A sensitivity analysis of freight transport forecasts for The Netherlands

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A sensitivity analysis of freight transport forecasts for The Netherlands

Abstract
Strategic freight transport models can be used for a quantitative analysis of long term forecasts. This paper discusses an analysis of the bandwidth of freight transport forecasts for The Netherlands with the strategic freight transport model 'BasGoed'. This model was developed over the past years as a basic model, satisfying the needs of policy making, based on proven knowledge and available transport data. Starting point for the analysis are the long-term scenarios for The Netherlands developed recently by CPB Netherlands Bureau for Economic Policy Analysis and PBL Netherlands Environmental Assessment Agency (WLO scenarios: Future outlook on welfare, prosperity and the human environment). The scenarios describe two base cases: The High and Low scenario. Both scenarios include a consistent set of assumptions on economic development (domestic growth by industry sector and international trade), infrastructure development, fuel prices, and logistic efficiency. The bandwidth of freight forecasts is further explored in five distinctive sensitivity analyses: different development in fuel prices, energy markets, CO_2-pricing, dematerialization and modal shift in the port of Rotterdam. The sensitivity analysis provides more insight in the level of importance of each scenario assumption and it can be useful in estimating a bandwidth for freight transport demand. This is valuable in providing insight in the robustness of the freight transport forecasts for policy studies.

Keywords: freight transport demand; long term freight forecast; scenario analysis; sensitivity analysis, The Netherlands

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1. INTRODUCTION

Freight transport forecasts are increasingly important: the freight transport sector generally grows at a higher pace than passenger transport (ITF-OECD, 2015), and the possibilities to make freight transport more energy efficient are less compared to passenger transport. As a result, the freight transport sector is a crucial driving factor behind the growth of future energy consumption (European Commission, 2016).

Strategic transport models are a common tool to provide forecasts for long term transport demand at national scale and for long time horizons. To predict freight transport demand for The Netherlands, the 'BasGoed' model was developed (Tavasszy et al, 2010; De Jong et al., 2011). The strategic freight transport model Basgoed provides predictions of multi modal freight transport forecast between regions by commodity type up to 2050, so for a 35 year time horizon. The freight forecasts from Basgoed are used as quantitative inputs in sectoral (uni-modal) studies that analyze the rail-, inland waterways, or road networks in more detail. Outside The Netherlands other strategic freight models are in use as well: for a recent overview see De Jong et al (2013). Examples of freight forecasting tools in European freight transport studies include the PRIMES-TREMOVE (E3MLab, 2015) which was used for the EU Reference scenario (European Commission, 2016), or TRANS-TOOLS used for the iTren-2030 Reference scenario (Schade et al., 2010).

Literature provides many examples that describe the calibration of strategic freight transport models or validation of cost sensitivities, such as Beuthe et al for Belgium (2001), Ben Akiva and De Jong for Sweden and Norway (2008) or Markianidou et. al, (2012) and Grebe at al. (2016) for the Flemish strategic freight model. The quantitative scenario assumptions that are input to the model applications, such as energy transition or dematerialization, also have a large impact on freight transport forecasts and can have a large degree of uncertainty. In spite of the strong impact of these assumptions there are much less studies available on the derivation of quantitative scenario assumptions for it.

In this article we present the use of BasGoed to explore the impact of scenario assumptions on the bandwidth of freight transport forecasts. These forecasts are quantitative inputs for the National Market and Capacity Analyses (NMCA) policy study in The Netherlands: once every four years, the Dutch Ministry of Transport analyses its transport infrastructures to create an inventory of potential bottlenecks for freight and passenger transport (Ministry of Infrastructure and the Environment, 2017a). This inventory includes different transport infrastructure networks and is made for the long term. The multimodal forecasts from Basgoed are used as input in uni-modal sectoral studies that make a more detailed analysis of the rail-, inland waterways-, or road networks.

Starting point of the analysis are two base scenarios of freight transport demand, each with a consistent set of assumptions on economic development (domestic growth by industry sector and international trade), infrastructure development, fuel prices, and logistic efficiency. Sensitivity analyses are a useful method to test the impacts of specific scenario assumptions. By varying the quantitative assumptions behind the scenario, the bandwidth of freight transport forecasts can be explored.

The article first discusses the general specification of the model Basgoed. Next the freight scenarios are discussed: the implementation of the scenarios and assumptions behind it, as well as the quantitative outcomes. Next, sensitivity analyses are presented for five distinctive scenario developments: development in fuel prices, energy markets, CO_2-pricing, dematerialization and modal shift in the port of Rotterdam.

