fully recovered from the decline which occurred in 2010 and 2011. In the longer term more structural drivers with regards to the size and composition of cargo flows, are the development of the population and the depletion of the gravel mining locations along the main rivers (such as the Rhine and the Meuse) and the increase in the use of recycled materials. Although the development of the population (aging, continued immigration) indicates that in the longer term the market will still not show a high growth, the depletion of the current mining locations and the use of more recycled material are more difficult to judge in their effect on the use of IWT. Looking for alternative sourcing locations (e.g. on sea) may result in an increase of average distances of transport. This development shall make the transport more attractive to IWT. However, the increased use of recycled materials could work, but in the opposite direction.

Table 3.7 Transport demand by the construction industry; performance by IWT

(in bill. Tkm)	*2007*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Total	29	28	30	31	35
Index (2007)	100	100	105	109	122

Medium term (2020): Just as the tanker transport market the transport markets for the construction industry showed a lagged reaction to the financial and economic crisis. However, by the end of 2010 freight volumes showed a substantial decline. This sector is much more profoundly affected than other sectors by the financial and economic crisis because:
a) it suffers not only from a general consumer demand reduction but it also has to cope with the impact of a very restrained credit and mortgage market and
b) a decline of government spending on infrastructure because of the bailing out of banks, budget deficits and concerns about debt levels versus GDP.
It is considered unlikely that freight volumes will return to the levels of 2007 prior to 2020.

Long term (2040): In the long run, similar to the agribulk sector, freight volumes will depend on the development and composition of the population in the future and the level of welfare.

Generally these trends are negative so it is also expected that the IWT freight volumes will not show a drastic increase after 2020.
Environmental requirements and taxation with respect to the mining of sand and gravel are expected to alter the present main sources of mining (often local and / or along rivers such as the Rhine, the Danube and the Meuse) these raw materials.

There may also be an increased level. Substitution of sand and gravel by other building materials may lead to a change in the type of cargo flows.

3.1.7 Sea-river transport

Intermodal sea river transport:

- **Current size (2010): 0.37 mln tkms**
- **This market is not included in the IWT industry in the official statistics**
- **Small niche market, focusing on container transport between Germany, Scandinavia and United Kingdom**
- **Black Sea area is an emerging market, can provide critical mass for sea-river services on the Danube**

Characteristics

This market is very small compared to the previous described market segments. Only a few operators are active in this niche market. The UCI sea-river container service is operating on the key freight corridor between Germany and the UK, linking major centres of industry and population in Germany with the largest concentration of population and industrial centres in the UK via Tilbury (for the south of England) and via Goole (for the Midlands and the North of England). The UCI sea-river container service provides an integrated door-to-door service, for a few major industrial customers to transport semi-finished industrial products such as steel. The line therefore provides the shipper with containers for loading the product and then the line is likely to organise the door-to-door transport including the maritime transport, terminal handling and road collection and delivery. The two vessels deployed are small (190 TEU capacity) container vessels with shallow draft (3.9m) so that they can navigate on the Rhine, while also being sea-going across the North Sea.

There are no official statistics on the volumes of traffic carried by sea-river container services in Western Europe. However, based on the capacity of ships deployed and assuming 70% capacity utilisation, we estimate that the UCI service handled some 80,000 TEU in 2010 between Germany and the UK, amounting to about 300,000 tonnes of freight westbound and 100,000 tonnes eastbound (estimates by MDS Transmodal, based on trade data from the MDST World Cargo Database).

The key determinants of demand are door-to-door costs and service reliability. The UCI service is likely to be cost-effective because it maximises the use of sea transport, while minimising long distance road haulage. Transit time is likely to be slower than other modes such as direct road haulage (and ferry) and rail through the Channel Tunnel. The strongest competition is likely to come from unaccompanied ferry services across the North Sea (e.g. Zeebrugge-Tilbury and Zeebrugge-Immingham) because the ferry operators are able to double stack containers on the ferries and offer faster door-to-door transit times.

Supply chain organisation

The UCI service provides a fully integrated (i.e. door-to-door) container service for its customers, providing both transport equipment and door-to-door transport services.

The added value for shippers/customers from the UCI service is likely to come from the relatively low cost of the service compared to some alternatives and the provision of a reliable, integrated door-to-door service for semi-finished and "slow-moving" industrial goods.

Based on a "typical" door-to-door transport chain between Düsseldorf in Germany and Dagenham in the UK, a sea-river service between Duisburg and Tilbury can, based on a number of assumptions, be about 10% more cost effective per container than a door-to-door transport chain involving road haulage from Düsseldorf to a North Sea port and then an unaccompanied RoRo service to the Thames estuary (analysis by MDS Transmodal).

Based on a "typical" door-to-door transport chain between Düsseldorf in Germany and Dagenham in the UK, a sea-river service between Duisburg and Tilbury may take about twice as long on a door-to-door basis than a door-to-door transport chain involving road haulage from Düsseldorf to a North Sea port and then an unaccompanied RoRo service to the Thames estuary (analysis by MDS Transmodal).

Actual capacity of the container terminals is not known, but the two UK terminals at Goole and Tilbury are unlikely to be operating at near to capacity. As far as we are aware there are no capacity constraints at the terminal in Duisburg.

Developments

Sea-river container transport in Western Europe is a relatively small niche sector of the short sea LoLo shipping industry, which offers an integrated door-to-door service for the transport of short sea trade across the North Sea between Germany/Sweden and the UK. The key drivers for volumes of sea-river transport in Western Europe are therefore trade growth between Germany and Sweden on the one hand and the UK on the other and competition from other maritime modes (mainly short sea unaccompanied RoRo and Lolo services) transporting containers between sea ports. It is not expected that this market segment will show an explosive growth in the future comparable to hinterland container shipping by inland navigation.

Table 3.8 Transport demand in intermodal sea river transport

*(tonne kms*1000)*	*2010*	*2020 (min)*	*2020 (max)*	*2040 (min)*	*2040 (max)*
Rhine tonne kms*1000	373	386	575	505	752
Index	100	103	154	135	201

Medium term (2020):

Trade growth up to 2020 and 2040 will be determined by patterns of manufacturing production and consumption of semi-finished industrial goods and non-perishable consumer goods in Germany, Sweden and the UK. While the basic distribution of population in Western Europe is unlikely to change significantly over the next 30 years or so, the location of manufacturing capacity is more difficult to predict. It is likely, however, that there will be some switch of manufacturing capacity from Western Europe to Central and Eastern Europe (including Turkey) and, perhaps, North Africa over the next 10 years. As the Black Sea region is expected to be one of the emerging markets in the next years, sea-river transport will presumably gain importance in the Danube region.

The North Sea unitised freight market is likely to remain highly competitive, with short sea RoRo and LoLo operators providing strong competition with sea-river transport, based on providing faster door-to-door transit times than is usually possible with sea-river transport, at a competitive price.

Long term (2040):

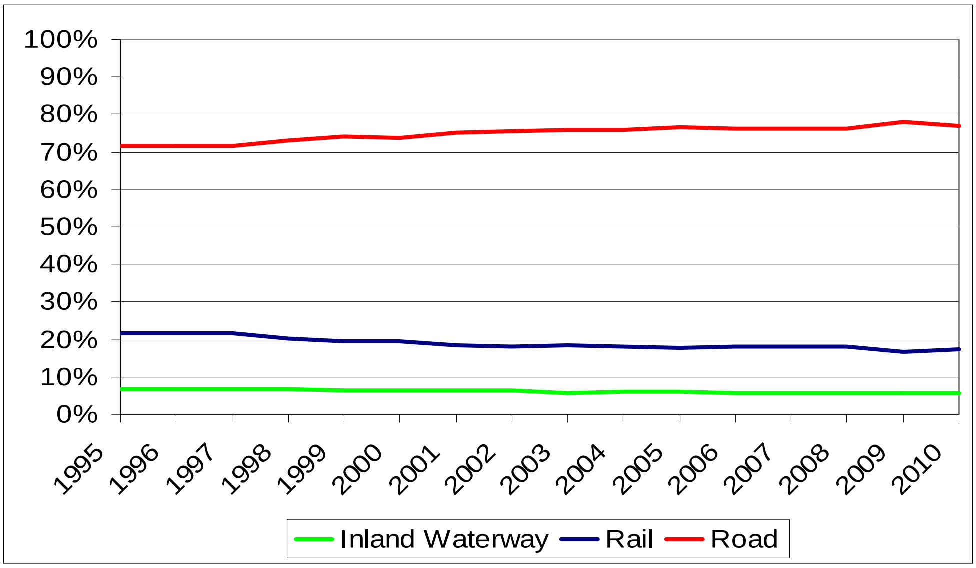
There are not expected to be any long term significant changes in the geographic patterns of unitised trade on the North Sea between the UK and the Rhine/Baltic for container traffic, particularly as the geographic distribution of population (the ultimate consuming regions) is unlikely to change significantly. However, as set out above, the future location of manufacturing activity within Europe may change over the next decades.

3.1.8 Modal share inland waterway transport EU27

Development 1995 – 2010 EU27

The modal share of inland waterway transport compared to other land transport modes is an important indicator. In particular the comparison with road transport and rail transport is relevant. The following graph shows the development of the modal share based on the transport performance (billion tonne km) of Inland Waterway Transport in the EU compared with road and rail transport in the period 1995 – 2010.

Figure 3.3 Modal share road, rail, IWT 1995-2010 in EU27

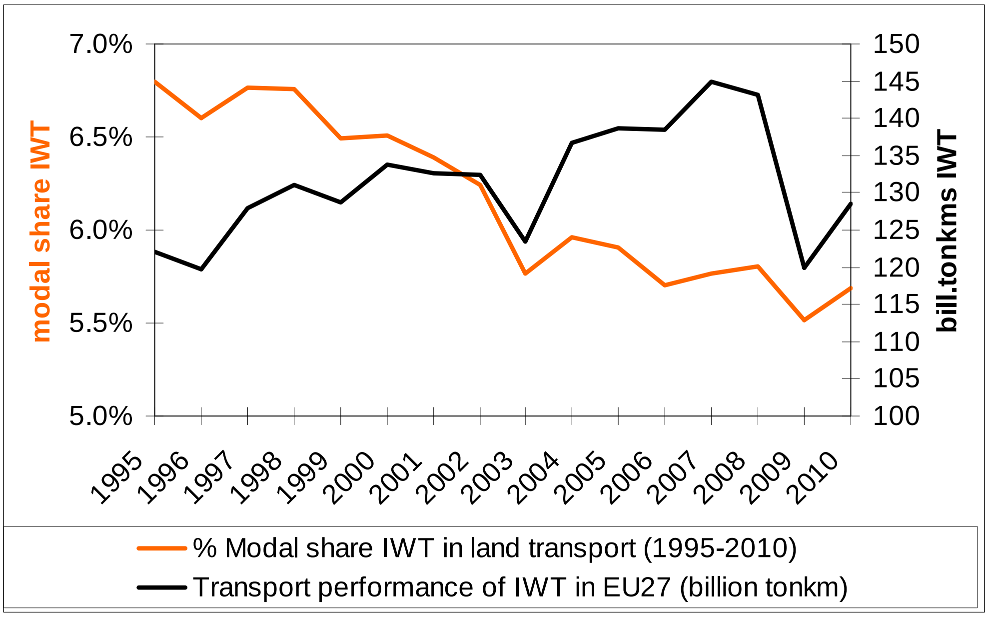


Source: EU Transport in figures/ NEA estimate 2010

It can be seen that the modal share has been declining over the years for the modes rail and IWT while road haulage gained significant market share in the EU27. The reason for the relative low growth of IWT in the period 1995-2010 is in the market position. The markets where IWT has a strong position did not grow as fast as markets where road haulage is strong. In particular, bulk cargo such as coal, ores, sand and gravel, oil and grain are important commodities for IWT. However, the corresponding production and processing industries have not grown very fast (e.g. steel industry, agriculture, oil refinery and distribution) since 1995. More and more Europe is developing into a service oriented economy and has a higher welfare rate. As a result and in particular, transport demand increased for the movement of (semi-) finished goods (NSTR 9). There has been a substantial growth in this type of transport, but in this particular segment the distances are relatively small and the flows are highly fragmented, more time critical and therefore less suitable for IWT.

Only in the transportation of maritime containers between seaports and the hinterland (e.g. consumer goods produced in Asia), does IWT provide an adequate service. However, in other parts of the market (e.g. continental cargo) IWT does not succeed in bundling and accommodating such cargo types. A more detailed presentation of the development of the modal share of IWT is presented in the next figure.

Figure 3.4 Modal split and performance IWT 1995 – 2010 in EU27



Source: NEA / Transport in Figures EC 2011

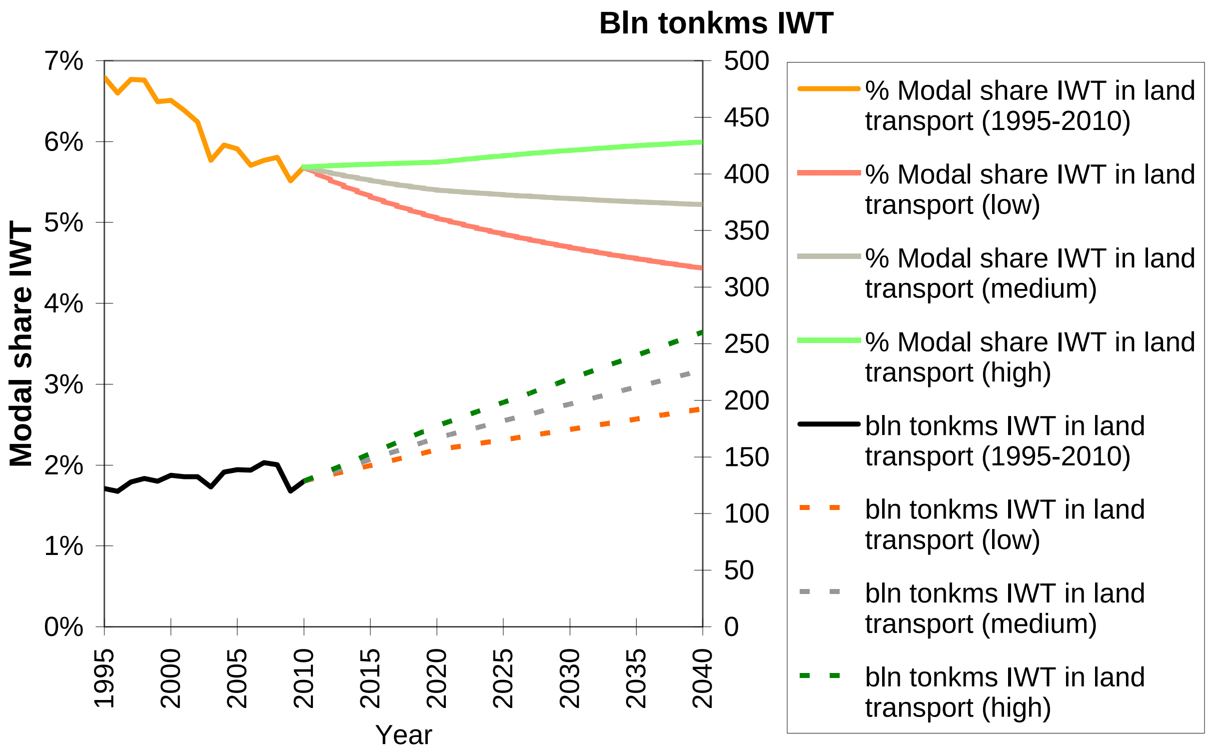
In the figure above the right hand Y-axis presents the overall performance in billion tonne kilometre (black line) while the left hand Y-axis presents the modal share of IWT versus road and rail transport (orange line).

It can be concluded that the overall performance in tonne kilometre has increased, in particular in the years with good economic growth. However, road transport grew much faster. In some Member States that joined the EU in the last decade, road transport especially has seen a considerable increase to the detriment of rail and waterway transport over the past years – most distinctly in Slovakia, Hungary and Romania. One of the reasons for this development lies in the political changes in South-Eastern Europe which, in many cases, have led to insufficient investment in rail and waterway transport, in turn tipping the balance of the modal split in favour of road transport.

Forecast 2020 – 2040 EU27

The following figure shows the modal share development and the transport performance of IWT for the high and low scenario as well as a medium growth (average of high and low).

Figure 3.5 Modal share forecast- baseline scenario



Source: NEA

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.

It can be seen that the overall transport performance of IWT is expected to grow in the baseline scenario. 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.

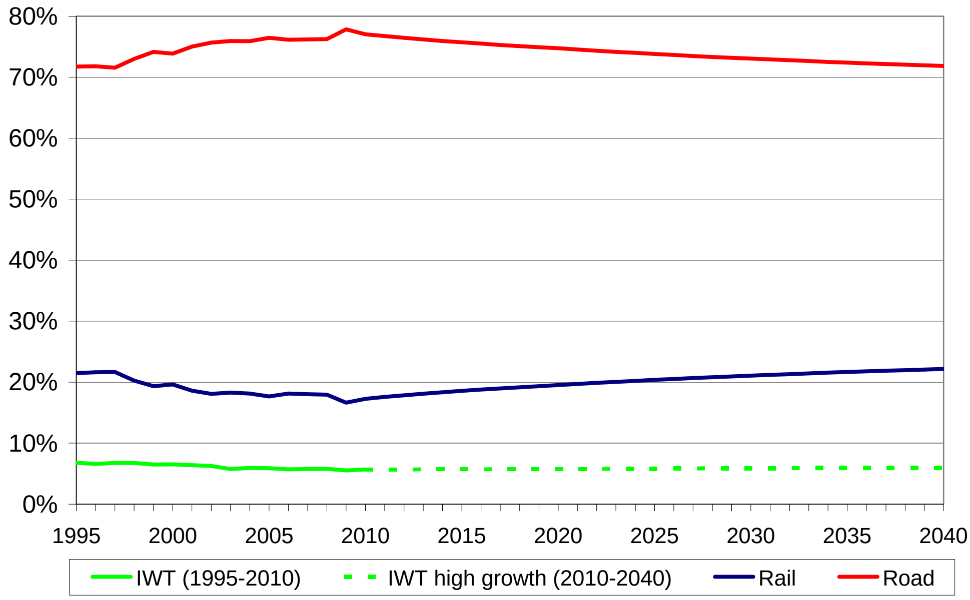
It can therefore be concluded from figure 3.5 that if no particular policy measures are taken, the medium and long term development of the modal share of IWT is likely to decline. A number of policy measures are considered to directly contribute to a higher modal share and such measures could offset the negative trend of the modal share[15].

Moreover, the geographic possibilities of IWT are limited as there are no suitable inland waterways in large parts of Europe, while rail networks are often more dense. As a result it is expected that in particular, rail transport will be able to

[15] See also chapter 8 in this report describing the policy measures related to raising the modal share of IWT

improve the market share. The following figure shows the expected development for road and rail.

Figure 3.6 Modal share road, rail, IWT 1995-2040 EU27



Source: NEA/ TENconnect2 / EU Transport in Figures (1995-2009)

3.1.9 Developments per corridor

The next map shows the waterway network and indicates the volumes transported on the network in the year 2007.

Figure 3.7 Inland waterway transport network intensities 2007

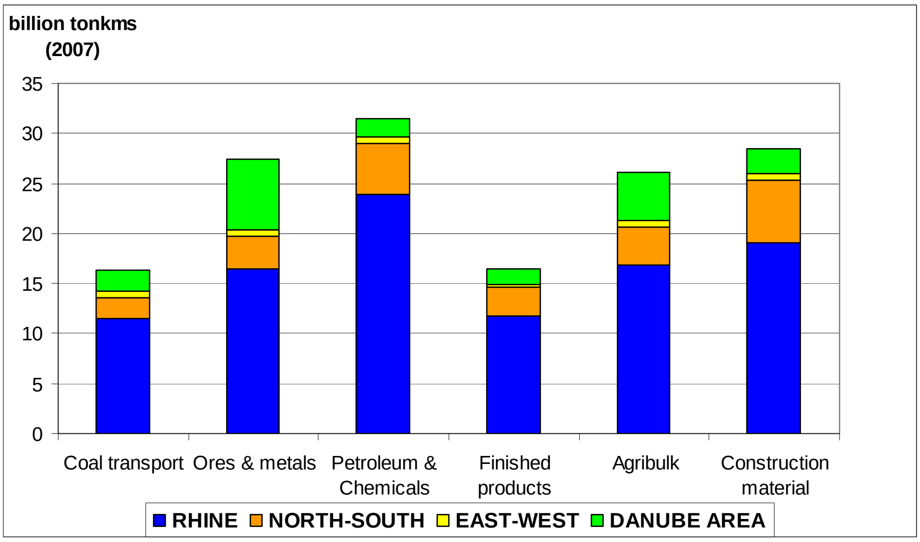
Source: NEA, via donau, VNF, 2009 (Design streamlined by PLATINA)

Source: PLATINA Deliverable D5.5

It can be seen that the Rhine River has a very high intensity, in particular the link between Rotterdam / Antwerp and the Ruhr area (Duisburg). On this section the transported volume was far over 100 million tonnes in the year 2007. On the Danube waterway the current highest cargo transport density is found on the Romanian section between Cernavodă and Galaţi. In 2007 16.5 million tonnes of goods were transported on the Cernavodă–Brăila section and 15.4 million tonnes of goods on the Brăila– Galaţi section.

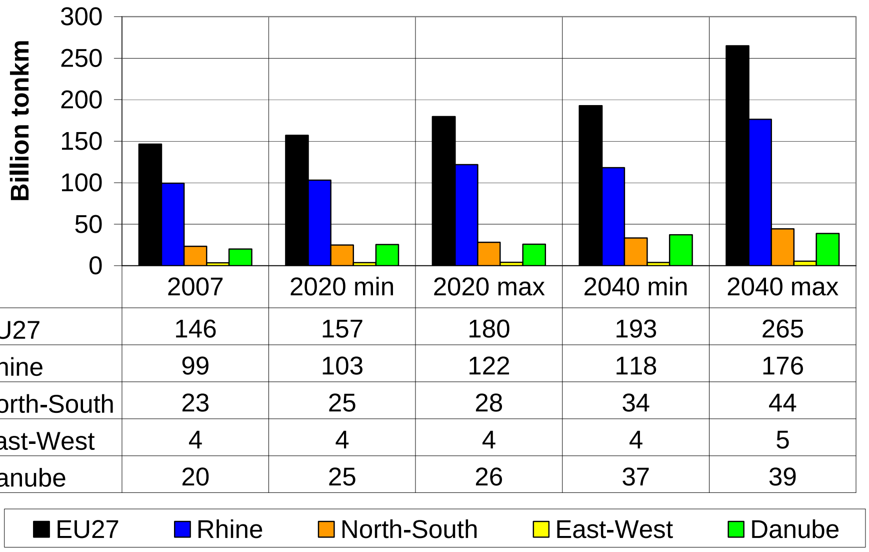
In addition to the map presenting the overall situation in 2007, the figures on the next page show the structure of the market split by corridor, as well as the overview of the modal share for each type of commodity in the year 2007 for various corridors, as well as the corridor outlook for the years 2020 and 2040. Based on the outlook it can be concluded that the Rhine corridor will remain the most important market. However, the relative growth is the biggest for the North-South market. In particular, in the period between 2020 and 2040 an increase in transport performance is expected due to the upgraded Seine-Schelde connection.

Figure 3.8 Transport performance per corridor (2007)



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 presents the differentiation for each corridor. 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). More detailed data are available in the Annex Report (Annex 2) including the explanation on the methodology.

Figure 3.9 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

With respect to the modal split the following table presents the breakdown for each corridor and type of commodity (NSTR 1 digit classification).

Table 3.9 Modal share IWT, split by type of commodity (NSTR) in year 2007

NSTR	*Type of goods*	*Share IWT Rhine corridor*	*Share IWT North-South corridor*	*Share IWT East-West corridor*	*Share IWT Danube corridor*
0	agricultural produce	11%	7%	1%	12%
1	foodstuff and fodder	8%	3%	1%	3%
2	solid mineral fuels	53%	51%	2%	22%
3	petroleum and petroleum products	40%	30%	4%	10%
4	ores and metal waste	40%	30%	3%	36%
5	iron, steel and non-ferrous metals	13%	10%	1%	10%
6	crude minerals, building materials	18%	15%	1%	8%
7	fertilizers	32%	21%	4%	28%
8	chemical products	15%	11%	1%	3%
9	vehicles, machinery and other goods	5%	3%	0%	1%
0-9	TOTAL	14.3%	9.7%	1.2%	7.2%

Source: NEA

Again it can be concluded that the market share of IWT for certain type of commodities is very high, such as the transport of coal on the Rhine and North-South corridor and the transport of ores and metal waste. Moreover it can be seen that on the Danube the modal share of tanker transport (petroleum products and chemical products) is relatively low while on this corridor the agricultural products and fertilizers have a high modal share of IWT compared to road and rail.

The following table shows the modal split expectation for the low and high scenario for the four corridors distinguished.

Table 3.10 Modal split outlook per corridor 2020 and 2040

	2007	*2020*	*2040*
Danube[16]	7.2%	6.8%	6.0%
East-west low scenario	1.2%	0.9%	0.8%
East-west high scenario		1.1%	0.9%
North-South low scenario	9.7%	8.9%	10.6%
North-South high scenario		9.9%	11.9%
Rhine low scenario	14.3%	12.8%	14.1%
Rhine high scenario		14.8%	16.4%

In the North-South market the impact of the upgraded Seine-Schelde connection becomes visible in the business as usual outlook for 2040. On the Rhine markets in particular the container transport is expected to grow significantly, due to, amongst others, the modal split agreements made for new seaport area's (Maasvlakte II to have a modal share of IWT of 45% in hinterland transport by 2035). Without additional policy actions the modal share of the Danube is expected to decline as well as the share of IWT on the East-West corridor.

3.1.10 New markets for Inland Waterway Transport

It can be concluded from the analyses made for the "business as usual" scenario that the modal share of IWT in Europe is not likely to increase significantly. Opportunities to raise the modal share shall therefore be found in new markets for inland waterway transport by means of providing competitive propositions of potential clients. The following segmentation is made for these opportunities:

- Geographic expansion of the IWT market
- Accommodating new cargo flows and serving new industries
- Competitive door-to-door transport chains for continental cargo

Geographic expansion of the IWT market

The analyses made clear that the IWT market is limited to certain areas in Europe. In case inland waterway transport is not possible due to lack of waterway infrastructure (e.g. CEMT class IV) the market will be served by other modes, in particular road and rail. Providing new high quality inland waterway connections are available, new markets for inland waterway transport can emerge, in particular if there is a significant transport demand on these corridors. It can be concluded from the 'business as usual' scenario analyses that the development of the Seine-Schelde connection results in a significant

[16] Regarding the transport demand on the Danube corridor the majority of interviewed experts from the market segments were not able to provide quantitative bandwidths. The outlook for 2020 and 2040 are therefore largely based on model estimations provided by the TEN CONNECT2 project.

improvement of the modal share on this corridor. Also elsewhere in Europe there could be feasible business cases for such infrastructure expansions. For example the Rhine-Rhone/Saone connection is taken up in the recently published proposal on the revision of the TEN-T Guidelines (Connecting Europe Facility). Other missing links in Europe that have been identified in the past are:

- Danube – Oder – Elbe connection
- Rehabilitation of the Sava River, Danube – Sava canal
- Meuse – Rhine link
- Seine - Moselle

Within the framework of the Connecting Europe Facility (TEN-T) it could be part of Corridor Development Plans to analyse the business cases for expansion of the IWT network in Europe. If infrastructure expansion is combined with new industrial and logistic sites along these new/upgraded waterways, new cargo flows could emerge for IWT. It is however a long term approach since infrastructure adaptation and spatial planning requires many years between making plans until implementation. Therefore, it is not expected that geographic expansion will be a feasible measure that will already have an impact in 2020 (besides Seine-Schelde). However, until 2040 this could be a suitable measure to increase the use of inland waterway transport. In chapter 6 of this report specific attention is paid to missing links and infrastructural bottlenecks on the waterway network.

Accommodating new cargo flows and serving new industries

As the previous analysis showed, the high capacity for bulk transports offered by inland vessels is currently mainly used by the metal industry, the agricultural industry and the petroleum industry and in Western Europe for hinterland transport of maritime containers. Apart from the traditional inland waterway transport of bulk cargo there are numerous sectors and niche markets which transport higher-value and high-value goods. Because of their specific requirements these goods are of interest to inland navigation and have further growth potential. Some of these markets with the highest growth potential include the paper and automobile industries, special transports or the transport of liquefied gas.

In addition to traditional bulk cargo transported by inland vessels, numerous other sectors need to transport high-quality goods, which are of interest to inland waterway transport because of their specific requirements and hence constitute a great potential.

Paper industry

The mass-transport capacity of inland vessels is a particular advantage when it comes to transport services provided for the paper industry. Cargo shipped by the paper industry includes both finished and semi-finished products (paper, cardboard, and paperboard) and raw, additive and auxiliary materials (timber, waste paper, filler materials and pigments). For example in Austria, as one of the key paper producers in Europe, the total transport volume amounted to approximately 17.4 million tonnes, whereby supplies of raw, additive and auxiliary materials accounted for 11.4 million tonnes. Deliveries of paper, folding box cardboard, paperboard, pulp and wood pulp amount to about 6 million tonnes.

Unlike raw materials, paper products are sensitive logistics goods, imposing high requirements on the logistics services of transport, storage and transhipment. The transport of these goods requires special attention to be given to securing the cargo. The rolls or pallets have to be stored and protected against weather influences.

Automotive industry

The automotive industry places great demands on transport logistics. Terms such as "just-in-time" or "just-in-sequence" contribute to the success or failure in this sector. In line with the different stages of the procurement/production process and the vehicles' life cycles, logistics services are divided into the three following sub-areas:

1. Production: supply of parts and components for the automotive industry
2. Distribution: transport of new vehicles to the consolidation centre/dealer/importer
3. Disposal: transport of scrap vehicles

Relevant for opportunities on Danube corridor is the increased production of cars since several factories moved to Central and Eastern Europe in the last decade. The relocation of automotive suppliers to CEE countries (notably Slovakia and Romania) is still ongoing. In these countries, suppliers expect a turnover of approx. 40 billion euro for 2015, which is equivalent to a doubling of the turnover in the mid-2000s. This rapid development requires a secure transport infrastructure, which needs to be improved substantially in Eastern Europe. While inland navigation has a great advantage over other transport modes in this respect, its transport speed might be regarded as a problem. However, adherence to schedules and a relatively high level of reliability compared to other transport modes constitute an essential advantage, which pays off, or might pay off, particularly in the time-critical automotive industry.

With the help of innovative logistics solutions, inland waterway transport can also be used to carry high-value goods – in this case brand-new cars. Since 1998 for instance, new cars manufactured by Mitsubishi, Ford and Renault have been transported on the Danube from Kelheim and Vienna to Budapest. On the way back, Suzuki cars are transported from Budapest to Kelheim. This helps to avoid empty voyages and increases the cost-efficiency of inland waterway transport. The schedule depends on capacity use, i.e. it varies from season to season. The vehicles are transhipped to and from the vessels via a bow ramp placed on top of the concrete roll-on/roll-off ramp of the port.

Figure 3.10 Location of car manufacturing plants

Source: via donau

"High and Heavy" transport

Special transport operations, i.e. the transport of heavy or outsized cargo (e.g. construction equipment, generators, turbines, wind turbines, etc.) naturally constitute a great potential for the use of inland waterway transport. The major advantage over road transport consists in the fact that inland waterway transport requires no adjustments to the transport infrastructure, such as the removal of traffic lights and signposts, protective covering for plants or the exact determination of the load-carrying capacity of bridges. The occurrence of damage to the infrastructure is far more frequent in road-based freight transport. Also, inland waterway transport does not impose any burden on the general public, caused for example by road closures, bans on passing, or noise pollution. Because of their dimensions and the relevant infrastructure, inland vessels are therefore particularly well suited for the transport of large-volume and extremely bulky goods.

Basically, any dry cargo vessel with an undivided cargo hold (with a length of approx. 70m and a width of approx. 10m) is suited for the transport of outsized cargo. However, particularly heavy goods can only be transported by specially designed vessels, such as ships with reinforced bottoms or ballast tanks. In many cases, heavy cargo is also carried by RoRo (roll-on/roll-off) vessels.

Waste industry

Waste is low-value bulk cargo which is mostly independent of the factor of time. Because of these qualities, the transport of waste by inland vessel provides an interesting alternative to rail and road transport. Basically, it is conceivable to use inland waterway transport for all material groups (both bulk cargo and cargo carried in transport containers). The waste transport market is more and more liberalised and it is expected that processors of waste (recycling plants, incineration plants) will become more specialised and increase their scale of operation. As a result the transport distance of waste will grow significantly. In case transport distances are sufficient, inland waterway transport could offer on certain corridors in Europe a competitive and sustainable alternative. Again also the location of incineration plants and recycling plants is of key importance: if they are located in ports, expensive pre-end haulage costs can be avoided resulting in competitive transport chains using barges.

However, it has to be kept in mind that parts of the transported waste are classified as hazardous waste, thus requiring compliance with all applicable ADN provisions and resulting in possible transport restrictions. Yet, hazardous waste can also be transported by inland vessel without any difficulty. Waste management schemes are generally implemented at regional level, keeping transport distances as short as possible. Such schemes have been successfully implemented in France, Germany, the Netherlands and England. In the French city of Lille, for example, domestic waste is transported the 60 kilometres to the recovery plant of Blaringhem by waterway. Each year, about 120,000 tonnes of waste are transported in this way, thereby removing at least 10,000 lorry journeys per year from the roads.

Competitive door-to-door transport chains for continental cargo

Although inland waterway transport does have a strong position in hinterland transport of containers from the major seaports (in particular Antwerp and Rotterdam) IWT does not have a significant role in the transport of semi-finished products (general cargo) in continental chains. Road haulage is the dominant mode for these chains.

Despite of the established network of inland terminals in the past decades, the existing container shuttle services do only focus on transportation of containers between seaports and inland terminals. Between inland terminals there is no transportation service for continental containerised cargo, except for the repositioning of empty containers.

A major barrier in this respect is the double transhipment and pre-/end haulage operation that is needed in these transport chains, often resulting in higher door-to-door costs compared to direct road haulage. In particular if the origin/destinations are not located close to waterways, pre/end haulage is often too expensive. Recent investigations within the PLATINA project for the Rhine corridor[17] however showed a substantial potential of road transport on longer distances.

[17] See Annex Report for more information on the analyses for the Rhine corridor and also PLATINA Deliverable 5.11 for full details

Moreover, a door-to-door chain by barge is much more complex due to:

- Multiple parties/people involved (trucker, terminal operator, barge operator)
- Necessity (often) to consolidate cargo from multiple shippers/receivers
- Longer transit times requiring a different stock and purchasing scheme

It is therefore quite challenging and difficult to provide a competitive 'one-stop-shop' service for shippers that are used to the flexibility and simplicity of road haulage. It requires cooperation and coordination between many parties to setup a viable business case for intermodal transport by barge.

On the other side the road haulage sector is confronted with increasing cost levels and also congestion in motorways. Furthermore, the growing importance of the carbon footprint for production industries can trigger additional interest among shippers to use intermodal transport by barges.

There have been experiments and pilot projects in the past with a new vessel transporting palletised goods such as "Distrivaart" in The Netherlands. This transport system was very innovative but in proved in practice not cost competitive with road haulage.

3.2 Main problems

From the interviews, stakeholder consultations and desk research many weaknesses and problems were identified. In the Annex report the SWOT analyses for each market segment are presented (Annex 1). The identified problems and weaknesses address various fields of the inland waterway transport. See also the policy analyses framework in chapter 2. For example problems related to infrastructure were frequently mentioned by stakeholders as well as problems in the labour market (employment and education). These problems are addressed later on in this report. This section presents specific problems related to the Market & Awareness field and therefore excludes problems related to fleet, infrastructure, employment & education and RIS.

