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Modal Shift Target for Freight Transport Above 300 km: An Assessment

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Introduction

One of the goals of the recent White Paper from the European Commission is that 30% of road freight transport over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050 (European Commission, 2011). For the purpose of a discussion on the feasibility and implications of this target, this paper reviews its rationale and the mechanisms by which a substantial modal shift could be achieved.

Several concrete questions emerge as to the realisation of the modal shift target. Is it realistic to expect that this much freight can be shifted from road to alternative modes? Can these modes absorb the increase in volume? If we look back, which developments in the past support the possibility of a major shift? In what way could this shift become reality in accordance with the economic laws of the freight transport market? The aim of this paper is to provide lines of reasoning and to discuss some possible answers.

Clearly, the mechanism of mode choice by shippers and logistics service providers is an important ingredient in our discussion and covers a substantial part of the paper. Before going into the detailed mechanisms of mode choice, however, Section 1 explores the background assumptions and implications of these modal shift targets somewhat further, to put the target in a broader perspective. Our discussion of the choice of mode takes place in Sections 2 and 3 and follows two main lines of reasoning:

- Firstly, we explore the potential for alternative modes of transport. We look at the potential for shifting from the perspectives of demand (logistical requirements of the goods to be moved) and supply (available capacity).
- Secondly, we explore how, within these bounds, the share of modes can be shifted. Here, we use simple models of choice where service quality variables, price and speed come together with demand attributes.

We finalise our paper in with a synthesis and some concluding remarks on how current trends in modal split could change due to new developments in supply chain management.

1 Some notes on the rationale of the modal shift target

A target for long distance freight transport

The text of the White Paper has the following to say about the distance limit of 300 km (EC, 2011):

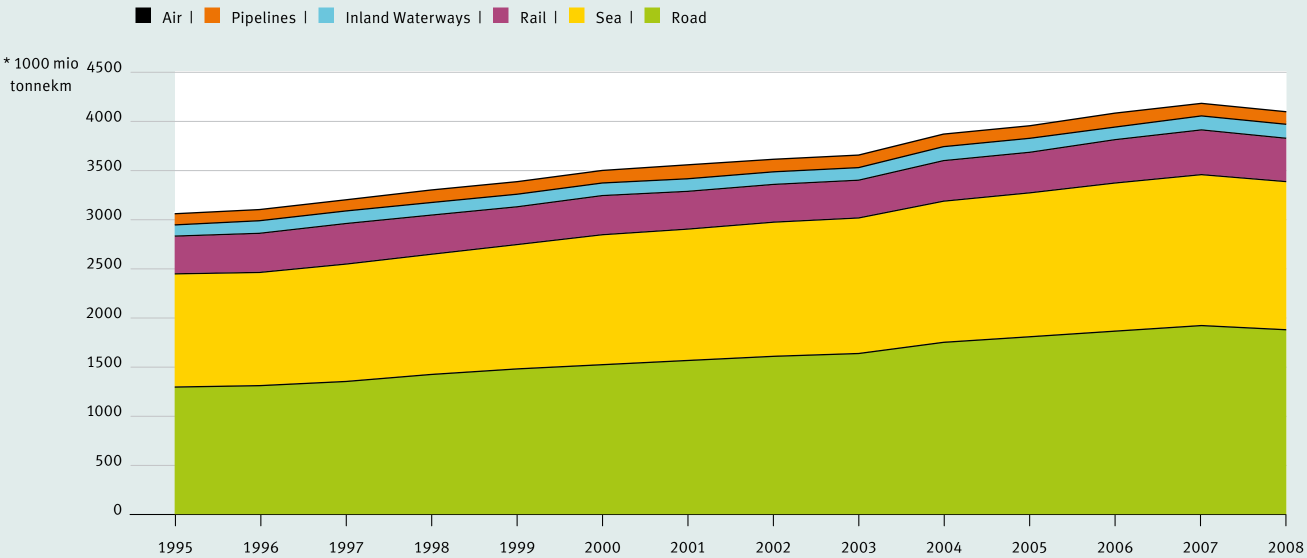
Freight shipments over short and medium distances (below some 300 km) will to a considerable extent remain on trucks. It is therefore important, besides encouraging alternative transport solutions (rail, waterborne transport), to improve truck efficiency, via the development and the uptake of new engines and cleaner fuels, the use of intelligent transport systems and further measures to enhance market mechanisms.

In longer distances, options for road decarbonisation are more limited, and freight multimodality has to become economically attractive for shippers. Efficient co-modality is needed. The EU needs specially developed freight corridors optimised in terms of energy use and emissions, minimising environmental impacts, but also attractive for their reliability, limited congestion and low operating and administrative costs.

In short, in the White Paper, different objectives are mentioned for different distance segments: road decarbonisation for short and medium distances and modal split for long distances. It is important to keep in mind that the modal-split target of shifting 30% of road transport to rail and inland navigation is for the transport segment above 300 km. In many studies on elasticity and potential, the results are given for the total freight market, not just for the segment above 300 kilometres. For comparison with studies showing results for the total freight market, it should be kept in mind that the 30% shift of road transport above 300 km is equal to a shift of only 3.4% of road transport for the total freight transport market (i.e., all distance classes together)[1]. As these loads are moved over relatively long distances, the effect on emission reduction is expected to be higher, however.

FIGURE 1: MODAL SPLIT DEVELOPMENT 1995-2008 IN THE EU27

SOURCE *Eurostat*



1. Based on TRANS-TOOLS results

Modal shift: A trend break

Clearly, the new target calls for a major trend break in modal split. Looking back, the autonomous trend in modal split over the last 13 years shows an increase in the share of road and sea transport (Figure 1).

There are different underlying trends that together make up this picture, including:

- Increased value density of goods and values of service, favouring road transport
- Privatisation of transport markets in Central & Eastern Europe countries, also favouring road
- Strong internalisation and a modest growth in domestic transport flows
- Decreasing shares of rail and waterways transport

These autonomous trends indicate that an increase in rail and waterways was not favoured by the market and that any modal shift policies of the past have been unable to change the share of the modes. There are, however, some autonomous future tendencies within the logistics and transport sector that might help to break this trend; these occur both on the demand and supply sides of the transport system. We discuss these in Section 3.