2. THE BASGOED FREIGHT TRANSPORT MODEL

BasGoed was developed over the past years as a basic model, satisfying the basic needs for policy making, based on available knowledge and transport data. The design principles were described in Tavasszy et al. (2010) and the empirical specifications are provided in De Jong et al. (2011). The model uses available transport statistics for The Netherlands, scenarios for economic development and detailed infrastructure networks that describe the accessibility of Dutch regions and the hinterland, as inputs. It has a modular structure following the generic four-step modelling approach (see Ortúzar and Willumsen, 2011), including an additional module for maritime freight forecasts:

1. Economy Module: this module generates freight transport demand, depicting the relation between economy and transport and generation of the yearly volumes (weight) of freight produced and consumed;
2. Distribution Module: predicts the freight transport flows between these regions;
3. Modal Split Module: predicts the market shares of each transport mode, resulting in the freight transport flows between regions by mode;
4. Vehicle module: converts the road freight forecasts from tons into vehicle forecasts for network assignment.
5. Maritime Module: predicts a forecast of maritime freight transport flows to and from the deep sea ports in The Netherlands.

This section first discusses the outline of each step individually, before the implementation of freight scenarios is explained in the next section.

The economic module of BasGoed is based on the original SMILE+ module for freight generation (see Bovenkerk, 2005; Tavasszy et al, 1998). This module is based on an input-output framework and translates economic growth scenarios by industry sector into regional forecasts for the production and consumption of commodities (domestic and import/export). The geographical level of detail comprises 40 regions within The Netherlands (NUTS3) and 37 in the rest of the world. Input to this module are scenarios for the distribution of employment and population by region and international trade scenarios. The economic and trade scenarios for Basgoed are derived for the so-called WLO scenarios for The Netherlands ('Future outlook on welfare, prosperity and the human environment'), described in Romijn et al. (2014). International trade flows which have no origin or destination in the Netherland are not directly related to the I/O framework of The Netherlands, but these flows could transit through The Netherlands, e.g. from the UK to Germany. These transit tables are calculated by the economic module based on the calculated export and import to and from the respective regions.

The second step of the model is the distribution model that generates OD-commodity flows in tons, based on a double constrained gravity-based model. In the next step, the modal spit model, the market share of road, rail and inland waterway is predicted for each OD-pair using a multinomial logit choice. The modal split model receives input from the underlying assignment models to concerning transport costs and times between regions. For the derivation of the distribution and modal split modules see De Jong et al. (2011). The commodity classification used is NSTR-level1 (10 commodity groups).

The vehicle module converts the road freight forecasts into a vehicle forecasts. Exogenous models are used for the assignment of freight traffic flows to infrastructure networks. For freight traffic assignment the National Model System from Rijkswaterstaat can be used. For rail the Nemo model is used, which is owned by ProRail, the Dutch railway infrastructure provider. Finally, for inland waterways the BIVAS waterway network simulation model is used. For prediction purposes, Basgoed uses a growth factor method (or pivot point method) in which the calculated growth factors are applied to the observed vehicle, ship- and train matrices which serve as input for the detailed assignment models.

The Maritime Module is a separate module that uses a base matrix with observed maritime freight transport flows and economic growth factors from the Economy Module, to calculate a forecast of maritime freight flows to and from the Netherlands.

3. FREIGHT TRANSPORT SCENARIOS IN BASGOED

3.1 Long term transport scenarios

Basgoed is used for strategic analysis of impacts of scenario uncertainties in freight transport demand. The implementation of freight scenarios in the model is visualized in Figure 1: it illustrates how forecast indicators are calculated with the Basgoed model, using input parameters that are derived from assumptions on scenario uncertainties. The main modules in Basgoed, and the associated input parameters are indicated. As main sources of uncertainty for freight transport demand the following scenario uncertainties are identified: the world economy, international trade, the strategic position Dutch deep sea ports, domestic industrial development, climate policies, European transport policy, logistical organization and Dutch policy (on infrastructure or pricing).

The development in the World economy and international trade are two strongly related scenario uncertainties. It is a challenge to predict the pace of the growth of the world economy, and the economy of regions. On top of that the level of interaction between economies, or trade, is the outcome of complicated global political processes: it depends on specialization, globalization, transport cost development, the disappearance or emergence of trade barriers. Due to such developments, over the past decades, international trade grew more rapidly than economic growth. This tendency might continue but may also slow down, or even reverse.

The strategic position of Dutch deep sea ports also depends on complex global factors, because it’s high share of international transit flows. Between the hinterland of Rotterdam and world regions. The position may be affected by a trend towards larger vessels in deep sea shipping or emergent alternative trade corridors.