The following main problems are identified:

A. Lack of visibility, information and knowledge regarding IWT as supply chain partner for potential clients
B. Lack of cooperation among owner-operators and integration with other modes
C. Lack of a general accepted framework for internalisation of external costs and user charges for IWT
D. Lacking market information
E. Difficulties to access capital

A. Insufficient visibility, information and knowledge regarding IWT as supply chain partner for potential clients

Inland navigation is often not sufficiently visible and integrated into the door-to-door services provided by the larger third-party logistics service providers. In some cases the awareness among shippers of the opportunities of IWT is sometimes even unknown. A reputation analysis and survey made clear that within a broader audience the knowledge of inland waterway transport was generally poor[18]. The many individual companies in the IWT sector complicate the identification of business partners that can offer door-to-door solutions. Due to its SME character and its low degree of market organisation, IWT is generally lacking a one-stop-shop approach. The main focus of IWT operators is on the day-to-day operations and there are generally speaking quite limited resources available for marketing and development of business propositions to attract new clients and cargo flows. Moreover, information on supply-side services is often incomplete, scattered over many sources or in the worst case totally in transparent.

In order to attract new customers to the inland waterway transport sector, however, neutral information and data on available services e.g. transport, transhipment, and value added services, need to be provided via dedicated platforms.

B. Lack of cooperation among owner-operators and integration with other modes

An important problem within the market is the poor co-operation and the integration with other modes. A driver is the highly fragmented supply side of the market. This is a situation, however, that must be addressed in the first place by the industry itself. In Western Europe the inland waterway transport sector is characterised by a large number of private vessel owner-operators. The share of one-vessel-enterprises exceeds 70% in most countries.

The fragmented structure (and the small profit margins) within the inland waterway transport business are a barrier to innovation and further supply chain integration. The a-typical SME character of the inland navigation sector (small and medium-sized enterprises combined with partly inhibitive investment costs) hampers the necessary continuous innovation process, not only regarding fleet innovations, but also related to organisational innovations. Effective cooperation among these actors would ensure a better economic base for the small and medium-sized enterprises active in inland waterway transport. Moreover cooperation including more centralised planning and optimisation of transport would result in more efficient transport, resulting in lower cost and better quality (e.g. door-to-door services, one-stop-shop solutions) and raising the competitive position of IWT.

[18] Reputation analysis of inland waterway transport in Europe, PLATINA, 2009

C. Lack of generally accepted framework for internalisation of external costs and user charges for IWT

Internalisation of external costs (e.g. a kilometre based charge) can be an important policy instrument to provide significant incentives to users to rationalise transport. The White Paper (April 2011) announced that the European Commission shall examine mandatory application of internalisation charges on all inland waterways on EU territory. The accompanying staff document to the White Paper states the following:

> *"A major part of **inland waterways** navigation in Europe takes place on the Rhine and its tributaries where it is subject to the rules of the Mannheim Convention. Article 3 thereof, stating that "no duty based solely on navigation may be levied on vessels or their cargoes or on rafts navigating on the Rhine or its tributaries", has been interpreted as forbidding any charges on navigation – including internalisation of external costs. Any revisions of these rules will have to go through international negotiations, as contracting parties to the Convention include Switzerland which is not an EU Member State. Similar problem exists on the Danube – another important trans-European inland waterway, the navigation on which is governed by a Convention in which Croatia, Moldova, Russia, Ukraine and Serbia take part along EU countries. **The Commission will develop by 2020 an approach to the internalisation of external costs in IWT; it will later examine mandatory application.**"*

It can therefore be concluded that (sooner or later) internalisation of external costs will take place resulting in an impact of the actual transport price of inland navigation. There are however different assumptions, approaches and scenarios possible for determining the external cost levels and setting the price for usage of waterways in order to internalise external costs. There is also lack of information on the actual share of infrastructure costs that should be earmarked to freight transport. Determining the share of costs to be linked to IWT is a complex issue due to the various functions of a waterway (recreation, flood protection, industry, power supply, nature, etc.). In order to address the lack of information more research and development work is needed on this topic as pricing measures may become an important issue for IWT beyond 2020. The Inland Waterway Transport sector needs to be prepared for this dialogue. In the Annex Report (Annex 4, section 4.4) more detailed information is provided on the issues related to internalisation of external costs for IWT.

D. Lacking general market information

General market information is not readily available while different types of user groups require the information such as interested shippers, policy makers, vessel owners, banks and waterway managers. Basic sources suffer from a lack of standards, European coverage and reliability. In collaboration with the European inland navigation organisations regular market observation and analysis of the inland waterway transport sector are carried out by the Central Commission for Navigation on the Rhine (CCNR) on behalf of the European Commission. This information is quite useful for general purposes but not sufficiently detailed for business purposes.

For example it does not include detailed freight price data, a detailed capacity utilisation monitor and freight flow forecasts. Therefore it lacks detailed information for businesses to support their decision making, e.g. deciding to build and finance new vessels as well as targeted policies (e.g. information required to make sound Impact Assessment studies). As a result the decisions are not optimal and the mode would be stronger in case much information would be available. For example by means of better information, the current overcapacity could have been signalled earlier resulting in warnings to the industry to stop ordering new vessels.

E. Difficult access to capital and funding programmes

European inland navigation is characterised by a high number of vessel owner-operators. These micro, small and medium-sized enterprises often have problems to finance the modernisation of their vessels as well as investment in new equipment which enables them to open up new markets and increase their overall sustainability and competitiveness in order to contribute to the improvement of the transport system. In the context of the financial crisis, thin margins and limited re-investment ability makes business decisions risky, especially in inland navigation assets are rather specific, capital-intensive and have a longer lifetime (20-35 years) than other land transport vehicles. In many countries in the EU there is no adequate access to finance available for these atypical SME’s. Moreover, the level of knowledge on applications for financing investments is limited (e.g. how to make a business plan). The banking sector plays a crucial role in these operations. Information is missing on best practices with respect to funding. The current funding schemes are also rather conventional and innovative financial instruments to support the entrepreneurs in the market are less developed.

3.3 Long list of measures

In the next table (table 3.11) a long list of policy measures is provided corresponding with the identified problems in the previous section. A further analysis, clustering and selection are presented in chapter 8 of this report. More detailed descriptions concerning the measures are presented in the Annex 8 of the Annex Report.

Table 3.11 Long listed policy measures for the policy field "Market & Awareness"

Problem	*Measure*	*Short description of proposed policy measures*
A. Insufficient visibility, information and knowledge regarding IWT as supply chain partner for potential clients	1. Provide neutral information and data on available inland waterway transport services	Increase market transparency by providing information on suppliers and available services in order to increase modal share in the long run
	2. Collect and disseminate successful multimodal modal shift projects	Collect and disseminate good practices on how to shift cargo onto waterways in order to trigger multiplier effect and common learning
	3. Creation of IWT multimodal integration kit	Demonstrate how most frequent problems in multimodal transport can be overcome and thereby raise share of multimodal transport
	4. Initiate IWT innovator of the year award	Collect and disseminate good practices, acknowledge efforts of the private sector and trigger multiplier effect
	5. Support setup of business-to business conferences	Raise general awareness, bring together supply-side and demand-side (logistics service providers with potential customers), raise modal share of IWT
	6. Operate and maintain European information portal as general point of entry for information	Improve knowledge basis on IWT for potential customers, political decision-makers and other interested groups to raise awareness
	7. Support networking activities of modal shift experts and logistics advisors	Bundle know how of modal shift moderators; exchange know-how and implement joint projects and lobbying initiatives with key users of waterways thereby raising the modal share of IWT
	8. Explore new markets	Support for the industry to develop promising markets which currently either do not exist all or are not served by IWT (e.g. pallets, perishables, waste, automotive, LNG)
B. Lack of cooperation among owner-operators and integration with other modes	9. Support cooperation between IWT and other modes (rail and road operators)	By means of supporting R&D projects and collecting and disseminating good practices on multimodal logistic organisation and transport planning the market is supported to improve cooperation between modes of transport.
	10. Support the development of cooperation models between IWT operators	Identify and disseminate good practices in the field of cooperation models. Analyse possible barriers in competition rules, foster cooperation to enhance overall competitiveness

C. Lack of generally accepted framework for internalisation of external costs and user charges for IWT	11. Provide standards for externality calculation	Develop knowledge on possible impacts and scenarios regarding the internalisation of external costs in order to identify the possible impact on the modal share of such a measure
D. Lacking general market information	12. Provide market information, observation and forecasting	By means of funding research a regular investigation is carried out on economic trends and specific aspects of inland waterway transport, improve knowledge basis on IWT for potential customers, IWT operators, banks and policy makers
	13. Maintain a RIS-based inland waterway traffic and transport statistics tool	Increase market transparency and improve knowledge basis on IWT for waterway administrations to optimise waterway management and maintenance works
E. Difficult access to capital and funding programmes	14. Promote access to capital and funding programmes	Raise capital within the sector and provide knowledge and awareness of funding opportunities to allow for further market expansion and innovation

4 Field 2: Fleet

4.1 Overview present situation and outlook 2020, 2040 business as usual

In this section recent developments in the European IWT fleet will be discussed and the market for vessels more in general. The fleet is a critical production factor for inland waterways transport services and is directly connected to the market as discussed in the previous section.

4.1.1 Current available fleet by number of vessels and total tonnage

Fleet situation in Western Europe

Recent years witnessed major investments in the expansion of the IWT fleet. As the old-for-new regulation ceased to be in force and market conditions were favourable during the years 2004 – 2008, many new and large vessels were ordered, in particular by Dutch operators. Most of these vessels were ordered some time before the economic crisis. Many of these vessels became operational in 2009, precisely at the time when the impacts of the crisis were being felt the most. Despite the current market conditions and the relatively slow recovery rate, even more new vessels were added to the fleet in 2010 and 2011. On the other hand, it could be observed, that the number of small vessels was steadily declining. The following subsections present the development of the supply side of the IWT sector for the group of countries consisting of The Netherlands, Germany, France, Switzerland and Belgium[19].

Tables 4.1 and 4.2 and figure 4.1 present the values of the **dry cargo** fleet in terms of number of vessels and loading capacity and also give a breakdown of the fleet vessel classes. This overview includes the push barges and presents the overall figures for the group of countries. The total number of dry cargo vessels up to 2000 tonnes has been gradually decreasing since 2004. On the other hand, especially in the last years many dry cargo vessels have been added to the market. The number of vessels between 2000 and 2500 tonnes has increased with approximately 2% on a yearly basis. The largest increase could be observed for vessels in the category with a loading capacity above 2500 tonnes (+43.1% in 2010 compared to 2004). This can also be seen in the development of the overall loading capacity of dry cargo vessels. In the period 2004 to 2010 the overall loading capacity increased with 10.5%.

[19] The data on the active fleet comes from the Central Commission for Navigation on the Rhine (CCNR). It concerns only the active fleet (vessels that have travelled at least once a year). Based on market inquiries, it is estimated that approximately 65% of the barges are used for storage and between 10 and 15% of the larger vessels in the tanker market for bunkering activities.

The total load capacity of dry cargo vessels sums up to 10.3 million tonnes.The share of dry cargo vessels over 2000 tonne increased from 40% in 2004 to 50% in 2010 in terms of loading capacity. During this period the average size of a vessel increased from 1108 tonnes in 2004 to 1310 tonnes in 2010, an increase of the average size of +18.2% in this period.

Table 4.1 Development of the available fleet for dry cargo in The Netherlands, Germany, France, Switzerland and Belgium, number of vessels

Class	*Dry cargo*						
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
< 400 tonnes	1,743	1,697	1,607	1,507	1,361	1,375	1,331
400 -1000 tonnes	3,107	2,921	2,721	2,638	2,612	2,625	2,497
1000-2000 tonnes	2,202	2,162	2,155	2,123	2,153	2,238	2,232
2000-2500 tonnes	455	465	467	464	471	510	512
>2500 tonnes	891	924	978	1,038	1,086	1,250	1,275
Total number of dry cargo vessels	**8,398**	**8,169**	**7,928**	**7,770**	**7,683**	**7,998**	**7,847**

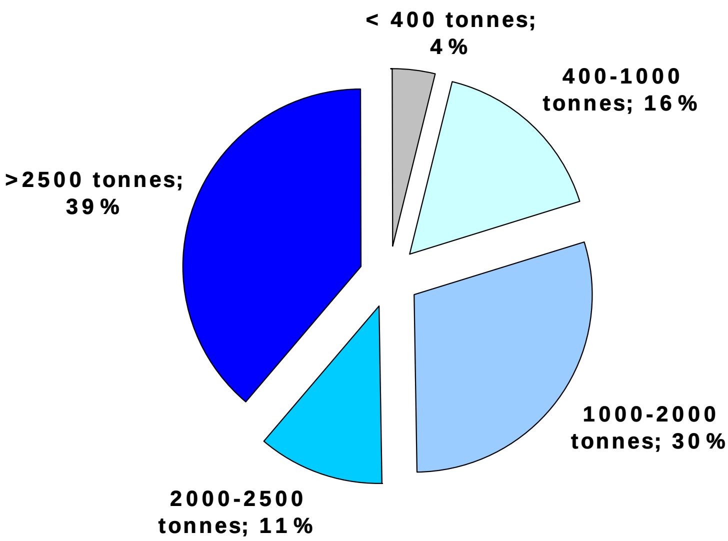
Source: NEA and CCNR

Table 4.2 Development of the available fleet for dry cargo in The Netherlands, Germany, France, Switzerland and Belgium: load capacity in tonnes

Class	*Dry cargo*						
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
< 400 tonnes	553,544	528,047	497,651	469,656	417,344	417,454	400,941
400 -1000 tonnes	2,062,060	1,947,118	1,812,055	1,759,016	1,731,984	1,769,186	1,669,552
1000-2000 tonnes	2,973,447	2,942,258	2,935,449	2,898,462	2,936,465	3,052,607	3,046,752
2000-2500 tonnes	1,026,828	1,047,704	1,054,865	1,049,192	1,066,865	1,153,303	1,156,222
>2500 tonnes	2,688,656	2,800,061	2,982,476	3,201,835	3,377,995	3,927,626	4,007,106
Total loading capacity for dry cargo vessels	9,304,535	9,265,188	9,282,496	9,378,161	9,530,653	10,320,176	10,280,573

Source: NEA and CCNR

Figure 4.1 Fleet composition in the year 2010 for dry cargo vessels in The Netherlands, Germany, France, Switzerland and Belgium: share in loading capacity



Source: NEA and CCNR

Correspondingly, the development of the number of *liquid cargo* vessels and the total loading capacity is presented in table 4.3, 4.4 and figure 4.2.

In the **tanker market**, the overall loading capacity of liquid cargo vessels has increased with 48% in 2010 compared to the year 2004. The total loading capacity sums up to 2.815 million tonnes and 1,641 units (including barges) in 2010. Between 2004 and 2010, the average size of a vessel increased from 1326 tonnes to 1715 tonnes, an increase of average size of 29.4%. In 2010 approximately 66% of the fleet (measured in tonnes) consisted of vessels over 2,000 tonnes load capacity, while in 2004 this share was 52%. One could therefore conclude that the enlargement of capacity and scale (average size) was even bigger in the liquid cargo market than in the dry cargo market. However, one has to take into account that many tanker vessels have been build in the framework of the substitution of single-hull tankers by new double-hull tankers as a consequence to ADN. The figure of a 48% net increase of the loading capacity of the fleet (compared to 2004) partly indicates that the process of the phasing out of single-hull vessel is not progressing as fast as the process of addition of double-hull vessels to the fleet. In 2009, almost 66% of the loading capacity of the European tankers were double-hull vessels and 34% were single-hull vessels. This is made clear in figure 4.3 which show developments in the structure of the tanker fleet in Western Europe until 2009 based on the total loading capacity in tonnes of single and double-hull vessels.

Table 4.3 Development of the available fleet for liquid cargo in The Netherlands, Germany, France, Switzerland and Belgium, number of vessels

Class	*Liquid cargo*						
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
< 400 tonnes	320	290	285	264	245	270	280
400 -1000 tonnes	239	216	210	207	205	197	197
1000-2000 tonnes	503	507	509	491	500	526	542
2000-2500 tonnes	184	183	192	193	194	207	212
>2500 tonnes	186	266	290	295	304	351	410
Total number of liquid cargo vessels	1,432	1,462	1,486	1,450	1,448	1,551	1,641

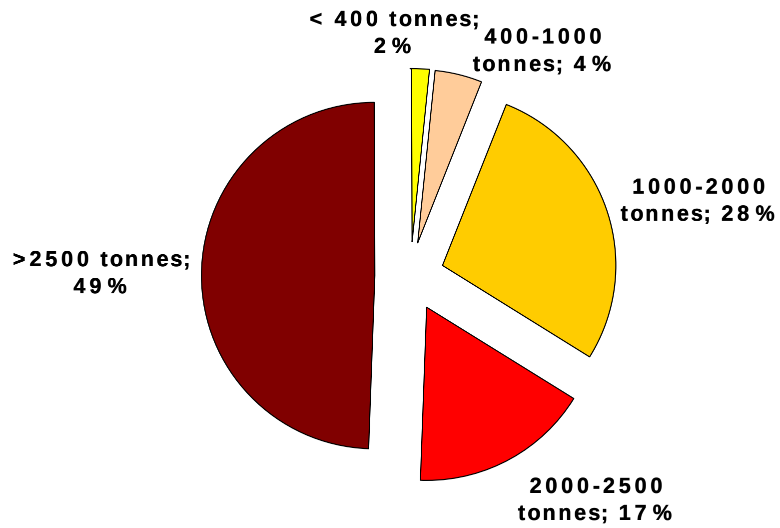
Source: NEA and CCNR

Table 4.4 Development of the available fleet for liquid cargo in The Netherlands, Germany, France, Switzerland and Belgium, load capacity in tonnes

Class	*Liquid cargo*						
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
< 400 tonnes	47,810	46,679	46,421	43,741	40,371	41,024	44,327
400 -1000 tonnes	157,103	143,153	138,518	135,891	135,067	126,581	126,137
1000-2000 tonnes	707,240	717,237	721,290	698,280	710,419	754,690	783,330
2000-2500 tonnes	410,970	408,599	427,455	430,269	433,949	460,750	471,632
>2500 tonnes	575,427	860,205	952,829	975,300	1,005,897	1,173,723	1,389,449
Total loading capacity for liquid cargo vessels	1,898,550	2,175,873	2,286,513	2,283,481	2,325,703	2,556,768	2,814,875

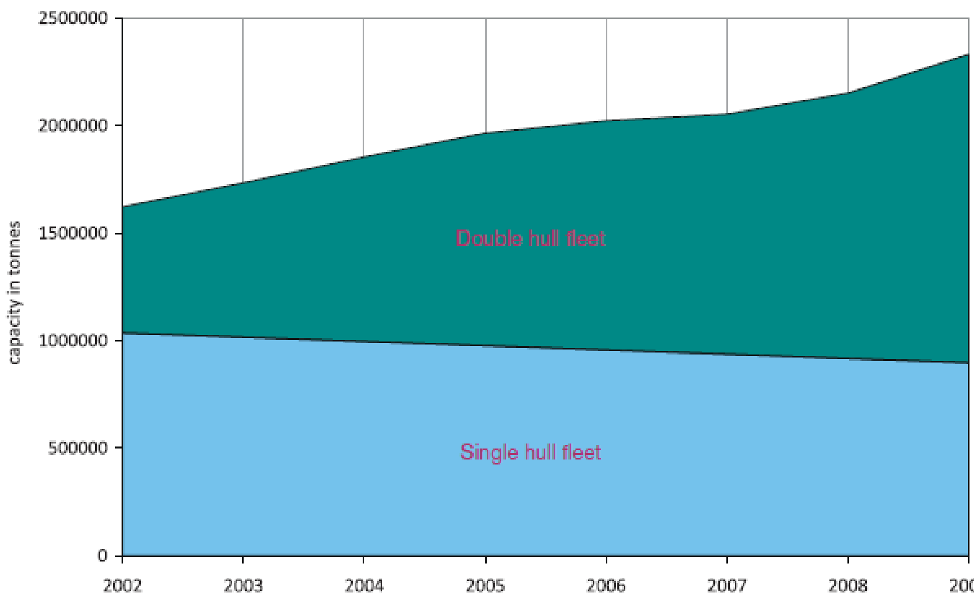
Source: NEA and CCNR

Figure 4.2 Fleet composition in the year 2010 for liquid cargo vessels in The Netherlands, Germany, France, Switzerland and Belgium: share in load capacity



Source: NEA and CCNR

Figure 4.3 Development of the structure of tankers in Western Europe



Source: CCNR Secretariat

4.1.2 Average year of construction

The average year of construction for the total fleet in Europe is presented in Table 4.5. This table also shows the total number of vessels, the total and average loading capacity by year of construction. The average loading capacity of newer vessels has increased, especially in the last ten years. There was however a clear slowing down of this trend in vessels built between 1990 and 2000. This is due to the introduction of double-hull ships, which generally imply less loading capacity compared to a single-hull ship of the same dimensions. Table 4.6 gives a breakdown to CEMT classes for motor vessel.

Table 4.5 Average year of construction, total number of vessels and loading capacity by year of construction (for motor vessels and barges, with information on year of construction and loading capacity)

Type of goods	*Construction year*	*Number of vessels*	*Total loading capacity*	*Average loading capacity*
Dry cargo	<1945	1,506	1,268,578	842
	1945-1960	1,929	1,438,026	745
	1960-1980	3,706	3,877,449	1,046
	1980-1990	1,938	2,926,314	1,510
	1990-2000	828	1,606,797	1,941
	>2000	757	2,045,636	2,702
	Unknown	213	195,166	916
	Average year of construction	*1967*		
Liquid cargo	<1945	91	26,504	291
	1945-1960	322	235,718	732
	1960-1980	771	899,524	1,167
	1980-1990	175	324,725	1,856
	1990-2000	186	341,709	1,837
	>2000	423	1,202,836	2,844
	Unknown	13	23,309	1,793
	Average year of construction	*1976*		

Source: IVR database[20]

[20] The table includes data on vessels registered at the following countries: Austria, Belgium, Bulgaria, Czech Republic, England, France, Germany, Hungary, Luxemburg, Netherlands, Poland, Romania, Slovakia and Switzerland.

Table 4.6 Average year of construction and total number of vessels per CEMT-class by year of construction (for motor vessels only, with information on year of construction and ship dimensions)

Type of goods	*Construction year*	*0*	*I*	*II*	*III*	*IV*	*V*	*VI*
Dry cargo	<1945	164	186	350	425	266	49	2
	1945-1960	29	641	197	781	123	38	8
	1960-1980	54	448	331	818	547	147	15
	1980-1990	5	1	19	45	123	321	32
	1990-2000	9		1	14	67	179	21
	>2000	9	1		20	54	343	64
	Unknown	2	2	7	9	3	9	
	Total	**270**	**1,277**	**898**	**2,103**	**1,180**	**1,077**	**142**
	Average year of construction	*1939*	*1954*	*1947*	*1954*	*1963*	*1987*	*1992*
Liquid cargo	<1945	70	3	7	11	5		
	1945-1960	100	32	23	102	35	11	2
	1960-1980	166	16	67	84	265	71	4
	1980-1990	14		6	4	25	87	3
	1990-2000	17	1		6	18	117	1
	>2000	17			6	57	260	66
	Unknown			1	1	3	2	
	Total	**384**	**52**	**104**	**214**	**408**	**548**	**76**
	Average year of construction	*1959*	*1956*	*1960*	*1961*	*1976*	*1995*	*2001*

Source: IVR database[21]

[21] The table includes data on vessels registered at the following countries: Austria, Belgium, Bulgaria, Czech Republic, England, France, Germany, Hungary, Luxemburg, Netherlands, Poland, Romania, Slovakia and Switzerland.

Fleet situation for the Danube area

The average age of vessels operating on the Danube varies depending on vessel type and country.

A **pushed convoy** on the Danube has an average age of 20 years, with the exception of Serbia and Croatia, where the average age of vessel units is more than 25 years, because ex-Yugoslavia was the first country in the corridor to mass-introduce barge pushing technology at the end of the 1960s. The pushed convoys of Romania (735 units with an average age of 17 years) and especially Ukraine (369 units with an average age of 12 years) are by far the largest and youngest ones on the Danube.

The average age of **self-propelled vessels** on the Danube varies between 18 years (Croatia, Ukraine) and 32 years (Slovakia, Moldova). With the exception of Germany, Austria, Serbia, and Ukraine, which also had self-propelled units in their Danube fleets before, there is a large deficit of this vessel type in the corridor. Up until ten years ago, the newly established private ship operators on the Danube used to purchase second-hand vessels from the Rhine corridor. Nowadays, some 100 units with an average age of 25 years are registered in countries like Slovakia, Hungary, Romania and Bulgaria.

The Danube fleet is composed differently as compared to the active fleet in Western Europe. The pushing technology is still dominant in terms of number of units and loading capacity. The statistical data are however not complete and not updated, as data on some countries are lacking. The table on the next page presents the fleet composition in the year 2007.

Table 4.7 Fleet specification Danube countries

Country	Vessels in operation													
	Push and tow vessels			Self propelled vessels					Non-motorised barges			Total		
	Number of units	Performance in kW		Number of units	Carrying capacity in t		Performance in kW		Number of units	Carrying capacity in t		Number of units	Carrying capacity in t	Perfor-mance in kW
		Total	Average		Total	Average	Total	Average		Total	Average			
Ukraine	90	127 420	1 416	94	207 045	2 203	132 849	1 413	499	772 058	1 547	683	979 103	260 269
Moldova	6	2 940	490	9	11 150	1 239	4 065	452	23	34 030	1 480	38	45 180	7 005
Romania	252	242 746	963	79	73 132	926	41 334	523	1 081	1 540 799	1 425	1 412	1 613 931	284 080
Bulgaria	66	49 933	757	56	64 937	1 160	38 853	682	210	306 187	1 458	332	371 124	88 786
Serbia	124	68 047	549	67	65 924	984	17 171	256	387	444 494	1 149	578	510 418	85 218
Croatia	59	15 833	268	4	2 137	534	2 722	681	131	86 957	664	194	89 094	18 555
Hungary	79	..	..	89	..	..	..	..	338	..	..	506	..	..
Slovak Republic	42	42 678	1016	26	17 791	684	11 823	455	167	248 586	1489	235	266 377	54 501
Austria	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Germany	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total 2007	**718**	**549 597**	**766**	**424**	**442 116**	**1 043**	**248 817**	**587**	**2 836**	**3 433 111**	**1 211**	**3 978**	**3 875 227**	**798 414**
Total 2006	713	546 476	766	373	413 100	1 108	226 161	606	2 887	3 463 430	1200	3 973	3 875 990	772 637
% change between 2006-2007	100,7	100,6	100,0	113,7	107,0	94,1	110,0	96,8	98,2	99,1	100,9	100,1	99,98	103,3

Source: Statistical Yearbook of the Danube Commission, Budapest, 2007

4.1.3 Age of engines

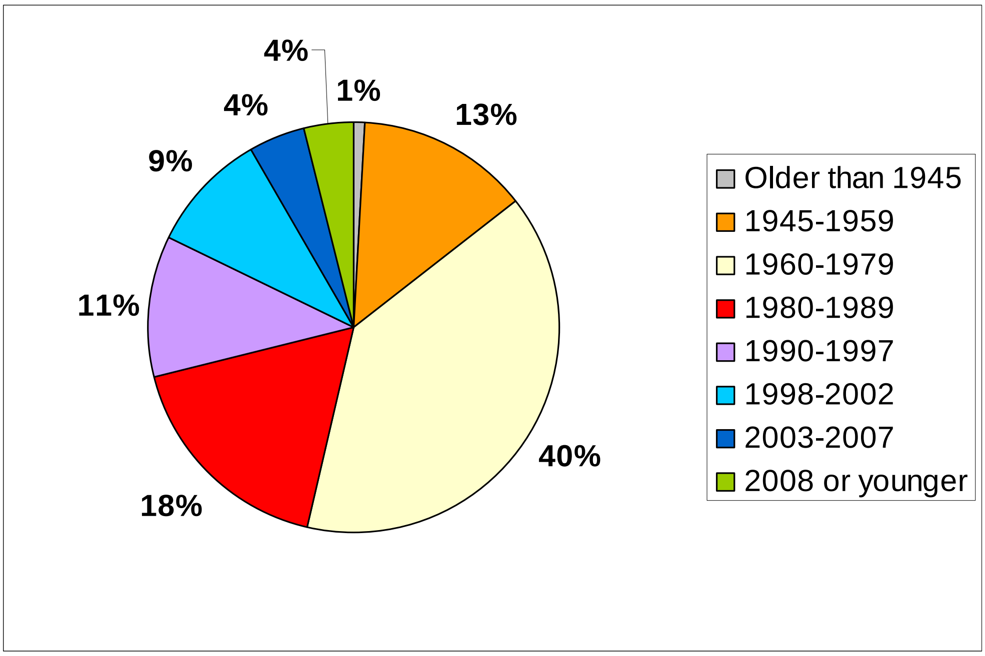
The following figures present the average construction year of the main engine employed in the IWT sector and also the construction year of the engine divided into different categories. The figures are derived from the IVR fleet database.

The conclusions from the IVR database is that for the dry cargo sector, more than half of the engines are 30 years or older. The engines used in the liquid cargo sector are relatively newer than the ones in the dry cargo sector.

The figures also show that only 4% of the engines in the dry cargo sector and 9% in the liquid cargo sector would potentially meet the CCR-II criteria and more than 90% of the engines in the IVR-database would not even meet CCR-I.
There are however questions on the reliability of the data. IVR claims that the data are reliable, but a study from TNO/VITO indicates that the engines are less old. IVR however is the only source that provides such data on EU level.

Since 2004, inland shipping emissions are regulated by Directive 2004/26/EC. The phase 2 limit values in this Directive are comparable to the CCR-II limit values. The European Commission has announced a proposal to tight of the limit values per 2016, for 2012.

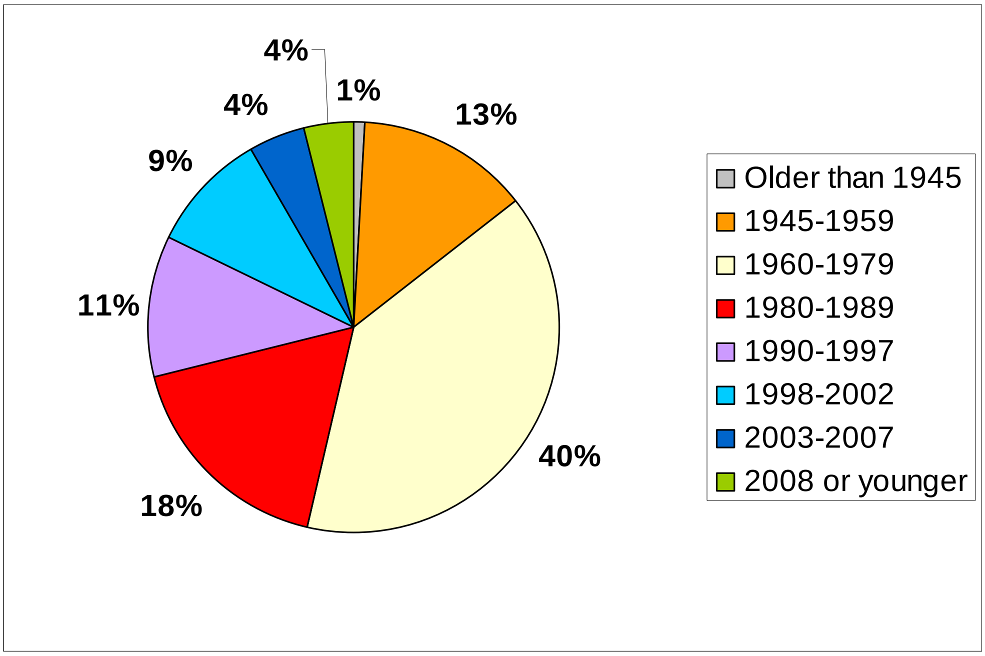
Figure 4.4 Construction year of the main engine for dry cargo vessels



Average construction year of the engine: 1978

Source: IVR

Figure 4.5 Construction year of the main engine for liquid cargo vessels



Average construction year of the engine: 1983

Source: IVR

4.1.4 Environmental performance of IWT

In this section, the performance of IWT will be discussed, in comparison with the main competing modes on the basis of CE Delft (2011). Since logistical factors play an important role, the emission factors for the different modes are presented for two specific links, providing an illustrative overview. These links have been selected as relevant for modal shift within the next 10 years.

A more detailed analysis and the background data and methodology are presented in the Annex Report (Annex 4).

Rotterdam –Duisburg (container)

In this case average container transport from Rotterdam to Duisburg is evaluated. The effect on the emission per tonne kilometre for end haulage to Essen and Dortmund are included in the comparison. In the Figures below the following cases are shown:

- Duisburg: Transport from Rotterdam to Duisburg
- Essen: Transport from Rotterdam to Essen; for rail and inland waterways containers are transhipped in Duisburg (26 km in addition)
- Dortmund: Transport from Rotterdam to Dortmund; for rail and inland waterways containers are transhipped in Duisburg (63 km in addition)

Amsterdam-Regensburg (heavy bulk: steel)[22]

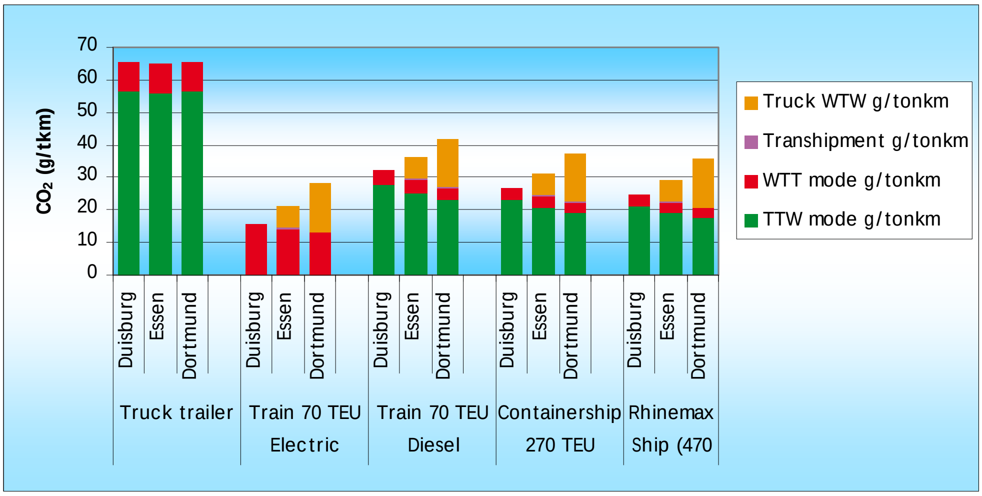
In this case average transport of steel from Amsterdam to Regensburg is evaluated. The effect on the emission per tonne kilometre for end-haulage to Munich (141 km in addition) is included in the comparison.

It should be noted that in the case of end-haulage, also the number of road kilometres changes, compared to the non end-haulage situation.

Figures 4.4 and 4.5 show the 2009 results for the CO_2 emissions per tonne kilometre. For container transport (average weight) with different modes, the lowest emissions per tonne–kilometre are found for the electric train, the highest for truck. Detouring for the different modes on the track Rotterdam Duisburg is limited and the emissions per tonne kilometres over the shortest link are hardly increased by detouring. Introduction of end-haulage to Essen (26 km) or Dortmund (63 km) does not change the outcome of the comparison although for the non-road modes the end-haulage to Dortmund has a rather large impact on the total CO_2 emission per tonne kilometre.