The impact of the shift on freight flows

In order to get an idea of the impact of this policy goal on the transported volumes by transport mode in Europe, a European trend scenario for the year 2030 based on a TRANS-TOOLS run is analysed. This analysis focuses on the transport flows within the EU27 for the year 2030; the year 2050 is not included. In the European trend scenario, limited policy measures are included to influence the modalsplit. The 2030 database contains information about origin regions, destination regions, transport modes, commodities, volume in tonnes and the distance between regions.

FIGURE 2: SHARE OF FREIGHT TRANSPORT MEASURED IN TONNES IN THE EU27 BY COMMODITY GROUP AND DISTANCE CLASS

SOURCE *Eurostat / TransTools*

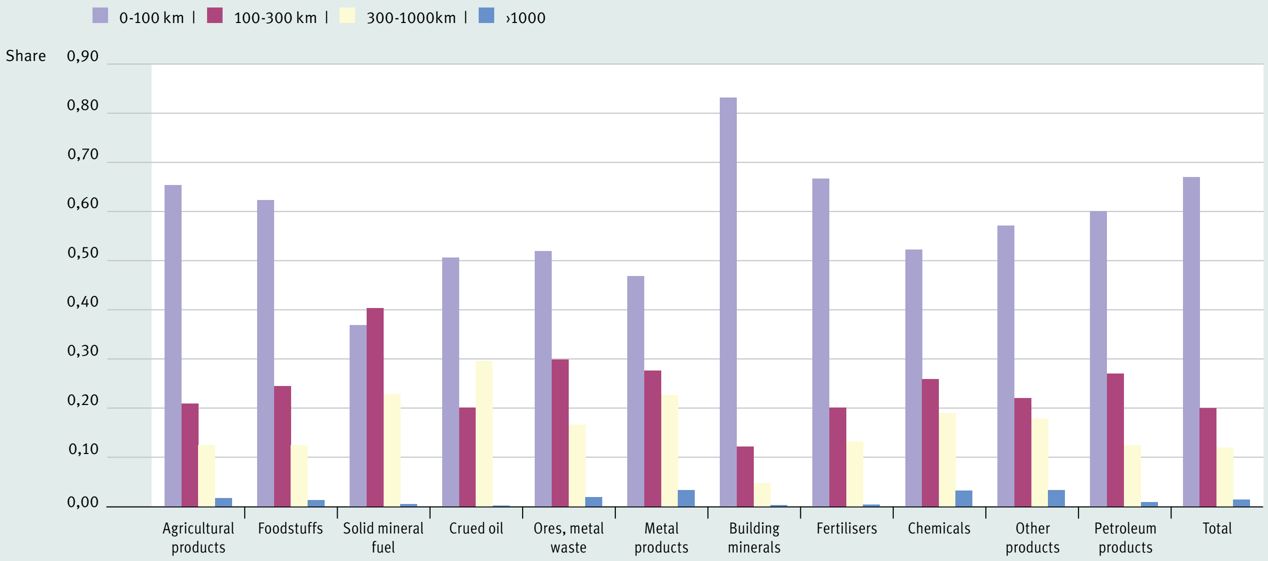


FIGURE 3 DISTRIBUTION OF TONNES AND TONNE-KM OVER TRANSPORT DISTANCE FOR ROAD TRANSPORT

SOURCE *Eurostat / TransTools*

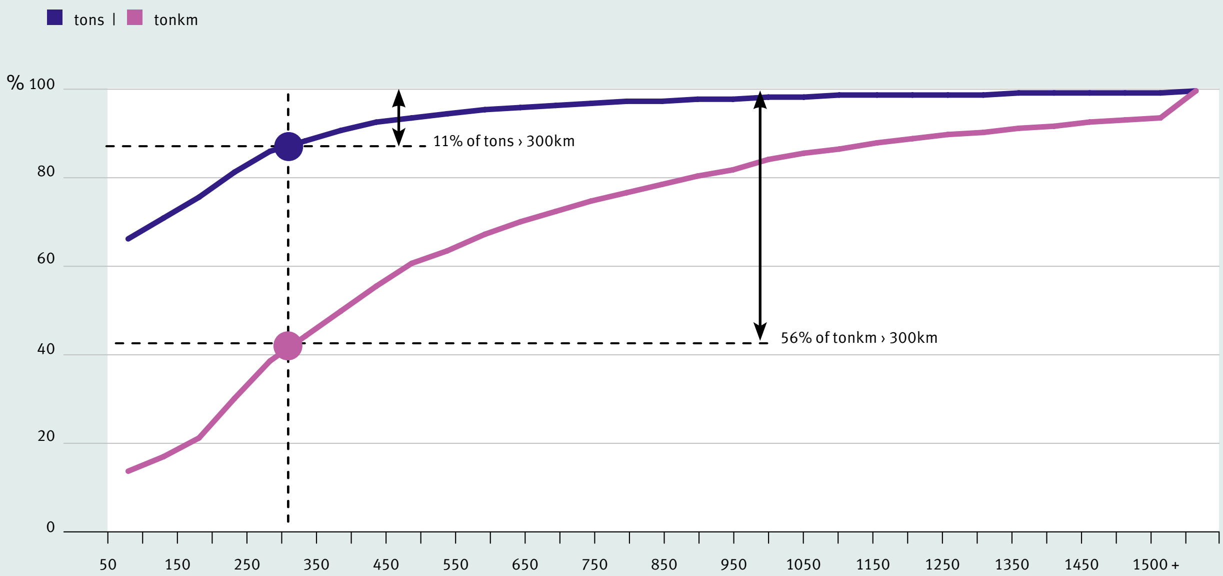
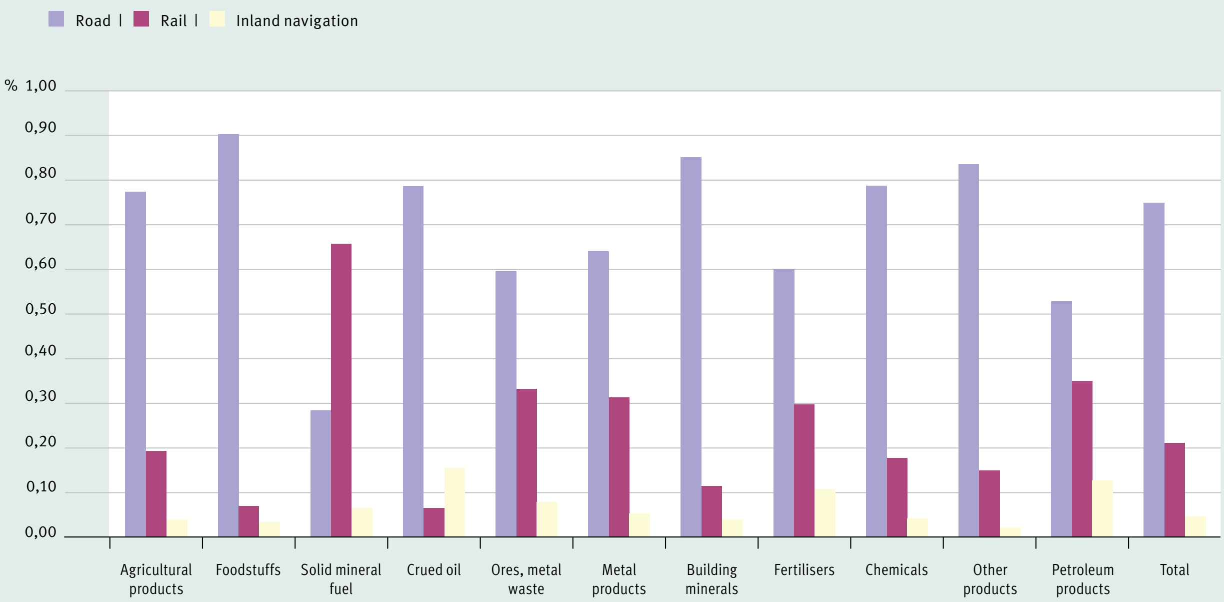


