Freight modal shift: A means or an objective in achieving lower emission targets? The case of Sweden

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ABSTRACT

For several decades, modal shift within the freight transport sector has been promoted by policy makers as an important basis for achieving lower transport emission targets. Even though the literature on mode choice is well established, there is less consensus about the volume of freight with the potential to shift and, more importantly, the actual contribution of freight modal shift to achieving less climate and air pollution impacts. The climate contribution of freight modal shift can be increasingly questioned, as decarbonization is taking place at increasing rates within road freight transport. In this paper, the role of modal shift policies in realizing climate objectives is scrutinized by focusing on the case of Sweden, which serves to illustrate some general insights. We highlight how modal shift is often analyzed and discussed in isolation, even though it forms an important part of a policy mix in which it may contribute to achieving climate objectives. Treating modal shift as an objective in its own right may render less effective and cost-efficient policy instruments.

1. Introduction

Compared to many other sectors, the reduction of greenhouse gases in the freight transport sector is lagging behind. Globally, the transport sector is contributing to almost 25% of total greenhouse gas emissions (IPCC, 2014). The road sector contributes by far the highest share of these emissions; the sector was responsible for almost 72% of CO₂ emissions in the EU in 2018, with heavy-duty vehicles responsible for 27% of road transport CO₂ emissions, and almost 5% of total EU CO₂ emissions (EEA, 2021a). Freight transport contributes to several environmentally damaging externalities, including emissions of CO₂, NOₓ, SOₓ, VOC, and PM. Historically, these externalities have, on average, been higher per ton kilometre (ton-km) for road transport compared to rail and waterborne transport (Nocera et al., 2018). Especially for long distance freight transport, policy makers in many regions (including the EU, the US, China, and Japan) have set up modal shift objectives with the intention to shift freight away from road and towards rail and shipping. Modal shift is often raised as one of three fundamental approaches to lower the greenhouse gas emissions from freight transport, along with changing to more efficient vehicles and low carbon fuels. Modal shift is also often motivated by overarching societal objectives related to environmental emissions reductions, health and road safety (Tao et al., 2017; Pinchasik et al., 2020). In Europe, modal shift objectives are mostly influenced by the Transport White Paper (European Commission, 2011), specifying that 30% of road freight transport over 300 km should shift to more energy efficient modes by 2030, and that more than 50% should shift by 2050. EU-wide policies to support certain transport modes and promote multimodality have been introduced, including TEN-T, Motorways of the Sea, and the Combined Transport Directive (92/106/EEC).

Even though policy ambitions are high, there is only scarce evidence of modal shift realizations in most countries. On an aggregated level, both the international and national policy toolbox seems to be limited when it comes to influencing modal split (Takman and Gonzalez-Aregall, 2021). Out of the member countries of the OECD International Transport Forum (ITF), only three – Slovenia, Austria, and Italy – are found to have successfully shifted freight from road transport over the last 40 years. In the majority of countries, the modal share of road freight transport has increased (ITF, 2022). Most particularly, rail freight infrastructure is lagging behind throughout Europe, and the market share of rail freight is decreasing within the European Union (Islam et al., 2015; Kaack et al., 2018).

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E-mail address: kevin.cullinane@gu.se (K. Cullinane).
1 Carbon Dioxide (CO₂), Nitrogen (NOₓ), Oxides of Sulphur (SOₓ), Oxides of Volatile Organic Compounds (VOCs) and Particulate Matter (PM).

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In combination with technological developments, several political trends are also contributing to the general strengthening of the dominance of road freight transport. Increased weight and length allowances for heavy trucks, for example, directly contribute to keeping road costs low. Automatization and digitalization could also help to keep driver wages low – one of the biggest shares of total costs for road transport (Buczsky, 2018; Engholm et al., 2020; Wurst, 2021).

Perhaps the most important trend is the development of alternative fuels and electrification. Due to the faster vehicle turnover and the speed of technological development in the sector, road is predicted to decarbonize faster than other modes. This means that the road sector’s share of overall transport emissions will decrease, while the share of emissions from shipping is predicted to increase (Fig. 1).