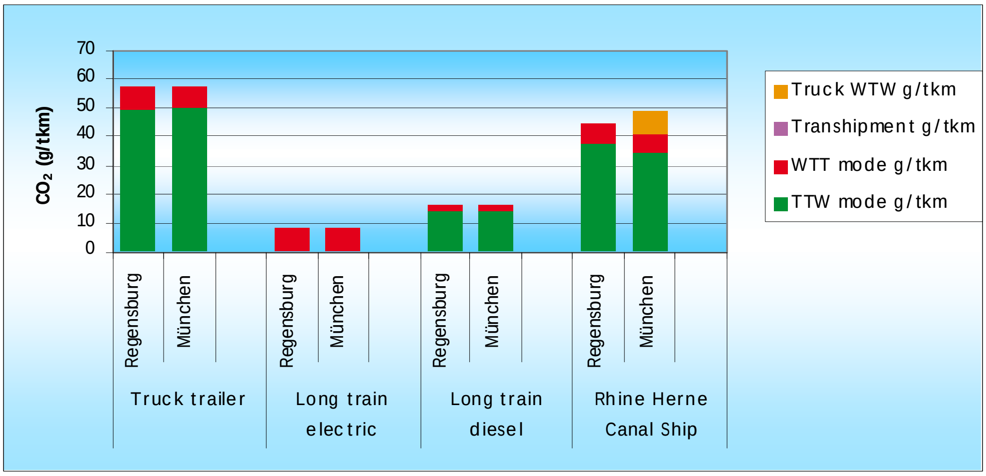
[22] A Tata steel plant is located in the Amsterdam port area.

Figure 4.6 CO2 emission per tonne kilometre for container transport; case: Rotterdam-Duisburg (2009)



Source: CE Delft, 2011

Figure 4.7 CO_2 emission per tonne kilometre for heavy bulk transport; case: Amsterdam-Regensburg (2009)



Source: CE Delft, 2011

For the Amsterdam-Regensburg case (heavy bulk) with different modes in 2009, the lowest emissions per tonne kilometre are found for the electric train, the highest for road. Due to detouring, emissions per tonne kilometre for inland water transport come close to those of road, in particular for end-haulage by truck to Munich.

The cases show that generally truck transport CO_2 emissions are found to be the highest and electric rail transport emissions the lowest. However, the EU average power generation emissions play a role here. Different national figures may result in significant differences, although not to different overall conclusions.

For rail and inland waterway transport, the scale of transport, the need for pre- and end haulage, detouring and the type of traction determine the specific emissions for a trip. However, only in cases worse than presented, the emissions of the non-road modes are higher than those of road transport. An example of this is a lower load factor (shallow water period) or smaller scale of transport.

For other types of emissions (SO_2, NO_x and $PM_{2.5}$) similar analyses and comparisons were made and for these the main conclusions were:

- In general electric trains have the lowest emissions except for the upstream SO_2 emissions. Detouring of rail transport can hardly undo the benefits electric rail has over the other modes. It should, however, be noted that electric train score very well for the average EU electricity mix. For another mix, in which the fossil fuel content for electricity production is high, emission can easily be 50% higher.
- $PM_{2.5}$ emissions for rail diesel and inland waterways in 2009 can be similar or higher than road transport, depending on the scale of transport and the amount of detouring. NOx emissions can be either higher or lower, depending on the factors mentioned.
- In the presented cases exhaust SO_2, NO_x and $PM_{2.5}$ emission for short sea shipping are high as compared to the other modes. The reasons for this are both the small size of the ships selected that compete with other modes and the relatively high emissions per kWh. In the case of ocean going ships, the emissions are significantly lower.

The emissions of transhipment hardly play any role on distances over 200 km.

In the figures 4.8 until 4.11 the development of the emission from 2009 to 2020 are illustrated by the emission factors (g/tkm) of several selected vehicle types for average bulk and general cargo transport.

Figure 4.8 Comparison of CO_2 emissions 2009 and 2020 for selected vehicle types (average bulk and general cargo transport)

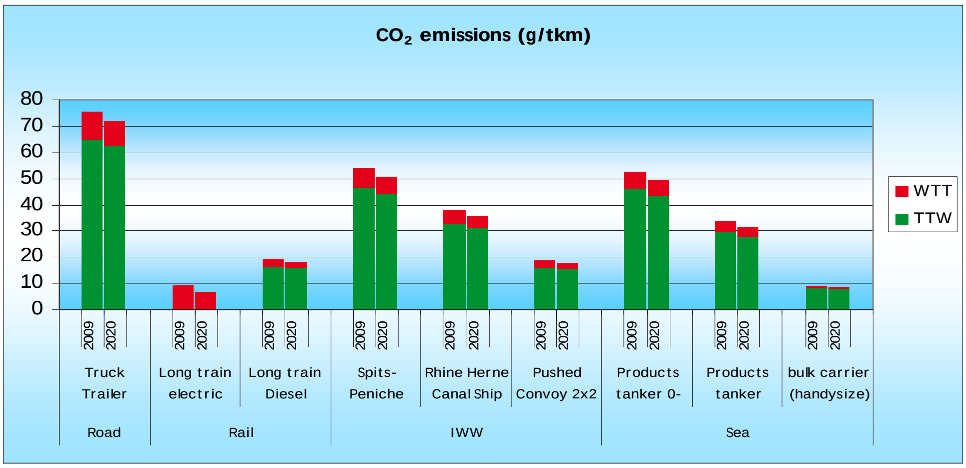


Figure 4.9 Comparison of $PM_{2.5}$ emissions 2009 and 2020 for selected vehicle types (average bulk and general cargo transport)

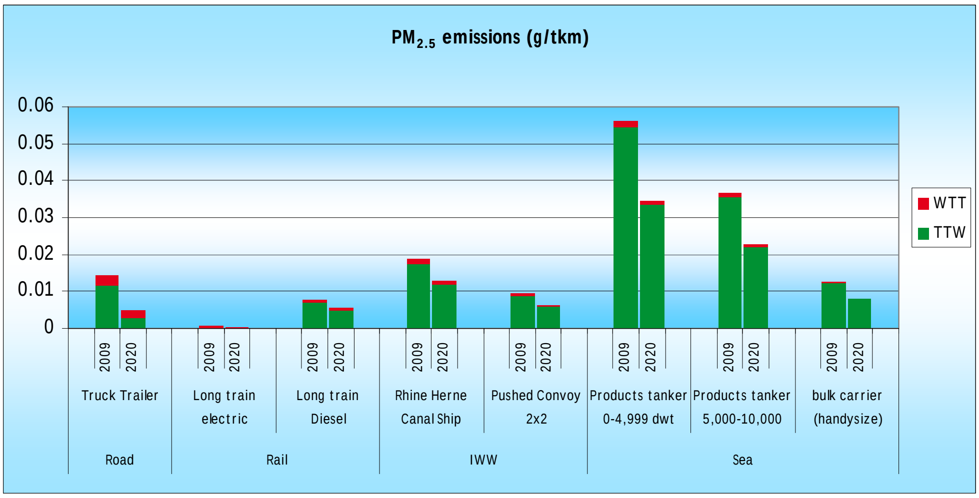


Figure 4.10 Comparison of NOx emissions 2009 and 2020 for selected vehicle types (average bulk and general cargo transport)

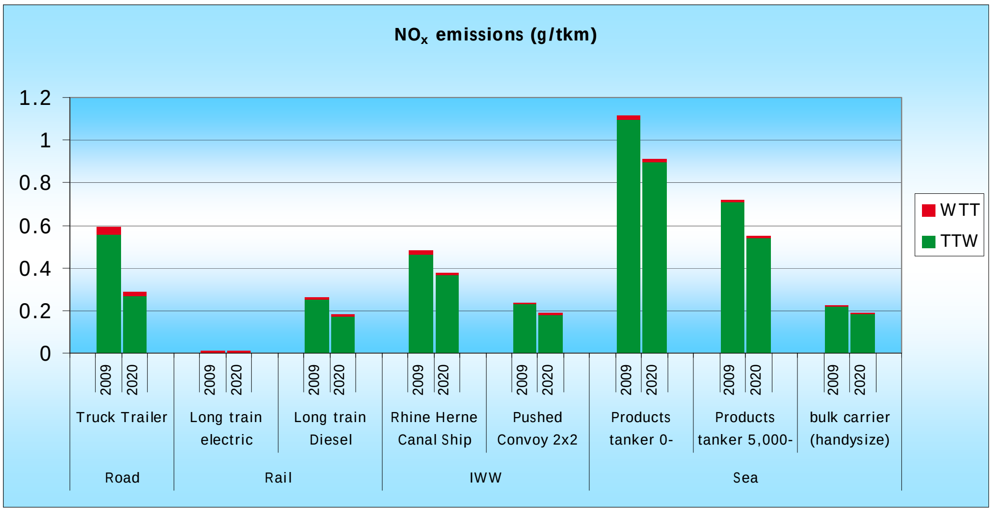
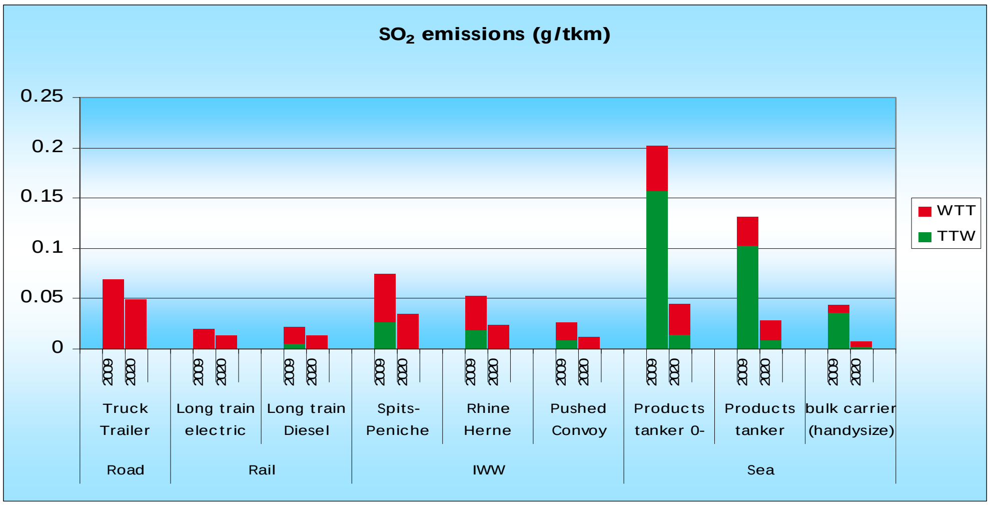


Figure 4.11 Comparison of SO_2 emissions 2009 and 2020 for selected vehicle types



The main things to note are:

- As can be seen in the figures CO2 emission the decrease of emission factors for CO_2 are quite similar (5%), but limited, for the different modes. However, the European Commission is currently studying the options for curbing the CO_2 emissions from trucks. Options and instruments for reducing the CO_2 emissions of IWT are discussed in the Annex report (Annex 5).
- For PM_{10} and NO_x emissions the reduction of emissions from 2009 to 2020 are the strongest for road, which can be explained by the European emissions standards for road (50-60%). For the other modes emission reduction are lower (20-30%), as a result of longer engine lifetimes and less strict emissions standards. This implies that road transport will over time become as clean or even cleaner than the other diesel-powered modes of transport with respect to emissions of PM_{10} and NO_x per tonne km.
- The high SO_2 emissions in 2009 for diesel trains, inland waterway vessels, and in particular sea shipping will be significantly reduced in 2020. In 2020

only for sea shipping SO_2 exhaust emissions have a significant share in the total well-to-wheel emissions. For the other modes upstream SO_2 emissions are dominant in 2020.

Innovation

Since the market for EU inland barge engines is relatively small, it is difficult to develop innovative concepts and bring them to the market. There are 5 players on the market for propulsion engines: Caterpillar, Cummins, Mitsubishi, MTU and the Anglo Belgian Corporation (ABC). The European market is small compared to the US market. It currently amounts to a maximum of 200 engines per year, half of which are used in new vessels. The Netherlands take about half of the market. The demand for engines could increase in the next decade as a result of the access criteria that will apply in the Port of Rotterdam area as of 2025. As a comparison, the EU-27 market for large compression ignition engines (>560 kW generator sets and construction equipment) is nearly 4,000 engines yearly (Arcadis & TML, 2009).

R&D investments are needed to develop cost efficient future solutions. Furthermore, a lack of incentives is being reported by the engine and components supplying industry. Many of the innovations in recent years have therefore been established with help of government subsidies. Some recent innovation projects are[23]:

- LNG as a ship fuel,
- Diesel electric traction
- The use of diesel particulate filter (DPF) and selective catalytic reduction (SCR) technologies to reduce pollutant emissions
- The use of (multiple) Euro-V/EURO VI truck engines in ships

2020-2040 periods

Available studies do not cover the 2020-2040 periods. Therefore, the analysis for the 2040 period is mainly based on extrapolations and expert judgements.

Both heavy trucks as well as the average inland barge engines are estimated to be 23-24% more fuel efficient in 2040 compared to 2010 (Hill et. all, 2010). This implies that the differences will not change significantly. However, the European Commission is evaluating the options for curbing the fuel consumption of trucks. This may put road vehicles at lead.

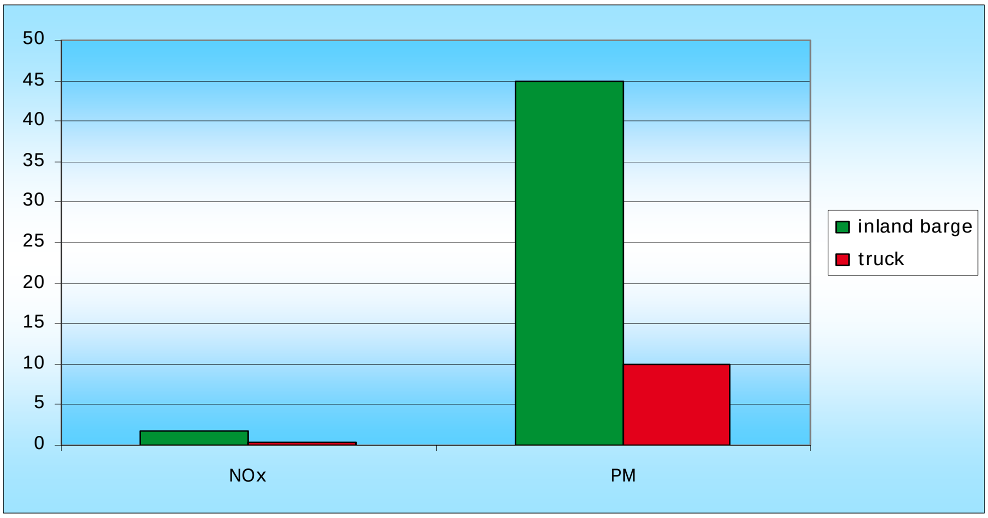
Most important is the question whether inland navigation will be able to change the developments depicted for the 2009-2020 period, regarding air pollutants.

If Phase IV legislation will be introduced in 2016, the inland barge fleet would be completely renewed with updated technology, in the next 40 years. However, the emission factors for Euro-VI trucks would still be lower (0.4 g/kWh NOx versus 1.8 g/kWh NOx and 10 mg/kWh PM versus 45 mg/kWh PM for trucks and inland barge engines respectively) than those of phase IV inland barge engines. A complicating factor is, in addition, the difference in the age structure of the engines. The pollutant emissions of inland barge engines will drop dramatically due to the effect of phase IV legislation, but the phase out of all CCNR-2 engines

[23] http://www.naiades.info/good-practices/?theme=fleet

– the standard in force in the period 2008-2016 - would still take several decades under the assumption that there will be no additional measures. On the other hand, the trend of an increase in ship capacity is expected to continue, resulting in lower emissions per tonne kilometre.
If no stricter emission legislation is introduced and no additional measures are taken after 2020, the emissions will develop as presented in figure 4.12
This figure shows that the emissions standards for inland barges that are under discussion at the moment are less stringent than for trucks.

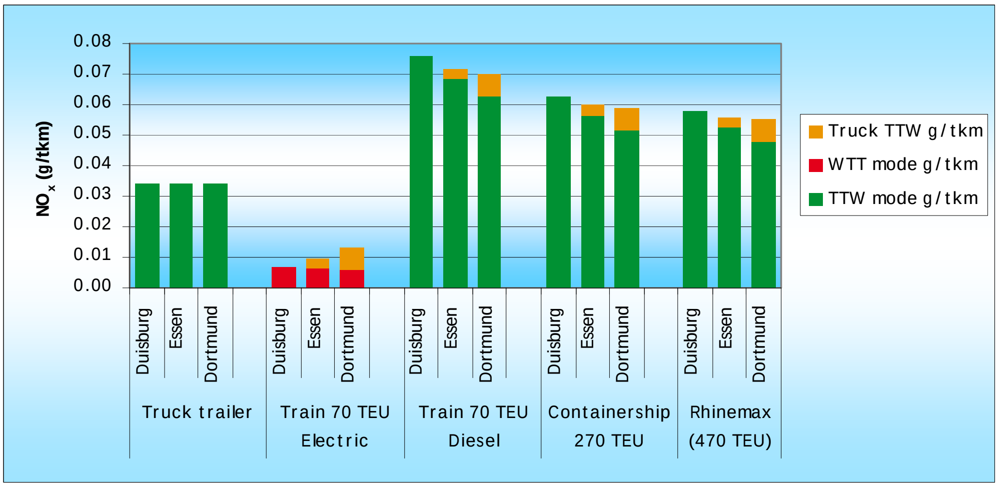
Figure 4.12 Comparison of NOx (g/kWh) and PM (mg/kWh) emission standards for new vehicles in fleet after 2020



If one takes the logistical characteristics for the modes into account from the cases presented above[24], emissions per tonne kilometre are depicted in the figures 4.11 and 4.12. It is likely that the pollutant emissions of inland navigation per tonne kilometre will be higher in 2040 than that of trucks, without a follow up on the current proposals. The gap between trucks and inland barges is much smaller per tonne kilometre than per unit of fuel burned, since inland barges are more fuel efficient.

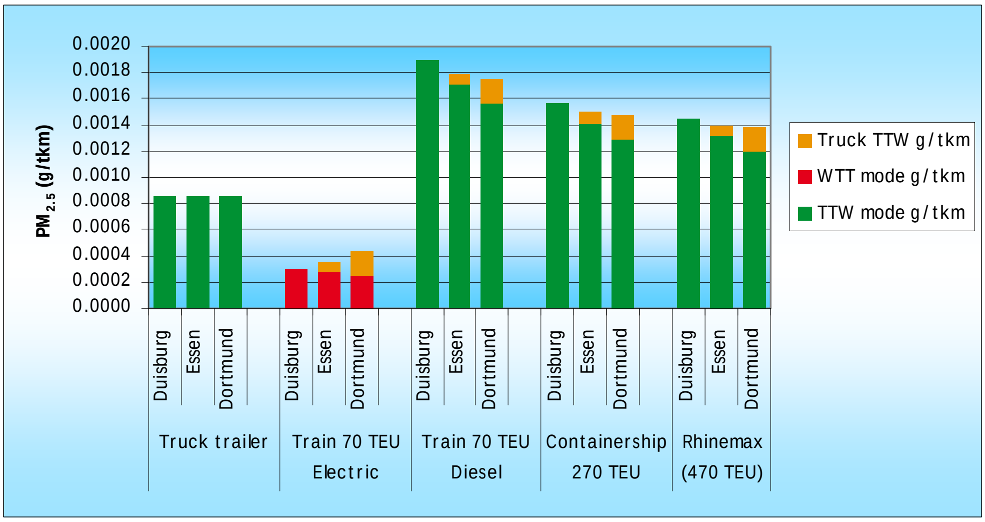
[24] see Annex report for details on the logistical characteristics

Figure 4.13 Comparison of NOx emission standards for new vehicles in fleet (g/tonne kilometre): Rotterdam-Duisburg case in 2040



Note: for electric rail transport a 50% emissions reduction compared to 2020 has been assumed, well-to-tank emissions not included for the other modes. Potential off-cycling not taken into account.

Figure 4.14 Comparison of $PM_{2.5}$ emission standards for new vehicles in fleet (mg/tonne kilometre): Rotterdam-Duisburg case in 2040



Note: for electric rail transport a 50% emissions reduction compared to 2020 has been assumed, well-to-tank emissions not included for the other modes. Potential off-cycling not taken into account.

All in all, the pollutant emissions of all transport modes are expected to drop significantly, however with a lead for road transport, due to the significantly lower Euro-VI standard. Therefore, to become competitive on the field of air pollutant emissions, a strengthening of the phase IV targets for IWT will be needed.

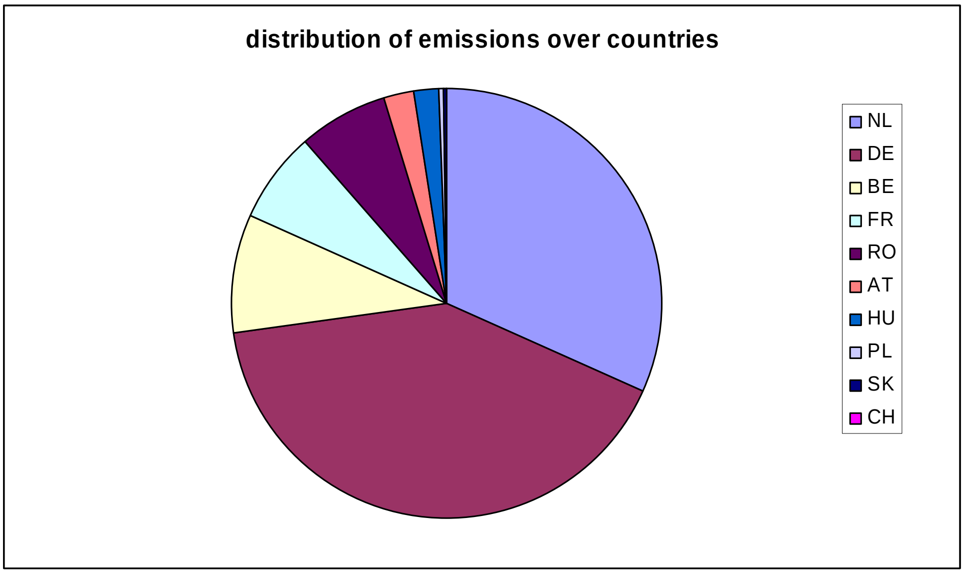
Distribution of emissions over countries and ship types

Detailed information on the emissions of inland navigation in the EU as a whole is not accessible easily, since statistics are limited, and often mixed with other sources like coastal shipping and river cruising. One has to rely on model estimation to get an impression of these quantities.

As can be seen from figure 4.16 (see next page) the main part of emissions is emitted by dry cargo ships. The figure illustrates the relatively inefficiency of small ships. The share of 650-1000 ton dry cargo ships in the performance is smaller than the share in emissions.

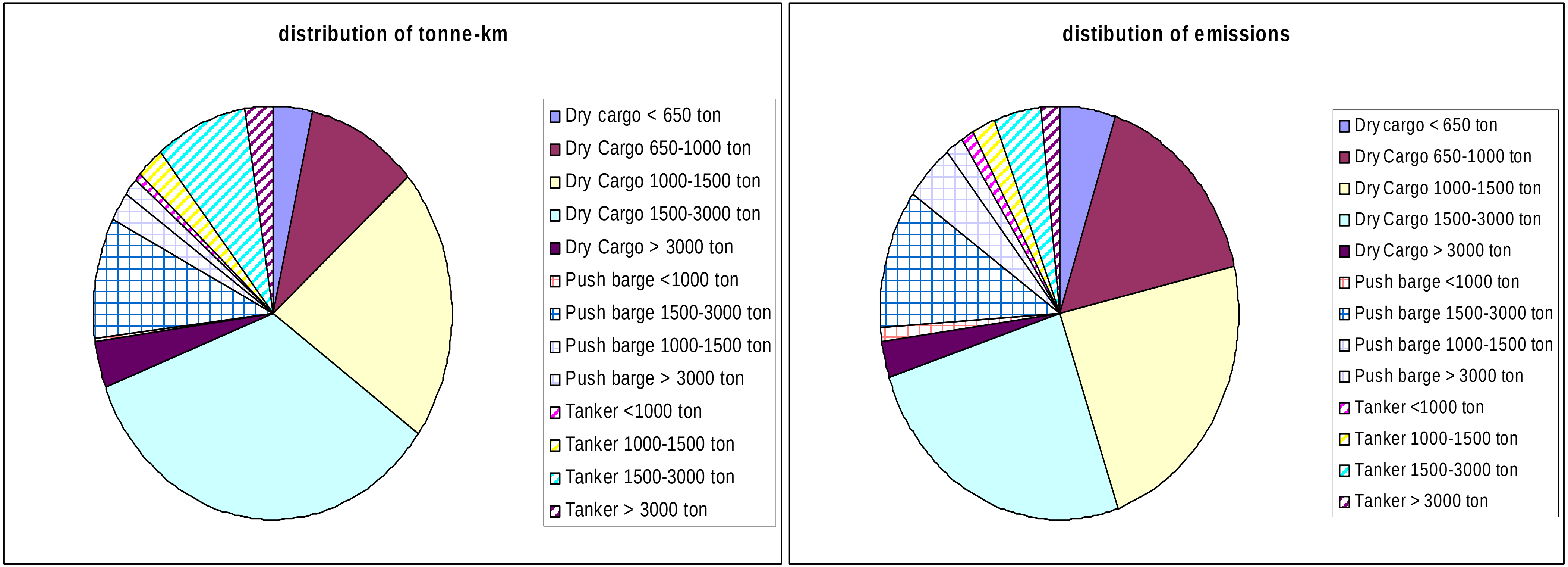
Figure 4.15 shows the distribution of the total emissions over the different EU countries. The shares of Germany and the Netherlands, followed by France are the highest, reflecting the significant performance of this mode in these countries.

Figure 4.15 Distribution of emissions over countries



Note: the distribution of emissions over different ship categories applies NOx, PM and CO_2.

Figure 4.16 Distribution of performance and emissions over ship types

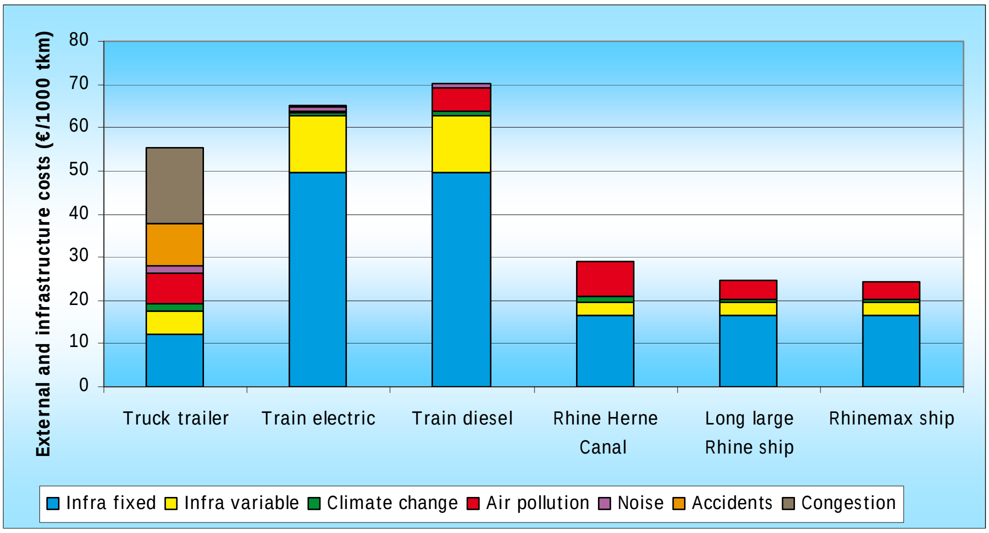


Note: the distribution of emissions over different ship categories applies NOx, PM and CO_2.

4.1.5 External cost calculations

An important value for society of IWT is the low external and infrastructure cost profile of inland waterway transport operations. The following figure shows the average external costs for the various modes of transport for container transport. For a comparison with other modes, the container market is most relevant due to the stronger competition between the modes in this market segment. For bulk transports the costs difference is even bigger due to the higher load rate of vessels.

Figure 4.17 Average external and infrastructure costs of container transport in 2009 (€2009 per 1000 tkm)[25]



NOTE: The results presented in figure 4.17 are based on first analysis and primarily based on available studies carried out in The Netherlands, Germany, France and Belgium. The specific external costs for corridors and routes will be different and depend on the local situation and logistic parameters. Moreover, further analyses and investigations would be necessary to establish generally accepted allocation mechanisms for calculating and allocating infrastructure costs. Average refers to the method of cost calculation. This figure represents the average social impacts of the modes. Marginal cost calculation is linked to internalisation of external costs. In that case only the variable costs are taken into account.

A more elaborated overview of external cost figured and the methodology used is included in the Annex report (Annex 4, section 4.4).

[25] CE Delft 2011, based on the methodology in the IMPACT study for the European Commission (2008) and information available through studies made by CE Delft in The Netherlands (update STREAM study, 2011) and the internalisation of external costs study for the corridor Amsterdam – Paris made for VNF (2011).

In particular in comparison with road haulage the current external cost for a ton of goods transported by IWT are significantly lower. Increase of the modal share of IWT in comparison with road haulage therefore provides significant savings to society due to less accidents and loss of life, less congestion on roads, less noise disturbance and less climate change. It is however the case that road haulage uses more modern engine techniques, resulting in less emission of pollutants (NO_x, PM_{10}) per litre consumed diesel compared to engines used in IWT. For the smaller vessels already the level of air pollutants is higher per tonne kms.
Moreover, the higher energy efficiency of IWT compared to road contributes to less fossil fuel consumption and therefore to less emission of CO_2, an important component of the green house gasses considered to contribute to global warming. In cases where IWT can provide alternatives for road haulage operations it can therefore contribute to a reduction of $CO_{2,}$ depending on the logistical characteristics.

Compared to rail transport the advantage with respect to infrastructure costs is large. Additionally there are some advantages with respect to noise costs. In the first analysis made for Western Europe the infrastructure costs for trucks turn out to be smaller compared to rail and IWT but road haulage has substantially higher costs for accidents, congestion and climate change.

There are however clear signals that the gap with the other modes concerning the costs of air pollutants will become bigger in the next decade. Freight trains are more and more powered by electricity, resulting in a decrease of costs for air pollution and climate change (GHG). For PM_{10} and NO_x emissions the reduction of emissions from 2009 to 2020 are the strongest for road (50 to 60%), which can be explained by the European emissions standards for road in combination with the relative short lifetimes of truck engines. For the other diesel powered modes emission reduction until 2020 is lower (20 to 30%), as a result of longer engine lifetimes and less strict emissions standards. The emission factors for Euro-VI trucks are for example lower than those for the upcoming phase IV inland barge engines.[26]

Comparison with Marco Polo calculator

External cost calculations are sensitive to significant number variables that need to be quantified, on the different cost categories shown in the figure. Examples of these are vehicle utilization, fuel consumption, pollutant emission factors, geographic coverage, and the valuation of externalities. In addition methodological choices can also influence the outcome of calculations.

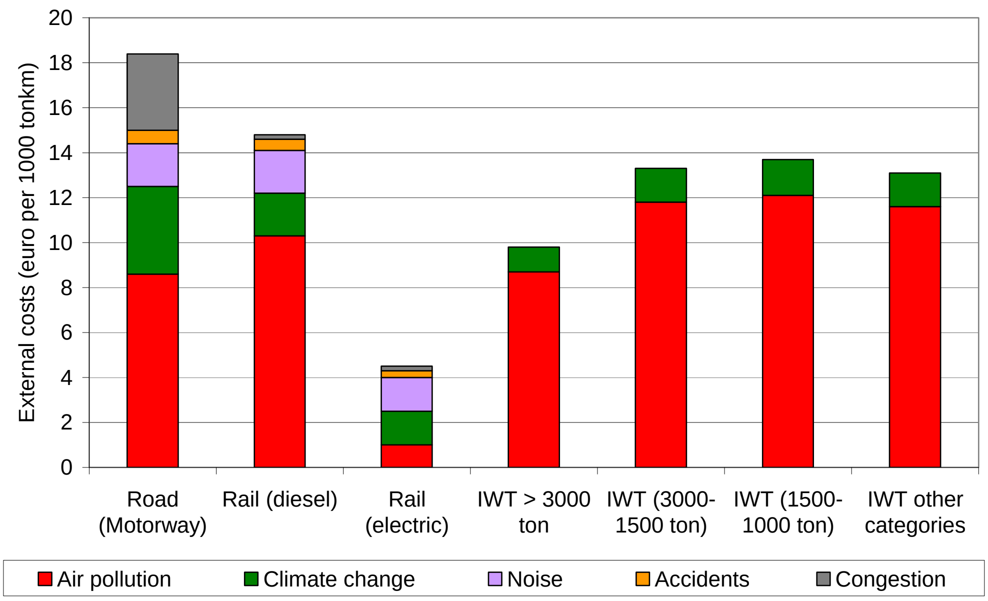
The recently published Marco Polo calculator (Brons, 2010), to be used for selection of proposals under the EU Marco Polo Programme[27] by calculating external cost of the reference situation and after project implementation, uses the same basic methodology. However, due to the use of different data sources and different methodological choices for the quantification of the different cost

[26] Euro-VI trucks 0.4 g/kWh NOx and 10 mg/kWh PM versus 1.8 g/kWh NOx and 45 mg/kWh PM for phase IV inland barge engines.
Source: Impact Assessment Study – Reviewing Directive 97/68/EC-Emissions from non-road mobile machinery, page 147).

[27] http://ec.europa.eu/transport/marcopolo/

categories, the calculated external cost for specific vehicle categories deviates from the results from the CE Delft study. The resulting external costs are shown in figure 4.18.

Figure 4.18 External costs of transport in 2010 (€2011 per 1000 tkm)[28]



Source: European Commission DG MOVE, figures from Marco Polo Calculator 2011

Despite the differences between the studies, the same conclusion can be drawn from the Marco Polo calculator results as from this study: air pollution costs are higher than those for trucks, especially for small ships. The costs of climate change are lower.

4.1.6 Incentives for a cleaner IWT fleet

If the introduction of clean engines shall be accelerated, also instruments to reduce the emissions of existing engines need to be considered. This section presents different options. More information is provided in the Annex Report (Annex 5).

Emission standards for existing ships

Stricter NOx and PM emissions standards to existing engines can be achieved by the use of Diesel Particulate Filters (DPF) and SCR catalysts or the use of alternative fuels such as LNG. A regulation which prescribes stricter standards is potentially quite effective, but needs to be carefully examined with respect to its technical, economic and legal implications. A detailed Impact Assessment study

[28] infrastructure costs are not included in the Marco Polo calculator

would be needed to study the various options and their costs and effects in detail.

As a first and rough illustration of the investment needed for a significantly cleaner fleet, the cost of applying the upcoming phase-IV standard for the entire fleet is roughly estimated on current practise and cost figures. R&D efforts and size of scale effects might lead to lower costs.

Based on current prices and available equipment the data from literature[29] shows that the overall investment costs amount over 650 million euro if SCR catalysts are installed on the entire European fleet, not taking possible lower costs of installing SCR catalysts on new build ships into account. The additional overall investments costs for a DPF installation on the entire fleet amount 550 million euro. The order of magnitude of the costs would not be very different in case of large application of the LNG technology in ships.

However, it is highly questionable if all engines would be equipped with SCR and DPF. From the viewpoint of effectiveness priority could be given to larger vessels with a high number of operational hours. Moreover, at least a part of the engines could be replaced, which would also induce other economic and external cost benefits due to fuel savings.

Environmental zoning

Another option to reduce emissions from inland navigation is the designation of environmental sensitive zones in ports, from an air quality perspective. For example in the Port of Rotterdam, inland barge engines will have to at least meet CCR-II regulation from 2025 on. The decision was made in the context of the expansion of the Maasvlakte area. The measure was needed to ensure that air quality levels in the Rotterdam area could be guaranteed in order to comply with European[30] Directive 2008/50.