FIGURE 4: MODAL SPLIT IN THE EU27 FOR TRANSPORT ABOVE 300 KM

SOURCE *Eurostat*



First of all, the Figure illustrates the share of transport by commodity and distance class in the EU27. As expected, most of the transport volumes are carried over a distance of less than 300 km. For road transport and all commodities, 89% of the volume is transported over a distance of less than 300 km, while 11% of the volume is transported over a distance greater than 300 km. Per commodity, the share of transport above 300 km differs. The commodities "other products", chemicals, metal products, crude oil and solid mineral fuels have relatively high shares of transport over distances above 300 km.

Note that these numbers refer to tonnes lifted; the distribution of transport performance (tonne-km) over distance shows quite a different picture: here the majority of tonne-km (56%) is moved below distances of 300 km. Figure 3 shows the cumulative distribution of weight and transport performance.

In a next step, we focus on the transport flows over a distance greater than 300 km. Since the European trend scenario contains only a few policy measures that influence the modal split, these results can be regarded as the expected modal-split baseline. The modal split in the EU27 for transport above a distance of 300 km is shown in the figure below.

Of the total volume over all commodities, 75% is transported by road, 21% by rail and 4% by inland navigation (note that the accessibility of inland navigation is limited in the EU27). The commodities solid mineral fuels, petroleum products, ores and metal waste, fertilisers and metal products show relatively high shares of rail and inland navigation.

If the White Paper modal split objective is applied to these results, the modal split for the total over all commodities will change as indicated in the next figure.

The reduction of road transport by 30% leads to a decrease in the share of road from 75% to 52%,

FIGURE 5: MODAL SPLIT IN THE EU27 WITHOUT AND WITH CHANGED MODAL SPLIT OBJECTIVE

SOURCE *Eurostat / TransTools*

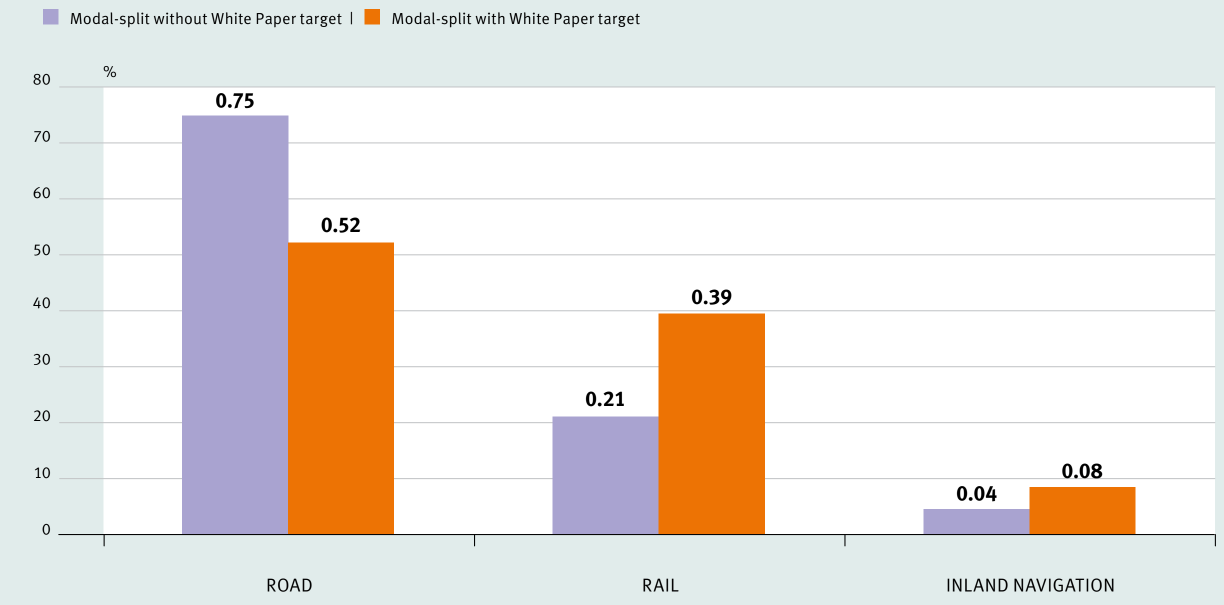


TABLE 1: REDUCTION IN CO_2 EMISSIONS IN 2030 DUE TO A 30% SHIFT AWAY FROM ROAD TRANSPORT

	RELATIVE	ABSOLUTE
Tonne-km (tkm) road above 300 km	56%	1400 bn tkm
Modal shift	30%	30%
CO_2 gain / tkm	50%	50 gCO_2/tkm (3)
CO_2 gain overall	8.4%	21 Mt CO_2

an increase of rail transport from 21% to 39% and an increase of inland navigation from 4% to 8% (if the shift of road transport is equally distributed over rail and inland navigation). This means that the volume of rail and inland navigation increases by 88%. The question whether this is a feasible scenario, from the perspective of available railway capacity, is discussed further in the paper. The commodities with the highest potential of this shift – simply in terms of volume of road transport – are in the "other products" category, in building minerals, chemical products and foodstuffs.