The domestic economic development by industry is another important driving force behind the Dutch freight transport demand. Industries that provide services are expected to have a stronger growth than the traditional manufacturing or agricultural sectors. Urbanization is a second aspect of regional economic development that will affect the pattern of transport demand.

Policies, at European or international level, are also considered a source of uncertainty on freight transport demand. International climate policies imposes an important uncertainty because it may impact the availability or the costs for energy carriers such as coal, oil, LNG or biomass. Furthermore European transport policies affect the organization of the transport infrastructure on European transport corridors. That may affect international freight transport barriers, costs, and as a result the freight volumes. National policies affect the supply of transport infrastructures, and the pricing schemes for transport modes by excise taxes or user charges.

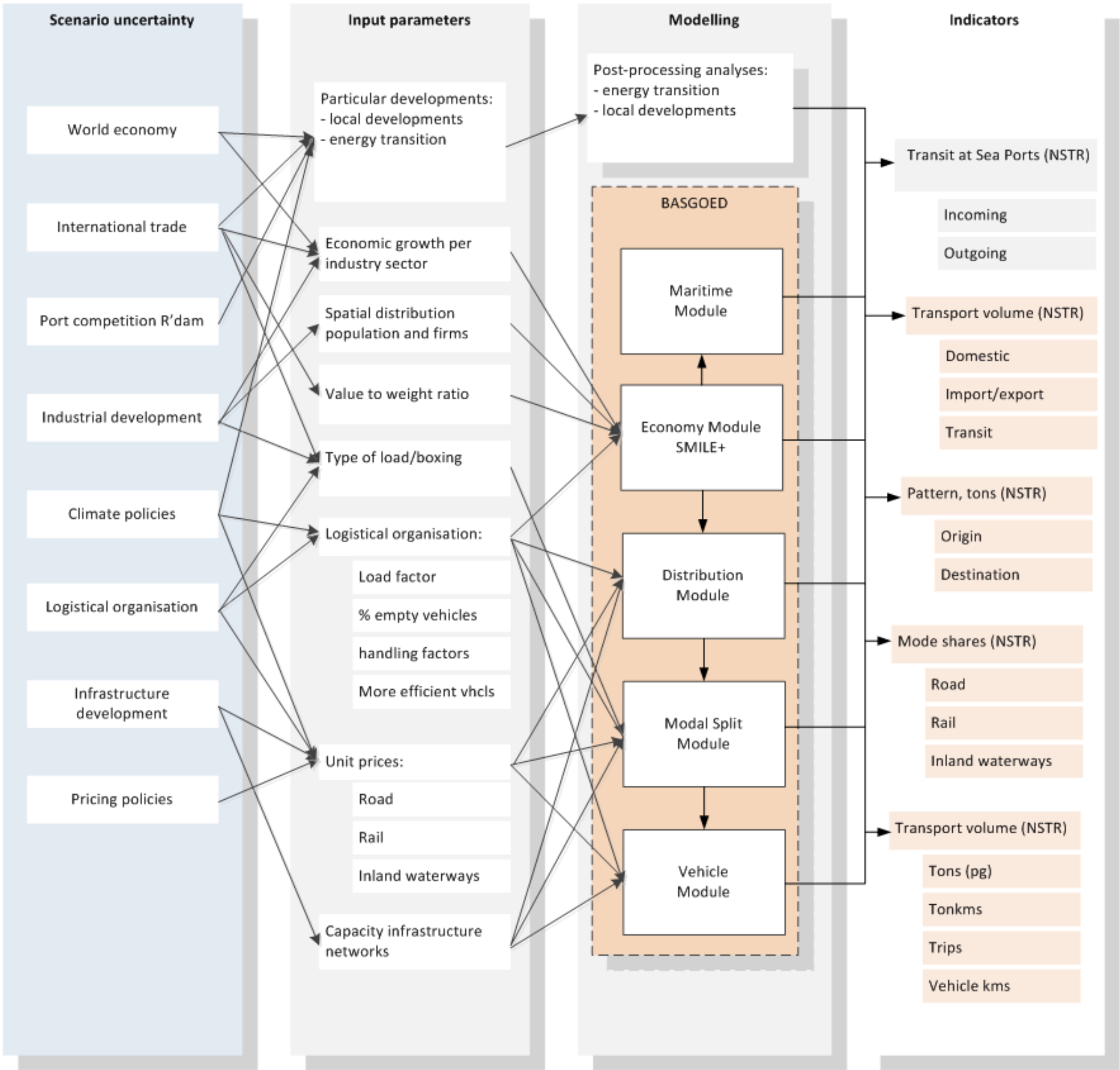

Figure 1: The position of BasGoed in the analysis of freight transport scenario uncertainties in WLO. Source: Romijn et al. (2014).