However a multiplication of such environmental zones could potentially conflict with European objectives related to the Internal Market[31] as zones could make regulations in Europe more complex and could conflict with level playing field.

Organisation of market for clean and efficient transport (voluntary standardization)

Better market organization through voluntary standardisation and incentives can lead to improved environmental behaviour, if also shippers are interested in better environmental performance. Shippers may be interested with a view to their image regarding their clients and their corporate social responsibility. Voluntary standardisation and incentives from shippers that compensate for additional costs by ship-owners to invest in clean technologies (e.g. LNG, SCR, DPF), could therefore contribute to an expansion of the number of clean vessels.

[29] Source: Arcadis, 2011

[30] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[31] See http://europa.eu/legislation_summaries/internal_market/index_en.htm

Voluntary standardisation and voluntary environmental measures are applied in several economic sectors in the EU. In case of inland shipping, parties such as shippers, brokers and operators could select only clean vessels to fulfil their transport demand even though the costs to contract those clean vessels might be higher.

For a significant increase of the number of clean engines and vessels, ports and shippers will need to provide incentives (discounts or operational benefits, better market position) for certified ships. At present, the number of incentive providers (charterers and inland ports) are still limited, but discussions with the main seaport in the Netherlands are ongoing.

Voluntary environmental initiatives and certificates can be mainly found in business-to-consumer markets. Inland waterway transport is, however, mainly a business-to-business market (coal, sand, gravel animal fodder, chemicals). This may make it more difficult to introduce voluntary environmental initiatives and limits their potential effectiveness.

Subsidies

Subsidy programmes to accelerate the introduction of CCR-2 engines, DPFs and SCR catalysts existed in the Netherlands, Germany and Belgium in the period 2007-2010. The majority of subsidies was used for CCR-2 engines and only to a lesser extent for investments in SCR catalysts and DPFs. Uncertainty with respect to costs and functioning was the main reason. The Dutch programme has been assessed as ineffective since the subsidy did not cover the full investment (and operational) costs and there were no additional financial incentives (e.g. environmental taxes) to make investments in these technologies economically viable (SenterNovem, 2009). Furthermore, the immaturity of the SCR technology was identified as another bottleneck. It can therefore be concluded that additional flanking policies are needed. In Germany, a subsidy scheme was introduced in 2007 which however was not used to more than 40% of the allocated funds, mainly for re-installing of CCR-2 engines and DPFs in a number of cases. No SCR catalysts were subsidised.

Emission taxation (NOx tax) and NOx fund

Specific tax and subsidy schemes could be considered regarding NOx. For example in Norway, a fiscal NOx tax was introduced in 2007 together with an Environmental Agreement. Affiliated enterprises to the Agreement pay, instead of paying the government tax, to the NOx Fund. Undertakings that join the Agreement are however obliged to invest in measures to reduce NOx emissions. Financial support for these investments is granted by the NOx Fund as well as for the operating costs. In Norway the maritime sector also needs to report the emissions of their fleet, on the basis of engine certificates and bunker delivery notes.

In EU Member States, both such a NOx tax approach and NOx fund approach (including a fall back option) can be used to reduce emissions. The advantage for the sector of the NOx fund is that the payment levels are lower, and that levies paid are reinvested in industry.

National governments are the most obvious regulative bodies to introduce of NOx tax but should take note of European Internal Market objectives. At EU level however, the introduction of such instruments would need to overcome significant political obstacles, since taxation measures require unanimity. The Mannheim convention does not seem to explicitly forbid a levy on NOx emissions. However, whether or not such a levy could hold, remains subject of discussion and further investigations.

Differentiated port dues

Also the differentiation of port dues according to the emission standard of a vessel can be used as incentive for clean shipping. The Port of Rotterdam for example recently introduced differentiated port dues that provide an option for discount if vessels are equipped with clean engines[32]. Other ports are also implementing such schemes.

CE Delft (2004) investigated this approach and concluded that the impact of differentiated port dues used as only incentive to encourage SCR application would be too small. However, they could be effective as part of a package of measures described. CE Delft calculated that the needed incentive would be roughly 10 times higher than the current port dues in the Port of Rotterdam (if the Port of Rotterdam is the only port which applies differentiated port dues). Based on differentiation in both the origin and destination port, the financial incentive would need to be roughly 3-4 times higher than the current port dues.

Port dues for ships would need to be increased significantly if investing in SCR catalysts shall become viable. In case of the combination of DPF and SCR, the needed incentive would even be bigger. In case of cheaper measures, the incentive could be lower instead (e.g. internal engine measures to achieve a CCR-2 level).

A detailed analysis of available options is presented in the Annex to the Report (Annex 5).

[32] http://www.portofrotterdam.com/en/Shipping/harbour-dues/Pages/harbour-dues-inland-shipping.aspx

4.1.7 Growth rates fleet 2020 and 2040 in the business as usual scenarios

If one assumes that the growth rates for the various categories of goods as presented in chapter 3 for the years 2020 and 2040, compared to year 2007, would be applied to the fleet of 2007, one would get the following table of growth rates:

Table 4.8 Implied growth rates of the fleet of 2007 in various scenarios in a rough approximation

Type and size of vessels	*2020 low*	*2020 high*	*2040 low*	*2040 high*
Dry cargo motor vessels				
< 1000 tonnes	10%	23%	45%	98%
1000-1500 tonnes	16%	23%	46%	100%
1500 -3000 tonnes	18 %	34%	76%	164%
> 3000 tonnes	22%	44%	89%	190%
Dry cargo push barges	6%	23%	16%	41%
Tankers and tanker push barges	1%	15%	4	56%

The figures in the table are only very general and rough indications, assuming that the productivity and fleet specialisation patterns (share of vessels in the transport of particular commodities) of 2007 do not change in the future.

As mentioned a significant expansion of the fleet did already take place in the period 2007-2010. This can be seen in the figures in table 4.9 in the largest dry cargo vessel class already 25% expansion has been seen in the market. On the other side the number of the small vessels (< 1000 tonnes) decreased between 2007 and 2010.

Table 4.9 Development of the available fleet in The Netherlands, Germany, France, Switzerland and Belgium; loading capacity in tonnes

	2007	*2010*	*2010 vs. 2007*
Dry cargo			
< 400 tonnes	469,656	400,941	-15%
400-1000 tonnes	1,759,016	1,669,552	-5%
1000-2000 tonnes	2,898,462	3,046,752	+5%
2000-2500 tonnes	1,049,192	1,156,222	+10%
>2500 tonnes	3,201,835	4,007,106	+25%
Liquid cargo			
< 400 tonnes	43,741	44,327	+1%
400-1000 tonnes	135,891	126,137	-7%
1000-2000 tonnes	698,280	783,330	+12%
2000-2500 tonnes	430,269	471,632	+10%
>2500 tonnes	975,300	1,389,449	+42%

Source: NEA

Moreover, in the future a productivity growth can be expected due to higher average speeds and less delays (RIS), increasing transhipment speeds and better load rates. The average load rate of vessels can increase, for example as a result of better fairway conditions and more cooperative planning of vessels. Therefore, also these types of improvements shall be taken into account. Until the year 2020 a productivity improvement of 10 to 20% can be expected.

Over a 20 year period (2020 – 2040) the productivity may further increase by 25% to 50% (1 - 2% on a yearly basis), resulting in less vessels needed to carry the same amount of cargo.

Due to the scrapping of small old vessels in the past as well as the high investments needed to comply with updated technical requirements, the number of available small vessels in the market is expected to decline. In the **dry cargo** sector an expansion (new vessels) could therefore be needed for smaller vessel categories until 2020.

This corresponds to signals from the market (interviews) indicating that a shortage of smaller vessels below 1000 tonnes is an upcoming issue for short/medium term. In the period 2020-2040 more big vessels in the dry cargo market would be needed in case of the high scenario.
For the **liquid cargo** sector, there is in the medium term no more space for expansion. With the current fleet, expansion is only possible in the high growth baseline scenario for 2040. However, one has to keep in mind that by 2019, when according to ADN the phasing out process of single-hull vessels is completed, a total of approximately 1,000,000 tonnes of loading capacity of single-hull vessels will disappear compared to the current situation.

These are mainly vessels in the small and middle class. In case the "high" scenario becomes reality, this could leave room for some expansion again.

4.2 Main problems

Based on the precedent analysis and stakeholder consultations, the following problems with regard to the fleet are identified. A more detailed analysis is included in Annex 5 of the Annex Report discussing several policy and market instruments to reduce air pollutant and CO_2 emissions.

The main problems are:

A. Slow replacement rate of the existing engines
B. Poor focus on decarbonisation of IWT fleet
C. Unambitious engine emission standards for new engines
D. Fragmentation of available sources of information on innovations and lack of coordination and R&D and deployment plans
E. Lack of decision support tools preventing overcapacity in the market
F. Poor shipping waste arrangements to operating areas outside the Rhine

One of the main issues is the threat that inland waterway transport will not reduce significantly the reduction of emission of air pollutants, in particular NO_x seriously compromising the image of IWT as an environmental friendly mode of transport. This may have possible consequences for the interest of politicians, policy makers and clients of IWT (shippers) as well as the wider society in general in inland waterway transport. Another issue is that the fleet shall "decarbonise" i.e. to become more fuel efficient and less dependent on fossil fuels.

A. Slow replacement rate of the existing engines

Whereas the size of the motorised fleet is approximately 8,500 vessels[33], about 14% of these vessels (with engines younger than 2003) is subject to emission requirements (CCR phase 1 or 2 regulation). Given the life cycle of typical main propulsion engines, more than half of the engines gradually need replacement or technical adaptations in the next decade. Currently however, limited dedicated research efforts into inland navigation applications are combined with the relatively low speed at which innovation takes place with respect to engines and power trains spreading across the long tail of small inland navigation operators. There are also not sufficient incentives to invest in improvements of the fleet and/or engines to improve the environmental performance. As a result IWT is gradually loosing the advantage in terms of air pollution performance compared to road haulage. If no action is undertaken, the air pollution of trucks will be better than that of inland navigation in 2020.

Fragmentation of the fleet-owners in the supply side of the market is one of the barriers for innovation and market entry of new technologies as a result of limited knowledge and access to finance and risk aversive behaviour of SME's.

[33] IVR Register, 2011

The relatively small and specific market for inland vessels causes disadvantages of scale to occur. The IWT sector lacks joint development and co-operation in the field of innovation and consequently fails to build up countervailing buying power for specific inland navigation applications (see also problem D). In the EU27 the number of companies involved in IWT does not exceed 9,300. Engine manufacturers rather concentrate their research and development activities on larger and potentially more profitable markets for which they have also to take foreign standards into account (such as US EPA). However, the latter may be overcome by the Phase-IV standards in 2016, depending on the decision on the specification of Phase-IV (see also problem C).

B. Poor focus on decarbonisation of IWT fleet

Inland navigation holds a pole position in terms of relative fuel consumption and related GHG emissions. However there is no particular attention since incentives for a further decarbonisation of the IWT fleet are missing. For example the fuel is free of duty and there is no legislation on the required efficiency of engines of vessels.

C. Unambitious engine emission standards for new engines

In terms of future emission standards, the European Commission has not yet tabled a proposal in the framework of the Non-road mobile machinery exhaust emission Directive (97/68/EC) for the so-called phase-IV with stricter emission standards which shall apply as from 2016 on. As part of non-road mobile machineries, inland waterway vessels would face emission limits that are similar to the US Environmental Protection Agency’s standards and which would allow for a bigger market for specific engines. However, in view of closing the gap with road transport that already has stronger emission restrictions on new engines, the next steps of tightening the emission standards for inland waterway vessels following phase-IV, need to be carefully evaluated on a short term.

D. Fragmentation of available sources of information on innovations and lack of coordination and R&D and deployment plans

Although many different research and development activities have taken place in the field of inland navigation, systematic collection and dissemination across Europe of research results is currently lacking. Knowledge on fleet innovations, transhipment equipment and new logistics concepts is dispersed over many different sources. This results in inefficiencies in the development of new technologies, increased development efforts and a limited market transfer of research results.

The Strategic Research Agenda (SRA) for Inland Waterway Transport[34] needs to be developed further and become an innovation roadmap for the near future including accompanying innovation deployment plans. The definition and regular update of the Strategic Research Agenda as well as its integration into national

[34] Strategic Research Agenda for Inland Waterway Transport 2011, see www.naiades.info (downloads)

and European research and innovation funding programmes will be needed to ensure long term research and the development for IWT to overcome intrinsic SME structure and lack of critical mass.

E. Lack of decision support tools preventing overcapacity in the market

Regular market observation is required to monitor the current economic situation of the sector in the form of a detailed overview of developments and forecasts (fleet, freight flows). This amongst others will provide for scientific ground for political measures (e.g. measures to temporarily reduce overcapacity, declaration of severe market disturbance, state aids to counteract economic crisis, etc.). Moreover it supports decision making in the sector regarding fleet expansion. Such a decision support tool is however not available.

F. Poor shipping waste arrangements to operating areas outside the Rhine

Along with the increase of transport growth, waste from IWT is going to increase as well. On the River Rhine, shipping waste arrangements for the Rhine and inland waterways are set out under the terms of the CDNI Shipping Waste Treaty. On the 1st of November 2009 the Convention on the collection, deposit, and reception of waste during navigation on the Rhine and inland waterways (CDNI) has come into force. The CDNI is a waste treaty elaborated and ratified by the member states of the Central Commission for the Navigation of the Rhine (CCNR) and Luxemburg. It establishes internationally uniform regulations for the collection and disposal of waste produced during navigation. A sufficiently dense network of reception stations has to be established, in order to facilitate a proper deposit of waste by inland vessels. The CDNI system is financed since July 2010 on the basis of a surcharge of EUR 7.50 per 1,000 litres of diesel oil fuelled. For this transaction so called ECO-Cards are issued to the ship operators. The ECO-Card has to be presented at the bunkering stations, which are equipped with terminals for debiting. The tariff of the elimination charge is adapted annually[35].

Ship waste management along the River Danube and other rivers can be described as quite heterogeneous with regard to legal and administrative framework as well as technical equipment. In order to account for this, the establishment of a sustainable, environmentally sound and transnationally coordinated approach in ship waste management along European rivers will need to be further investigated and implemented.

4.3 Long list of measures

In the next table (table 4.10) policy measures are listed corresponding with the bottlenecks identified in section 4.2. A more detailed description of the measures is presented in the Annex 8. (see Annex Report).

[35] Berger, H. et al. (2010), WAste management for inland Navigation on the DAnube (WANDA): A cross border approach to the management of oily and greasy ship wastes, European Inland Waterway Navigation Conference, 10-11 June, 2010, Baja.

Table 4.10 Long listed policy measures for the policy field "Fleet"

Problem	*Measure*	*Short description of proposed policy measures*
A. Slow replacement rate of the existing engines	1. Investigate and implement options to reduce pollutant emissions of existing engines	Study and introduce policy instruments to reduce emissions of existing engines (e.g. setting standards to existing engines, implement environmental zones, introducing a NOx business fund, differentiate port dues)
	2. Implement efficient eco-refit concepts	Design and implement approaches to speed up the implementation of technical innovations into the existing vessels (refitting technologies and strategies) by means of funding schemes.
	3. Financial incentives from shippers and ports for eco-innovation investments	Define market driven awards for innovation investments until 2015, roll-out the award at an annual basis.
B. Poor focus on decarbonisation of IWT fleet	4. Introduce policy instruments to reduce fuel consumption and co-fund research	The measure to be considered can be a design or operational index, of a fuel tax. Additional research and development shall be supported on technologies and innovations to reduce fuel consumption and CO2 emission.
	5. Maintain and implement technical requirements for inland vessels and create eco-competitive technical regulations	Review of Directive 2006/87/EC on technical prescriptions for inland waterway vessels and NRMM Directive 79/68/EC with a view of reducing implementation barriers for vessel innovations such as application of LNG as alternative fuel
C. Unambitious engine emission standards for new engines	6. Revise engine emission standards beyond introduction of phase-IV	The relevant legislation for engine emissions are updated beyond the introduction of the phase IV standard (e.g. to Euro-VI truck level)
D. Fragmentation of available sources of information on innovations and lack of coordination and R&D and deployment plans	7, Create innovation roadmap and accompanying innovation deployment plans: integration in EU RTD and funding instruments	Prepare an Innovation Roadmap defining intermediate steps until 2015 and update the roadmap on a regular basis, carry out research and innovation funding instruments.
	8. Support innovation and technology transfer and roll out planning	Create critical mass for specific IWT innovations, bundle know how and guide transition from research to implementation, support innovation clusters
E. Lack of decision support tools preventing overcapacity in the market	9. Monitor (over)capacity in market segments	Simplify legal framework with regard to market disturbance (Directives 96/75/EC, Regulation EC 718/1999, and survey quantitative indicators regarding the IWT fleet as a basis for (over)capacity measures in specific market segments
F. Poor shipping waste arrangements to operating areas outside the Rhine	10. Analyse waste disposal practice in inland navigation (ship waste)	Carry out pilot projects and define sustainable and environmentally friendly approaches for ship waste disposal.

5 Field 3: Employment & Education

The employment and education of personnel in inland waterway transport is an important issue, because the number of people working in the industry, their skills and expertise determine to a large extent the way, the efficiency and performance how the industry operates and how the mode competes and collaborates with other transport modes and how it plays its role in supply chains.

A sufficient number of available workers in the market as well as high quality in education and mentality of staff is a necessary condition for a high overall performance in IWT and the successful integration of IWT in door-to-door chains.

However, for some time, serious problems exist in the IWT labour market. In particular for middle and higher qualified staff categories there are shortages in the market: more people are demanded than are available or enter the labour market. Moreover, these staff shortages may, very likely, further increase in the future. The reason for this is, firstly, the aging of the present labour force with comparatively more older people working here than in other industries and, secondly, the expected further increase of the transport demands for IWT services.

Furthermore, there are several weaknesses and opportunities in the field of education and some regulatory issues that need to be discussed.

5.1 Overview present situation and outlook 2020, 2040 business as usual

5.1.1 Current situation

This section summarises the current situation in the labour market for IWT services based, as much as possible, on available statistics and studies. The focus is on the quantity and quality of staff.

Number of workers

Although for some countries there is a lack of reliable data, the current estimate of the amount of workers in the EU27 is 42,500 workers (Eurostat, Transport in Figures 2011). This figure includes also the owner-operators and part-time and temporary employment and staff active in passenger transport. The majority (about 65%) of the workers is active in the Rhine corridor.

The development of employment statistics shows a rather stable number of employees in IWT over the last years. There are, however, some differences between countries, e.g. in the Rhine corridor the development of employment in the Netherlands was better than in Belgium and Germany. In Central and Eastern European countries, since EU accession, the downward trend of the 1990s has more or less halted and employment figures stabilised.

The two main reasons for the decline in the 1990s are the reduced manpower requirements due to technical development (especially because of the switch from tug boat to push boat technology) and the reduced transport volumes after 1989 and (temporary) caused by the economic crisis. The number of IWT workers in the Danube region can at present be roughly estimated at 10,000 people.

Looking at market segments, it could be observed that employment in tanker shipping is lower than in dry cargo transport proportional to the lower volume of transport of liquid cargo. A significant share of the total IWT employment in statistics refers to passenger transport. For example in Germany more than 50% of the staff registered as being active in IWT, are in fact active in passenger transport. In general, the growth of passenger transport employment has compensated the decline in freight transport employment in the past years.

The available workforce in inland navigation along the Rhine countries includes a growing share of foreigners. Pushed by EU accession in particular workers from Central and Eastern European countries are employed. In total about 1,200 foreigners are employed in Germany according to recent employment statistics. The majority of 72.1% belongs to EU countries. According to the statistics, the register of service for foreign workers accounts for 13.6% of the workforce in the Netherlands. About half of the foreign workers come from other EU countries. According to other surveys in the Netherlands the proportion is above 20%[36]. The percentage share of foreign workers In the Dutch IWT workforce doubled in the period 2000-2007.

In Belgium, Germany and the Netherlands the share of foreign workers in IWT significantly exceed the average values in the wider economy.[37] A closer look learns that the foreign employees are primarily employed in lower positions; however, a small but increasing number of boat masters are from foreign EU countries.[38] The end of transitional limitation of free labour movement from accession countries in 2011 may increase the share of foreign workers in Germany and Austria.

Significant differences in potential earnings between countries initiate a migration of inland navigation workers within Central and Eastern Europe, as well. In Hungary, about 400 foreigners are employed, in particular ashore. An increasing number of workers from Non-EU countries such as Moldavia are recruited in Central and Eastern European EU countries. To a certain extent personnel migration shift shortages to the east as examples from Lower Danube indicate. It becomes increasingly difficult to recruit staff there, due to comparatively low potential earnings.[39]

While it appears that the wages of migrant workers do not differ much from the wages of domestic workers, their working and social conditions are not always equal to those of domestic staff.

[36] Source: Table 6.6.in Aa van der R. et al. Monitor Maritieme Arbeidsmarkt 2008 (NML, December 2008)
[37] Source: CCNR, Inland navigation in Europe, Market Observation, 2009/1
[38] Source: BAG, Monitoring of working conditions in freight transport and logistics, 2010
[39] Source: CCNR, Inland navigation in Europe, Market Observation, 2010/2

There is still a lack of legislative harmonisation regarding working conditions, in particular for workers from Non-EU countries. Demanding equal conditions might be problem for them as well because they often are not able to easy communicate with employers because they have not a mastery of the language This make their situation even more difficult.[40]

Required number of workers

The number of available qualified workers is insufficient to meet the demand of qualified staff in IWT. The number of registered vacancies for example in German IWT is stable around 100. However, there might be a large number of unregistered vacancies in the German market as well[41].The increasing number of trainees and low unemployment figures are other indicators for a strong demand in Germany. Furthermore, the trend to use larger vessels and the increase of transport demand lead to an automatic increase the number of required workers. In the Netherlands in the year 2008 the number of vacancies was about 6% of the workforce in IWT which is twice as high as the average number of vacancies for others types of employment[42]. This vacancy percentage had been stable in the Netherlands since about 2006. In particular, job vacancies for deckhands but also for boatmen and boat masters are hard to fill. Furthermore, in the same market monitoring report 65% of the 205 companies investigated, expect that vacancy fulfilment will be more difficult in the years 2009-2013[43].

Partly the lack of staff stems from a lack of information of young people of the industry in general and job opportunities in the industry more in particular.

The most important reason, however, is the fact that the companies simply fail to present themselves as attractive employers. Working conditions often initiate workers to leave IWT. The work in IWT is physically demanding and not always very safe[44]. A comparatively high sickness leave is the consequence. For example crew members are usually absent from home during working periods with continuous journeys. This limits the possibilities to interact with family and friends and restricts also the leisure-time activities. Apparently, these unfavourable conditions are insufficiently compensated by positive aspects such as earning possibilities and social standards because of this reason outflow to other sectors.

The lack of newcomers in Danube countries has some specific grounds. Reasons are to be found on both sides of the market since the privatisation process of the former state owned IWT companies along the Danube starting in the early 1990, companies reduced their investments in human capital drastically and several nautical schools were closed. In the Danube area the qualified nautical staff

[40] Source: Buck Consultants International/Progtrans/VBD/viadonau, Prospects of inland navigation within the enlarged Europe (PINE), 2004

[41] Source: BAG, Monitoring of working conditions in freight transport and logistics, 2010

[42] Source: See table 4.6 in Aa van der R. et al. Monitor Maritieme Arbeidsmarkt 2008 (NML, December 2008)

[43] Source: See page 84 in Aa van der R. et al. Monitor Maritieme Arbeidsmarkt 2008 (NML, December 2008)

[44] Although IWT is known as a safe transport mode, the safety risks for staff working in the industry is not insignificant (see also report: Visietraject Veiligheid Binnenvaart, NEA Netherlands, 2011).

(captains, boat masters) is over aged (50+). It is expected that a large share of boat masters will leave the sector within the next 10 years which leaves an even bigger demand gap in the future.

One has to conclude that the sector has (so far) not come up with strategies for recruitment and human resources development (including life-long learning) that could halt this trend of gradually increasing staff shortages which manifested itself already 5-10 years ago in some Member States..

It is important to note that the nature of the shortage problem is distinct for different types of functions on board of vessels. For the operational / support level (boatmen, deckhands) IWT companies do not assess the situation as critical. Auxiliary personnel can be hired and trained quite quickly. On the other hand, for the higher qualified functions the situation is very critical. In this respect one should also observe that, because of the use of more advanced technologies and advances in logistics, there is a gradual autonomous relative increase in the demand for this type of staff. E.g. in the Netherlands in the period 2000-2007 there has been an increase of about 10% in the need of staff with a higher professional or academic education[45].

Due to the economic crises the problem of personnel shortages has temporarily been less pronounced. In some instance personnel were even laid off in the past two years. But as soon as the economy recovers from the crisis the problem will manifest itself again.

Salaries of workers and entrepreneurial staff

Potential earnings are an important determinant of the attractiveness of IWT for employees. Salaries increased moderately in the past years in Western Europe and the wages differ approximately between 14,000 € per year for an ordinary seaman and 35,000 € per year for a boat master.

In general, foreign personnel from Central and Eastern European countries still earn less compared to workers from Western Europe. The wage differential has however narrowed over the past years with rapidly increasing wage levels in countries in Central and Eastern Europe. For instance, average wage level in Czech IWT has increased by 44% between 2005 and 2008. However, average monthly wage of 738 € is still far below Western European levels.[46] In Romania, average annually earnings of employed were about 7.000 € in 2008. Slightly higher are average monthly earnings in Hungarian inland navigation with 687 €.[47] Considering wages in purchasing power parities due to higher price levels in Western Europe the advantage is smaller.

[45] Source: table 2.58 in Aa van der R. et al. Monitor Maritieme Arbeidsmarkt 2008 (NML, December 2008)
[46] Source: Czech Republic Ministry of Transport, Transport Yearbook Czech Republic
[47] Source: CCNR, Inland navigation in Europe, Market Observation 2010/2

Level of education

As has been remarked above, there will be an increasing need of staff with high job qualifications.

Basic vocational training is important to meet staff requirements. Furthermore, it is the base for sufficient high-qualified navigational staff in the future. The shares of theoretical and practical components in training are different among countries. Finishing vocational training, depending on country after 1 to 4 years, the basic profession boatman is achieved.[48]

Subsequently to basic vocational training further qualification of workers during their IWT career is important to meet requirements of high-qualified staff. Building on the basic profession boatman additional theoretical knowledge and experience onboard is included in the course to become helmsman. Helmsman may further graduate to become boat master. Boatman with sufficient experience receives patents for particular rivers such as the Rhine patent. For higher qualifications other courses such as radar, radiophone and handling of dangerous goods are required in most countries.

Apart from nautical skills other aspects such as business management, linguistic capabilities and logistical know-how will become more relevant given the major challenges for IWT to further integrate in intermodal transport chains and to become familiar with and be able to apply new ICT-technology. It will also be required to include more knowledge on the specific environmental impacts of IWT and strategies to mitigate these impacts into training courses since this will become increasingly important in the future.

Linguistic qualification is, moreover, increasingly important due to the increasing share of foreign workers on-board of vessels. Also for safety reasons this is relevant, as misunderstandings could lead to accidents. Regarding qualification of logistical skills of staff in IWT there is still room for improvements. IWT-related logistics education is at present still rather limited in most European countries.[49]

The general educational level of workers in IWT is at present still rather low. For instance, the majority of trainees starting vocational training in German IWT have mastered only a lower or medium school education. Although the share of employees with a high school and university degree has increased over the past years it is still on a low level. In 2009, only 1.3% of workers covered by social security system had finished high school and another 1.3% of employees had completed a course at universities or universities of applied science.[50] Interestingly, this percentage is 10% higher in the IWT-sector in The Netherlands [51]

[48] Source: PLATINA, Deliverable 3.1, Inventory of existing IWT education and training institutes and curricula, 2009

[49] Source: PLATINA, Deliverable 3.6, Inventory of IWT related logistics education institutions and training content, 2010

[50] Source: BAG, Monitoring of working conditions in freight transport and logistics, 2010

[51] Source: See again table 2.58 in Aa van der R. et al. Monitor Maritieme Arbeidsmarkt 2008 (NML, December 2008)

It has to be noted that the educational systems concerning nautical personnel are quite different in the Danube countries. In most countries there is a supply of nautical training in one form or the other (from little training to education on university level). In general there is no obligatory training for operational level.
The European Union as well as the River Commissions have recognized the problems which are caused by different training and certification systems in an international business sector like inland navigation and have already undertaken efforts to achieve ore harmonisation in this field. The two following ongoing initiatives are to be mentioned:

- Within PLATINA the European network of nautical schools (EDINNA) is elaborating STCIN Standards for Training and Certification in Inland Navigation (STCIN). Similar to the existing system of Standards for Training and Certification and Watch keeping for Seafarers (STCW) by the international maritime organisation (IMO) STCIN could be the future of a harmonised IWT training and certification in Europe.
- In 2010 the Danube Commission published "Recommendations on the organisation of the education of inland navigation personnel (deckhands)"[52] The document recommends a three years dual vocational training, very similar to existing training systems applied for example in Germany or Austria. Member States of the Danube Commission decided to implement the recommendations as of 1st June 2011. But, recommendations of the Danube Commission are not legally binding for the Member States.

In the project NELI[53] it was found that IWT plays only a minor role within general transport and logistics education at all levels (from high school to University). Future transport decision makers therefore often do not acquire enough knowledge on how to integrate inland waterway transport into multimodal transport chains.

Average age of workers

The development of the extent of the staff shortage problem In IWT will critically depend on the number of graduates finishing training on the one hand versus the number of retirees leaving inland navigation on the other hand. The present age structure of the workforce gives a good indication of the extent of retirements in the next years. Looking at the various countries in particular in Germany the demographics are increasingly non-favourable. The share of workers aged 50 or above increased to 41 % of the total employment covered by social security system. The share of this age group is 31% in Belgium and France and only 13% in the Netherlands. In the Netherlands the relative share of young staff is much higher: 47% are younger than 25 and the age of 25% of the staff is between 25 and 35. Among nautical personnel in Germany the age structure of boat masters is particularly unfavourable. Hence, the share of German boat masters that is retiring and will retire in the next years is high.[54].

[52] Source: Dok. DK/TAG 75/21. German version available at: www.danubecommission.org/index.php/de_DE/publication.
[53] Source: Cooperation-Network for logistics and nautical education focusing on Inland Waterway Transport in the Danube corridor supported by innovative solutions: www.neliproject.eu
[54] Buck Consultants International/Progtrans/VBD/viadonau, Prospects of inland navigation within the enlarged Europe (PINE), 2004

The share of elder workers is particularly large among self-employed. E.g. 44% of self-employed in Belgium are aged 50 or above. In particular for owner-operators it is difficult to find replacement, as for this type of professions a high qualification is required.

In Germany with more than 40% of employed aged 50 or above more than 3,000 people will retire in the next 15 years. This means that, on average, 200 workers will have to be replaced each year. Considering the fact that 120 graduates are currently finishing schools in Germany a net loss of 80 workers per year will result or else will have to be supplied by other countries. Similarly, in Belgium a net depletion of the Belgium workforce of about 15 workers may occur. However, the Netherlands with a comparatively younger workforce the situation is less critical.[55]

For most countries in the Danube region there are no statistics on the age structure of the IWT workforce. Interviews with inland waterway companies revealed, however, that the qualified nautical staff (management level like boat masters) frequently is also above 50 years of age. It is therefore expected that a large group of boat masters will leave the sector within the next 10 years, which leaves a demand gap in the Danube countries in the future as well.

For Romania more detailed data available for 2010. Taking in consideration that Romania is the most important IWT country along the Danube the conclusions drawn are of relevance for the whole region. Operational level employees are aged between 18 to 65 years and 30% of above number are aged between 18 and 35 years. At management level employees are aged between 25 to 65 years with the following age structure for specific positions below:

- boat masters are aged between 45 and 65 years
- river boatmen are aged between 25 to 45 years
- chief mechanical engineers are aged between 40 to 65 years
- mechanics are aged between 18 to 65 years

Number of students

Given the ageing of the workers, it is important that the number of students passing their exams is sufficient to compensate for retirements of workers. The job perception and specifically the relatively bad working conditions have, unfortunately, continuously reduced the number of young people interested in an IWT career in the past decade. Moreover, on European level IWT trainees in vocational training show a high drop-out rate.[56]

Because of the decreasing trainee numbers and a growing shortage of qualified personnel the industry decided to enhance recruiting activities and to improve the image and increase awareness of IWT among potential trainees.

The figures reported by PLATINA in 2009 indicate a total number of approximately 5,500 students in Europe. Among countries, the number of

[55] CCNR, Inland navigation in Europe, Market Observation 2009/1
[56] Source: Commission of the European Communities, Communication from the commission of the promotion of Inland waterway transport, "NAIADES", 2006

students is comparatively large in the Netherlands with 40% of the total students in Europe. The PLATINA study registered 1,500 to 3,000 students in the Netherlands. Fewer students are registered in Germany (18%). In the Danube region Romania (16%) and Bulgaria (7%) have the largest number of IWT students among other countries.[57] Other countries with students are: France, Switzerland, Czech Republic, Poland, Serbia, Belgium, Hungary, Austria and Slovakia.

The number of graduates corresponds to the quantity of students. Approximately one third of students finish training successfully each year in the Netherlands and Germany.

Indirect employment

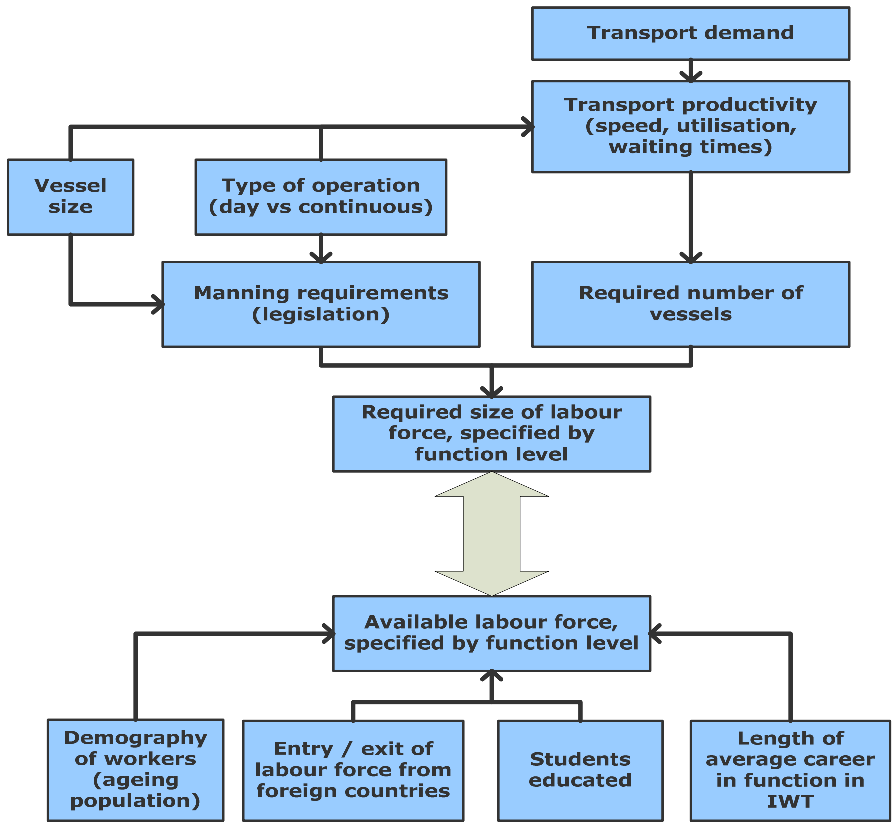
Significant employment is indirectly generated by IWT in sectors such as the petroleum and shipbuilding industry that supply the IWT with inputs needed, such as fuel, vessels, and vessel related services. Furthermore, several jobs at customers are related to IWT. The volume of employment at suppliers and customers of IWT is difficult to quantify and statistics are not available on European level. In order to give an indication: in the Netherlands, indirect employment associated with IWT is estimated as FTE 3700 in 2009, with part-time workers taken into account the total indirect employment generated by IWT is estimated around 10.000.[58]

5.1.2 Outlook for 2020 and 2040

As already observed in the previous section, the present age structure of the workforce in combination with a limited number of students is expected to result in a shortage of workers in future. The expected growth of transport demand is of course also a factor that is influential and that may increase the gap. However, new technology may improve labour productivity which might help to reduce the pressures on the labour market somewhat. It is expected that in the next decades (after 2020) fully or almost-fully automated vessels might begin to be used in IWT. This may of course dramatically reduce again the demand of personnel. So there are a number of factors that should be taken into account when trying to analyse the developments in the labour market. In figure 5.1 the most important factors are presented.