Anticipated environmental impact

The modal shift target was brought forward with the purpose of making the transport system more environmentally-friendly and putting less pressure on the main mode of transport – road – within the perspective of creating a co-modal transport system. How large are the potential gains in terms of emission reduction? Table 1 shows the expected benefits using a back-of-the-envelope calculation[2].

Overall, the measure appears to be a significant contribution to the CO_2 reduction targets of the future. We should make two notes with regard to this result. Firstly, we note that the assumed CO_2 gain per tonne-km can vary strongly depending on the circumstances. The degree of utilisation of modes is an important factor if we compare the modes in terms of their emissions. A well utilised truck can have lower emissions per tonne than a poorly utilised train (PE International, 2009). Besides empty running, part of the difference in emissions can also be caused by poor access to rail links by road. In short, even if the modal shift target is realised, this is not yet a sufficient condition for reducing GHG emissions per tonne.

Secondly, if we interpret these numbers from the perspective of the ambitious target to reduce GHG emissions by 80% in 2050, modal shift alone will not be sufficient. From a supply chain perspective, modal shift is just one of the many measures for energy reduction and decarbonisation within the transport and logistics sector and represents 8% of the full reduction potential. The remaining 92% could come from other measures in the broader supply chain (see Figure 6). Many of these also apply for longer distances.

FIGURE 6: EFFECTIVENESS AND FEASIBILITY OF MEASURES FOR EMISSION REDUCTION WITHIN THE LOGISTICS AND TRANSPORT SECTORS

SOURCE *World Economic Forum, 2009*

SUPPLY CHAIN DECARBONISATION OPPORTUNITIES	POTENTIAL ABATEMENT MT CO_2E	ASSESSED INDEX OF FEASIBILITY
Clean Vehicle Technologies	175	High
Despeeding the Supply Chain	171	High
Enabling Low Carbon Sourcing: Agriculture	178	Medium
Optimised Networks	124	High
Energy Efficient Buildings	93	High
Packaging Design Initiatives	132	High
Enabling Low Carbon Sourcing: Manufacturing	152	Medium
Training and Communication	117	Medium
Modal Switches	115	Medium
Reverse Logistics/Recycling	84	Medium
Nearshoring	5	Medium
Increased Home Delivery	17	Medium
Reducing Congestion	26	Low

2. In order to arrive at a first estimate, we took the following assumptions for our calculation: (1) an effect of modal shift in terms of a reduction of 50 gCO_2/tonne-km, equivalent to a relative savings of 50% CO_2/tonne-km and – (2) gains were calculated using distance band averages and linear approximation of the true functions.
3. We used a crude average of several sources summarised in McKinnon (2008).

Many of the initiatives mentioned above involve a rationalisation of transport and supply chain processes. These provide a decent return on investement in combination with a greening effect and are primarily driven by the sector. Initiatives for environmental certification and green awards go in parallel with a careful consideration of investments under the current business models. In their competitive market, carriers are starting to see this as part of their licence to operate as far as there is pressure from shippers to offer green services. Among shippers, however, the greening of the broader supply chain (including production and warehousing) is far less a growing practice, due to the consumer's limited willingness to pay for sustainable products. A limited amount of government intervention can be useful for hedging investment risks or improving the availability of information.

To the extent that the market cannot absorb the burden of internalisation of external costs itself (i.e., consumers are not willing to pay extra for greener products), this can be enforced through government regulation, emissions trading schemes or additional taxes or levies. Here, government is needed to select, introduce and maintain the financial schemes, limiting investments to those cases that create a net social benefit.

The Commission's target for the distance band for modal split does not appear to be supported by an argument in favour of either increased efficiency due to lower internal costs, or internalising external costs[4]. Further in the paper, we will look more closely into the reasoning that could be applied to this measure to justify it in economic terms. Sections 2 and 3 mainly deal with the fit between the goods' logistical requirements and the service quality of transport alternatives. In the next section we explore the potential for a shift along these lines in more detail.

2 The potential for modal split

Demand factor: Logistics

In a TNO study from 2006, the theoretical potential for rail transport, inland navigation and short sea was determined for the Netherlands. From the perspective of the demand of transport flows (logistical requirements of the goods to be moved), the study determined limiting factors for the theoretical potential of alternative modes. These factors are listed in the table below.

These factors were used to determine the potential of rail, inland navigation and short sea from the perspective of shipments. The maximum share for alternative modes of transport in the Netherlands, according to these criteria, came to 34%. The influence of the different factors considered is shown in Table 2. As this was a theoretical exercise, it is only a crude indication of the potential. For inland waterways, the realisation is higher than the potential, due to factors not taken into account. For rail transport, the realisation was below the potential. A doubling of flows for rail and inland waterways would be an extreme scenario, however, which would not fit well to the known characteristics of the goods.

In this study the theoretical potential for rail, inland navigation and short sea was determined from the perspective of the demand side of freight flows. Of course, the supply side is also an important factor: the availability of capacity is an important requirement and increasing congestion on the road or transport charges can have a substantial impact on the shares of the different transport modes.

4. A real life example of a target for modal split is the recent agreement between the Dutch environmental NGO Milieudefensie and the Rotterdam Port Authority for the biggest recent landfill and port extension in Europe: the Maasvlakte 2 initiative. The extension was allowed under the condition that new terminal owners would sign a contract for a modal share of road transport of maximum 45%.