Finally, the logistical organization has an intrinsic tendency to strive for efficiency. There are different ways in which the logistical sector strives to become more cost efficient: consolidation of freight flows, usage of more efficient vehicles, improved trip planning. There are no logistical road maps that detail the availability and take-up of technological developments but this will affect the logistical organization of freight transport.

The developments in these uncertainties are translated into input parameters to the analyses: where possible, BasGoed is used. Where developments are not included in the model, external analyses or post-processing can be used.

Starting point for the analysis are the long term scenarios for The Netherlands, the so-called WLO scenarios ('Future outlook on welfare, prosperity and the human environment'). These scenarios are formulated by the Netherlands Bureau for Economic Policy Analysis (CPB) and Netherlands Environmental Assessment Agency (PBL). They describe two base cases: The High and Low scenario (Romijn et al, 2016). Both scenarios include a consistent set of assumptions on economic development (domestic growth by industry sector and international trade), infrastructure development, fuel prices, and logistic efficiency. Table 1 provides a global overview of the main assumptions in the High and Low scenarios.

Table 1: Main scenario assumptions in the High and Low scenario in the updated WLO.

	High scenario:	**Low scenario:**
World economy	Strong growth	Slow growth
International trade	Strong growth	Slow growth
Strategic position Dutch deep sea ports	Remains constant	Remains constant
Industrial development	Large service sector	Small service sector
Climate policies	Substantial: reduction of coal and oil volumes	Moderate: no reduction of coal and oil volumes
European transport policy	Neutral trend	Neutral trend
Logistical organization	Widespread upscaling, consolidation and increasing efficiency	Minimal upscaling, consolidation and increasing efficiency
National policy	Minimal differentiated	Minimal differentiated

Source: Romijn et al. (2014).

The transport infrastructure related uncertainties, such as the port accessibility and transport policies, are kept neutral in the WLO scenario with the purpose to provide 'business-as-usual' base scenarios. Transport infrastructure specific policies or developments can be added to the input of simulation scenarios to make an impact assessment of a policy alternative.

3.2 Local developments

Not all policy measures, local developments or specific events can be simulated explicitly with a strategic model like Basgoed. Such events can be the closure of specific mines or power plants, or the opening of a new multimodal container terminal. As this may involve a shift in high volumes in tons or TEUs, such events should be taken into account in a strategic forecast. For this reason, the BasGoed forecasts have been further improved by adding developments which cannot be predicted by BasGoed but that have a significant impact on freight transport flows at local or national level by means of post-processing.

Two types of developments have been distinguished. Developments that already took place between the base year 2014 and 2016, and developments that will be realized over the coming years. The selection of all relevant developments was provided by the planners at Rijkswaterstaat. Some developments are known to take place, and others are likely to occur and are important enough to be included in the base scenario of freight transport demand. More specific, these developments include:

- Closure of sand and gravel pits in the southeast of The Netherlands (both -1.75 mln. ton per annum (p.a.))
- Opening of new sand pits in the province of Flevoland (+1.75 mln. ton p.a.)
- Import of gravel from Belgium (+1.75 mln. ton p.a.)
- Opening power plant at Eemshaven (+1 mln. ton coal p.a. shift from other power plants)
- Closure of power plants that use coal (-1.5 mln. ton p.a. shift to other power plants)
- Opening bio mass power plant in Utrecht (+200.000 ton p.a.)
- Closure of paper production in Nijmegen (-350.000 ton p.a.)
- Opening of a sugar terminal in Terneuzen (+240.000 ton p.a.)
- Shift of liquid manure in the province of Limburg (30.000 ton p.a.)
- Opening of new inland container terminals varying from 12.000 TEU – 500.000 TEU p.a.

All developments have consequences for the mode used. For example, the opening of container terminals led to splitting the OD-relation into two legs. One by rail or inland waterways –to and from the port of Rotterdam- and the other by road. The closure of power plants leads to a reduction of coal by means of inland shipping.

Altogether, the changes have minor impact on the total amount of transport in the future years (since most of these changes comprise a shift from one location/mode to another). However, on a local and regional scale the impact might be large. As the BasGoed results are used in other models for the assignment phase, such as the Dutch National Model, the opening of new container terminals will cause a rerouting of road freight transport. As a result, this local development will cause increased truck traffic intensities on routes to and from the container terminals.