[57] Source: CCNR, Inland navigation in Europe, 2009/1; PLATINA, Deliverable 3.1, Inventory of existing IWT education and training institutes and curricula, 2009
[58] NEA/EICB/Marin, Rivers of the World, Atlas, 2010

Figure 5.1 Scheme on required vs. available labour force



Source: NEA

Regarding the evolution of transport demand the expected growth of transport performance in IWT will be (based on the business as usual scenario discussed in previous chapters):

- 7 - 23 % growth between 2007 and 2020
- 32 – 81% growth between 2007 and 2040

In chapter 3 of this report a detailed breakdown of the outlook on the transport performance in billion tonne kilometres in various corridors is given. This may give a rough indication, not taking labour productivity into account, of the increase in the demand of transport. Growth rates for 2020 could be significant with for EU27 between 7% and 23% compared to 2007. The increase of transport performance between 2020 and 2040 could be between 23% and 47% compared to levels expected 2020 in the baseline scenario.

However, these figures on transport performance hide the fact that there are specific sectors with a high growth potential, like container transport, which clearly have a higher need of staff than other sectors. This applies also to countries within the corridors. For instance in France about 2108 people are directly or indirectly employed in IWT (only freight transport) but it is expected that the size of the workforce may more than triple in 2025 (increase to 6,874 employees)[59].

An important factor that pushes the amount of required staff down can be the increase of the vessel sizes. On the Rhine for motor vessels the manning requirements (required number and type of staff) are the same for a motor vessel of 90 metres (1500 tonnes) compared to a motor vessel of 135 metres (5000 tonnes). Therefore, through scale enlargement of the fleet efficiency can be reached and productivity of the labour can therefore increase.

5.2 Main problems

The competitiveness of the IWT sector and its sustainable development depends on its ability to attract a high-quality workforce. The excellent service level and efficiency record of inland navigation depends for a large part on the presence of skilled staff. A general shortage of qualified staff and entrepreneurial skills remains to be stumbling block for the further development of the IWT sector.

In several countries there is already proof that problems of ageing human resources are becoming serious due to a lack of influx of new workers resulting in a shortage of qualified staff. In particular since the outlook of the general transport demand for IWT is growing in the medium and long term, more workers in IWT are probably needed to transport the growing volumes of goods. In particular much demand for staff is expected in the rapidly growing container sector.

The main problems are:

A. Lack of qualified staff, in particular higher staff such as captains
B. Lack of standards for training, education and certification
C. Weak framework for social security and working conditions
D. Low internal safety, lack of safety culture
E. Lack of logistics know-how among IWT training and lack of attention to IWT in education programmes focussing on logistics
F. Language problems causing lack of efficiencies and safety risks
G. Lack of awareness and information on fuel consumption and carbon footprint

In the next pages the problems and needs of actions will be discussed more in detail.

[59] Source: Information supplied by VNF (2010 Bearingpoint France SAS)

A. Lack of qualified staff

The European IWT market suffers from a shortage of qualified nautical personnel.

High barriers to change jobs to work in IWT
People and students from e.g. technical or other transport professions or education systems could be one possibility to solve this problem. Some European countries are already exploiting this potential by offering tailor-made and efficient programmes for different groups of career changers to join IWT.

Lack of continuous recruitment campaigns
Although the European inland navigation sector offers secure job perspectives, it is not a very popular employer for young people and job seekers. The job opportunities and the profession are often not known and therefore not even considered among young people. . IWT as an employer suffers from the limited level of familiarity among potential newcomers. Consolidated recruitment activities and employer branding as such have only taken place to a very limited extent.

Manning requirements
Minimum manning requirements onboard of inland navigation vessels lay down the minimum number of crew members and their minimum qualifications. Those regulations are not yet fully harmonised within the European Union.
Moreover, given the current available information, communication and computer technologies and more modern and reliable technical systems, it can be studied into what extent navigation and vessel operation is possible using a reduced size of the crew but using modern equipment and ICT systems. This could reduce the problem of shortage of staff as well as improve the job image. Finally a smaller crew size needed may bring down the overall cost of transport by barge, therefore making IWT more competitive and attracting additional cargo to improve the modal split of IWT.

B. Lack of standards for education, training and certification

Job profiles are insufficiently harmonised across Europe: increasing international traffic (e.g. between Rhine and Danube corridor) and labour migration have revealed shortcomings in terms of mutual recognition of professional and equivalent qualifications (due to different education standards), knowledge of foreign waterways (river certificates) and language skills. The lack of harmonisation may not only potentially endanger safety on board, but also practically limit labour mobility in Europe.

Education and training for inland navigation personnel is organised at national level and differs quite strongly from country to country (ranging from learning-by-doing-approaches to education at university level). There are no European minimum standards for IWT education defined. Thus mutual recognition of nautical certificates is difficult. Furthermore the absence of minimum education standards leads to safety risks and hinders labour market mobility.

Within PLATINA a joint working group on professional competencies consisting of representatives of the CCNR, EDINNA, European Transport Workers' Federation, European Barge Union, European Skippers Organisation, Danube Commission and the Sava Commission is working on professional competencies for inland navigation personnel which will serve as a basis for the development of European Standards of Training and Certification in Inland Navigation (STCIN)[60].

C. Weak framework for social security and working conditions

Social security

Whereas European IWT mainly is an international business, social security rules mainly are a national responsibility. This makes human resources management complex, difficult to control and often leads to abuse of the system to the detriment of employees - especially for third country citizens. This fact harms the attractiveness of nautical jobs. The European regulation 883/2004 aims at the coordination of social security systems, though some problems in implementation need still to be solved.

Working times

Working time periods in inland navigation are specific, therefore the general EU's Working Time Directive (2003/88/EC, currently in reviewing process) is not adequate. Social partners of other (transport) sectors already worked out and agreed on specific arrangements. In the Sectoral Social Dialogue Committee for inland waterway transport, the social partners started negotiations in January 2008 on specific working time arrangements in the inland waterway transport sector. The provisions shall take account of the specific needs of the sector. A social partners' agreement is likely to be concluded in 2012.

A lack of predictable leisure times, unknown career opportunities in combination with a low profile and the general image of the inland waterway sector are mentioned as main causes for the current lack of qualified personnel. Once attracted to the sector, it proves to be difficult to retain the personnel for the sector. Relatively high numbers of personnel leave the sector within a few years of time, but also education dropout rates – though reduced in the last years – used to be as high 50% in the first decade of the 21st century[61].

D. Low internal safety, lack of safety culture

A generally high safety level is one of the major strengths of inland waterway transport. However, recent fatal incidents show that there is room for improvements. The risk to die or get injured as a worker in IWT is comparatively high compared to truck drivers or engine drivers. Many fatalities can be prevented by wearing a safety harness in case of falling overboard.

With respect to loading, the stability of vessels is a growing concern, in particular with respect to container, tank and steel transports. Moreover, the

[60] More information provided by PLATINA Workpackage 3 "Jobs & Skills", "Professional competencies for inland navigation, 2011", see www.naiades.info

[61] Scheepvaartkrant, 8 December 2004

variety of dangerous goods with different handling restrictions in chemical supply chains increases. This implies additional requirements regarding the skills of personnel. In addition language barriers on waterways and in ports during loading and discharging of goods are another problem threatening safety.

E. Lack of logistics know-how among IWT training and lack of attention to IWT education programmes focussing on logistics

In order to be able to expand IWT end use IWT better in multi-modal logistics chains it will be necessary to incorporate more specific logistics knowledge in the educational programmes that will be used tom educate future IWT staff.
Surveys and expert interviews undertaken within PLATINA, NELI and previous research projects have shown a clear under representation of IWT knowledge in transport logistics education. Future transport chain decision makers have no or little knowledge on IWT logistics and thus the potentials of this mode of transport are not fully used; a missed opportunity.

F. Language problems causing lack of efficiencies and safety risks

With an increasing mobility on IWT labour market language barriers start to unveil and endanger safety and efficiency in inland navigation. Different from maritime sector, where English is the common language (IMO Standard Marine Communication Phrases) no such common language exists in IWT. EDINNA has set up a working group to develop "River speak" - fixed phrases in English for different communication situations in IWT based on existing IWT lexica and maritime standards. The future implementation of River speak shall start in IWT education and have adequate transition periods before becoming obligatory.

G. Lack of awareness and information on fuel consumption and carbon footprint

Applied research (e.g. CREATING project) and smart steaming competitions like in the Netherlands have shown that smart steaming on inland waterways substantially saves fuel. Supported by smart steaming courses and decision support applications like speed control, river information services and energy consumption registration this potential of energy saving can be realised. A monitoring programme on fuel consumption is required and can be used to reward skippers that made the biggest improvement to run their vessel in the most fuel efficient way. Moreover such a monitoring scheme allows the monitoring on achieving the CO_2 emission reduction target. Experiences from the Netherlands have for instance shown that proper training and use of decision support systems have already lead to a reduction of fuel consumption (and CO2) by 7% (27 million EUR fuel costs savings per year) since the start of the "Voortvarend Besparen" programme in 2007[62].

[62] Ecorys, Monitor VoortVarend Besparen: Eindmeting, 2011

5.3 Long list of measures

In the next table (table 5.1) policy measures are listed corresponding with the bottlenecks identified in the chapter 5.2. See Annex 8 (Annex Report) for more details about the possible individual measures.

Table 5.1 Long listed policy measures for the policy field “Employment and Education”

Problem	*Measure*	*Short description of proposed policy measures*
A. Lack of qualified staff	1. Support European and national recruitment campaigns	Raise awareness on IWT careers and widen potential pool of newcomers to the IWT sector by supporting European and national recruiting campaigns aimed at young people and job seekers.
	2. Develop career changers programmes	Facilitate access to the IWT labour market for career changers by recognition of equivalent qualifications and offering tailor-made training programmes
	3. Support Joint Working Group on Professional Competencies	Create standards on professional competencies and thereby raise mobility on the labour market
	4. Optimise and harmonise manning requirements	Analyse and harmonise crew composition regarding number and qualifications of crew members and possibilities for automation of functions
B. Lack of standards for education, training and certification	5. Harmonise and implement education and training standards (STCIN)	Develop and implement EU-wide Standards of Training and Certification in Inland Navigation (STCIN)
	6. Support standardisation and certification of simulators	Develop standards for different kinds of simulators used in IWT education and training in order to facilitate mutual recognition of education programmes and reduce education time
	7. Support education and training networks and school exchanges	Support the bottom-up approach of existing school networks to harmonise and modernise IWT education and training
C. Weak social security and working conditions framework	8. Harmonise working time regulations	Improve working conditions, raise safety levels and facilitate efficient enforcement by implementing new tailor made working time arrangements that are currently negotiated by the social partners .
	9. Harmonise and establish social security rules in European IWT labour market	Solve implementation problems regarding EC regulation on the coordination of social security systems
D. Low internal safety, lack of safety culture	10. Strengthening safety culture of IWT staff	Contents of education and training in inland navigation will be geared towards achieving higher safety standards. Education will focus more on dangers related to specific goods (e.g. chemicals, containers).

E. Lack of logistics know-how among IWT training and Lack of attention to IWT in education programmes focussing on logistics	11. Integrate IWT knowledge in transport logistics education	Implement a European strategy for the integration of IWT knowledge in general logistics education
	12. Incorporate better and more extensive logistics knowledge in IWT training courses and education	Stimulate that integral practical supply chain knowledge and understanding of supply chain organisation in particular is more extensively included in curricula of IWT education and training programmes is included.
F. Language problems causing lack of efficiencies and safety risks	13. Develop strategy to overcome language barriers in IWT	Support implementation of "River speak" on European waterways
G. Lack of awareness and information on fuel consumption and carbon footprint	14. Provide smart steaming courses and support decision support applications	Support applications and education and training measures to improve sailing behaviour

6 Field 4: Infrastructure

6.1 Overview present situation and outlook 2020, 2040 business as usual

6.1.1 Introduction

Multiple functions of waterways

Freight transport is only one way a lake, a river or a canal is used. Other uses are:

- Tourism: recreational craft, recreational areas, fishing
- Water management: flood protection, agricultural irrigation, water supply for industries and consumption
- Living, landscape and wildlife: ecosystem with wildlife habitats, nature conservation, development of attractive real estate, housing boat
- Hydroelectricity: energy production by means of dams

This means that decisions on IWT infrastructure development generally will not be based on freight transport developments alone but will have to take the other functions of waterways into account as well. Different parties with different interests in the waterway are connected to the other functions. In order to respond to this complex situation in an adequate way, an integrated approach is needed. Because in practice the multiple functions of inland waterways are difficult to separate, it is not easy to unambiguously allocate the costs for infrastructure to the transportation function for goods.

The importance of infrastructure for the IWT industry in general

For transport companies in the IWT industry, the infrastructure is one of the critical production factors in the supply of transport services (besides the vessel and the crew). Only with sufficient size and fairway depth of waterways the transport companies can achieve scale effects of operations and offer transport services at competitive prices. Furthermore, the organisation of traffic management on the waterways is important as well. In particular higher class waterways that allow large vessels to navigate at a 24/7 operation enable highly efficient transport operations. The existence of waterway connections as such, the physical characteristics of the waterway network and traffic management of waterways are therefore determining factors in the costs of transport. Given this dependence, the infrastructure conditions directly determine the competitiveness and modal share of IWT. Moreover, traffic management and the physical characteristics of waterways are also determining factors for the fuel consumption of vessels (energy efficiency) and they thus influence the environmental performance of IWT.

The importance of infrastructure in traditional IWT bulk markets

In 'traditional markets' for large scale transport of bulk products the transport ,in most cases, takes place between origins and destinations which are directly located along waterways. In these markets the total transport costs are primarily the costs for the vessel. An example of such a market is transport demand for coal and ore transport from the seaport to power plant or steel plant located directly at a canal or river. Infrastructure characteristics and the traffic management have, comparatively, the highest impact in precisely these types of markets. Good maintenance of the waterway network (e.g. dredging) is extremely important for heavy bulk products because the fairway depth determines the maximum load factor of vessels and therefore the cost per ton. This again could influence the transport price and the modal share of IWT.

In particular during dry/low water periods the impacts of backlogs in maintenance become very clear. The final consequences could be very serious; e.g. the higher transport rates could result in loss of market share of IWT. Moreover in low water, usually, higher levels of fuel consumption are required to attain the same velocities (due to higher resistance). Well maintained waterways are therefore not only important for enabling the economic efficiency of transport but also for the fuel consumption and the environmental performance of transport.

The importance of reliability in supply chain decision making

Reliability of transport is a decisive factor for the modal choice. Reliability is of course impaired when waterways become temporarily partly or completely unavailable for transport. However, in the context of modal choice the factor of reliability usually has a broader meaning for customers. Most customers do not just want reliable arrival/departure of the goods but also appreciate reliable transport rates, preferably fixed rates in order to know beforehand the share of transport costs in their overall production costs.

In the worst case low water periods could, temporarily, make a waterway partly or completely inaccessible to vessels. Low water periods increase the risks of grounding of vessels in particular and accidents in general. Depending on the circumstances, both the grounding and other types of accident could lead to the situation that there is a blockage of the waterway. These risks therefore directly affect the reliability of IWT as a transport mode in the corridor in which the waterway is located. Furthermore, due to the impact of the water level on the capacity of vessels, customers often have to cope with fluctuating transport prices in periods with rapidly changing water levels. These periods occur on average a few times per year. Lack of waterway maintenance could aggravate this situation and could make transport prices much more volatile.

The importance of infrastructure in non-traditional IWT markets

For less traditional markets, e.g. intermodal chains, the situation is slightly different. The share of the costs for operating a container vessel within the overall transport chain costs (door-to-door) is usually much smaller than in bulk markets. The reason is that much more frequently clients are not directly located at waterways and transhipment to other modes or storage areas is needed. As a result in this type of door-to-door transport the costs for pre- end haulage and transhipment at terminals are mainly critical for the competitiveness of IWT. This is for example the case in continental transport chains with pre- and end haulage on both ends of the chain. In this respect the waiting times of trucks at the terminal or at the premises of the client should be minimised.

At the container terminals high economies of scale may be achieved by transhipment of large volumes of containers. This will result in lower transhipment costs per container and thus a more competitive operation of container terminals. Ideally the terminals are linked to rail networks (trimodal) as well, so that customers have a 'one-stop-shop' terminal that could send/receive goods to/ from areas that either are connected to waterways or are not directly connected to the waterway network. It should be remarked, that such trimodal terminals can have an additional benefit in case of problems on one of the modes (e.g. accidents, low water). By offering an alternative transport option in case of emergencies customers are provided with a higher level of overall transport security. It can therefore be concluded that also the ports and terminals are an important element in the overall infrastructure available for IWT services.

The importance of facility locations and spatial planning

It should be noted that there is a **"trade-off effect"** between the transhipment costs and pre- end haulage costs in container transport. When a terminal serves a large area the transport demand volumes usually will be higher as well (resulting in lower transhipment cost (as was remarked above in the previous paragraph). However, due to the higher average distance that needs to be covered by the truck the pre- and end-haulage, the total costs will increase again. This means that there is an economic limit/ optimum to the expansion possibilities of the service area and that it is very desirable to have high transport demand (e.g. a number of large customers) very close to the terminals. This calls for geographic clusters of logistic industries along waterways. Therefore, the planning of the location of terminals, (new) industrial areas and distribution centres are critical for the modal share of IWT. Unfortunately, local authorities, who often have to decide on the terminal location, generally lack knowledge, lack awareness and lack insight in incentives to incorporate this in planning decisions.

This trade-off effect is much smaller for multimodal bulk transports. Firstly, in this case the specific equipment to load/unload goods is much less expensive. So less critical mass is needed to have acceptable transhipment costs. Secondly in the bulk market in many cases the flows of goods will be more concentrated (fewer pick-up/delivery locations).

For bulk transports and supply chains such as in the construction industry it is therefore more important to have a sufficient density of quays to load/unload goods. Preferably the user is also directly located at such a quay. Examples of users are concrete plants and agribulk silos. Such circumstances prevent expensive pre-end haulage by truck. In such cases IWT chains can provide a very competitive and sustainable transport service and may often work in an almost 'captive market'.

Again the spatial planning decisions to provide sufficient quays and locating industries related to bulk cargo directly along waterway are of crucial importance.

Conclusion

It can be concluded that one of the prerequisites to raise the modal share of IWT is to integrate IWT better into the European logistics market. Considering that IWT cannot offer competitive services for many origin-destination pairs in Europe, new IWT infrastructure or the expansion of existing IWT infrastructure needs to be taken into consideration. This includes the need for multimodal cargo handling areas and industrial zones with direct access to waterways.

But it should be remarked that there also exist conflicting interests with landscape preservation, environmental protection, urban development, etc. These interests have to be balanced against those of IWT.

6.1.2 Size and bottlenecks of the waterway networks

This section gives an overview of the size and the bottlenecks of the waterway networks for inland navigation. Table 6.1 presents the length of the waterway network for different European countries[63] according to the UNECE/CEMT waterway classification. 57% of the total length of the waterway network in Europe is CEMT class IV or higher. Approximately 39% of the European IWT fleet, belongs to CEMT class IV or higher. However, these vessels can only sail on specific corridors. Many IWT operations are closely connected to sea-going transport and several waterways can be used by sea-going vessels.

The most important IWT corridors in Europe are[64]:

- the North-South corridor (parts of the Netherlands, Belgium and France).
- the Rhine and its tributaries (Netherlands, mid-western Germany, north of Belgium, Luxembourg, France and Switzerland);
- the East-West corridor (northern and eastern Germany, Poland and Czech Republic);
- the Danube corridor (Germany, Austria, Slovakia, Hungary, Serbia, Croatia, Bulgaria, Romania)

Figures 6.1 to 6.4 present these corridors graphically according to the UNECE/CEMT waterway classification. It can be seen that there is a broad range of different waterway classes in Europe.

[63] Including the isolated waterway networks in the United Kingdom, Finland, Sweden, Lithuania, Italy, Spain and Portugal.
[64] Source: PINE – Prospects for Inland Navigation within the Enlarged Europe (2004)

Table 6.1 Length (in km) of the waterway network per CEMT class per country

Country	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*Total KM*
AT						360		360
BE	533	484	127	693	792	591		3,220
BG							866	866
CH					17	5		22
CZ				553				553
DE	1,012	395	388	2,989	4,396	3,292		12,472
ES			80					80
FI				218				218
FR	6,692	580	149	194	2,891	200	196	10,902
HR		120	654			106		880
HU	260	834	214	148		886		2,342
IT				636	608			1,244
LT			516					516
LU					37			37
LV			22					22
MD		620	240					860
NL	240	1,567	306	1,197	1,581	1,337		6,228
PL	110	1,761	1,905	275		151		4,202
PT			40	280				320
RO		694	136				1,562	2,392
SE					164			164
SK			400		200	52		652
UA		378					204	582
UK		150	42	54	144	431		821
YU		476	390	48	618	472	279	2,283
Total	8,847	8,059	5,609	7,285	11,448	7,883	3,107	52,238

Source: NEA

Maps of the waterways are presented on the next pages. Based on the map and the table on the previous page the corridors are described.

It can be seen that the **North-South corridor** is characterised by a large share (almost 75%) of minor waterways, mainly navigable for small vessels of about 250 tonnes capacity). Only the Seine and Rhône have a higher CEMT class (Vb). Almost all the other waterways on this corridor are of considerably lower capacity. Also, the condition and maintenance level of some locks and stretches remains sub-optimal compared to the Rhine.

The **Rhine corridor** is the most developed, maintained and utilised corridor. The Rhine corridor consists mainly of upper CEMT classes (IV or higher). For instance, almost 50% of the large network of Dutch waterways are of class IV or higher. This is also seen in Belgium and on waterways in the western part of Germany merging to the Rhine River.

The **East-West corridor** is characterised by: (1) relatively stable and favourable conditions on the Mittelland Canal and (2) quite unstable conditions on stretches of the Rivers Elbe and Oder, which have resulted in a very low modal share of IWT in this area[65].

With regard to waterway density, The Netherlands, Belgium, Germany and France have the densest network of inland waterways in Europe. For example, the Netherlands has by far the highest waterway network density in Europe, equal to an average length of 123 km of waterways per 1,000 km^2 of the land territory, followed by Belgium with 47 km per 1,000 km^2.[66]

The navigable length of the **Danube** available to international waterway cargo transport sums up to approximately 2,415 km, starting from Sulina at the end of the middle Danube distributary into the Black Sea in Romania to the end of the Danube as a German federal waterway at Kelheim. Similar to the Mannheim treaty for the Rhine (1868) the Kelheim–Sulina main route is subject to the Convention on Navigation on the Danube of 18 August 1948 (the Belgrade Convention). The convention ensures free navigation on the Danube for all commercial vessels sailing under the flags of all nations. Apart from the Kelheim–Sulina main route several navigable distributaries and side arms, canals and tributaries form an integral part of the Danube waterway system. Apart from the Kelheim to Sulina section all other transport routes are national waterways, which are subject to various different regulations.

[65] Source: PINE – Prospects for Inland Navigation within the Enlarged Europe (2004)
[66] Source: PLATINA, European Inventory of available knowledge on strategic inland waterway projects, 2010

Figure 6.1 North-South corridor

Source: Promotie Binnenvaart Vlaanderen and VNF

Figure 6.2 Rhine corridor

Source: Promotie Binnenvaart Vlaanderen and VNF

Figure 6.3 East-West corridor

Source: Promotie Binnenvaart Vlaanderen and VNF

Figure 6.4 Danube waterway network

Source: via donau

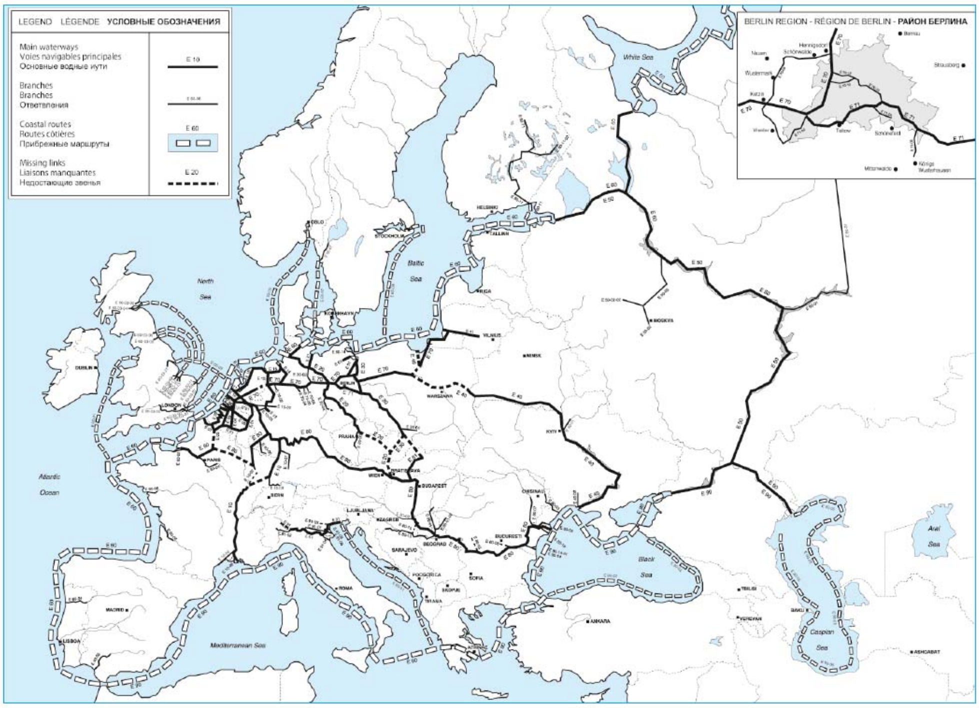
6.1.3 Bottlenecks on the waterway networks

A corridor is as strong as the weakest section in the corridor and therefore specific bottlenecks on certain locations (e.g. low bridges, low fairway depth) do reduce the competitiveness and potential of the corridor. The decision whether or not to solve such bottlenecks are driven by a cost and benefit comparison as well as impact for other functions of the waterway. Costs depend mainly on the requirement investments while the transport benefits are mainly determined by the size of the potential transport flows to be accommodated by the corridor passing such specific bottleneck points. In particular in areas with high transport demand (population, industrial activities) it therefore makes sense to invest heavily in improvements of transport infrastructure.

However also the other functions of waterways play a very important role and investments to improve the navigation conditions can have significant impacts for other functions as well (e.g. landscape, wildlife). Win-win solutions need to be found but it is the experience that developing and implementing an integrative approach takes much time and effort (e.g. Straubing – Vilfshofen).

The European Agreement on Main Inland Waterways of International Importance (AGN) which was prepared by the United Nations Economic Commission for Europe (UNECE) and published in 1996 is the main reference document for inland waterway infrastructure at the pan-European level. The AGN specifies technical and operational criteria for waterways of "international importance" (so-called E waterways of waterway classes IV and higher). The following map presents the network of E waterways.

Figure 6.5 Map of waterways of international importance



Source: European Agreement on Main Inland Waterways of International Importance (AGN), UNECE 1996, ECE/TRANS/120/Rev.2.

Source: UN-ECE 1996

As a follow-up document to the AGN, the Working Party on Inland Water Transport of the UNECE's Inland Transport Committee first published its so-called "Blue Book" in 1998 which is an inventory of the main standards and parameters of the E waterway network. The inventory, which was last published in 2006 as a first revised edition, shows the current inland navigation infrastructure parameters in Europe as compared to the minimum standards and parameters prescribed in the AGN. The "Blue Book" also contains the Annex of UNECE Resolution No. 49 which provides a common definition and classification of inland waterway bottlenecks and missing links as well as a list of the current bottlenecks and missing links identified in the E waterway network.

Apart from current waterway standards and parameters, the "Blue Book" also includes a list of the most important bottlenecks and missing links in the E waterway network which are identified by the national authorities of the UNECE Member States.

The following definitions are used in the "Blue Book" for bottlenecks and missing links:

- Basic bottlenecks: "sections of E waterways whose parameters at the present time are not in conformity with the requirements applicable to inland waterways of international importance", i.e. inland waterways of class IV.

- Strategic bottlenecks: "other sections satisfying the basic requirements of the class IV but which, nevertheless, ought to be modernized in order to improve the structure of the network or to increase the economic capacity of inland navigation traffic."
- Missing links: "such parts of the future network of inland waterways of international importance which do not exist at present."4

An extensive update of the list of bottlenecks and missing links contained in the UNECE AGN "Blue Book" and in the Annex of UNECE Resolution No. 49 was made and ongoing or planned projects in the European countries identified[67].

As physical infrastructure restrictions have been considered:

- Limited draught
- Limited bridge clearance
- Limited lock capacity/ dimension

For each corridor distinguished the bottlenecks were listed. The tables 6.2 to 6.5 present the results as well as a general description and the status of strategic projects. First a short explanation is presented on the type of restrictions and their impact on the competitiveness of IWT and social benefits[68].

Limited draught of the waterway

In general the removal of draught limitations by means of dredging provides substantial benefits to the society. There is a direct impact on the transport efficiency as more cargo can be carried with the same vessel. Each additional centimetre counts. As a result of dredging, not only the transport costs reduce but also the environmental performance improves significantly. The socio economic cost-benefit ratio for such investments is therefore usually rather positive. However the ratio depends on the transport intensity and required investments for dredging. Specific knowledge of the circumstances and the local transport characteristics (freight flows, transport costs, infrastructure, and investments) is needed to judge the profitability for society.

In particular markets with transport operations that fully utilise the available fairway depth will have benefits. Examples of these types of markets are: the transports of ores, coal, sand & gravel as well as liquid cargo. Container transport is usually less affected by a lack of draught (the cargo is less heavy). Furthermore, if there is a problem with lack of draught in only a small part of the entire corridor it will be, comparatively, very cost effective to remove that particular barrier.

[67] PLATINA Deliverable D5.5 "Inventory of existing Bottlenecks and Missing Links on European Waterways", www.naiades.info/waterways.
[68] Policy Research Corporation & NEA,. Policy Strategy Inland Waterway Transport Ministry of Transport and Public Works, 2007

Limited bridge clearance

The cost-benefit ratio will depend to a large extent on the size of the container transport intensity as well as the options and the costs to heighten the bridge. For bulk transport bridge clearance is not an issue. After increasing the bridge clearance it could become possible to add another layer of containers, for example:

- an increase from 2 to 3 tiers of containers per vessel, thus increasing the maximum payload for a standard 86 metre container vessel from 60 to 90 TEU
- an increase from 3 to 4 tiers per vessel, thus increasing the maximum payload from 156 TEU to 208 TEU for a standard 110 metre container vessel.

The transport costs per TEU for the container vessel could then decrease with approximately 20%. It has to be noted however that in intermodal chains the share of cost required for the vessel is usually modest in the overall port-to-door or door-to-door chain as there are also relatively high costs for transhipment and pre-end haulage operations. Therefore, for those stretches that are very important for hinterland transport of containers to/from seaports such investments to increase bridge clearance could have a positive cost-benefit ratio.

Limited lock capacity and/or dimensions

Locks can be a bottleneck in two ways:

- Lack of capacity resulting in waiting times for vessels,
- Too small dimensions, limiting the access to waterways for larger vessels.

The construction and/or expansion of locks is relatively costly compared to other types of infrastructure measures such as dredging or the increase of bridge clearance. Whether or not a project regarding locks has a favourable cost-benefit ratio depends highly on the specific circumstances. One of the indicators is the Intensity/Capacity ratio of the lock (I/C). If the I/C ratio becomes high (e.g. 0.8 or 0.9) there will be longer waiting times for vessels and therefore the costs of transport will increase resulting in loss of modal share and higher costs for shippers and consumers. In the Netherlands it turned out that for the replacement of locks an I/C ratio between 0.6 to 0.8 is needed in order to have a positive cost-benefit ratio in order to reduce waiting times for vessels.

Locks can also be the major components in a corridor to upgrade in order to allow access for larger vessels. For example there are projects to upgrade the waterway class from CEMT class II or III to class IV or V by means of expanding the lock dimensions. Often a completely needs to be constructed. The question whether or not to invest in upgrading of locks and waterways is rather complex. Detailed and extensive studies are needed to identify and determine various costs and benefits.

Rhine corridor

Table 6.2 Waterway bottlenecks on Rhine corridor[69]

General description:	The Rhine corridor is rather mature with respect to the available infrastructure. Also a high density inland terminal network is available. Focus for infrastructure development in this corridor will be on coping with low water problems (maintenance work) as well as preservation of quays and inland terminals. The general policy is to develop a 2.8m usable fairway on the lower Rhine - low fairway depth at dry seasons between Cologne and Duisburg (2.5 m) and from St. Goar to Mainz (1.9 m). Over 1 billion euro is needed for dredging. Also specific attention needs to be paid to waterside location of new logistic areas and industrial plants. Finally on some stretches more waiting/resting areas are needed.		
Specific bottlenecks	Limited draught	Limited bridge clearance	Limited lock capacity/ dimension
F: Moselle (E 80) Metz and Apach		x	
D: Rhine - Herne Kanal (E 10-03)	x		
D: Dortmund - Ems Kanal (E 13)	x	x	x
D: Mosel (E 80)			x
D: Main (E 80)	x		
D: Neckar(E10-07)	x	x	x
NL: Zuid–Willemsvaart (E 70-03)	x		
NL: River IJssel (E 70)	x		
NL: Meppel–Ramspol (E 12-02)			x
NL: Lemmer–Delfzijl route (phase 1) (E 15)	x	x	
NL: Twente Canal (E 70)	x		x
NL: Lek Canal (E 11-02)	x		x
NL: IJsselmeer-Meppel (E 12)	x		
NL: River Zaan (E 11-01)	x		
NL: Wilhelmina Canal (E 11)			x
NL: Gouwe (E 10)			x
Status of priority projects Rhine corridor			
Saône-Moselle (E 10-02) and Rhine link (E 10)	This is considered as a missing link in Europe. The connection would link the port of Marseille in Southern of France to the Rhine corridor. For implementation in the period after 2020 also the Rhine-Rhone and Mosel-Rhone connection are put forward on the European infrastructure development agenda. This project is currently under review in preparation for public debate. Studies are ongoing on the costs and benefits. Opening of the canal links is not expected before 2025.		

[69] Source: PLATINA Deliverable D5.5

North-South corridor

Table 6.3 Waterway bottlenecks on North-South corridor[70]

General description:	A significant upgrade is expected on this corridor through the Seine-Schelde corridor (to be ready by 2017). Focus for infrastructure development in this corridor will be on upgrading projects of waterways (missing links) including also new inland terminals and quays possible accommodating new types of industries and opening new markets (e.g. container transport between Paris and Antwerp/Rotterdam). Many investments are planned in the construction of upgraded locks as well as increased fairway depth and bridge clearance and are co-funded by TEN-T (30). Also the Meuse river is upgraded and co-funded by TEN-T (18).