TABLE 2: FACTORS LIMITING THE POTENTIAL FOR MODAL SHIFT

ACCESSIBILITY OF TRANSPORT MODES	While each region is accessible by road transport, this is not the case for the other transport modes. These modes are only accessible through terminals. Depending on the existence of terminals near the origin and destination regions, other transport modes can be an attractive alternative for road transport (where pre- and end haulage by road is still necessary in most cases).
TRANSPORT DISTANCE	As indicated above, for intermodal transport, transshipment is necessary at terminals near the origin and destination regions. This transshipment requires additional handling and costs compared to direct road transport. On short distances, these additional costs of transshipment cannot be compensated for by lower transport costs; for longer distances, the transshipment costs can be compensated for by lower transport costs of rail, inland navigation and short sea. Per mode, a minimal transport distance in order to be able to compete with road transport has been determined: inland navigation 50 km, rail 250 km and short sea 350 km. We note that these distances may vary depending on the actual product and market environment.
PRODUCT CHARACTERISTICS	In logistics, product characteristics such as value density (value in euro per m^3) and package density (number of packages per m^3) are used to determine the important cost components within the total logistic costs. For freight flows with a relative low value density (less than 6000 euro per m^3) and a relative low package density (less than 15 packages per m^3) interest costs and handling costs are relatively low and transport costs are a more important factor in total logistic costs. For these commodities, transport modes with lower costs than road transport are an interesting alternative.
SIZE OF SHIPMENT	The larger the size of the shipment, the higher the chance that transport modes will be chosen that can carry large volumes. Only shipments with a size above 1 tonne are considered to be interesting for rail, inland navigation or short sea. Note that this is a rather optimistic view, favouring the potential share of rail and waterways.
SPEED	When goods have to be delivered in a very short time, in many cases, road transport is the best option. Therefore, for the potential of the other transport modes, only those shipments are considered that should be delivered in more than one day.

TABLE 3: INFLUENCE OF CONDITION SURROUNDING TRANSPORT ON POTENTIAL

SOURCE *TNO, 2006*

LIMITING FACTORS	RELATIVE
Connection (Is there a transshipment terminal available near the destination?)	87
Distance (minimum 200-250 km for rail)	61
Product characteristics (Less than 12 packages per m3, value < 6,000 Euro per m^3)	50
Size of shipment (>1 tonne)	35
Speed (>2 days)	34

In a CE/TRT study from 2011 – focusing on the potential of rail transport – a literature study was performed on studies of modal-shift potential. A lot of studies were reviewed, but in the end, it was concluded that only two studies covered the maximum potential in Europe. The other studies had different objectives, scope and methodologies. The two relevant studies are briefly discussed below:

Vassalo and Fagan (2005)

In addition to supply and demand factors, several policies are mentioned that influence the share of rail in Europe:

- Insufficiently open markets
- Lack of interoperability
- The national focus of European railways
- Allocation of railway capacity in favour of passenger transport
- Lack of productivity-enhancing infrastructure (longer trains, double stack)

In a scenario with new policies that repaired all the above-mentioned deficiencies, rail freight transport could grow by 100%.

EEA (2008)

The base potential of road transport that can be shifted to rail was estimated by EEA at 19%. Two approaches are applied. In the first, a theoretical potential is based on trip length and the assumption that the share of rail can rise significantly over longer distances, leading to a growth in rail transport of 100%. In the second, factors such as distance, costs, quality of supply and rail access are also included, leading to a growth in rail transport in Europe of 7%.

Other studies vary a lot in scenarios, scope and methodology. In general, the potential growth of rail transport in these studies varies from 10% to 30%. We note that in many of these studies, the potential is expressed for the total rail freight market, not just for the distance segment above 300 km.

Supply factor: Capacity concerns

Besides the demand side factors, another important question that determines potential is whether there is enough capacity in the other modes of transport to absorb a doubling of flows. In the EC/TRT study, an analysis was made of the available free capacity of rail infrastructure. The main finding was that, if rail freight volume increased by more than 30% to 40%, the current rail network would not have sufficient capacity. We note that the free capacity depends strongly on whether flows are concentrated on corridors, the primary network or the whole network. A recent study on rail potential (CE, 2011) finds that an increase in rail capacity is only possible if the whole network can be employed to absorb freight growth. In a historical context of shrinking infrastructure and service networks by rail in Europe, this would require a re-direction of investment, developing terminal networks, upgrading technology outside main lines and corridors and a higher prioritisation of freight with respect to passenger traffic.

In the Netherlands, an analysis of inland waterways capacity was carried out by Ecorys (Ecorys, 2009). This study focuses on the waiting time at locks on the important inland waterways corridor Rotterdam – Antwerp. In the scenario with the highest growth, the transported volume in tonnes by inland navigation doubles in the year 2040. As a consequence of this growth, the waiting times at the locks would increase dramatically.

Discussion

A growth in the market share of rail and inland navigation transport depends on many factors, from both the demand and supply sides. The theoretical potential has been determined in several studies with a wide range of outcomes, depending on scenarios, scope and methodologies. A doubling of the volume of rail and inland navigation – the impact of the White Paper modal-split goal – is an ambitious target and is at the upper level of the outcomes of several potential studies of modal shift.

3 Can the potential be realised?

Even if freight could potentially be shifted from road to alternative modes, the choice of mode is still an open question. This choice is to be determined by the actual service quality offered by all modes and the preferences of shippers and logistics service providers. We briefly discuss a simple theoretical model and draw some conclusions about fundamentally different ways in which a shift between modes can be stimulated.

A simple mode choice model

Below we discuss the effects of policy using a simple theoretical model for mode choice. The choice of mode in freight transport has been well researched over the past decades. The textbook model of mode choice applied most often is based on the trade-off between the out-of-pocket costs of transport (the tariff paid by the shipper) and the lead time between origin and destination[5]. Transport time is weighted by the value of time (measured in euro/hr, per shipment or tonne). The weighted sum of tariffs and time is called the generalised costs of transport and determines the attractiveness of transport modes.