The post-processing of the BasGoed results show that a general strategic freight model can, by definition, cannot cover all the impacts. Implementation of specific big local developments improved the final results of BasGoed, in particular for the use of the forecasting results in the exogenous assignment models.

3.3 The high and low scenario forecast

The base forecast for the High and Low scenarios, are based on the assumptions for the exogenous variables from the WLO scenarios as described in 3.1 and with the local developments described in 3.2. The general results of these base forecasts are given in Table 2 and Figure 2. The general freight forecast are expressed in freight volumes in tons and includes domestic, import, export and transit transport.

The total volume of freight transport demand develops with a growth index of 148 in the High scenario towards 2050 and 113 in the Low scenario between 2014 and 2050. Although this concerns an independent projection, the bandwidth of the High and Low scenario aligns with the EU Reference Scenario. This scenario predicts a growth index of 134 for freight transport demand in ton-kilometers in The Netherlands (European Commission, 2016). Although growth measured in ton-kilometers is generally stronger than growth expressed as tons lifted, the growth in the scenarios have a similar order of magnitude. The pace of growth at EU level by mode also shows a similar pattern: road and inland waterways show a moderate growth towards 2050: an index 136 for road and 130 for inland waterways. The EU reference scenario predicts the largest growth index for rail as well: 152 for The Netherlands.

Table 2: Ton per modality (in mln. tons).

		Million Tons				Index 2014=100		
		2014	**2030**	**2040**	**2050**	**2030**	**2040**	**2050**
High	Road	939.6	1113.7	1227.0	1366.3	119	131	145
	Rail	41.4	61.1	77.8	98.7	148	188	238
	IWW	350.4	411.2	449.9	501.7	117	128	143
	Total	**1331.3**	**1586**	**1754.7**	**1966.8**	119	132	148
Low	Road	939.6	970.9	989.2	1013.6	103	105	108
	Rail	41.4	54.2	62.5	71.8	131	151	173
	IWW	350.4	379.0	394.5	422.4	108	113	121
	Total	**1331.3**	**1404.1**	**1446.2**	**1507.7**	105	109	113

Source: Ministry of Infrastructure and the Environment (2017b)

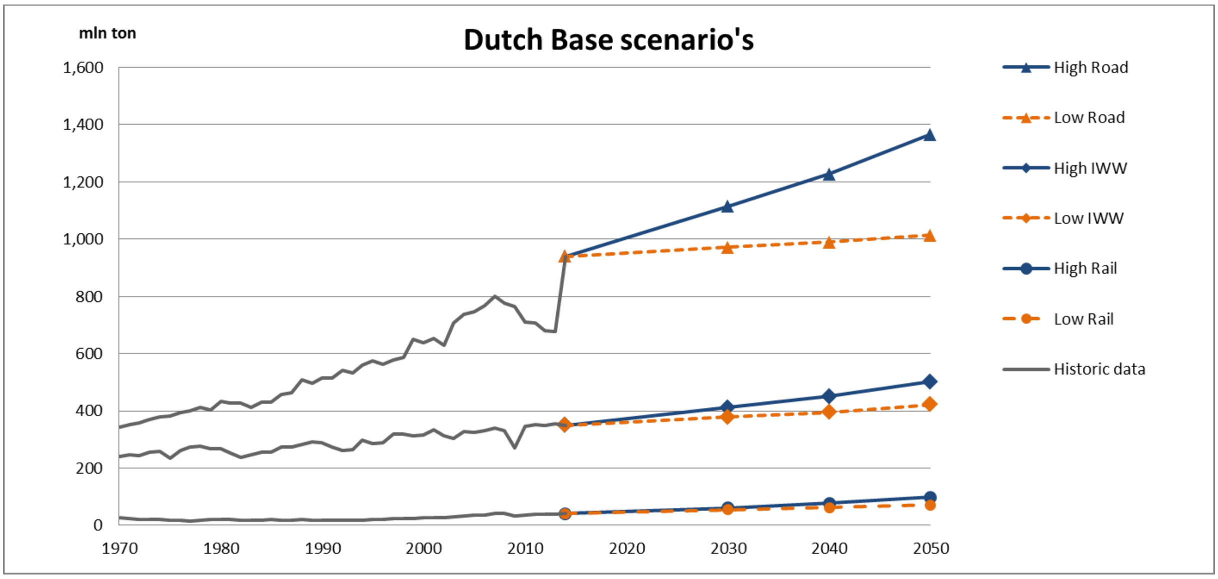

Figure 2: Freight forecasts in High and Low scenarios, in mln. tons and by mode: 2014-2050, compared to observed volumes 1970-2014.