Specific bottlenecks	Limited draught	Limited bridge clearance	Limited lock capacity/ dimension
B: Kanaal Bocholt–Herentals (E 01-01)	X		X
B: Zuid–Willemsvaart (E 01-01)	X		X
B: Gent–Oostende Canal (E 02), Brugge - Beernem section	X	X	
B: Harelbeke–Halluin lock (E 02)			X
B: Plassendale–Nieuwpoort Canal (E 02-02-01)	X	X	X
B: Charleroi–Bruxelles Canal (E 04), Lembeek - Bruxelles section	X	X	X
B: Bossuit–Kortrijk Canal (E 05-01), Zwevegem - Kortrijk section			X
B: Dender (E 05-04), Aalst - Dendermonde section	X		X
B: Canal de Lanaye (E 01)			X
B: Lys (Leie) Mitoyenne - Lys (Menin - Deinze section) and Lys Derivation Canal up to Schipdonk (E 02)	X	X	X
B: Albertkanaal (E 05), Wijnegem passage and section Kanne – Liège	X	X	X
B: Boven-Zeeschelde (E 04)	X	X	X
B: Bovenschelde (E 05) Locks Asper, Oudenaerde and Kerkhove		X	X
B: Meuse in Ivoz-Ramet and Ampsin Neuville (E 01)			X
B: Gent Circular Canal (E07)		X	X
B: Canals between Charleroi and the French Border (E01/E05-02)	X	X	X
F: Oise (E 80) from Conflans to Creil. Section to be increased up to Compiègne	X	X	X
F: Oise (E 80) Creil and Conflans		X	
F: Dunkerque - Escaut link and Escaut (E 01) up to Condé (no navigation possible currently)	X		
F: Deûle Canal (E 02) - lock at Quesnoy sur Deûle			X
F: Port of Le Havre (E80-02)			X
F: Seine (E 80-04) – section Bray and Nogent-sur Seine	X		
F: Rhône to Sète canal (E 10-04) Rhône to Sète	X	X	
NL: Maasroute (E 01)	X	X	X
NL: Rotterdam–Gent Corridor (including Canal Gent-Terneuzen) (E 03, E 06)	X	X	X

[70] Source: PLATINA Deliverable D5.5

Status of priority projects North – South corridor	
Seine- Schelde link (E 05)	To link Paris, the port of Le Havre and Rouen and the Parisian basin to the northern network. Canal will be 106 km long between Compiègne and Cambrai.Traffic forecast on the canal, in 2020 : 15 million tons carried and in 2050: 28 million tons carried. Construction works: 4 billion EUR. It is a major part of TEN-T project 30. Finalisation of the construction work is expected in 2017.
Meuse river (E 01)	The project is expected to be carried out between 2012 and 2018. It has a budget of 1,6 billion EUR in total and is part of TEN-T project 18. The fairway is adapted also for purposes of water management (fluctuating water levels, flood protection). 2 barge push convoys will be possible in future on the Meuse river. Another aim is to safeguard 4 layer container transport on Maas route (now 3 layers). Major works will therefore be executed between Nijmegen and Maastricht on locks and bridges. Moreover, the insufficient capacity of Ternaaien (Lanaye) locks cause long waiting times for inland navigation. One of the locks needs to be modernised as it is unreliable, the lock capacity (adding 4th lock) at Ternaaien will be increased to improve reliability of operating the locks.

Figure 6.6 Seine - Schelde connection

Source: VNF East-West corridor

Table 6.4 Waterway bottlenecks on East-West corridor[71]

General description:	Upgrading projects are ongoing on the German Mittellandkanal. However the German infrastructure policy tends to focus primarily on the major routes and gives less attention to smaller waterways such as the Elbe. In general it can be stated that there is big uncertainty about expansion or upgrading projects in Poland and Czech Republic for the Elbe and Oder waterways. As a result the cross border connection of the Rhine basin with Poland and Czech Republic fails to connect efficiently. In that area are also several low bridges that reduce the efficiency of container transport on this corridor.

Specific bottlenecks	Limited draught	Limited bridge clearance	Limited lock capacity/ dimension
CZ: Elbe (E 20), draught limitations and lock in Přelouč	x		x
CZ: Vltava (E 20-06)	x	x	x
DE: Saale (E 20-04) from Calbe to Elbe	x		
DE: Mittellandkanal (MLK) (E 70)	x	x	x
DE: Elbe-Havel-Canal (E 70)	x	x	x
DE: Untere Havel – Wasserstraße (E 70)	x	x	x
DE: Berlin region waterways (E 70)	x	x	x
DE: Havel - Oder - Wasserstraße (E 70)	x	x	x
DE: Weser (E 14)	x		x
DE: Elbe (E 20) – Middle and Lower Elbe	x	x	
DE: Elbe-Seitenkanal (E20-02)			x
PL: Odra river waterway (E-70) between Brzeg Dolny – Nysa Łużycka estuary	x		x
PL: Extension Upper Vistula river waterway (E 40) – 13,5 km	x		
PL: E 70 Odra and Warta - Notec - Bydgoski Canal (E 70) from Kostrzyn to Bydgoszcz	x	x	x

Status of priority projects East-West corridor	
Completion of project No. 17 German Unity (Rhine - Berlin) (E70)	Over the past years the Mittellandkanal was already upgraded to class Va and Vb. Substantial investments are planned for the Elbe-Havel-Canal (E 70) and the Untere Havel – Wasserstraße (E 70). For these two stretches the investment is already 400 million euro. Bridge clearance will be increased and lock dimensions expanded. Sharp bends will be solved. Waterway depth shall increase to at least 2.8 meters on this corridor.

[71] Source: PLATINA Deliverable D5.5

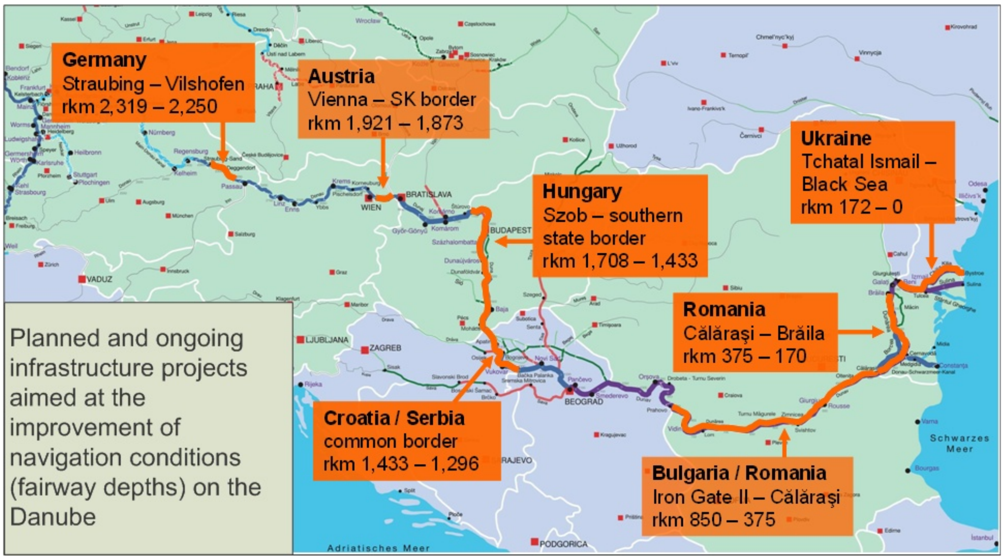
Danube corridor

Regarding the projects on the Danube the TEN T Annual Report [72] points out:

- For the 70 km long bottleneck situated between Straubing and Vilshofen, the German Federal Government, together with the Bavarian State Government, launched a three year Study in 2008.
- The bottleneck stretch east of Vienna up to the Slovak border is being dealt with in an integrated river engineering project. Studies and a pilot test project in Deutsch-Altenburg are being undertaken to guarantee reliable and consistent navigation capacity throughout the year. The pilot project is performed over a length of 3 km and comprises the restoration of the original banks by taking away the old constructions and by levelling the river bed.
- A study on the Hungarian stretch of the Danube, which was launched in June 2009, aims to identify the locations for the restoration of safe and reliable navigation.
- A feasibility study on the long section between Bulgaria and Romania is supported by the former accession countries programme (ISPA). An extensive monitoring programme to evaluate the environmental impacts has been initiated to accompany the works.

The planned and ongoing projects are illustrated by the following map:

Figure 6.7 Planned and ongoing projects on the Danube



Source: via donau

[72] TEN-T Trans-European Transport Networks, Annual Activity Report 2009-2010 for Priority Project 18 (Rhine/Meuse-Main-Danube Inland Waterway Axis) and Priority Project 30 (Inland Waterway Seine-Scheldt), Brussels, July 2010

Table 6.5 Waterway bottlenecks on Danube corridor[73]

General description:	The political and economic transition that has been taking place in East and Southeast Europe over the last 15 to 20 years has had severe repercussions on the transport system of the Danube region. Due to a lack of waterway maintenance in these years (insufficient funding, weak political backing etc.), there are currently several critical sectors (bottlenecks) on the Danube as well as on its navigable tributaries. For the elimination of these bottlenecks, feasibility studies have been finished for almost all critical sectors, and in a few cases, construction works are already ongoing. Compared to the other corridors there are in particular problems with the lack of draught. For container transport the bridge clearance is a problem. However, the size of the container transport volumes on the Danube waterway is quite small.

Specific bottlenecks	Limited draught	Limited bridge clearance	Limited lock capacity/ dimension
AT: Danube East of Vienna (E80) km 1,921.0 - 1,872)	x		
BA: Sava (E 80-12) km 507.0 – 174.8	x	x	
BG: Danube (E 80) km 845.5 – 375.0	x		
HR: Sava (E80-12) km 583.0 – 207.0	x	x	
DE: Danube (E 80) km 2,319.3 – 2,249.9	x	x	
DE: Danube (E 80) km 2,311.27		x	
HU: Danube (E 80) km 1,810.0 – 1,708.0	x		
HU: Danube (E 80) km 1,708.0 – 1,433.0	x		
MD: Prut (E 80-07)	x		
MD: Nistru (E 90-03) km 228 – 25	x		
RO: Prut (E 80-07) km 407.0 – 0.0	x		
RO: Bega Canal (E 80-01-02) km 65.6 – 109.6	x		x
RO: Danube (E 80) km 863.0 – 175.0	x		
RO: Danube (E 80) km 170.0 – 0.0	x		
RS: Begej (E 80-01-02) km 65.6 – 0.0	x		x
RS: Danube (E 80) km 1,254.25		x	
RS: Sava (E 80-12) km 207.0 – 0.0	x	x	
RS: Danube (E 80) km 1,405.6 – 1,227.9	x	x	
RS: Tisa (E 80-01) km 164.0 – 0.0	x		
SK: Váh (E 81) km 243.0 – 73.0	x		x
SK: Danube (E 80) km 1,880.26 – 1,867.0	x	x	
SK: Danube (E 80) km 1,868.14		x	
SK: Danube (E 80) km 1,810.0 – 1,708.2	x		
SK: Váh (E 81) km 101.9 – 63.1	x		x
SK: Váh (E 81) km 42.0 – 0.0	x		
UA: Danube, Chilia branch (E 80-09) km 172.36 – 0.0	x		

[73] Source: PLATINA Deliverable D5.5

Status of priority projects Danube corridor	
Danube: Straubing - Vilshofen (DE), rkm 2,319.3 - rkm 2,249.9	After many years of interdisciplinary studies there is currently no agreement about the variant to be used in order to eliminate this bottleneck. In order to be able to start construction works based on an agreed-upon variant, a study for an independent assessment of the different variants was started in October 2008 with a budget of 33 million EUR (at 50% TEN-T EU co-funding). The study investigates the effects of Variant A (river engineering measures) and of Variant C280 (river engineering measures & barrage) on the environment and on navigation, including a traffic prognosis as well as an investigation on the cost-effectiveness of the foreseen measures. The study will be finished in December 2012. Further steps and time frame for construction works are unknown.
Danube: Vienna - SK border (AT), rkm 1,921 - rkm 1,872	In December 2011, the Pilot Project Bad Deutsch-Altenburg received a positive assessment by the competent authorities. On a length of about three kilometres, the project will provide for comprehensive measures to renaturalise the Danube and to improve navigation conditions on this sector. Scheduled for Winter 2011, the beginning of the construction works will depend on ecological and navigation-related aspects. Construction works will last for about three years with a budget of 14 million EUR (at 50% TEN-T EU co-funding). Based on the scientific findings which will be gained during this Pilot Project, the Integrated River Engineering Project on the Danube East of Vienna will be continued. The IREP is budgeted at 220 million EUR (index: 2006), subject to cost changes through authority procedures. The construction period for the entire project will have a duration of 8 to 9 years.
Danube: Szap - Szob (SK/HU), rkm 1,811 - rkm 1,708	According to a TEN-T co-funded study finished in 2007, there are 15 critical sectors on this free-flowing common border section of the Danube river between Slovakia and Hungary. Waterway maintenance and development activities on this section are handled through the Hungarian-Slovak Water Management Committee, but to date, there are no activities known which are aimed at the elimination of the above-mentioned bottlenecks.
Danube: Szob - southern state border (HU), rkm 1,708 - rkm 1,433	According to a TEN-T co-funded study finished in 2007, there are 31 critical sectors on the entire national Hungarian section of the Danube waterway (excluding the common border stretch with Slovakia). In March 2008, another study budgeted at 8 million EUR (at 50% TEN-T EU co-funding) was started which includes surveying of the riverbed, drawing technical designs, making the necessary environmental studies and impact assessments, and getting the approval of the competent authorities for all of the interventions along the said river section. The study was finished in November 2011 with the completion of the global environmental assessment. Further steps and time frame for construction works are unknown.

Danube: Bezdan - Belgrade (RS/HR), rkm 1,433 - rkm 1,170	According to the Master Plan for IWW Transport in Serbia (2006), 18 critical sectors were identified on this free-flowing stretch of the Danube in Serbia. In May 2011, a project was started with the aim to draft the necessary designs and tender documentation for river training works on the five most critical sections, in order to start river training works and improve navigation safety conditions. Some critical sections are located at the Serbian-Croatian joint section of the Danube River. Cooperation is needed in terms of achieving common technical solutions for designs for critical sections located on the joint section. This cooperation will be executed within the Commission for implementation of Serbian-Croatian Bilateral Agreement on Navigation (signed in 2009). The end date of the project is January 2013 and it has a budget of 1.85 million EUR (IPA 2010 funding). Construction works are planned with a budget of 18 million EUR (IPA 2011-2013 funding).
Danube: Žeželj bridge in Novi Sad (RS) rkm 1,254.25	Construction of a new road and rail bridge across the Danube at Novi Sad instead of the provisional bridge which was built after the 1999 NATO bombings. The provisional bridge has low height (6.82 m) and insufficient fairway width for pushed convoys. In January 2011, the Vojvodina government and the Spanish-Italian consortium signed the construction contract. The value of works is 45.3 million EUR (IPA 2009 co-funding: 26.2 million EUR). According to the contract, the duration of construction works is set at 32 months; bridge construction will begin in February 2012, dependant on the finalisation of the technical design.
Danube: Iron Gate II - Călăraşi (BG/RO), rkm 863 - rkm 375	The project is a transboundary one and it will be implemented on the territory of Bulgaria and Romania. A feasibility study was performed by the Romanian side through the project "Technical Assistance for improvement of the navigation conditions in the Common Romanian - Bulgarian section of the Danube river and accompanying studies" (EU co-funded by ISPA) with the aim to have a detailed picture on the more than 30 bottlenecks on this free-flowing section of the river. Two of the most critical bottlenecks, namely in the section between km 530 and km 520 (Batin) and the section between km 576 and km 560 (Belene), shall be eliminated by a Bulgarian project for which the budget is set at 138 million EUR (85% EU co-funding from the ERDF). The start of construction works is dependant on the finalisation of the environment procedures, project design and tender documentation.
Danube: Călăraşi - Brăila (RO), rkm 375 - rkm 175	Finalised in June 2005, a feasibility study identified more than 10 bottlenecks on this Romanian stretch of the Danube waterway. The technical design for the elimination of these critical sectors was finished in April 2006. The Natura 2000 permit was received in March 2007, in April of the same year the EIA Agreement was accomplished. The contract for construction works was signed in June 2009, and construction works commenced in January 2010. In implementation Phase I technical works are only foreseen in the following, most critical sections: Bala and Caragheorghe (km 347-343), Epurasu Branch (km 342.7-341.6) and the Ostrovo Lupu area (km 197-195). Further works in the other seven critical sections are foreseen in a second phase, provided that the accompanying monitoring programme for phase I should prove the necessity of additional works. The costs of the intervention in the Phase I is 38 million EUR (co-funded by ISPA and further Cohesion Fund), the costs for the environment monitoring is 8.8 million EUR and the estimation for the construction of a fish passage is around 10 million EUR.

Danube: Kilia / Bystroe arm (UA), rkm 172.36 - rkm 0.00	The project "Danube-Black Sea Deep-Water Navigation Route" has the aim to restore the Ukraine's access to the Black Sea via the Danube's Chilia, Starostambulsk and Bystroe arms on Ukrainian territory. The project is to be implemented in two phases including the construction of a retaining dam to the north of the sea access navigation channel (Bystroe arm) as well as a training wall at the bifurcation of the Starostambulsk and Bystroe arms; in addition dredging of 14 shallows (at a cumulative length of 31 km) in Chilia and Starostambulsk arms and riverbank strengthening (length: 2.1 km) on Starostambulsk and Bystroe arms. Phase 1 to create fairway conditions for vessels with a draught of up to 5.85 m; Phase 2 for vessels of up to 7.2 m. Total costs of the project are estimated at 51 million EUR. Currently, the first phase of the project is being implemented.
Sava (RS/BA/HR), rkm 594 - rkm 0 (navigable river course)	The main objective of the project "Rehabilitation and Development of Transport and Navigation on the Sava River Waterway" is the rehabilitation and development of the Sava River waterway infrastructure and provision of an appropriate economic and organizational framework for restoring trade and navigation (cargo and passengers) on the Sava. Planned project activities are the development of the detailed design and the execution of river training works (groynes, sills, bank protection, dredging and bridge reconstruction). Currently, the detailed design for the foreseen river engineering measures is being drafted. The project's end date is December 2016, its costs are estimated at 85 million EUR (co-funded by IPA, Structural Funds as well as IFI loans by the World Bank and the EBRD).

TEN Funding

At the level of the European Union the elimination of inland waterway infrastructure bottlenecks and missing links is addressed within the framework of the Trans-European Transport Network (TEN-T). The infrastructure projects funded under the framework of TEN-T in large parts correspond with the bottleneck identification provided by the UNECE.

From 2007 onwards the EC has significantly increased its share attributed to IWT. In the perspective of the present Trans-European Transport Network (period 2007-2013), the EU has granted 610 million euro to TEN-T Priority Projects No. 18 (Rhine/Meuse-Main-Danube) and No. 30 (Seine-Schelde), being 11.5% of the total TEN-T priority projects budget. 50% of the overall TEN-T budget is spent on railways. In addition, the EU financially supports IWT infrastructure development for 66 million EUR in smaller projects (Po, Mosel, Cologne port, Mittelland Canal and Havel/Odra).

In addition, in the last year, detailed plans for the Seine-Nord canal have been unfolded. The competitive dialogue for the construction of the new Seine-Nord canal in northern France has officially been launched, which means that concrete steps are being taken towards the appointment of the construction company which will build the new canal which is planned to be open for navigation by 2017. The new canal will be 106 km long and will be accessible to barges of 4,400 tonnes. It will connect the Paris region to the north and west European waterway network. Voies navigables de France expects that by 2020 some 15 million tonnes of freight per year will be carried on the canal.

Connecting Europe Facility

On 19 October 2011 the European Commission proposed the new framework for European financial support for infrastructure projects of European interest, the Connecting Europe Facility[74]. The instrument will finance projects which fill the missing links and eliminate bottlenecks in Europe's transport network. The inland waterways of Class IV and higher will be part of the new core network. Selected inland ports will form the nodes of the core network.

Core network projects will prioritize projects along the 10 implementing corridors on the core network. Inland waterway projects will be part of the 7 multimodal corridors:

- **Corridor 2** (Warszawa – Berlin – Amsterdam/Rotterdam – Felixstowe – Midlands): West-German Canals, Mittellandkanal, Hannover – Magdeburg – Berlin, Amsterdam locks

- **Corridor 3** (Mediterranean Corridor): Milano - Mantova - Venezia – Trieste

- **Corridor 4** (Hamburg – Rostock – Burgas/TR border – Piraeus – Lefkosia): Hamburg - Dresden - Praha – Pardubice and Děčín locks

- **Corridor 6** (Genova – Rotterdam): Basel - Rotterdam/Amsterdam/Antwerp

- **Corridor 8** (Dublin – London – Paris – Brussel/Bruxelles): Le Havre – Paris

- **Corridor 9** (Amsterdam – Basel/Lyon – Marseille): Maas, Albertkanal, Terneuzen – Gent, Canal Seine – Escaut, Waterways upgrade in Wallonia, Canal Saône - Moselle/Rhin, Rhône

- **Corridor 10** (Strasbourg – Danube Corridor): Main – Main-Donau-Canal – Danube

These corridors correspond to the four corridors distinguished in this study. Table 6.6 presents the allocation.

[74] (2011/0294(COD)) and (2011/0302 (COD))

Table 6.6 Allocation corridors study compared to Connecting Europe Facility

Corridor Study	*Corridor Connecting Europe Facility*
Rhine	• **Corridor 6** (Genova – Rotterdam): Basel - Rotterdam/Amsterdam/Antwerpen
North-South	• **Corridor 8** (Dublin – London – Paris – Brussel/Bruxelles): Le Havre – Paris • **Corridor 9** (Amsterdam – Basel/Lyon – Marseille): Maas, Albertkanal, Terneuzen – Gent, Canal Seine – Escaut, Waterways upgrade in Wallonia, Canal Saône - Moselle/Rhin, Rhône
East-West	• **Corridor 2** (Warszawa – Berlin – Amsterdam/Rotterdam – Felixstowe – Midlands): West-German Canals, Mittellandkanal, Hannover – Magdeburg – Berlin, Amsterdam locks • **Corridor 4** (Hamburg – Rostock – Burgas/TR border – Piraeus – Lefkosia): Hamburg - Dresden - Praha – Pardubice and Děčín locks
Danube	• **Corridor 10** (Strasbourg – Danube Corridor): Main – Main-Donau-Canal – Danube

In addition to the identified bottlenecks (see tables 6.2 to 6.5), the new framework could also provide an opportunity to study missing links that were identified in the past, such as:

- Danube – Oder – Elbe connection
- Rehabilitation of the Sava River, Danube – Sava canal
- Meuse – Rhine
- Seine - Moselle

For each corridor a corridor platform for defining the general objectives and coordinating the measures shall be established and a development plan shall be prepared. In this framework, the bottlenecks, missing links, inland ports and terminals must be taken into account in order to strengthen the position and potential of IWT.

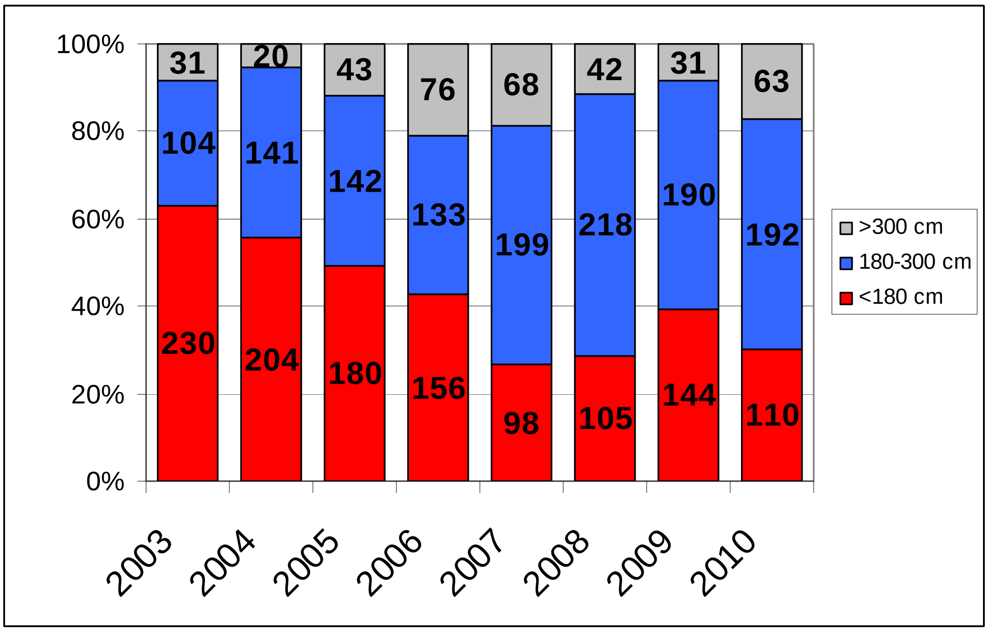
6.1.4 Availability and reliability of infrastructure

Low water conditions and maintenance

As indicated in the previous section, there are on many corridors problems with lack of draught of waterways (see tables 6.2.to 6.5). Low water levels do directly reduce the loading factor of inland waterway vessels. Due to the reduced loading factor the costs per tonne cargo transported increase. On the free flowing sections (e.g. Rhine) the IWT sector compensates low water conditions with low-water surcharges, which increases the price per tonne transported. This is generally (on short term) attractive for the IWT operators but unattractive for the users (shippers, forwarders). Maintenance works such as dredging is one of the major solutions as well to reduce the sensitivity to dry periods. The fairway may become smaller but deeper, resulting in a more demanding navigation but with high payloads at lower prices for the clients.

Waterways in the Rhine corridor are characterised by much higher nautical requirements than other waterway corridors in Europe. In certain periods of the year (e.g. in dry seasons) low-water levels can significantly constrain shipping operations. Figure 6.8 presents the number of days between 2003 and 2010, where water levels at the Kaub were below 180 cm, between 180-300 cm and above the 300 cm. This figure shows that in 2003 approximately 63% of the year the water levels at Kaub were below 180 cm. This meant that in 2003 all vessels of class IV and higher had to cope with constraints on specific sections of the Middle Rhine. The result was that a number of shipping companies had to suspend their operations and/or that vessels could only navigate with a much lower loading rate than normal. This situation occurred also in November 2011.

Figure 6.8 Number of days of the year with different water levels at the Kaub



Source: NEA analysis based on ELWIS data

On the Elbe and Oder (East-West corridor) operators also have to deal with large annual water level fluctuations and, in addition, cold winters with long-lasting periods with ice-related suspension of navigation and similar constraints on IWT operations. Also, given the limited usual water depths on these rivers, the barges have been constructed so that their maximum allowed draught does not exceed two metres[75].

In general, the average size of self-propelled vessels and barges operating on large rivers of the North-South corridor (e.g. Seine and Rhône/Saône) is similar to those on the Rhine. On the other hand, the large majority of fleet units operating on the remaining (smaller) rivers and canals of the North-South corridor are comprised of small self-propelled dry cargo vessels.

On the Danube corridor there are several stretches that are also very sensitive to dry periods (low water). E.g. in the spring and November 2011 certain parts of the corridor were completely blocked for weeks due to lack of water. The small fairway depth on the section Straubing – Vilshofen reduces the efficiency for Danube navigation as well. Apart from the limited number of strategic waterway bottlenecks, fairway conditions on the Danube are relatively good. For instance using the long-term annual average from 1995 to 2010, the Austrian section of the Danube waterway was open to navigation on 98.2% of days, or on 359 days per year[76].

Climate change effects on IWT

According to meteorologists climate change can result in more severe rain periods on one hand and on the other hand more dry and warm conditions in Europe. This can reduce the problems of ice significantly and therefore also positive effects are expected for the position of IWT, in particular the Main-Danube-Canal would be more reliable. Moreover the global warming can result in less melting water from the glaciers.

A negative expected impact for the position of IWT is caused by the further amplification of fluctuations in water levels, in particular on free flowing waterway sections, such as the middle and lower Rhine and parts of the Danube River. Mainly long lasting dry periods resulting in low water conditions for weeks are problematic for shipping goods via IWT as freight prices increase drastically. However, the preliminary findings from the FP7 ECCONET project indicate that no substantial impact of climate change is expected until the year 2050. It is certainly not expected that dry periods such as experienced in 2003 will become the 'normal' situation. Moreover, there is still much uncertainty about the climate models and the actual scenario that will take place. Even scenarios indicating an increase of average water level are considered as a possible outcome. Nonetheless, the hardly predictable developments and impacts cannot prevent from further research and investigation of possible adaptation strategies.

[75] Source: PINE – Prospects for Inland Navigation within the Enlarged Europe (2004)
[76] via donau, Jahresbericht Donauschifffahrt 2010.

Accidents and reliability of IWT

Another aspect that may put constraint on the reliability of the waterway infrastructure is accidents with vessels. Most accidents in the inland waterway transport do not lead to human losses, but mainly to damage on the infrastructure, vessel and in some cases damage and/or loss of cargo.

An example of the impacts of an accident in the IWT sector is the tank barge Waldhof (carrying sulphuric acid) which capsized on 13 January 2011 on the Rhine River near the Lorelei rock. This capsized barge has severely restricted commercial travel on the Rhine River and blocked hundreds of vessels for weeks. On 14 February the fairways was completely free again. According to a recent NEA study the overall socio-economic costs of this accident with the MTS Waldhof are at least 50 million euro. Most of the costs were made by the shippers and forwarders that had to arrange expensive transport alternatives via rail and road for time critical goods such as containers.

However, despite of some incidents each year, compared to other transport modes, inland waterway transportation is considered to be very safe and secure. The high level of safety is seen as an asset for IWT. Regulations and regular inspections necessitate elevated technical standards. Vessels transporting hazardous, flammable or poisonous materials are specially designed (e.g. double-hull vessels), special fume extraction equipment, stainless steel tanks, innovating pipeline systems, etc. Strict safety standards, combined with regular controls, investment in river information systems and low congestion on inland waterways, greatly diminish the risk of accidents. The number of accidents in inland shipping is relatively low[77]. On the other hand the risks for IWT workers are relatively high. The probability for a worker on a vessel to have an accident and to get injured or die is higher compared to working in other modes of transport[78]. There is room for improvement in the safety culture, e.g. always wearing life-jackets when working on the vessel.

[77] Source: Strengthening inland waterway transport: Pan-European co-operation for progress, European conference of ministers of transport, ECMT, 2006.

[78] The number of accidents is small but also the workforce is small as well. The number of accidents related to the total freight volumes is insignificant but the number of accidents related to the size of the workforce is rather high. In the Netherlands in the past years the number of fatal accidents is about 6/7 persons (NL workforce) per year, which is about a probability of 0.00075. The risk is much higher than e.g. for truck drivers (about 6 times higher).

6.1.5 Transhipment locations and inland ports

European inland ports can be seen as the "inland waterway station" for getting freight on and off the waterway. Since most of European inland ports are not only linking water with road but also with railways, inland ports are facilitating the integration of inland waterway transport into the co-modal transport chain. The modal integration is one of the basic prerequisites to boost the potential of IWT and is an important element in the White Paper on Transport 2011.

Integrating the different transport modes implies in the first place the creation and further development of efficient interfaces. Freight transport users and shippers need a "market place" where they can make choices regarding the combining in function of the product, the destination, the client, the cost (both internal and external). In essence, inland ports have a triple function:

- Co-modal Hub on the European Inland Waterway Corridors: inland ports serve as efficient transhipment nodes on the European inland waterway corridors. They are the interface between the IWT and maritime leg and the other land modes of transport.

- Business platform for the region: inland ports are functioning as the nodal point for the regional economy. Being at the crossroad between different transport modes, they attract businesses and suppliers of goods and services for the regional economy. Next to their transport and logistic function they are a suitable location for industries (e.g. distribution centres, production plants) who want to be close to the market and the European transport corridors.

- An interface between sustainable long distance transport and the urban last mile. Inland ports situated in a major urban agglomeration make it possible to bring the urban freight by water right into (or near to) the city centres, limiting as such the road transport to the "last mile". Also for construction and recycling products (e.g. waste) such interfaces close to densely populated areas are quite valuable. By exploiting the potential of a city inland port, the urban freight avoids the congestion barrier around the big agglomerations and limits the use of road transport to a minimum. Moreover by means of 'cold ironing' (electric power for idle vessels) the emission of vessels can be avoided in agglomerated areas.

Inland Ports, preferably connecting various modes, are therefore quite important for the success of inland navigation and the overall sustainability of the multimodal transport system in Europe. Based on the business as usual outlook as presented in chapter 3 the cargo flows for IWT are growing. This also results in a demand for expansion of (regional) transhipment facilities, in particular in the container market. However, the available space for additional activities is often limited, in particular in densely populated areas along waterways. Therefore in several corridors (e.g. .Rhine) it will not always be easy to expand business at existing inland ports or to develop new locations (e.g. objections because of noise and heavy traffic around terminals). Moreover the land along waterways is valuable and local authorities often give priorities to other functions such as housing projects.

Currently the main transhipment nodes for IWT in Western Europe are: Amsterdam, Antwerp and Rotterdam. These ports connect the overseas flows with the inland transportation by barge (and other modes). IWT plays a very important role for these ports in the hinterland transport of goods. In Eastern Europe the Port of Constanta is of major importance for inland waterway transport on the Danube.

In order to obtain data on inland ports/terminals with waterside cargo, PLATINA has executed within work package 5.1[79] an inquiry into the different statistics of all European countries with inland ports and terminals with relevance for IWT. The following list indicates the most important ports for IWT operations with more than 5 million tonnes transhipped:

Inland ports with more than 10 million tonnes waterside cargo handling in the year 2007 are:

- BE: Antwerp, Gent, Port of Liège
- FR: Ports de Paris
- DE: Duisburg, Köln, Hamburg, Neuss-Düsseldorf
- NL: Rotterdam, Amsterdam
- RO: Constanta

Inland ports in the range of 5-10 million tonnes waterside cargo handling are:

- CH: Port of Switzerland
- DE: Mannheim, Ludwigshafen, Bremen, Karlsruhe, Marl
- FR: Strasbourg
- NL: Vlissingen, Terneuzen, Utrecht, Velsen, Cuijck
- RO: Galati
- UA: Izmail

The number of substantial ports providing cargo for IWT is limited and it can be concluded that the trade and transport flows are concentrated on a new main nodes and mainlines on the network.

As a general remark, it can be concluded from the inquiry that there is a lack of data on the available inland ports, their characteristics, performance and facilities, and that it is difficult to collect them.

[79] PLATINA Deliverable "Inventory of available knowledge on strategic inland waterway projects", see www.naiades.info

6.2 Main problems

The main problems related to inland waterway infrastructure are:

A. Physical bottlenecks and missing links in the waterway network
B. Lack of maintenance and lack of reliable fairway conditions according to international standards
C. Inland Ports: pressure, poor quality and missing transhipment locations
D. Reduced reliability due to accidents and extreme weather conditions
E. Uncertainty about possible impact of climate change

A. Physical bottlenecks and missing links

Obviously the first pre-requisite to enable inland waterway transport is the existence of waterways that connect economic regions and are smoothly navigable by freight vessels. Inland waterways do connect some major seaports in Europe with cities and economic centres along major transport corridors.
In spite of ample spare capacity, the efficiency and competitiveness of inland navigation is largely undermined by insufficient quality infrastructure at critical parts of the network. In particular on the Danube and East-West corridor there is uncertainty about the planning and available budget for removal of bottlenecks. This puts off the modal shift aspirations of potential customers in search of energy-efficient and reliable logistics operations at stable prices and conditions.

It is concluded that on the current network there are still significant bottlenecks and missing links. If these missing links were constructed, socio-economic benefits could be the result and IWT would increase its modal share by means of a geographic expansion of the market.

In this regard, the Trans-European Transport Network (TEN-T) includes two priority projects of highest importance for developing waterway infrastructure in Europe: the Seine-Nord-Canal and the River Danube. The Seine-Nord Canal is under construction and is planned to be finished in 2017. Projects along the Danube are ongoing/being planned in Germany, Austria, Hungary, Romania and Bulgaria. Still the current situation on the Danube is that the recommendations by the Danube Commission and by the UNECE (AGN, Blue Book) on fairway parameters - basically fairway depths of 2.5 metres at low navigable water level - are not met on several stretches. Nonetheless, planning and implementation processes for IWT infrastructure usually take quite some time. Within the framework of the Connecting Europe Facility, the problems and challenges related to bottlenecks and missing links shall be addressed in future.