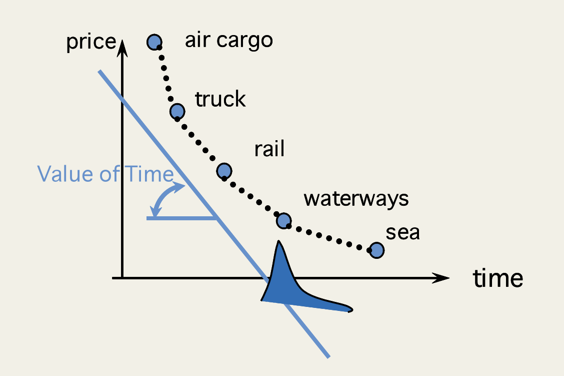
Shippers will choose those alternatives that have the lowest generalised costs. In mathematical notation:

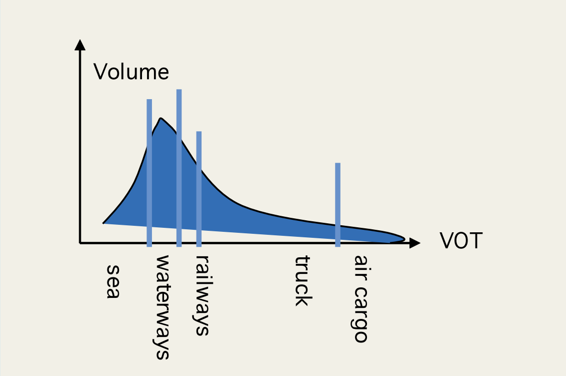
$$GC_{m,g} = VOT_g * T_m + P_m$$

Where **GC** = Generalised Costs;
VOT = Value Of Time; **T** = Time; **P** = Price
and subscripts: **m** = mode of transport; **g** = good

Figure 7 shows a stylised example of the spectrum of five modes available between two regions, each with its own times and costs. The right-hand side of the figure shows the distribution of the VOT over the whole sample of goods. In a simple deterministic choice situation, the VOT for which a shipper is indifferent between road and rail is the one indicated by the line between the two modes. The dotted line connecting all modes is called the efficient frontier and shows the whole portfolio of technologies that are Pareto efficient. Road will be preferred if VOT is higher than the one indicated by the line connecting road and rail transport. The aggregate share of transport modes between two regions will be determined by the volume distribution of goods with different VOTs.

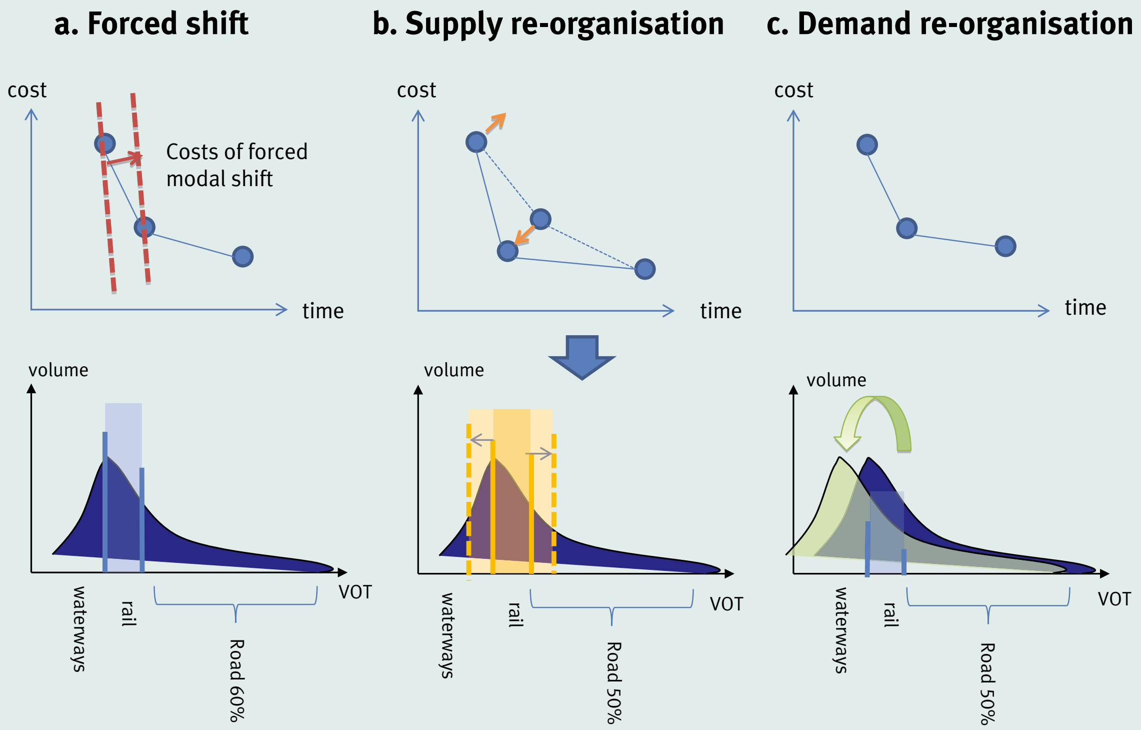
FIGURE 7: MODE CHOICE MODEL WITH TWO CRITERIA AND VALUE OF TIME





5. The model can be extended by including additional attributes of modes such as reliability. Also, extension is possible by adding combinations of different modes (multimodal routes).

FIGURE 8: DIFFERENT APPROACHES TO REACH A MODAL SHIFT



The value of time of transport is closely related to the logistics characteristics of goods (see e.g., Blauwens and Van de Voorde, 1988 for a discussion). Time-related cost drivers include physical characteristics, such as the value density of goods, their perishability, as well as other characteristics, such as order lead-time and production technology. An indication of the influence of value density on mode choice is that the value density of goods decreases for slower and cheaper modes of transport. This distribution is not fixed, however, and may change if prices or transport times change in the system. The graphs in Figure 8 show how transport policies and changes in the logistics environment translate into the mode choice model. Modal shift can be achieved as forced agreements (Figure 8a) or in accordance with the market choice mechanism, through changes on the supply side (Figure 8b) and/or the demand side (Figure 8c).

Figure 8a shows that a forced modal shift for a shipper with a high VOT (high enough to prefer road transport) implies that he has to choose the alternative of second preference, in this case rail transport.

Figure 8b illustrates how a change in transport time and/or tariffs results in modes attracting different types of goods (with another VOT), and hence in changes in modal split. As the times and costs change for one or more modes of transport, their relative position changes, and thus the VOT at which shippers will be indifferent between modes. Thus, there will be a small segment of shippers that will change their choice of mode. The value of goods moved by rail will increase in this case.

Figure 8c indicates how a change in the distribution of goods across different VOTs would lead to another modal split. In this case, the modes stay the same, but the preferences change within the population, and more goods are assigned to particular modes, and less to others.