Figure 2 shows the freight forecasts for the High and Low scenario, and the observed volumes between 1970 and 2014. The observed figures show a reduction of freight transport in the years 2008-2010 because of the recent economic crisis. Recent statistics show slight recovery. The figure shows a significant increase for road transport in 2014 but this is mainly the result of a change in base registration for road transport: the base registration in this year includes a total of 200 million tonnes of transport by Light Goods Vehicles (LGV = vans). For the other years from 1970 to 2013, the amount of road freight by LGV's is not included. This explains the steep rise of the road freight transport volume in 2014. We included the structural break in the figure, since the 2014 official statistics constitute the base year for BasGoed. The figure also shows that the high scenario has similar growth as was realized recent decades, while the growth in the low scenario slows down to a lower pace. This is in line with the assumptions for the scenarios. Sensitivity analyses of the main scenario assumptions showed that the economic scenario has the largest impact on the global scenario outcomes (Ruijs and de Bok, 2015). In this article we will explore the sensitivity to assumptions in specific scenario uncertainties that are relevant for actual trends or policy issues.

4. SENSITIVITY ANALYSES

To explore the bandwidth of the freight forecasts a number of alternative assumptions are made for specific scenario developments or policy measures. These include development in fuel price, energy transitions, CO_2-pricing, dematerialization, logistic efficiency and the implementation of an enforced mode shift policy in the port of Rotterdam. The sensitivity analyses are conducted for forecast year 2040 and either on the high or the low scenario, depending on the analysis.

4.1 Fuel prices

Fuel prices are affected by climate- and national policies. In Basgoed, fuel prices are included in the unit price parameters: the energy costs per vehicle kilometer. These parameters are input for the calculation of total transport costs in the Modal Split and Distribution modules, as indicated in Figure 1. The base case assumes a lower fuel price in the high scenario, resulting in lower energy costs per vehicle per kilometer for road transport. Currently, there is no gasoline excise tax for inland waterways, but the high scenario includes the introduction of an excise tax for inland waterways, leading to an increase in energy costs. In the low scenario a higher fuel price is assumed, due to lower levels of fossil fuel production, resulting in higher energy costs for road transport and inland waterways. The low scenario does not assume strong climate policies or a new excise tax for inland waterways. The energy costs for rail are assumed to be dependent on other sources of energy and are assumed to remain constant, in both in the high and low scenario.

The assumptions for fuel prices and energy costs in the high and low scenario are explored in two sensitivity analysis. For the high scenario the fuel prices are increased, leading to an increase in energy costs for road and inland waterways. In the low scenario the fuel prices development is lowered, resulting in lower costs for road and inland waterways. The energy costs for rail are assumed to not be affected by developments in fuel price. The corresponding values are listed in Table 3.

Table 3: Assumed energy costs in Base scenario and Fuel price scenario

Energy cost (€/vhc/km)	Base scenario		Fuel price scenario	
	High 2040	Low 2040	High 2040	Low 2040
Road	0.21	0.30	0.23	0.21
Rail	6.92	6.92	6.92	6.92
IWW	14.49	11.13	18.11	7.89

The results of the fuel price scenarios are presented by transport mode in Table 4. The effects of changing the fuel prices are relative small. Fuel price only has an impact on the transport cost functions in the modal split models and the transport impedance in the

Distribution module. The total amount of freight transport predicted by the Economy Module is not affected by the transport costs. Thus, fuel price developments only lead to a modest modal shift and a small impact on the OD pattern. The sensitivity run in the High scenario shows that the increasing energy costs for inland waterways (14.49 to 18.11 Euro/km) and road (0.21 Euro to 0.23 Euro/km), leads to an increase of the volume of rail transport by 2%. In the Low scenario, the lower fuel costs for road (0.30 to 0.21 Euro/km) and IWW (11.13 to 7.89 Euro/km), lead to a decrease of rail transport volume by 5%. The road volume increases by 1% and IWW decreases by 2%.

4.2 Energy transition

Energy sources, in particular coal and oil, have an important share in the freight transport volumes by rail and inland waterways. These transport flows may change drastically due to a radical energy transition, but there is large uncertainty on such transitions. Influencing factors are (international) climate policies, technological developments and societal acceptance of recent technologies such as capturing carbon dioxide. The base scenario from BasGoed predicts an average trend in the energy sector; it does not include a model to predict the energy transitions. So, the energy transition scenario is implemented in a post-processing step, where the outcomes by commodity are adjusted according to the quantitative assumptions regarding the energy transition.