B. Lack of maintenance and lack of reliable fairway conditions according to international standards

The economic performance and competitiveness of no other transport mode is so much dependent on the state of its transport infrastructure than IWT. Fairway conditions directly determine vessel utilisation and efficiency of operations. Every lacking decimetre fairway depth represents a loss of loading capacity of 70 to 100 tonnes per vessel (about 5% of total carrying capacity per vessel). Reduced vessel utilisation rates lead to fluctuating transport volumes and variable price levels. This in turn puts off potential customers, who are generally interested in reliable logistics operations and predictable prices.

The current waterway network however suffers from a lack of maintenance and requires dredging of certain sections to the overall standard of the entire connection. In particular in the year 2011, characterised by much low water periods, the problems became apparent. For example due to the lack of maintenance work on the Danube River navigation was hampered for quite some time. Given the long term outlook of more low water periods, the importance of well maintained fairways becomes bigger.

The multiple functions of waterways, the international character of transports and the national/regional responsibility make coordination of upgrading of infrastructure difficult, resulting in long-lasting planning and decision making processes. Inland waterways are complex systems with multiple functions; especially the potential conflict between the ecological function (ecoystem) and the transport infrastructure function which requires a cautious approach towards waterway management and development. Guidelines for planning waterway development projects which take into account the environmental protection requirements would be helpful for the planning processes.

Constant monitoring of critical fairway sections is a prerequisite for well maintained inland waterways. Especially for inland waterways of international importance (e.g. Rhine, Danube) the international coordination of these activities is crucial. There is still a lack of usage of ICT and the management of the fairway is still sub-optimal. Modern IT solutions are not (yet) available to ensure seamless communication chains between waterway administrations and skippers.
The information and data gained through a constant monitoring of fairway conditions at critical sections would help waterway users (especially captains) to better accommodate their voyage planning and thus increase the overall competitiveness and efficiency of inland navigation.

C. Inland Ports: pressure, poor quality and missing transhipment locations

The quality of handling equipment and the level of services provided in European inland ports depend to a large extent as well as on the general development level of the waterway infrastructure as on the port management and investment strategies. In particular on the East-West corridor and the Danube corridor there is a lack of available transhipment locations and the port quality is sometimes poor.
In densely populated areas such as the Rhine corridor it is observed that the development of inland ports and logistics centres is increasingly under pressure from housing, recreation and other functions. Inland ports however are an essential part of the waterways transport chain for transhipment. Business and logistics sites directly clustered around inland terminals along waterways extremely increase the competitiveness of inland waterway transport as costs for pre- and post-haulage can be minimised.

Inland ports do accommodate important industrial and logistics activities and create jobs, turnover, profits and welfare. Regional authorities dealing with spatial planning need increasingly become aware of these factors.

There is also the problem that most ships still generate electricity with their own engines while mooring in a port and thus emitting air pollutants and noise. If the port is situated near populated areas this can contribute significantly to environment and health problems. A possibility to tackle this problem is by landside power supply systems, the so called “cold ironing”. More and more port administrations equip their berths with the required facilities but the implementation is developing at a slow pace and uncoordinated way.

D. Reduced reliability due to accidents

Although safety, reliability and security of transport score high in inland waterway transport accidents cannot be excluded. They can cause severe disruptions of the transport system and have a negative impact on the reliability and competitiveness of IWT. Shippers therefore require emergency concepts providing back-up transport solutions by railways or roads in case ports are not accessible due to the blockage of the waterways. The availability of such "transport continuity plans" is particularly important for time-sensitive shipments such as container transport and the production of critical raw materials. Given the high growth rates expected in container transport on medium and long term, there is also a growing importance for reliability of IWT.

E. Uncertainty about possible impact of climate change

In the long run it cannot be excluded that climate change will also have negative impacts for the inland waterway transport system, due to more frequent severe high and low water situations. The projects "Effects of climate change on the inland waterway networks" (ECCONET) and KLIWAS[80] analyse the effects of climate change on inland waterway transport and related sectors. These two ongoing research projects indicate that in the very long term (after 2050) it is probable that climate change will have negative impacts for the inland waterway transport system, due to more frequent severe high and low water situations. However, both for the Rhine and Danube regime, no significant changes with regard to navigability are expected before the year 2050. For the Rhine-Main-Danube canal the navigability is even expected to improve due to fewer problems with ice.

It must however be acknowledged that there is still a lot of uncertainty in the modelling assumptions and scenarios that are being used in those research projects and that, therefore, the forecasts and expectations are still tentative. Despite the uncertainties in methods and forecast, possible scenarios need to be anticipated and adaptation strategies be developed in good time. For example “no regret” measures could be considered to increase efficiency and reduce the sensitivity for low/high water levels in general. It must be noted that also without climate change impacts there is already a large variation of water level situations on rivers such as Rhine an Danube. For example, attention could be paid to improved fairway maintenance and new vessel concepts providing higher efficiencies (payload) in low water conditions compared to the current situation.

[80] KLIWAS – Auswirkungen des Klimawandels auf Wasserstraßen und Schifffahrt – Entwicklung von Anpassungsoptionen, www.kliwas.de

6.3 Long list of measures

In the next tables the recommended measures are presented. More details can be found in Annex 8 of the Annex Report.

Table 6.7 Long listed policy measures for the policy field "Infrastructure"

Problem	*Measure*	*Short description of proposed policy measures*
A. Physical bottlenecks and missing links	1. Support the elimination of bottlenecks and missing links	Improve fairway conditions and thereby facilitate better vessel utilisation, more efficient operations and more competitive market prices
	2. Coordinate development of European core network	Coordinate development of core waterway network and keep IWT projects high on the agenda by means of an active role in the Connecting Europe Facility (e.g. providing input for Corridor Development Plans)
B. Lack of maintenance and lack of reliable fairway conditions according to international standards	3. Establish international expert groups for waterway maintenance and develop European standards	Establish harmonised standards for maintenance works along waterways by establishing international expert groups, workshops and manuals (know-how exchange)
	4. Support innovation in waterway management and development	Secure RTD and innovation budget for infrastructure development e.g. through Horizon 2020
	5. Ensure constant monitoring of fairway conditions at critical sections	Strengthen monitoring mechanisms for strategic bottlenecks, forward topical information and data to waterway users
	6. Apply standards for sustainable and integrated waterway management	Support expert group on sustainable waterway planning: know how exchange, workshops and dissemination of guidance documents, shorten planning horizons
C. Inland Ports: pressure, poor quality and missing transhipment locations (1/2)	7. Extend and promote network of quay side power in ports	Offer landside power supply to reduce local emission and noise levels by diesel generators and establish technical norms for quay side power in ports
	8. Provide funding for the equipment of ports and transhipment sites	Establish efficient handling facilities and infrastructure and thereby reduce logistics costs and facilitate modal shift
	9. Develop a set of European-wide benchmarks for services provided at inland ports	Define benchmarks for handling equipment, port charges, opening hours in inland ports across the European waterway network thereby reducing logistics costs and increasing service levels
	10. Support setup covenants between shippers-shipping industry-local/regional government for local waterside access	Demonstrate value of integrated waterfront development incl. logistics development areas, enhance network of possible transhipment interfaces, raise potential for water transport

C. Inland Ports: pressure, poor quality and missing transhipment locations (2/2)	11. Raise awareness for development of logistics sites along European waterways	Demonstrate, disseminate value of integrated waterfront development incl. logistics development areas, enhance network of possible transhipment interfaces, raise potential for water transport
	12. Improve efficiency and capacity of waterside transhipment and pre-end haulage operations	Support research and pilots, enhance network of possible transhipment interfaces and last mile trucking, raise potential for water transport
	13. Develop European toolkit for inland ports development	Develop port toolkits helping local authorities to develop waterside logistics
	14. Promote and disseminate environmental zoning in ports	Developing a toolkit to help port authorities and municipalities to properly assess the impact of IWT operations on the air quality
D. Reduced reliability due to accidents	15. Support expert groups on accident investigation, calamity abatement and insurance obligations	Establish a European expert group and develop a common framework for accident investigation, calamity abatement and insurance of inland vessels in order to reduce disruption of services and to increase the overall safety level
E. Uncertainty about possible impact of climate change	16. Support expert groups on climate change	Bundle available know-how by setting-up dedicated expert groups dealing with possible climate change adaptation strategies for the EU inland waterway network
	17. Develop adaptation strategies for climate change	Prepare robust waterway planning strategies and elaborate concrete and tailored measures for different international rivers (e.g. Rhine, Danube) and river stretches

7 Field 5: River Information Services

7.1 Overview present situation and outlook 2020, 2040 business as usual

The concept of River Information Services (RIS), which stands for the most substantial change in the inland waterway transport sector for the last two decades, aims at the harmonised implementation of information services in order to support traffic and transport management in inland navigation, including interfaces to other transport modes. The implementation of RIS will not only improve safety and efficiency in inland waterway traffic but enhance the efficiency of transport operations in general. Administrative barriers will also be removed by means of implementation of “Single Windows” and “Paperless IWT”.

The RIS concept is composed of advanced information services and functionalities which are supported by various technologies such as satellite positioning systems, electronic chart and display information systems, automatic identification systems etc. The provision of river information services leads to both operational (e.g. immediate navigational decisions) and strategic (e.g. resource planning) benefits for the users such as waterway authorities, skippers, terminal managers, the lock managers, transport service providers, shipping companies etc.

River Information Services can be divided into services which are either primarily traffic-related or primarily transport-related. Traffic-related services are e.g. fairway information services, traffic information services, traffic management support, traffic monitoring and calamity abatement, whilst transport related services are supporting voyage planning, port and terminal management, cargo and fleet management, statistics and water infrastructure charging.

The major benefits of the implementation of RIS can be summarised as increased competitiveness, optimised use of infrastructures, improved safety and security and increased environmental protection and energy efficiency. RIS facilitate the establishment of competitive inland waterway transport services and their integration into the entire transport chain since they comply with the information needs of modern supply chain management. They enable an enhanced use and monitoring of resources as well as prompt reactions to deviations from the original planning. RIS permit information interfaces with all supply chain members as well as with other transport modes. Currently an FP7 project “RISING’ has the overall objective of identifying, integrating and further developing information services such as River Information Services (RIS) in order to efficiently support inland waterway transport and logistics operations.

RIS enable further real-time monitoring of the inland navigation fleet and of changing fairway conditions en route. This allows improved fleet management including an optimised deployment of the vessels and personnel as well as better voyage planning.

The provision of estimated times of arrival and information such as stowage plans, vessel dimensions etc. will enable terminal and lock operators to optimise the use of the infrastructure and resources. For skippers this means a reduction of waiting times. RIS facilitates also the collection and provision of statistical and customs data in an automated and efficient way, which ultimately results in lower public expenditure.

Skippers are offered up-to-date and complete overviews of traffic situations by means of electronic charts, precise positioning data on approaching vessels, and electronic information about fairway and weather conditions. This allows them to take well-informed navigational decisions which will increase the safety level. Transparency is a main prerequisite for enhanced security (and efficiency) of transport operations. RIS supports the generation of comprehensive and transparent information processes and the smooth exchange of data (pre-announcement declarations, exchange of data on cargo/containers, customs data etc.).

RIS contributes to a better energy-efficiency by reducing fuel consumption as a consequence of better voyage planning and more reliable scheduling. It further provides the possibility to monitor the transport of dangerous goods. This allows fast response in the event of accidents and potential environmental calamities.

River Information Services are regulated through Directive 2005/44/EC and related Commission regulation, which define binding rules for data communication and RIS equipment as well as the minimum level of RIS Services for future RIS implementations. The Directive 2005/44/EC applies to 12 EU member states and one candidate country (Croatia). Serbia, Switzerland and the Ukraine are not formally concerned, however all three are undertaking significant steps in RIS deployment. Since the 1980s, much has been achieved by the administrations and the private sector.

The status of RIS can be summarised as follows (February 2011):

- Electronic Navigational Charts are provided for approximately 70% of the major European waterways (7,500km of Class V, 1,000 km of Class IV). On the Danube and the Rhine full coverage has already been achieved.
- More than 6,000 commercial vessels - commercial vessels and pleasure crafts alike - are already equipped with inland Electronic Chart Display and Information Systems (ECDIS) viewers, which represents approximately 45% of the total fleet. The availability and reliability of information on the actual depth of waterways is however poor.
- Authorities from 12 countries provide Notices to Skippers, several of them are working towards data exchange, so that information of all countries is available by means of national portals. Those authorities mainly provide Fairway & Traffic Messages, Water Related Message and Ice Messages. The work on exchange of Notices to Skippers information across country’s borders has been started successfully. At present 4 countries are working on respective pilot systems. With full implementation all European Notices to Skippers can be provided through national NtS Portals.
- In the Schelde River – an important maritime connection to Antwerp – RIS are included in the local traffic management system for mixed traffic.

- Authorities from seven EU member states and Serbia have started equipment programmes for inland AIS transponders. Beginning 2011, approximately 5,500 vessels are already equipped. By end of 2012 approximately 11,500 vessels will have been equipped with Inland AIS transponders.
- Inland AIS infrastructures support traffic management in 12 countries. Approximately 25% of the Class V waterways were equipped by the end of 2010 and approximately 50% are expected to be equipped by the end of 2012.
- At some dangerous spots in the waterway network there are VTS/RIS centres to improve the safety, increase the efficiency and the safeguard the environment. Such systems are in operation in the Netherlands, Belgium, Germany and Romania.
- The Netherlands and Germany have ship reporting systems in operation and exchange the reported information. The systems can be used for increasing the efficiency of lock and bridge operations and for calamity abatement support. 12 countries are expecting to have ship reporting systems in pilot or full operation at the end of 2012.
- Approximately 20% of the fleet reports cargo and voyage data electronically. For container vessels, electronic reporting is already mandatory for container transport on the River Rhine.
- First "European services" such as the European Hull Database, the European Reference Data Management System and the European RIS Portal have been developed within the Platform for the implementation of NAIADES (PLATINA) as pilot systems.

Long term vision

After a full installation of River Information Services it is expected that broad use of this ICT platform provides the following improvements in the operational and organisational aspects of inland waterway transport:

- improved information to provide reliable time schedules for trips;
- improved interfaces to connect with other transport modes;
- improved information to plan terminal/lock resources and operations;
- real-time monitoring of fairway and fleet conditions to guarantee safety, efficiency (maximum payload) and security;
- up-to-date overview of the traffic situation for timely control of manoeuvres;
- automation of cross-border operations to facilitate international trade;
- effective dangerous goods monitoring for transport safety;
- automation of statistical data collection for strategic monitoring and planning.

In this sense, RIS fully complies with the information needs of modern supply chain management as described in chapter 3 of this report. RIS will be an element of an integrated traffic and transport management system for all modes of transport. RIS shall therefore allow multimodal planning. By means of providing transparency and information interfaces RIS will boost the integration of IWT in supply chains and could be a catalyst for the cooperation with other modes of transport. However, this development will not take place by itself and several actions are needed to support the further implementation of RIS and linking RIS to other communication and management systems in supply chains, ports and terminals and other modes of transport. Such interfaces, which eliminate breaks in the information chain, allow the integration of inland navigation into inter-modal supply chains.

In the recent White Paper on Transport[81] 2011, RIS is therefore seen as one of the important land and waterborne transport management systems, in order to increase the efficiency of transport and of infrastructure use with information systems and market-based incentives. The deployment of RIS is part of the initiatives to develop a core network of strategic European infrastructure – A European Mobility Network.

Moreover, RIS technologies could eventually be used to (partly) automate the navigation of vessels which could result in a reduction of the crew size on the vessel. This could possibly result in lower labour costs and therefore a more efficient and competitive mode of transport.

7.2 Main problems

As indicated in the previous section, authorities have made significant efforts in implementing RIS in the past. Much has been achieved but additional steps are needed to make services more efficient and to make them available for the entire inland waterway network. Whereas the inland navigation sector has also taken up RIS, to date RIS applications however limits the focus mainly to the safety of inland navigation while automatic information exchange with terminal operators, freight brokers and shippers and other logistics applications did not emerge beyond the piloting phase as yet.

RIS Implementation Projects are complex processes, which demand cooperation among a range of partners including governmental authorities at national, regional and local level as well as logistical RIS Users (e.g. Fleet managers). As a consequence not only national RIS implementation projects shall be supported, but also European-wide projects addressing further development, harmonisation and pilot implementation of additional RIS Services. Such projects proved to be suitable means to support the harmonized RIS implementation. In addition to the deployment of RIS Services in the field of safety-related traffic management, measures for the implementation of RIS for logistical purposes need to be defined.

[81] COM(2011) 144 final, WHITE PAPER, "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system", SEC(2011) 359 final, 358 final, 391 final

The following main problems were identified:

A. Unfinished technical regulations
B. Unfinished implementation and co-ordination of RIS in Europe
C. Unused potential RIS for logistics

A. Unfinished technical regulations

The RIS Guidelines describe the principles and general requirements for planning, implementing and the operational use of RIS and related systems. Three Commission Regulations define the technical specifications for the RIS key technologies. A fourth one is about to be finalised. Experts from public administrations, RIS application providers and logistics users contribute to the RIS Expert Groups, which are assisting the European Commission in the preparation and maintenance of the technical specifications.

The European position information service will enable RIS Providers to provide the users with position information, the vessel identification(s) and country in which the vessel is currently sailing. The enabling element, the European server, has been conceptually designed within PLATINA. A pilot system has been set up and is currently being tested.

B. Unfinished implementation and co-ordination of RIS in Europe

There is an obvious need for a harmonised deployment of River Information across Europe. This is also acknowledged in the White Paper on Transport 2011. A status overview executed within the framework of PLATINA demonstrated the achievements in RIS deployment, but showed also gaps (e.g. vessels are obliged to report cargo and voyage data of container transport only on rivers in the Rhine corridor). The harmonised RIS deployment at European level should be supported by legislative stimuli (e.g. amendment of the RIS Directive), financial stimuli (e.g. EU co-financing for on-board equipment) and technical support (e.g. regular surveys on the state of play).

Experience from the first decade of RIS deployment has shown that interoperability problems require a quite long time to be solved. Strict monitoring and providing support (e.g. via expert groups) is therefore needed.

Moreover the RIS reference data management system needs to be further developed and maintained as it represents the basic element of all RIS applications (e.g. data of the entire inland waterway network, for instance the location of locks, bridges and ports). Therefore, this data needs to be consolidated and maintained on a structural basis, in order to avoid the use of different data versions in on-board applications. Also the maintenance of the digital parts of the Inland ECDIS Standard is required as well as the operation of the European Hull Database (EHBD) including the 'Unique European Vessel Identification Number' (ENI), the name of vessel, length, breadth. The minimum set of hull data needs to be exchanged among vessel certification authorities and with RIS authorities.

C. Unused potential RIS for logistics

There is an incomplete deployment of multi-modal information services. The application of intelligent information systems is a pre-condition for seamless multi-modal logistics chains. To date, River Information Services (RIS) have been primarily implemented in order to support traffic management and to improve the safety of navigation. The next step would be to create and integrate successful applications for seamless energy-efficient multi-modal logistics. The integration of information based on River Information Services in multimodal logistics planning procedures still is technically possible to a limited extent and consequently has been realised only on a limited scale[82]. Further development is needed to cope with the demands of the future. In particular, as the transparency, reliability and efficiency of transport will become more and more important. RIS needs to be integrated with other systems, such as port information systems and tracking and tracing systems used by larger forwarders (eFreight)[83]. This would need practical measures to stimulate the commercial and logistics use of RIS. A survey among logistics decision-makers carried out by the IRIS Europe II logistics task force indicated that shippers, terminal operators and other RIS users are not adequately informed about the possibilities that RIS offers for supply chain management and logistics planning. There is therefore a need to raise awareness among the relevant logistical RIS users, but also measures which reduce the entry barrier similar to Inland AIS support programmes need to be established.

The integration of information based on River Information Services in multimodal logistics planning procedures still is technically possible to a limited extent and consequently has been realised only on a limited scale. Within the Freight Transport Logistics Action Plan[84], the European Commission has outlined the concept of e-Freight. This concept is a vision of a paper-free, electronic flow of information associating the physical flow of goods with a paperless trail built by Information and Communication Technologies. River Information Services form an important element of e-Freight. RIS has been included in an overall policy concept i.e. connecting RIS with the EC eMaritime Single Window policy goals and the EC secure supply chain security and compliance strategy[85].

[82] IRIS Europe – Implementation of River Information Services in Europe, Final Technical Report, 2009

[83] http://www.efreightproject.eu/

[84] Freight Transport Logistics Action Plan, Communication from the Commission COM(2007) 607 final

[85] Final Event IRIS Europe II/ Rising December 2011. See website http://www.ris.eu/news/final_event_iris_europe_ii_rising_on_1_december_2011_unites_european_ris_community

7.3 Long list of measures

In the next tables the long list of possible measures are presented. In the Annex 8 of the Annex Report more detailed descriptions on the measures are presented.

Table 7.1 Long listed policy measures for the policy field "River Information Services"

Problem	*Measure*	*Short description of proposed policy measures*
A. Unfinished technical regulations	1. Update and further develop technical specifications for River Information Services (RIS)	Amendment of the RIS Directive and the creation, updating and further developing the technical specifications for RIS.
B. Unfinished implementation and co-ordination of RIS in Europe (1/2)	2. Support and promote harmonised implementation and deployment of RIS	Provision of financial and technical support e.g. through Connecting Europe Facility
	3. Operate and maintain European Position Information Service	Operate, maintain and further develop the European Position Information Server in such a way that all relevant logistical RIS stakeholders are provided with position information on the basis of controlled access.
	4. Organise compliance and progress monitoring in the field of RIS	Compliance and progress monitoring in the field of RIS
	5. Operate and maintain Reference Data Management system	Operate, maintain and further develop the ERDMS in such way that all countries providing River Information Services participate.
	6. Operate and maintain Inland ENC Register and digital parts of the ENC Standard	The data of the Inland ENC Register and the digital parts of the standard is available for all RIS application manufacturers and authorities producing IENC's, being an enabler for administrative and logistics RIS services.

B. Unfinished implementation and co-ordination of RIS in Europe (2/2)	7. Support RIS expert groups	Provide support for the RIS Expert Groups. RIS experts from public administrations, application providers and logistics users have the right framework conditions and support to actively participate in RIS standardisation and harmonisation.
	8. Operate and maintain single RIS portal	Operate, maintain and further develop the RIS Portal in such way that all RIS stakeholders (EC, RIS authorities, RIS providers, RIS users, etc.) can obtain information on RIS (status, specifications, projects, etc). All RIS stakeholders have the relevant information; the central access point provides Notices to Skippers and Inland ENCs of all administrations.
	9. Operate and maintain European Hull Database	Operate, maintain and further develop the European Hull Database in such way that all countries issuing ENI's participate.
C. Unused potential RIS for logistics	10. Stimulate the commercial and logistics use of RIS	Create awareness among relevant logistical RIS users, definition and implementation of support programmes, which reduce the entry barrier for such users.
	11. Support creation of eFreight and seamless handling formalities	Develop RIS further - and integrate it with other modes through eFreight; moving towards paperless transport for inland waterways consistent with the eMaritime Single Window concept .

8 The recommended policy packages

8.1 Introduction

To achieve the policy objectives of the Europe 2020 Strategy and the 2011 White Paper on Transport a range of actions need to be taken in the next years. Within this framework, active support of inland waterway transport is required. In this chapter three policy packages will be presented, which outline how the IWT industry could contribute to achieve the policy targets. The packages were composed from the long list of measures that were listed in the tables in the previous chapters (Chapters 3 to 7).

For IWT two major policy objectives should be pursued focused on the performance (output) of the sector:

1. Raise modal share of inland waterway transport, in particular through expanding the intermodal transport segment

2. Reduce accidents, air pollutants and climate change impact of inland waterway operations

Raising the modal share is the primary objective given the societal benefits of inland waterway transport compared to other modes. The second objective is to further reduce air pollutants, accidents and green house gas emissions of inland waterway operation. The two objectives are interrelated. The reduction of accidents and air pollutants will further strengthen and expand the social benefits of the use of IWT. Note that these reductions also have again a favourable effect on the first objective because the reduction of the external effects does result in continued and growing public support to strive in transport policy for an increase of modal share of IWT. It is, therefore, of strategic importance to tackle in particular the emissions to air since this is the main external cost factor for IWT. Other external cost factors of IWT are already quite low or insignificant (see figure 1.2 in Chapter 1). Moreover, the IWT sector should prepare for a possible internalisation of external costs in the future. This is also a good reason to reduce the air pollutant emissions.

Apart from factors that have a direct impact on the modal share or emission performance of IWT, also factors need to be addressed that indirectly determine the performance of IWT on these two policy objectives.

These market conditions consist of:

- legal and administrative framework conditions,
- River Information Services (major ICT platform for IWT and operational tool),
- labour markets, capital markets, equipment suppliers and shipyards,
- market information to support decision making,
- knowledge and know-how among users and stakeholders and
- research and development on innovations for the future transport market.

The factors considered are important and not resolving them would seriously limit the effectiveness of the two main policy options. Therefore, improving the market conditions does support and amplify the two policy objectives that focus on the key performance indicators of the sector (modal share and external costs). The third policy objective therefore is:

3. Improve market conditions for operators and users of IWT

In several of the fields presented in chapters 3 to 7, problems have been identified that belong to the market conditions. The identified limiting factors need to be addressed in order to ensure a smooth further development of IWT in Europe. For example a shortage of human resources (see chapter 5) would result in higher salaries resulting in higher transport prices and subsequently less market share. A shortage of qualified personnel could also result in longer working times which may bring safety risks. In the definition of 'market conditions' also most of the required innovation efforts are included. In general it can be concluded that research and development is needed in the following fields:

- *Technical innovations* in transhipment systems, cargo conditioning and load units, navigation aids, hull design, traffic management, infrastructure development and maintenance
- *Organisational and management innovations* in cooperation models and cooperative transport planning, supply chain management, marketing, ship finance and exploitation models.

The analysis in this chapter of the report does explain the main determining factors behind modal share and external costs and also the interdependencies of the three specific policy objectives. In the next 3 sections of this chapter these policy packages will be concisely described.

8.2 Policy package 1: Measures to raise modal share of inland waterway transport

The first policy package is geared directly towards the generation of a higher modal share for inland waterway transport in Europe. Over the past decades, IWT has generally been losing market share on all corridors, this trend shall be turned. The analysis revealed a number of different reasons for this structural development: industrial restructuring, intermodal IWT is not offering competitive door-to-door transport costs, IWT is not sufficiently known among potential customers, the limited geographic coverage of the waterway network and infrastructure bottlenecks, IWT is not integrated enough in multimodal supply chains, etc.

Main determinants of modal share

The modal share of a transport mode is basically determined via simple market mechanisms, that is, by a mix of cost/price and quality indicators (transport speed, on-time reliability, frequency of services, ease of use etc.). Whereas some transport markets put higher value on the transport price (e.g. construction materials), others have a relatively higher value of time (e.g. consumer products). Inland waterway transport acts in different markets and therefore should be competitive in a variety of markets circumstances.

The main costs drivers in inland waterway transport consist of standby costs (personnel, depreciation/interest payments, insurance, and repair & maintenance costs) and operational costs (mainly fuel costs). To a large extent the costs cannot be influenced by policy actions as they are largely determined via the market. Average fuel consumption per vessel type basically depends on three factors: utilisation rates of vessels (due to loading restrictions), the parity of traffic (empty voyages) and the prevailing fairway depths (shallow water resistance). Moreover in intermodal chains the costs of transhipment and pre-end haulage are very decisive for the competitiveness of the intermodal IWT solution. Finally the utilisation of vessels (payload versus loading capacity and the share of empty sailing) influences the transport price per tonne.

The main non-market factors determining cost and quality level of IWT operations, and which could be influenced via direct or indirect policy actions, are:

- **Waterway infrastructure quality**: The specific situation for inland waterway transport is that both cost and quality factors are strongly determined by the state of the infrastructure and fairway conditions. Fairway conditions and bottlenecks directly determine cost levels per unit (vessel utilisation, load factors) as well as level of service (transport speed, on-time reliability). Maintenance such as dredging is of high importance because the available depth determines the possible load rate as well as the reliability of transport and stability of freight prices.
- **Quality and efficiency of inland terminal network and waterside logistics sites**: The competitiveness of multimodal supply chains often depends on the efficiency of port operations, since the costs for transhipment, pre- and end haulage typically add up to more than 50% of the door-to-door transport costs. In case directly near the river or canal the shipper or customer is located, pre- end haulage can be avoided resulting in much lower door-to-door costs.
- **Level of supply chain integration and co-operation**: Apart from technical integration (e.g. harmonised transport or loading equipment), the application of intelligent information systems is a pre-condition for seamless multi-modal logistics chains. More operational co-operation and seamless modal interfaces lead to higher operational efficiency (high utilisation and less empty trips), higher reliability of transport and consequently to more attractive transport and logistics services.
- **Level of awareness among potential customers**: Inland navigation is currently not sufficiently visible for third-party logistics service providers and potential customers. IWT is generally lacking the human resources and know-how to develop one-stop-shop multimodal logistic solutions. In

particular this is valid for more complex and demanding door-to-door transport needs of those customers that are used to the flexibility and simplicity of road haulage. Although there are in fact larger organisations active in the market (e.g. large brokers, shipping lines in liquid cargo and container transport) these larger organisations do mainly focus on serving the traditional markets. Only a few pioneers are investing in time-consuming modal shift projects.

Most effective policy measures to raise (multi-)modal share of IWT

Current EU policies (NAIADES) have much concentrated on raising the awareness and image of IWT. Whereas these are important determinants of the IWT modal share, they are not the only ones. In order to have an impact on the ground, IWT policy actions by the European Commission must also be influencing operational factors like transport price and quality of service. The paradox of IWT such policy however is that those policy measures that would be most effective would entail directly influencing market forces, which often interferes with basic principles of the internal market. While respecting the principles of the EU Treaty, effective policy measures to promote inland waterway transport need therefore to move close to the market.

For transport policies to have an impact on the ground, the illustrated causal chain scheme offers different possible points of policy intervention (see figure 8.1). A policy package addressing the modal share of IWT should therefore consist of a mix of interconnected and complementary policy elements. Policies aiming at raising the modal share would primarily focus on the reduction of operational costs and raising quality aspects of IWT (i.e. reliability), thereby influencing modal choice behaviour. Considering the most important direct determinants of the modal share of inland waterway transport, the following policy actions are expected to have an effective and direct impact on modal share:

- **Eliminate inland waterway bottlenecks and support development plans and construction of missing links in European waterway network (e.g. Seine – Schelde, Rhine-Rhone, Sava River, Straubing-Vilshofen, other critical sections on the Danube, Elbe) [I1, I2]**

- **Develop high quality network of inland ports including waterside logistics sites: funding for ports and transhipment sites [I8]**

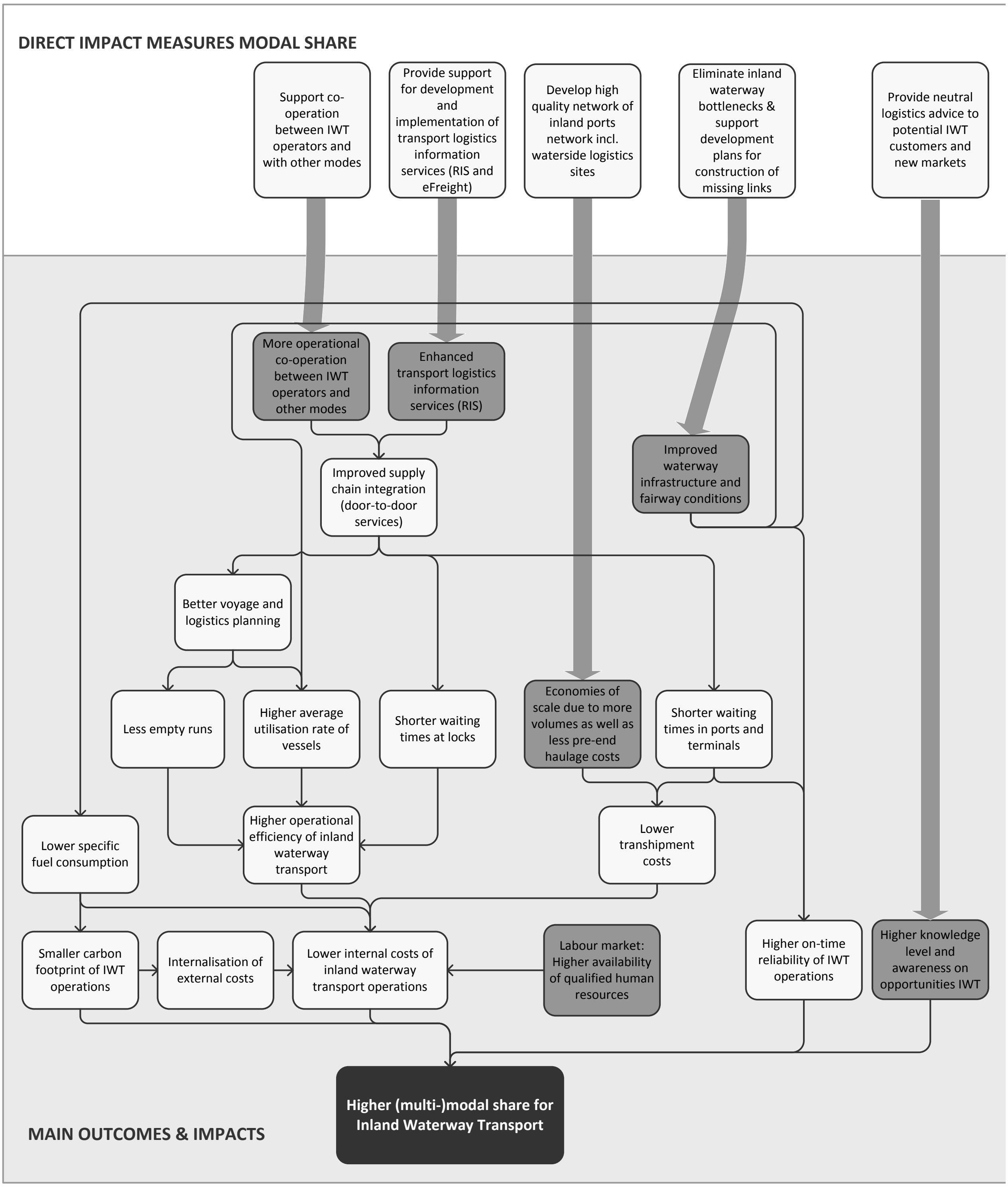
- **Provide support for development and implementation transport logistics information services (RIS and its integration into eFreight; moving towards paperless transport and integration with eMaritime Single Window concept) [R10, R11]**

- **Provide neutral logistics advice to potential IWT customers to raise knowledge level and awareness on opportunities of IWT [M7, M8]**

- **Support cooperation between IWT operators and cooperation of IWT operators with operators using other modes [M9, M10]**

The measures have been listed in the tables in the various chapters (3 to 7) for each policy field. They are further detailed in Annex 8 under the respective category M = Market, F=Fleet, E=Employment& education, I = Infrastructure, R = RIS, and the consecutive number in the tables and in Annex 8.