In this paper, we analyze: i) the potential to realize modal shifts and, given such a realization, its potential contribution towards achieving climate objectives, and ii) the strategies and motivations of realizing freight modal shifts within a single country, here Sweden. Despite having a geographical and political focus on Sweden, the case study serves to illustrate and generalize insights with respect to the role of modal shift policies in the broader transport policy framework aiming at reducing greenhouse gas emissions. We identify general insights including the difficulty of analyzing modal shifts at an aggregate level and the interpretation of modal shift as a political objective, rather than a political means to achieving climate objectives within the transport sector. Although yielding general insights, we recognize that there is a lack of literature analyzing modal shift potential in developing countries and acknowledge such a research gap. We concentrate on longer-distance freight transport chains, including road, rail, and sea transport. The analysis is carried out through a literature review and summary of official statistics. This means that we use aggregated figures in which smaller changes in modal shift can be hard to discover – a well-recognized problem within the literature. However, the use of official statistics provides the means for carrying out similar case studies in other regions to learn more about different policy rationales, modal shift realizations and effects on climate objectives.

The remainder of this paper is organized as follows. Section 2 provides background on the general findings on freight transport mode choice and common methodological approaches used to study policy impacts on the freight transport market. Section 3 analyzes the potential for realizing freight modal shift, with a focus on the Swedish experience as an exemplar. Common policy instruments used to incentivize modal shift, and their potential contribution to realizing modal shift, are discussed in section 4. Section 5 concludes the paper.

2. Mode choice and policy instruments

One way to understand how policy instruments may influence freight modal distribution is by applying a stylized representation of the market represented by the available transport solutions (supply), the choice (demand) for transport, and the boundaries defining the market such as geography, the overall policy framework, and technical and demographic trends.

The modal supply, both in terms of availability of transport solutions and the capacity of existing supply, depends on infrastructure and geography (Pownes et al., 2004; Brogan et al., 2013). A longer coastline promotes shipping, whereas mountains may restrict transport by rail. In the short term, road and rail transport are constrained by network capacity, whereas sea transport is constrained by port capacity and configuration, fairways, and the hinterland infrastructure. The supply of multimodal transport depends on the quality of the modal and modal infrastructure in terms of linkages between terminals, ports, dry ports and airports (nodes) and roads, railways, and waterways (modes) (Ng et al., 2018). Several studies in recent years have concluded that, on average, there is little competitiveness between modes (see e.g., Rich et al., 2011; Haram et al., 2015). Most goods are transported with the most comparatively advantageous mode.

Modal demand, e.g. transport chains and mode choice, is covered extensively in the literature (Holguín-Veras et al., 2021). The most influential parameters are transportation cost, transit time, and reliability. These parameters depend on the character of the goods (setting the boundaries for the available transport alternatives), goods flow (determining trip frequency and regularity), and load factor. Beyond these central criteria, there are other aspects such as service quality, security, sustainability, etc. that influence decision makers to varying extents in different segments (Flooden and Woxenius, 2017).

Transportation cost includes the shipping cost from origin to destination and other services such as handling cost and insurance paid to the carrier to cover the transfer of risk (Brogan et al., 2013; Lindgren and Vierth, 2017). Elasticity studies represent one way of analyzing how responsive transport demand is to changes in transport costs and time. The magnitudes of own- and cross-price elasticities can therefore, to some extent, be taken as an indication of the potential effect of policy instruments on modal shift (see for example Vierth and Merkel, 2020).

Transit time is impacted by distance, number of transfers, drayage

![Fig. 1. Changes in greenhouse gas emissions from transport in the EU-27 since 1990, by transport mode and scenario. WEM (With Existing measures) refers to existing policies and WAM (with additional measures) refers to additional measured planned in the member states. Road sector includes both passenger and freight transport. Source: EEA (2021a)](image-url)
operations, container loading, and local delivery, etc. Time in transit is generally considered by shippers in all segments, with time variability ranging from a few minutes to several weeks depending on, for example, transport distance and type of commodities (Brogan et al., 2013). The importance of time relative to cost differs between different segments and transport distances (Nealer et al., 2012; Steer Davis Gleave, 2015). Road generally has a time-related cost advantage for shorter distances, while rail and, particularly, sea transport become more competitive over longer distances. Road and air transport tend to be used by commodities that are time-sensitive, such as food products and post, as well as goods with high value-to-weight ratios, such as computers and electronics, or high damage costs (Feo et al.; 2011; Nealer et al., 2012; Brogan et al., 2013; Lindgren and Vierth, 2017). Sea transport has a comparative advantage for time-intensive goods. For certain goods, the longer time in transport can be desirable and used as a moving inventory to avoid large storage costs (de Jong and Johansson, 2009; Windisch and de Jong, 2010).