We discuss these approaches further in the following three subsections.

Effects of a forced modal shift

A simple application of the model is to calculate the costs of a forced modal shift using some crude performance indicators for transport modes. Box 1 provides an illustrative calculation. This simple example indicates that the generalised costs of transport would increase by 30% for a high value product.

If we assume a reduction in CO_2 emissions because of the shift from road to other modes of 50 g/tkm, the implied shadow price of CO_2 amounts to 1543 euro/tonne ([6]). This price is well above the shadow prices that are being discussed in the context of climate change policy (less than 100 euro/tonne). Thus, a forced switch to alternative modes of transport could be very costly for higher value products, compared to a scenario of internalisation of external costs, when these would incur new CO_2 taxes, following the "polluter pays" principle.

Supply side changes

There are many changes on the supply side of the transport market that are relevant for modal shift; examples of these include the following:

- Deterioration in the performance of road, through pricing, changes in cost components such as driver wages or fuel prices, increased regulation and congestion
- Improvement in the performance of rail and waterways transport, in time dimension (through increased frequency, reliability, etc.) or tariffs, information availability (transparency of schedules)

Note that with improvements in rail transport, rail will also improve its competitive position with respect to inland waterways and take over part of its volume. In addition, in our model, competition between road and inland waterways may be limited, and improvements in waterways may go only at the cost of rail movements. Obviously, the exact configuration of times and costs will depend on the specific circumstances (e.g., availability of rail sidings, frequencies, etc.). For specific commodities,

BOX 1: THE COSTS OF FORCED MODAL SHIFT (ILLUSTRATIVE)

A 7-tonne shipment with a VOT of 5 euro/hr/tonne has to be transported over 1000 km. Alternatives are road and rail transport. Road tariffs are 800 euro, rail tariff is assumed to be 500 euro including transshipment and access/egress transport. Transport time including loading and unloading is 24 hours by road, and 48 hours by rail. The generalised transport costs are as follows:

- For rail 500 + 7 x 5 x 48 = 2180 euro
- For road 800 + 7 x 5 x 24 = 1640 euro

The shipper will prefer road, if he can decide autonomously. If he is forced to use rail, his total costs will increase by 540 euro.

6. A savings of 0.35 tonne CO_2 is achieved at the cost of 540 euro, due to an increase in transport time. Note that this shadow price takes into account the generalised transport costs difference and not only the out-of-pocket costs. For the emission gain per tkm, we use a crude average from various sources summarised in McKinnon (2008). The calculation assigns all the costs to CO_2 and disregards other possible gains.

it is possible that rail will perform worse than road and waterways for all VOTs (in this case, in the time/ price graph rail will lie behind the efficient frontier), and waterways will compete with road only.

How do we estimate the effect of concrete policy measures directed at the supply side of the transport market? A considerable number of modelling studies have looked at the price elasticities of freight transport[7]. The elasticity of road transport in mode choice situations in Europe was found to be roughly around -0.5, meaning that a 10% change in road prices would translate into a 5% reduction of road flows. This implies that a tariff increase of 60% for long distance transport could theoretically result in the desired shift. At the present time, this seems politically infeasible. An internalisation of external costs for all distances would involve a more limited increase in tariffs and reduce road transport between 2% to 8% (IMPACT, 2008). Effectively, this would provide an overall result in the same order of magnitude as the EC target for the road market. In other words, if the White Paper measure included distances below 300 km, the intended environmental effect appears to be feasible.

The effect of changes in transport times is less well studied. Elasticities for changes in the transport time of other modes of transport in competition with road transport vary widely (dependent on the type of product), but may be around unity (a 10% decrease of transport time or increase in frequency can result in 10% increase in volume). It is questionable, however, whether these elasticities could be applied to major changes in transport times. In any case, a doubling of flows would require a substantial improvement in transport performance.

In addition to policy, there will be autonomous trends that will determine future modal split:

- New technologies will change the appearance of the portfolio of transport services on the European network: modes will be able to provide better service through seamless integration.
- Improved interoperability will not only influence strategic mode choice decisions by improving the service level of rail, as intended by the policy; it will also allow new dynamic approaches towards mode choice to emerge, within shipping and forwarding companies.
- Real-time information on network performance and open, a modal transport booking systems will allow flexible consolidation schemes and dynamic switching between modes.

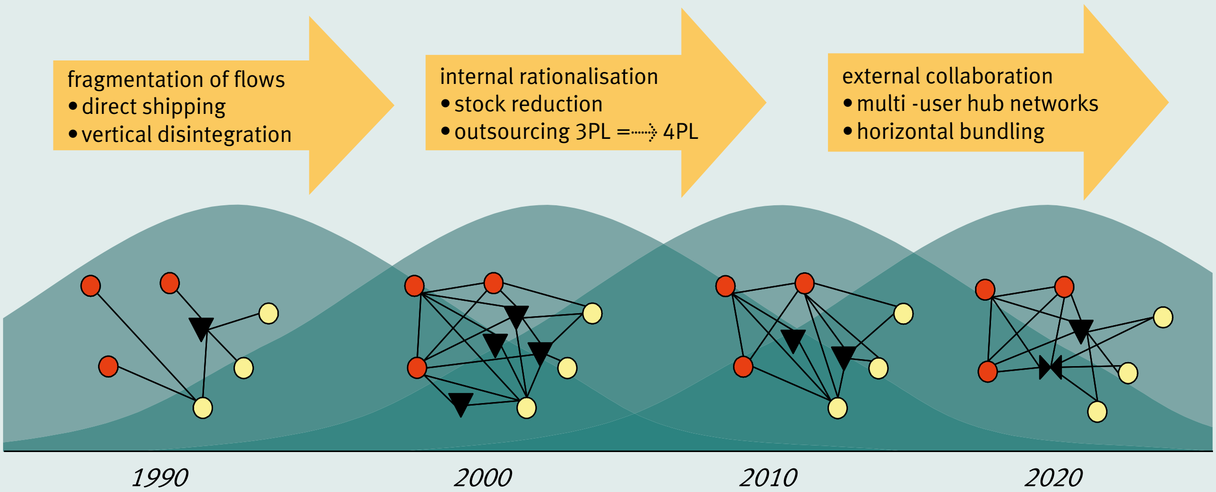
Road transport will still be the backbone of such a flexible freight transport network. However, we expect that other modes of transport will be able to increase their share, servicing the segments of the freight market that require slow, stable and high volume movements. Improvements in service quality will need to include both transport services themselves, as well as the interconnection between transport management and supply chain information systems, such as Enterprise Resource Planning (ERP) and Warehouse Management System (WMS), through improved visibility and data exchange facilities. Due to the access costs of rail and waterways transport, it is likely that these modes will only maintain a relative advantage on longer distances. We can expect that improved synchronisation between road and alternative modes will lower the distances at which these alternatives are competitive. As an example, between sea and inland ports in the Netherlands, inland waterways compete with road transport as of distances of 50 km.