Two alternative scenarios for the energy markets are explored: a radical transition scenario towards renewables and a transition scenario to more coal. The quantitative assumptions are based on the broader explorative study by Matthijsen et al. (2016). The first energy scenario assumes a transition of the energy production to local sources of renewable energy such as solar and wind energy. By 2040, the import of energy sources is assumed to be reduced by 75% in the High scenario, and by 16% in the Low scenario. The second energy scenario assumes a larger role for solid mineral fuels and less oil / petroleum products, based on the assumption of the overall availability of capturing and storing carbon dioxide. The impact of both scenarios is presented in Table 4.

Table 4: Impact of Fuel price- and Energy transition scenarios (in men tons resp. % impact against base in 2040)

		Base scenario 2040	Fuel price scenario	Transition to renewables	Transition to more coal
High	Road	1227	0%	-2%	-1%
	Rail	77.8	2%	-16%	3%
	IWW	449.9	-1%	-20%	13%
	Total	**1754.7**	**0%**	**-6%**	**1%**
Low	Road	989.2	1%	0%	-1%
	Rail	62.5	-5%	-3%	4%
	IWW	394.5	-2%	-4%	22%
	Total	**1446.2**	**0%**	**-1%**	**1%**

Concerning the renewable energy, the results show that a drastic transition to renewable energy sources as in the High scenario has a substantial impact on freight volumes transported. In particular inland waterways (-20%) and rail transport (-16%) show strong reductions in predicted volumes for 2040. In the Low scenario these impacts are less strong.

In the energy transition scenario to the increased use of coal it can be seen that the transport volume by inland waterways is growing strongly in both the High and Low scenario (13% vs 22%). Rail shows a small increase (3% vs 4%), while the road transport volume is declining by 1% in both scenarios.

4.3 CO_2-pricing and inland waterway transport

One of the climate policy assumptions in the High scenario is the introduction of an excise tax for inland waterways, leading to a strong price increase of transport costs for inland waterway transport. This measure is disputed and therefore highly uncertain. The isolated effect of this policy measure is studied with a sensitivity run for the High scenario only, without the introduction of the excise tax for inland waterway transport. It can be seen that not implementing this tax for inland waterways, the IWW transport volume increases by 4% in 2040 and 8% in 2050.

Table 5: Results sensitivity analysis excise tax IWW (in mln. tons resp. % impact against base)

				Base scenario			No excise tax IWW	
		2014	**2030**	**2040**	**2050**	**2030**	**2040**	**2050**
High	Road	939.6	1113.7	1227	1366.3	-1%	-1%	-2%
	Rail	41.4	61.1	77.8	98.7	-2%	-5%	-7%
	IWW	350.4	411.2	449.9	501.7	2%	4%	8%
	Total	**1331.3**	**1586**	**1754.7**	**1966.8**	0%	0%	0%

4.4 Dematerialization

Developments in value-weight ratio have an impact on the volume of the freight flows. The value-to-weight ratios are input to the Economy Module (Table 1) and are used to convert the monetary volume of trade flows into freight volumes. In the base case it is taken into account that this value-weight ratio is expected to (continue to) increase in the future, a trend also known as dematerialization. This implies that with constant economic value, freight volumes in tons decrease. The precise extent of dematerialization to be expected is an important uncertainty. However, this uncertainty is reason to investigate the consequences if actual dematerialization stays behind or exceeds the expectations. In the High base scenario the value-weight ratio increases 0.5% annually, in the Low base scenario this ratio increases with 0.3% annually. The impact of these assumptions on the total bandwidth are explored in two sensitivity analyses: in the Low scenario the value-weight ratio increase is doubled to 0.6% annually, and in the High scenario the value weight ratio increase is halved to 0.25% annually.

The result of the alternative value-weight ratio development is presented in Table 6. The dematerialization assumptions have a large impact on the total freight transport: the volume in the High scenario forecast increases by 7% equally across all modes. This is because the value-weight ratio development is applied equally on all commodity types. The low scenario shows a decrease in transport volume of 7%, assuming the stronger value-weight ratio development.

Table 6: Results sensitivity analyses dematerialization (2040, in mln. tons resp. % against base).