The reliability of transport includes both the degree of predictability and certainty of transport time. It is affected by factors such as the maintenance of infrastructure, congestion, accidents and mismanagement, but also by extreme weather or natural disasters (Kaack et al., 2018). Reliability is of increasing importance for just-in-time and just-in-sequence supply chain strategies, as well as for shippers of urgent deliveries or in cases of limited-service frequency (Fowkes et al., 2004; Steer Davis Gleave, 2015). To meet reliability requirements, multimodal transport schedules often have built-in slack time to account for unexpected changes in travel time (Brogan et al., 2013). Reliable delivery times also allows for longer time in transit for goods where inventory costs are high. How the Covid pandemic is influencing the importance of time and reliability for mode choice is still too early to determine. Early analysis from Sweden suggests that although the types of transported goods have changed slightly, the effects on ton-kms is rather small, with the measured decrease of 5–10% in ton-kms lying within normal annual variation (Transport Analysis, 2020a).

There is a range of other mode choice criteria, depending on the segment. Security, or damage risk, refers to the likelihood that goods will be damaged or lost during the transportation process, which can result in high costs for firms (Lindgren and Vierth, 2017). For the transportation of high-value goods, such as luxury cars, security may be such an important factor that shippers only trust a few carriers in terms of protection of the shipment (Kaack et al., 2018). Moreover, the availability of value-added services in nodal infrastructure, such as storage space, recharging points, repairing facilities and transport service providers all impact on mode choice, as well as the compatibility of infrastructure to the characteristics of different modes (e.g., capacity and dimensions of quay cranes). Other factors that relate to the attractiveness of transport service include the possibilities to track cargo and the availability of certain conditions such as refrigerated cargo, service help desk, etc.

In recent years, transport companies have been confronted with higher demand for environmental certification and increased scrutiny of their environmental impacts, for example with regards to pollution, land use and climate change (Brogan et al., 2013). Environmentally efficient transport is, however, less of a priority in relation to price and time aspects. A repeated survey with Swedish companies shows a persistent low ranking of environmental aspects in transport purchase decisions over time (Lammgård and Andersson, 2014). Of the environmental attributes, the emission trucks are ranked highest. This is not surprising since the EURO class requirements on environmental performance of trucks are increasing predictably over time through EU legislation (European Commission, 2021). As stricter environmental requirements are introduced there is increasing potential to differentiate transport modes based on climate performance. Finally, some of the barriers to moving freight from road identified in the literature and by stakeholders is a lack of coordination and outdated contractual arrangements. For example, within segments where flows are unbalanced, modal shift requires new forms of coordination and risk sharing between freight owners and forwarders.

Allegedly, all estimations of the theoretical potential for modal shift are only indicative. In the short run, some freight could technically be absorbed by using existing capacity on rail and sea more efficiently. In the longer run, the potential for freight modal shift depends on how the market responds to trends in technology development, the degree and quality of infrastructure investment, and the wider policy mix. There are different attempts to classify policy instruments directly targeting modal shift (Pinchasik et al., 2020). Here, we briefly present policy instruments within the categories economic (subsidies and taxes), administrative (regulations and infrastructure), and information (research, innovation, dissemination) that seek to strengthen the relative competitiveness of rail and sea transport (pull measures) or making road transport less attractive (push measures).