7. see Significance and CE, 2010 for a review

BOX 2: THE EVOLUTION OF LOGISTICS NETWORKS THROUGH TIME8

Hybrid networks form the latest stage of evolution of firms' logistics capabilities, in their search for improved services and simultaneous cost reductions (Figure 10). The first wave of change took place in the 1990s and involved the reduction of shipment sizes, an increase in frequencies and just-in-time transport, as a first sign of mass individualisation. This wave of fragmentation was followed by a wave of internal rationalisation of flows through the turn of the century. Firms are now seeking economies by collaboration across company boundaries and horizontal collaboration is seen as one of the transformational innovations that will change the logistics business landscape in the coming years (see e.g., Mason et al, 2007).

FIGURE 10: EVOLUTION OF LOGISTICS NETWORKS THROUGH TIME .



Demand side changes

Changes on the demand side that can lead to a modal shift are less straightforward to explain than supply side changes, as they require a change in the logistics processes. In our choice model, a move away from road transport would be achieved if the VOT, or time sensitivity of the goods were to decrease. Where firms are able to reduce the VOT, their generalised costs of transport would already decrease even if they used the same mode of transport. Examples of measures to slow down flows include:

- Reduction of perishability with improved conditioning (example: flowers in reefer containers)
- Increasing slack in the supply chain with higher inventories, increasing shipment sizes and lead -time (example: urban consolidation centres)
- Horizontal cooperation with other shippers to consolidate shipments (example: Dutch GreenRail system)

8. The dark dots (top, left) indicate suppliers, the light ones (right, bottom) indicate consumers, and the black triangles warehouses and cross-dock locations

Note that these changes are very difficult, if not impossible, to induce or influence through public policy. These measures are not even easy to implement for companies themselves, as they require a careful reconsideration and reorganisation of logistics structures and operations. Companies are generally well aware of typical issues, such as the trade off between transport and inventory costs, or the benefits of improved conditioning. However, other measures are more complex, such as the creation of hybrid networks, where logistics channels are split into two or more parallel channels, according to demand volume and variability. Currently, such innovations are still decades away for many companies. At the same time, it is part of a long term autonomous evolution of supply chains and will, sooner or later, transform the industry (see box).

Some companies are already making serious attempts to slow down their flows and looking to alternative modes of transport. Some recent cases in logistics reorganisation and modal shifts of retail companies in the Netherlands and Belgium relate to short distance movements. From the perspective of potential change in the system, the limit of 300 km disregards segments with real opportunities for modal shift.

If this trend of collaborative logistics persists, the bundling of flows will increase and slower, large-scale modes of transport will be in a more advantageous situation. This change in supply chains towards collaborative logistics will also depend on the quality and capacity of infrastructure networks.

Discussion

Both theoretical studies and practical experience with modal shift policies seem to suggest that our expectations should be low with respect to the feasibility of the new target for modal split. There is no consensus about the potential volume of road freight that could shift towards rail and waterways transport. Theoretical studies suggest different numbers for this potential – between no potential at all to a doubling of current volumes in rail transport. Even in the event that there was a theoretical potential, there is little evidence pointing to promising policy measures that could help to reach the target. A forced modal shift would imply high additional indirect costs for freight shifting. A tariff increase that achieved the target would need to be around 60%. It is difficult to imagine that such a policy induced tariff increase would be accepted.

The effects of improvement in transport time of alternative modes could be substantial, given that elasticities are close to unity. Even then, a step change in service quality would be needed. Ultimately, we can also identify reasonably new autonomous trends that might support a shift from road to rail. These include increasing congestion and fuel prices for road transport, growing transport distances with the opening of markets in peripheral countries, and the tendency of shippers and carriers to increase the bundling of shipments to reap new economies of scale and density.

Concluding remarks

We conclude that the ambition level of this target is very high. Even though there is a theoretical potential, the feasibility of shifting such volumes in the segment above 300 km seems low. The objective of reducing internal and external costs may be achieved more easily by other means than through a modal shift exclusively above 300 km. We note that there are new and promising cases for modal shifts below this distance, where the majority of freight movements take place. In addition, there are other opportunities for the redesign of supply chains that have a stronger carbon reduction potential and higher feasibility. In both situations, transport policy can only play a minor role.

Some potential for further modal shift above 300 km appears to exist, but is theoretical, as it is constrained by economic, technological and institutional factors. Most studies address the potential across all distance bands and find that this is below what is targeted in the White Paper. Seen from the supply side, the potential shift is mainly constrained by infrastructure capacity, especially on the major multimodal corridors and terminals.

Looking at the feasibility of the modal shift target in more detail, we can distinguish between two levels of reorganisation that would help to achieve this. The "business as usual" level involves a rationalisation with relatively little effort, possibly leading to a limited volume shifting with a slight greening effect, and a decent return on investment under current business models. There are some autonomous trends that will support this autonomous shift. Such a shift may already require an extension of infrastructure capacity.

The second level of reorganisation involves additional charges to road and high investments in the multimodal transport system. These measures are interrelated. The larger the improvement that can be reached in the service quality of rail and waterways, the lower the level of taxation needed to achieve the target. If the average service quality of all modes remains as it is now, the additional charges on road use needed for the envisaged modal shift will be far above current levels of external costs.

Scenarios for future modal split should take into account some critical external success factors. These include a broad range of autonomous developments and technological innovations that may push companies to use other modes of transport: road congestion, increasing oil prices, better multimodal interoperability through ICT and collaborative logistics. Many of these developments are now starting to have a tangible influence on the transport business and could thus contribute to breaking the trend in modal split.

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