Figure 8.1 Causal chain to directly intervene on modal share of IWT



Expected outcomes of modal share policy actions in IWT

- Better fairway conditions and a higher quality core waterway network leading **to scale advantages (larger vessels), improved vessel utilisation and lower specific fuel consumption** and consequently to **lower transport costs** per unit. A better state of the waterway infrastructure also leads to less delays and waiting times at locks and during operation as well as improved fairway depth throughout the year (less disruptions of navigation and loss of payload due to low water). On-time reliability of IWT operations will be improved. Both the reduction of transport costs and the **increase of reliability** make IWT more attractive at the transport market.
- Higher quality network of inland terminals and quays raising the level of service and intermediate transhipment opportunities. More efficient transhipment close to the client would **reduce the share of transhipment and operational costs in door-to-door chains** and would consequently allow for IWT to become more competitive also on shorter distances. In cases where pre- end haulage can be avoided, IWT can already be competitive on shorter distances (from 20-40 kilometres onwards). **Innovative spatial planning efforts** resulting in industries and logistic sites directly located along waterways could therefore be very successful to boost the modal share of IWT. In particular for new industries that have plants and distribution points to be located in the next years (e.g. production of bio fuels) such an approach would be highly effective.
- Further development of River Information Services and eFreight leading to an unbroken multimodal information chain, which is a prerequisite for the exchange of cargo between modes. This innovation will lead to more visibility and **higher level of supply chain integration**. By reducing the frictions and increasing the interoperability between modes, IWT can play a larger role in multimodal transport chains.
- A network of neutral logistics advisors helping to raise **awareness on specific opportunities of IWT** in **new market segments** (e.g. biomass, bio fuels, waste transport, continental containers) and **identify new cargo flows for IWT and concrete modal shift potential and support implementation**. Equipped with a specific set of knowledge tools, a network of neutral logistics advisors should execute concrete and corridor-based modal shift projects. A policy initiative to set up a **pro-active neutral interface** between supply and demand would help overcome the reluctance and lack of awareness of market parties. Moreover it answers to the lack of human resources and know-how in the IWT sector needed for such modal shift projects and it would as well **raise visibility of the sector.** By means of best practices and dissemination, the general know-how on logistics within the IWT sector would be raised resulting in growing interest and activity in door-to-door projects.
- Active support for innovative co-operation models within the IWT sector and between other transport modes will help overcome the negative side effects of the atomised supply side of the market. More operational co-operation will result in **better voyage and logistics planning** and consequently in **less empty runs** and **higher utilisation rates of vessels and more efficient transhipment and pre-end haulage operations**. This in turn translates into lower operational door-to-door costs and more competitive transport services (as well as into lower external costs).

Vision 2040 and policy measures beyond 2020 related to modal share

In 2040 inland waterway transport plays a major role in more geographic areas, alternative energy markets and multimodal supply chains including continental cargo such as palletised goods over shorter distances. IWT is fully integrated in the transport system with fruitful cooperation, professional management and seamless links to other modes, fully integrated transport planning systems, an efficient network of transhipment locations and consolidated industrial/logistic centres directly located at strategic locations at nodes of waterways. Successful business models are in place providing sustainable financial performance and a strong innovative mindset focussed on providing competitive door-to-door solutions.

Measures to be considered for implementation after 2020 with a direct impact on market share are:
- Implementation and realisation of new TEN-T projects (e.g. Rhine-Rhone connection)
- Internalisation of external costs on an equal basis, pricing measures as a "push factor" for improved modal share of IWT
- Expansion of port facilities and spatial planning policies aiming at creating clusters of industrial and logistic sites directly along waterways and well connected to other modes of transport

8.3 Policy package 2: Measures aiming at reducing environmental, climate change and safety impacts

Without policy intervention in the year 2020 the average emission level of air pollutants of inland navigation ships will be higher than that of trucks in many cases. Without significant improvement, the gap will become even bigger in the period 2020-2040. A policy package providing push and pull measures to reduce the air pollutant emissions until 2020 is needed to anticipate on the projected autonomous development. Reducing the external effects will guarantee the public support for promotion and investing in IWT due to the social benefits and also avoids a possible loss of market share in case of internalisation of external costs after 2020.

Main determinants

The main factors determining the declining environmental and safety situation in the IWT sector are:
- **Innovative power of IWT sector**: the state of the fleet and the level of innovation determine key factors such as specific fuel consumption, safety levels and emissions to air. The slow innovation rate is in turn largely caused by:

  - **Number of new engines in this market (approx. 200 per year).** The small size of the market as well as the fragmented structure of ship-owners hinders research due to lack of scale as risks increase, and if research is done, the consequence is that the costs of innovations will be high.

- **Economic and legislative incentives to modernise**: Whereas the size of the motorised fleet is approximately 8,500 vessels, according to the IVR database only about 14% of these vessels (with engines younger than 2003) is subject to stricter emission requirements (CCR phase 1 and 2 regulation). The large majority of vessels are not subject to stringent emission standards. Apart from legislative incentives, economic incentives to innovate are often lacking as well. For instance, end-of-pipe treatment technologies which significantly reduce pollutant emissions are, even if subsidies are available, often not implemented since they add operational costs instead of adding value to the individual entrepreneur. Additional incentives are needed and will make it easier for the engine, equipment and shipbuilding industry to develop innovative solutions to reduce air pollutant and GHG emissions.
- **Awareness of available innovations in the sector**: High fragmentation among ship-owners within the IWT sector currently is a barrier to market entry of new technologies, including those which would help reduce fuel consumption and emission levels. Innovations are not disseminated and transferred as fast as would be possible.
- **Access to capital and re-investment capacity**: another side effect of the SME character of the IWT sector is the low reinvestment capacity. Many companies are currently not in a position to provide convincing business cases for innovative investments to banks or financiers due to the scale of their operations and the generally low profit margins as result of overcapacity and fierce competition between IWT operators and/or ship-owners.
- **Continuous and dedicated research and development for IWT**: Continuous research and investment processes are important in order to provide the market with efficient, clean and safe technical solutions, practices and approaches. This is also needed in order to retain a competitive advantage in terms of GHG emissions and safety levels. Dedicated research and development is however limited as a result of the relatively small home market for IWT applications.

• **Qualified human resources**: the optimum cruising speed of an inland vessel depends on a number of factors, such as engine capacity, stream velocity, etc. The marginal costs and additional fuel consumption of 1km/h speed increase are often disproportionately high. Demonstrations and experiences in The Netherlands showed that significant reductions of fuel consumption and emission levels could be achieved by a combination of training, awareness measures and technical decision support system. The human factor and the level of qualification is also a decisive factor in terms of safety.

• **Infrastructure conditions and availability of traffic management systems**: the state of the waterway infrastructure has safety aspects as well impact on transport efficiency (possible payload) and the specific fuel consumption. Low water periods, possibly aggravated by lack of maintenance and the subsequent narrowing of the fairway can lead to more dangerous navigational situations and result in loss of transport efficiency due to loss of payload. The availability of supporting RIS services for traffic management can significantly raise safety levels.

Most effective policy measures to reduce external costs

For the transport sector in general, a higher modal share of IWT trough providing a competitive alternative for road haulage would result in a reduction of external costs. However, also within the IWT sector the external costs need to be reduced, in particular the emissions to air of CO_2 and NO_x. Such policies aimed at reducing external costs could either be aimed at direct mitigation (directly reducing fuel consumption per tonne-kilometre through technological or behavioural changes) or at the emission factors (reducing the emissions by clean fuels or emission abatement technologies).

The amount of new engines to be installed will probably be quite limited and relatively small compared to the total number of engines in the European fleet. Because of the long lifetime of vessels and engines, the overcapacity and the poor financial position of vessel owners the expected level of investments will very likely be low. Therefore, for a significant drop of the average air pollutant emission level of inland barge engines, not only measures to reduce the emissions of new engines are needed, but **also measures aimed at the reduction of the pollutant emissions from existing ships and engines.** Several measures could be implemented to lower the emission level of the existing fleet. The subsidy regimes applied in different countries over the last years (e.g. Netherlands and Germany) have shown limited effect, since the financial incentive for ship-owners was not sufficient to balance the additional investment and operational costs. Therefore, to reduce the emissions of the existing fleet, additional incentives would be needed to reduce the emission level of the existing fleet.

Options for additional incentives to be considered could be the following[86]:

- Mandatory standardisation
- Environmental zoning
- Emission taxation (cf. Norwegian NOx tax and NOx fund)
- Differentiation of port dues (clean vessels pay less, dirty vessels pay more)
- Voluntary standardization and shipper incentives (e.g. current Green Award)

A mandatory standard will be most effective, although the overall costs of adapting the existing fleet may be very high if a stringent standard were to be imposed with short deadlines. A subsidy system is legally simple, but as a single instrument not effective and subsidies do not perform well in terms of cost effectiveness as a result of 'free rider behaviour'. Economic incentives, such as differentiation of port dues and taxing emissions are cost effective measures, as the market will find the most efficient solution to the incentive. However, the overall effectiveness depends upon the level of differentiation/taxation and the scale with which differentiation/taxation is applied. The deployment of a voluntary instrument (e.g. Green Award) is unlikely to result in significant further emission reductions. However, such an instrument is cost effective and does not face any legal constraints.

[86] In the Annex Report a detailed description is provided about the options for incentives

There is also a risk that there will be a scattered development of different environmental schemes (for example environmental access zones in ports, different type of port dues calculation). This is due to the fact that decision-making on that legislation is at the regional level. In order to ensure interoperability and uniformity, coordination and guidance by the European Commission would be valuable to prevent a broad range of different schemes causing problems for operators to navigate across Europe.

To achieve a level of pollutant emissions comparable to that of road transport for new engines, a strengthening of emission limit values beyond phase-IV is needed. To foster technology development and cost reduction, a stimulus could be provided for the manufacturing industry through R&D and networking projects to speed up the development of clean and efficient techniques to reduce IWT emissions. They could be partially financed by governmental subsidies.

Greenhouse gas reduction in inland shipping can be guaranteed if a kind of standardisation or economic instrument (fuel tax) is implemented. The IMO has proposed ship efficiency indicators for seagoing ships in a complex international environment. Although this principle could also be used in inland shipping, less complex solutions may be more straightforward.

Because of the relatively small size, and the fragmented structure of fleet owners, active support from public bodies is desirable to provide coordination and to bring actors together in order to consolidate and create scale advantages and critical mass. The European Commission can offer support in this area by supporting networking and R&D projects. Knowledge of innovations in the field of inland navigation need to be disseminated and applied broadly with the support of innovation transfer clusters, enabling the fleet to be more competitive and sustainable. Also an intensive dialogue is needed between engine manufacturers, shipyards, equipment suppliers and fleet operators.

Even though mobile bilge water services have a successful history of more than 40 years in the Rhine region, implementation in the Upper Danube region faces obstacles. Certain differences — notably lower traffic frequencies, different administrative framework conditions — restrict the transferability to the Danube region. In the long run however, targeted development activities[87] should also lead to the implementation of a harmonised system for the collection and treatment of oily and greasy ship waste along the River Danube. The establishment and maintenance of the necessary network of reception facilities (mobile bilge water collection vessels, shore-based reception stations and treatment facilities) is expensive. Therefore, a financing model will be necessary that should incorporate the 'polluter pays' principle, thus encouraging waste prevention, as well as the principle of indirect payment, thus discouraging an evasion of the deposit of waste.

Fairway conditions are also a main determining factor of safety levels, for example narrower fairways will lead to higher risks, and fuel consumption (shallow water resistance), and consequently have an impact on the external costs of IWT operations. Measures in the field of fairway conditions have already

[87] For example the European WANDA project; www.wandaproject.eu

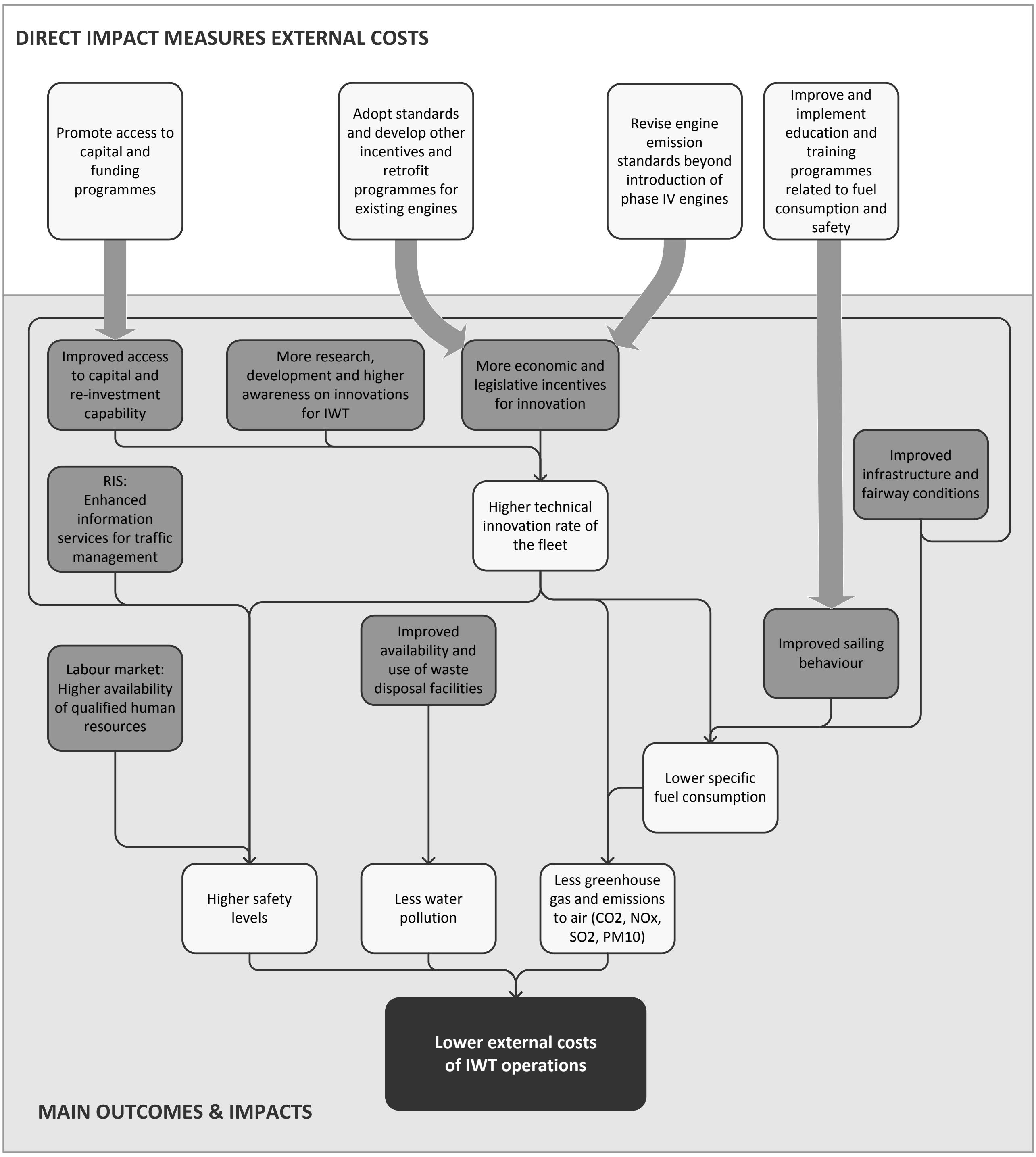
been included in the first policy package (modal share) and will therefore not be duplicated.

Considering the most important determinants of the external costs of inland waterway transport operations, following measures are expected to expected to have an effective and direct impact on the external costs (see also causal chain figure 8.2):

- **Adopt standards and develop other appropriate incentives and retrofit programmes to reduce pollutant emissions of existing engines [F1, F2, F3]**
- **Revise engine emission standards beyond introduction of phase IV engines [F6]**
- **Promote access to capital and funding programmes [M14]**
- **Improve and implement education and training programmes related to fuel-saving sailing behaviour and safety [E14]**

The measures have been listed in the tables in the various chapters (3 to 7) for each policy field. They are further detailed in Annex 8 under the respective category M = Market, F=Fleet, E=Employment& education, I = Infrastructure, R = RIS, and the consecutive number in the tables and in Annex 8.

Figure 8.2 Causal chain to directly intervene on external costs of IWT



Expected outcomes of external cost policies in IWT

- Innovative schemes providing economic incentives, serious investment support and retrofit investment programmes help to **overcome market barriers towards a greener fleet**. Bundling of expertise, knowledge and market parties resulting in a large scale innovation and investment programme helps to reduce required investment budgets. Given the long economic life time of typical main propulsion engines, more than half of the engines gradually shall be replaced or technically adapted in the next decade.
- More stringent emission standards, also for existing engines shall be a trigger for the IWT sector to make a quantum leap towards a greener fleet. The long economic lifetime of vessels and their equipment currently however prevents a higher innovation rate. Policy measures that **create a more favourable investment climate** on the one hand and that set higher emission standards on the other will eventually lead to **shorter innovation cycles in the sector** and consequently to **lower emission levels**.
- **Improved maturity of phase-IV solutions** and reduction of the costs. Analysis has shown that achieving a phase-IV level for the whole fleet, the total investment costs (public and private) amount roughly €1 billion, taking current cost estimates for SCR and DPF into account. An innovation atelier shall be constituted for the manufacturing industry that stimulates the development of clean and efficient techniques to reduce IWT emissions, accompanied by structural roll-out planning and subsidies covering parts of the investment costs. This would help to **raise the re-investment capacity** as well as facilitate the **faster take-up of innovations**.
- Further support for the harmonised development and implementation of River Information Services (especially traffic management systems) significantly contribute to **more efficient transport and less fuel consumption** (optimal speed due to traffic management on corridors) **as well as higher safety levels in inland waterway transport operations**. Sophisticated and innovative RIS services, which offer up to date tactical traffic images and topical depth information will raise safety of navigation (less vessel-vessel collisions, less groundings) and therefore have an important preventative impact. In terms of calamity abatement and rescue management, traffic-related RIS services have an important function as individual ship movements can be traced by almost unlimitedly (reconstruction of incidents and accidents; learning cases) and crucial cargo data can be exchanged more quickly between rescue forces in cases of emergency. This will have **significant positive effects on the number of casualties and water pollution levels**.
- The performance on GHG emissions does not only depend on technological solutions, but also strongly on the human factor. As the safety and environmental performance of IWT depends on sailing behaviour to a large extent (and consequently on the availability of qualified personnel), measures to promote education standards and proper training will have a **positive effect on accident frequency, fuel consumption as well as GHG emissions**. Experiences from the Netherlands have for instance shown that proper training and use of innovative decision support systems have already lead to a reduction of fuel consumption by 7% (27 million fuel costs savings) since the start of the "Smart Steaming" programme in 2007.

A combination of training and technology support therefore will be effective in terms of carbon reduction targets.

Vision 2040 and policy measures beyond 2020 related to environmental performance

In 2040 inland waterway transport makes use of the state-of-the-art techniques and is beyond controversy the most environmental friendly mode of land transport. There are clear incentives and regulations in place to trigger continuously shorter innovation cycles (such as direct financial incentives through internalised external cost). Co-ordinated research and technology development is going on to further reduce external costs and develop new and updated techniques.

Measures to be considered for implementation after 2020 with a direct impact on external cost are:

- Internalisation of external costs for all modes under equal conditions
- Strengthening of policy instruments to reduce specific fuel consumption (e.g. fuel tax or design standard)

8.4 Policy Package 3: Measures aiming at improving market conditions for operators and users of IWT

In policy packages 1 and 2 only the measures have been included that have a direct impact on the modal share or external costs. There are however also measures with an indirect impact on modal share and/or external effects which need to be implemented. Not resolving the problems which these measures address would seriously limit the effectiveness of the other two previous policy packages. Taking action would support and amplify the ultimate policy goals to increase modal share of IWT and to reduce the external cost.

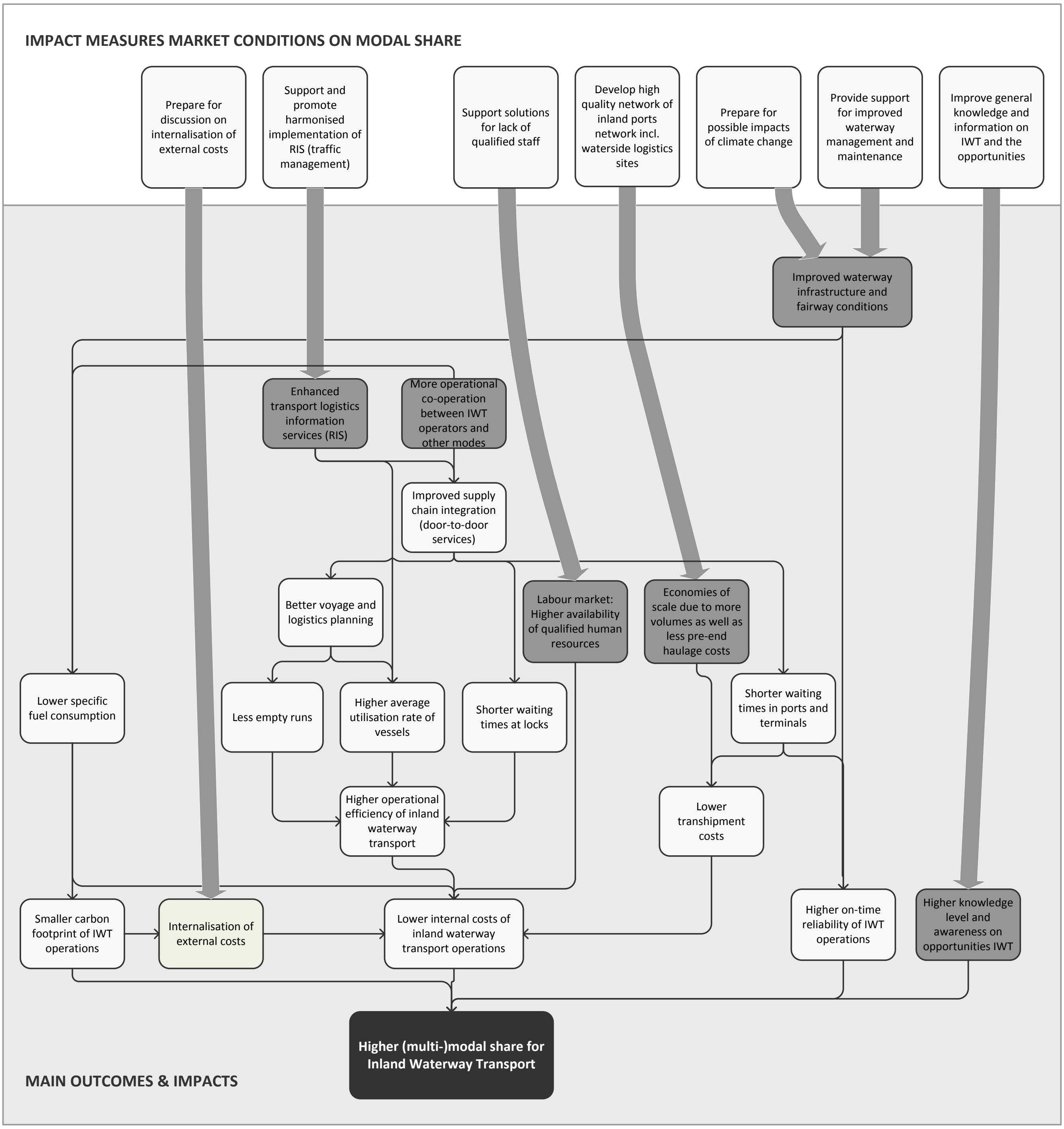
River Information Services are for example not yet fully available and several rivers and canals deal with lack of maintenance. One of the most alarming developments in the past years is the quickly declining number of people that are willing to work in the IWT industry. The present workforce is ageing considerably and the inflow of new entrants to the industry is insufficient despite the fact that the average rate of salaries has considerable risen in some market segments (e.g. in tanker shipping). With respect to fleet relates issues there is a lack of research and development for environmental friendly and efficient techniques, practices and roll-out planning as well as a lack of scale. Also the long planning procedures and even longer decision processes hamper the development of IWT. There is a lack of policy attention for spatial planning in relation to inland ports, in particular at regional levels. IWT is often insufficiently taken into account in formal infrastructure decisions. Moreover there is a general lack of reliable market information. This does make strategic and tactical decisions more difficult both in the private sector as well as detailed policy analyses (e.g. Impact Assessments). Moreover it causes a lack of awareness and visibility.

In 2020 there shall be a sufficient amount of workers in inland navigation resulting in acceptable labour costs and high safety and efficiency.

Also the safety for workers is improved due to improved safety culture and awareness. IWT offers attractive career perspectives and IWT must attract and retains significantly higher numbers of new personnel. Infrastructure maintenance and development shall be speeded-up including the attention for the quality, effectiveness and the efficiency of the inland port network. By means of RTD support a drastic improvement of the tools, knowledge and equipment shall be available at low costs for improving the environmental performance of inland waterway transport.

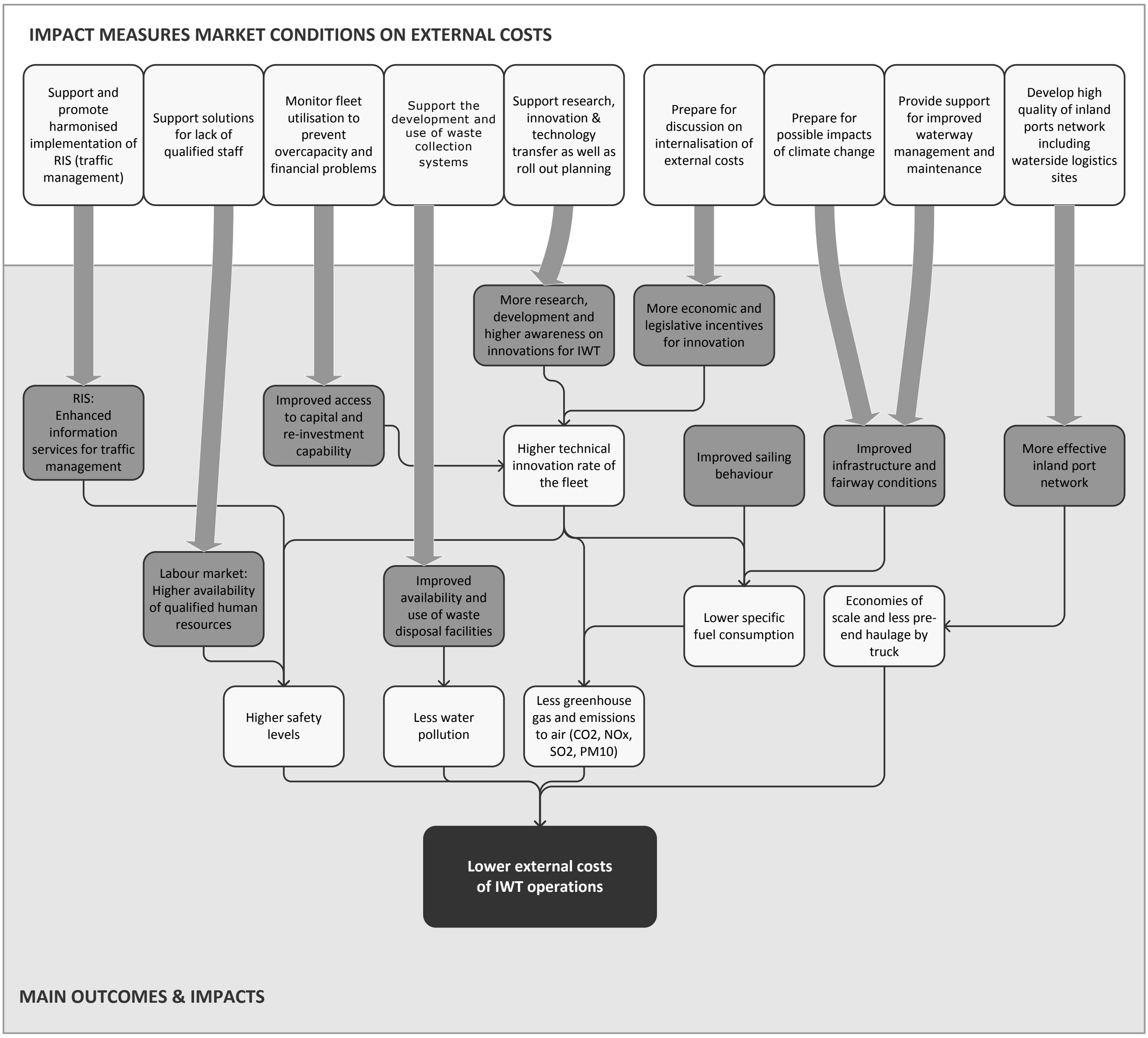
The following figure shows the relation of the measures through the causal chain with the objective to raise modal share.

Figure 8.3 Causal chain to intervene on modal share of IWT via market conditions



The following figure shows the relation of the measures through the causal chain with the objective reduce external costs.

Figure 8.4 Causal chain to directly intervene on external costs of IWT via market conditions



A number of measures have been clustered in a sub-group and linked to the policy fields since there are different specific measures but with the same overall measure.

The following measures are proposed under Policy Package 3:

Sub-groups policy package 3

- **MARKET:**
  a) Improve general knowledge and information on IWT and the opportunities [M1,M2,M3,M4,M5,M6,M12]
  b) Support financial strength of the sector by preventing disruptions in the market due to overcapacity [F9]

- **FLEET:**
  a) Support research, innovation & technology transfer as well as roll out planning [F4,F5,F7,F8]
  b) Support the development and use of waste collection systems [F10]

- **EMPLOYMENT & EDUCATION:**
  a) Support solutions for lack of qualified staff [E1,E2,E3,E4,E5,E6,E7,E8,E9]
  b) Improve and implement education and training programmes related to safety and logistics [E10,E11, E12, E13]

- **INFRASTRUCTURE:**
  a) Develop a high quality inland ports network including waterside logistics sites [I7, I9,I10,I11,I12,I13,I14]
  b) Provide support for improved waterway management and maintenance [I3,I4,I5,I6, I15,M13]
  c) Prepare for possible impacts of climate change [I16,117]
  d) Prepare for discussion on internalisation of external costs [M11]

- **RIS: Support and promote harmonised implementation of RIS [R1, R2,R3,R4,R5,R6,R7,R8,R9]**

The measures have been listed in the tables in the various chapters (3 to 7) for each policy field. They are further detailed in Annex 8 under the respective category M = Market, F=Fleet, E=Employment& education, I = Infrastructure, R = RIS, and the consecutive number in the tables and in Annex 8.

Vision 2040 and policy measures beyond 2020 related to market conditions

In 2040 the problems with staff shortages should be completely solved amongst others by the increased used of automated (either fully or partly) vessels. The work profile of staff in the industry should be radically changed and turned into a much higher level ("from sailor to vessel manager"). The industry will be much more attractive for young people because it will be safer to work and better career opportunities. Infrastructure problems have been solved in reasonable time span due to the streamlining of legislative requirements and the availability of useful guidance tools. There is continuous research and development on new techniques in close co-operation between engine and equipment manufacturers, shipyards, IWT operators and public stakeholders.

Policy measures addressing market conditions that can be considered beyond 2020 are the following:

- Support further automation of vessels
- ICT/ RIS real-time sailing assistance which identifies safety risks for vessels helping to improve safety levels in IWT even more
- Preparing for higher level education and training of staff
- European infrastructure slot access management of locks, ports and terminals

Full deployment of additional RIS services like support for logistics, resting place reservation system; affordable internet access

8.5 8.5 Implementation and monitoring

This final section presents the recommendations with respect to implementation aspects as well as the monitoring of key indicators that are relevant for the reaching the policy objectives.

8.5.1 Implementation aspects

The previous sections provide the recommendations for the policy on inland waterway transport for the medium and long term. The focus on the recommendations has been on the period towards the year 2020. The analysis would not be complete if not also the implementation of the policy is considered. For certain measures an Impact Assessment may be needed and therefore more elaboration is needed on the specific impacts of a measure and the costs and benefits.

Establishing the links to funding programmes

Main financial resources for the period 2014-2020 should come from the European Horizon 2020 programme as well as the Connecting Europe Facility.

Horizon 2020, the proposed new, integrated funding system that will cover all research and innovation funding currently provided through the Framework Programme for Research and Technical Development, the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT). These different types of funding will be brought together in a coherent and flexible manner.

The "**Connecting Europe Facility**" will finance projects which fill the missing links in Europe's energy, transport and digital backbone. It will also make Europe's economy greener by promoting cleaner transport modes, high speed broadband connections and facilitating the use of renewable energy in line with the Europe 2020 Strategy. It is proposed that the Connecting Europe Facility will invest €31.7 billion to upgrade Europe's transport infrastructure, build missing links and remove bottlenecks. This includes €10 billion ring fenced in the Cohesion Fund for transport projects in the cohesion countries, with the remaining 21.7 billion available for all Member States for investing in transport infrastructure.

The idea is to improve links between different parts of the EU, to make it easier for different countries to exchange goods and people with each other. By focussing on transport modes that are less polluting the Connecting Europe Facility will push the transport system to become more sustainable. Inland waterway transport is one of the modes that are less polluting and therefore IWT has a strong case to acquire funding for upgrading of the waterway network and ports. Transport systems in Europe have traditionally developed along national lines. The EU has a crucial role to play in coordinating between Member States when planning, managing and funding cross-border projects. A well-functioning network is essential to the smooth operation of the single market and will boost competitiveness. The European Commission proposed to create corridors to cover the most important cross-border projects. It has estimated that by 2020, €500 billion will be needed to realise a real European network, including €250 billion for removing bottlenecks and completing missing links in the core network.

Close cooperation with public and private stakeholders

The variety of measures are to be implemented at various political levels. Setting of framework conditions needs to be done by legislator and authorities at EU and national level. For acceptance and real-life implementation also the cooperation of market parties, the IWT industry, production, freight forwarder and logistics industries is crucial. It is therefore needed to have a close cooperation with all stakeholders in order to be aware of the various interests and positions and to work together on the further development and implementation of measures for stronger position of inland waterway transport mode in Europe.

In this study the project team had many fruitful interviews with large clients of IWT, the representatives from freight forwarders, production and trading industries (e.g. oil, chemicals, construction, energy, agriculture, steel industries). Therefore it is recommended to not only have an intensified co-operation with the public authorities and the inland navigation sector representatives but also to have a regular dialogue with the representatives of the main clients of IWT. Stakeholders that could be involved are the European Shippers Council, CLECAT but also direct representatives from the major companies that use IWT (e.g. steel industry, chemical industry, and oil and energy industry).

The key users of European inland waterway transport regularly experience what measures would be most urgently required to develop the sector further. In order to ensure that policy measures implemented on the European level are in line with the requirements and needs of these main users, such an IWT industry round table could be set up in order to increase the effectiveness of implemented policies. Such a group of experts could also provide regular and additional inputs to the already successful coordination of policies with social partners and official representatives of the IWT sector. It is therefore recommended to regularly organise workshops with industry representatives (shippers, forwarders, logistics providers) on topics and issues relevant to the European inland waterway transport sector.

8.5.2 Monitoring

In order to know if the policy measures do reach their goals the European Commission needs to monitor the progress made on the score of key indicators. A measurement dashboard could be prepared that presents the information on the development of the key indicators and as well actual forecasts based on trends and expectations. A part of this monitoring exercise can be based as well on the Market Observation System on IWT that is currently operated by the CCNR. However, the policy dashboard should be a broader scope and should also pay attention to forecast for the short and medium term.

For example such an advanced market observatory shall also follow the added value of IWT, turnover and profitability figures, detailed market freight prices, loading rates, the external effects/ external costs (a.o CO_2 emissions, NO_x emissions, accidents, environmental performance, detailed modal share figures of IWT in various supply chains and corridors, status of the engines of the fleet and the competitive position of IWT compared to other modes both on internal and external costs (e.g. for a number of representative origin-destinations)

The experience of the consortium that did carry out this study is that it was often very difficult to find reliable data (if any) for several indicators. In many cases the data was scattered and not uniform and also different in terms of the applied methodology and definitions to acquire the data. Probably for several indicators new ways of data collection and measurement need to be developed.

The Annex 7 in the Annex Report presents the recommended indicators that could be followed in order to monitor the development of the sector.

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