2.1. Economic instruments

Taxes and fees are levied on the transport market motivated by different political objectives. Very generalized, some taxes are motivated to internalize externalities (e.g., carbon tax - in line with the polluter pays principle), some are motivated to finance parts of the infrastructure necessary for the operation of the traffic mode (e.g., energy tax, pilot fees, rail fees, and road fees for heavy vehicles – in line with the user pays principle), and some are introduced because of their fiscal qualities. External costs refer to the difference between social costs (societal costs due to use and infrastructure) and private costs of transport (directly borne by the transport user). The internalization of external costs is a way to make the transport user consider a broader set of costs than private costs. The way external costs are calculated for different modes depends largely on the availability of information about damage functions and emission levels. Air pollution costs are one of the most studied categories of external costs. The emission factors for different emission classes for rail, inland waterways and maritime transport are regarded as more uncertain than those for road transport (CE Delft and European Commission, 2020). In the maritime sector, for example, where CO₂ emissions make up a large part of the non-internalized external costs related to shipping, carbon pricing remains an unused potential (Nikolakaki, 2012; Parry et al., 2018). The Energy tax directive (2003/96/EG) regulates the design of taxes and fees – and their exemptions – for transport. The Commission’s proposal for a revised directive (COM/2021/563 final) includes new minimum tax levels reflecting environmental performance and the abolition of tax exemptions for maritime and truck transportation.

Subsidies for freight transport are often politically motivated to reduce the differences in costs between road and alternative transport modes, as the higher costs for these alternatives are perceived as the main competitive disadvantage. In principle, EU law (EUF Treaty, article 107.1) does not permit state aid to commercial activity. However, exceptions can be made to facilitate the development of certain industries or regions, if it does not adversely impact trade (article 107.2–3). For example, the Community guidelines on State aid to maritime transport (2004/C 13/03) restricts state aid favoring maritime transport. State aid can be granted for a shipping service within EU territorial waters for a period of maximum three years. The service must facilitate the shifting of transport, partly or fully, from road to sea, and aid can only be issued to a pre-specified service in which environmental effects are pre-determined. Similarly, Community guidelines on State aid for railway undertakings (2008/C 184/07) allow compensation for external costs that can be avoided by rail transport compared to transport using other modes; for example, non-internalized marginal social costs related to air pollution, climate gas emissions, traffic accidents, and infrastructure maintenance and investments. In Sweden, Norway, UK, and Italy, subsidies schemes targeting modal shift to maritime transport or rail, sometimes called eco-bonus schemes, have been introduced based on these guidelines.
2.2. Administrative instruments

Important administrative policy instruments targeting modal shift are regulations (prohibitions, standards etc.), infrastructure investments and programs including the improvement of capacity on the rail network, road access to dry ports, and navigable waterways (modal infrastructure), as well as investments in ports and combi-terminals (modal infrastructure) and public procurement. These measures are usually motivated from several policy objectives, including modal shift and multimodality. The construction of the world’s longest road and rail tunnel, the Fehmarn Belt, is an example of a large infrastructure project that will impact on rail transport supply. It is funded by EU grants (under the Connecting Europe Facility scheme) and is supported by Danish and German funds, as well as user charges. Within the EU, the TEN-T directive, together with the Transport White Paper, sets the overall regulatory framework for the development of a long-distance freight transport sector shifting towards less carbon intensive modes of transport.

The TEN-T aims at ensuring the connectivity of all regions of the EU (comprehensive network) while prioritizing parts with the highest strategic importance for the union (core network). The implementation of the networks is legally binding, with the core network to be implemented by 2030 and the comprehensive network by 2050. Infrastructure availability and capacity directly influence the potential for the realization of modal shift. The Covid pandemic’s influence on reducing congestion on railways and, thereby, increasing punctuality for freight, is one example. In contrast to the normal prioritization, freight trains were given priority in slot allocation and delays were in general reduced across the network during the pandemic (IRG Rail, 2021). The EU Combined transport directive (92/106/EEC) is an administrative policy which is intended to increase the competitiveness of combined transport against road-only transport. It is one of the EU measures to promote a shift from road freight transport to rail and water. In 2017, a simplification of the directive was proposed, along with the introduction of economic compensation for investments in infrastructure such as international combi-terminals, etc. Amendments to the directive are still under negotiation, but they are expected to facilitate the further development of multimodal transport by simplifying cross-border procedures, including the provision of additional exemptions to cabotage rules and allowing the provision of economic incentives (Pastori et al., 2018).