		Base 2040	Stronger Dematerialization	Weaker Dematerialization
High	Road	1227		7%
	Rail	77.8		7%
	IWW	449.9		7%
	Total	**1754.7**		**7%**
Low	Road	989.2	-7%	
	Rail	62.5	-7%	
	IWW	394.5	-7%	
	Total	**1446.2**	**-7%**	

4.6 Modal shift policy Port of Rotterdam

An important policy objective for the Port of Rotterdam region is to provoke a modal shift from road transport to rail or inland waterways of all hinterland transport to and from the Port of Rotterdam. The motivation is to reduce the growth of trucks and congestion on the highways in the Rotterdam region and to reduce the growth in pollutant emissions. In the base scenarios of the NMCA it is assumed that as of 2030 the road modal share will not be higher than 35% for all hinterland transport to and from the Maasvlakte port basins in Rotterdam. It is assumed that all policies are implemented to reach this objective. This policy objective is implemented as one of the post-processing steps described in section 3.2. By means of a sensitivity analysis the impacts of this policy assumption are studied by removing the modal share maximum from the post-processing analysis. The results are summarized in Table 7.

Both the rail and the inland shipping show a small decrease in transported volume. If this policy is not implemented, the road transport volume almost remains the same in both scenarios. The shifts in total volume by transport mode is small at the national level as the mode shift enforcement is only implemented at the Maasvlakte which produces a modest share of the freight transport demand in The Netherlands. It is still important to make this policy explicit in the forecast because it will have a significant effect on local freight truck volumes on the Rotterdam highway network.

Table 7: Results sensitivity analysis Maasvlakte Modal Split policy in mln. tons resp. % against base).

				Base scenario			No Modal shift	
		2014	**2030**	**2040**	**2050**	**2030**	**2040**	**2050**
High	Road	939.6	1113.7	1227	1366.3	0%	0%	0%
	Rail	41.4	61.1	77.8	98.7	-2%	-1%	-1%
	IWW	350.4	411.2	449.9	501.7	-1%	-0%	-0%
	Total	**1331.3**	**1586**	**1754.7**	**1966.8**	-	-	-
Low	Road	939.6	970.9	989.2	1013.6	0%	0%	0%
	Rail	41.4	54.2	62.5	71.8	-2%	-1%	-0%
	IWW	350.4	379	394.5	422.4	-1%	-0%	-0%
	Total	**1331.3**	**1404.1**	**1446.2**	**1507.7**	-	-	-

5. CONCLUSION AND DISCUSSION

This article discusses an exploration of the bandwidth of freight transport forecasts with the strategic freight transport model Basgoed, within a particular policy context. The bandwidth of the freight transport forecasts was explored in sensitivity analyses by making alternative quantitative assumptions behind the scenario inputs. This provides a systematic estimate of the impact of particular developments and a bandwidth for the freight transport forecast. By discussing the sensitivity to a range of factors, more insight is provided in the level of importance of each scenario assumption.

The outcomes of the sensitivity runs show that the assumptions in the scenarios have different impacts: from negligible effects in the alternative fuel price scenarios, to large effects in an energy transition scenario or alterative development of the value to weight ratios (dematerialization). The largest impact can be expected from the assumptions in the scenarios for energy transition, with a decrease of inland waterway transport of 20%. The developments in energy transition and dematerialization are also characterized by large uncertainties.

This bandwidth of outcomes provides an indication of the robustness of the freight transport forecasts to scenario uncertainties. The strong impacts and large uncertainty of some scenario developments have two important implications. First of all it is important to acknowledge this uncertainty in freight transport forecasts, for instance by deriving bandwidths of predictions. Second, more insight is needed into the likeliness of these events or developments to occur. This analysis only included the exploration of developments relevant for the NMCA study: other developments, such as the growth of world economy and international trade may also impose large impacts on future freight transport demand and are also characterized by a high level of uncertainty.

Despite the availability of strategic models for freight transport, and the use of forecasts in policy analysis, only few studies are available on strategic freight forecasts at national level. Publications on the derivation of quantitative assumptions behind the freight transport forecasts are missing. The finding that some developments with large uncertainties can have a strong impact on freight transport demand, emphasizes the need for more research into these uncertainties and their impacts.

BasGoed predicts freight forecasts in a top-down approach from global economic developments, through developments in infrastructure networks and transport costs, to vehicle specific forecasts, in a comprehensive and consistent manner. We do realize that a strategic model like BasGoed has its limitations to implement specific developments or logistic choice responses. In order to further improve the BasGoed model to the responsiveness to specific logistic developments, the Dutch Ministry of Infrastructure and Water Management has laid out an improvement strategy in the long term road map for R&D of freight transport models (Tavasszy et al., 2010; Berg et al., 2015). The first topics for improvement are the implementation of a multimodal container transport module which simulates the impact of new multimodal container terminals (see De Bok et al, 2017).

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