Other administrative instruments indirectly affect the competitiveness of transport modes through prices. The Sulphur Directive (2012/33/EU) came into force in the EU in 2015. It demands lower Sulphur content in marine fuels within SECA (covering the North Sea, the Baltic Sea and the English Channel) to decrease air pollutants. As fuels with lower Sulphur content are more expensive, the directive is an example of an administrative instrument with an impact on relative transport costs between modes, in this case through fuel cost. It has attracted attention from the perspective of a modal backshift. Concerns have been raised that the directive would induce a higher road transport demand at the expense of sea transport. The long-term effects of the directive on modal shift and transport efficiency and environmental impact are yet to be determined (Raza et al., 2019).

2.3. Information instruments

Information-based policy instruments, or investments in knowledge and innovation generation, are usually motivated by the desire to internalize positive externalities (knowledge externalities, network externalities) that could improve the conditions for modal shift. The public-private enterprise Shift2Rail, formed under Horizon 2020, to coordinate research and innovation within the rail sector (EU nr. 642/2014) is one example. The research should contribute to an increased modal shift to rail by increasing its competitiveness and interoperability within the union. The EU also encourages coastal member states to install Shortsea Promotion Centers to promote short-sea shipping. The design and objective of the centers are tailored to different needs within member states. In Sweden, the Short Sea Promotion Centre is a private actor, co-funded by the Transport Administration, with the ambition to engage shipping companies, shippers, and ports to identify ‘low-hanging fruit’ for modal shift from road to sea.

3. Potential for freight modal shift? The case of Sweden

The Swedish freight transport market is heavily influenced by the natural resource and base industries, with ore, steel, forestry, and petrochemicals producing the largest freight volumes. Ore and minerals constitute the largest share of the total freight in tons transported by truck (34%) and rail (46%). While shipping is used for international movements and long-distance heavy cargo transportation (petrol), road is mostly used for shorter distance transport and transport where there is limited access (forestry). For wood and ore products, some rail infrastructure has been developed to move the goods from industry to ports (Rich et al., 2011). Freight shuttle trains go between 25 railway terminals located in different part in Sweden (Bergqvist and Woxenius, 2011; Wallmark, 2015; WSP, 2019).

Freight transport is predicted to increase in Sweden by 50%–2040, particularly transport concentrated on larger paths and corridors (Swedish Transport Administration, 2020). The share of freight transport by road in Sweden, in ton-kms, is increasing at the expense of both rail and shipping (Vieth et al., 2020). Similar developments are seen in other Nordic countries (Pinchasik et al., 2020). Previous studies of mode distribution for freight transport based on revealed preferences in the Swedish Commodity Flow Survey, show that mode choice responsiveness to cost and time is small on average (Abate et al., 2014; Vieth and Merkel, 2020). However, cost responsiveness differs between different commodity types, shipment sizes, value density of goods, and level of access to rail and waterways (de Jong and Johansson, 2009; Windisch and de Jong, 2010; Rich et al., 2011; Jensen et al., 2019; Abate et al., 2019). Transport Analysis (2016) estimates that less than 10% of the freight transport flow within Sweden, in tons, has the potential to shift from truck to other modes, based on assumptions about suitable distances and commodity types. Vieth et al. (2020) conclude that around 5–18 percent of current road transport volumes, in ton-kms, have the theoretical potential to shift from road to sea and rail transport. The authors stress that the real potential probably lies closer to the lower bound and that the most ‘low-hanging fruit’ is to shift back some of the 7% ton-kms that has shifted from rail and shipping to road during the period 2011–2017.

The Swedish transport sector is experiencing a structural shift towards transport chains using larger vehicles operating between a few important nodes (WSP, 2019). The multimodal freight transport market is dominated by a few multimodal operators and a few large forwarders/carriers (Vieth, 2012; Floden and Woxenius, 2017). Similarly, most of the activities in ports are handled by the same company (Gonzalez-Aregall et al., 2021). This trend towards consolidation and specialization within logistics is global. The share of goods transported in standardized units is increasing, improving the attractiveness of multimodal transport solutions. The EU’s Sustainable and smart mobility strategy could further advance conditions for multimodal transport solutions through improved load standardization, digitalization, data-sharing, and innovations (Kaack et al., 2018; Ambra et al., 2019; Johansson et al., 2021).

In Sweden, growth in transportation by rail is taking place for commodities that are transported in multimodal chains. In particular, semi-trailers are gaining increasing importance. They can more easily optimize the load factor in both directions compared to container transport that more often involves carrying empty containers on the return trip. Between 2009 and 2017, semi-trailers had a load factor of 85–90% on average, while containers had an average load factor of 60%. As reloading costs make up a large share of total transport costs in multimodal transport chains, the load factor is of major importance.
port of containerized freight on road-rail chains can compete with

Source: Johansson et al. (2021).

Table 1
Average direct emissions (tank to wheel) per freight transport mode and ton-km on Swedish territory based on statistics from year 2017.

<table>
<thead>
<tr>
<th>Mode</th>
<th>CO2e g per ton-km</th>
<th>NOx g per ton-km</th>
<th>SO2 g per ton-km</th>
<th>HC/VOC g per ton-km</th>
<th>PM g per ton-km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>0.0648</td>
<td>0.2255</td>
<td>0.0002</td>
<td>0.0052</td>
<td>0.0049</td>
</tr>
<tr>
<td>Rail</td>
<td>0.0020</td>
<td>0.0239</td>
<td>0.0000</td>
<td>0.0020</td>
<td>0.0009</td>
</tr>
<tr>
<td>Sea</td>
<td>0.0286</td>
<td>0.6558</td>
<td>0.0178</td>
<td>0.0267</td>
<td>0.0089</td>
</tr>
</tbody>
</table>

Source: Johansson et al. (2021).

(Bergqvist, 2019). Transport Analysis (2019) estimates that the transport of containerized freight on road-rail chains can compete with unimodal road transport on distances above 350 km, considering transfer costs and time. For ship-road/rail chains, the corresponding distance increases to 550 km. On these distances, transfer costs are estimated to be about 73% of the total transportation costs for rail-road chains, and 75% for multimodal sea transport. At the same time, the bulk of transport in Sweden is short distance. In 2016, more than half of the Swedish transport distances by truck were shorter than 50 km and only four per cent above 300 km. These trips constituted 42% of all ton-kms performed by Swedish trucks during the same year (Takman et al., 2020). In general, empty returns in stable Ro-ro freight flows within the Swedish base industries and forest sector could be used to realize mode shift for some commodities. The major barriers are the large transfer costs and difficulties in meeting the demand for transport frequency. The industry argues that logistics chains can be hard to reinvent. Realizing a modal shift within the chain is complicated, as the whole system must be reconsidered. Moreover, for larger commodity flows, logistics decisions are seldom reevaluated with frequency. Transport buyers may negotiate with price for an existing solution, but much more rarely do they question the choice of transport modes within the chain. The major barriers addressed by the stakeholders relate to the habitual choice of transport solutions, low knowledge of other alternatives, and a lack of coordination and business models for risk sharing between product owners and logistics service providers (Styhre et al., 2019).

Johansson et al. (2021) calculate the direct emissions from road, rail and sea transport based on the Swedish national freight transport model. Freight transport by road generates, on average, more CO2e emissions per ton-km than transport by sea, and particularly by rail (see Table 1). Compared to the EU Handbook on the external costs of transport (CE Delft and European Commission, 2020)\(^2\), the CO2e emissions per road ton-km in Sweden in Johansson et al. (2021) are lower than the EU average (0.07 compared to 0.09-0.26 kg CO2e per road ton-km). This can be explained by the high share of CO2e-efficient trucks with a total weight up to 74 tons in Sweden. In fact, truck is the only transport mode in Sweden that has reduced its greenhouse gas emissions between 2010 and 2018, at a rate in line with the Swedish climate target of a 70% reduction of GHG emissions within the transport sector by 2030. This is partly driven by the increased usage of HVO (Hydrogenated vegetable oil) in the fuel mix (Takman et al., 2020). The CO2e emissions per rail ton-km in Johansson et al. (2021) are six times lower than the corresponding values in the European Handbook. This is due to the high level of electrification of railways and the high share of renewable electricity in Sweden. Finally, the estimated CO2e emissions per sea ton-km are roughly the same in Sweden and the European Handbook (around 0.029 CO2e per sea ton-km), illustrating its highly international character with low vehicle turnover, as well as few policies directed towards CO2e-reductions. Considering other airborne emissions, including NOx, SOx, VOC and PM, freight transport by sea is generating the highest (direct) emissions per ton-km. While environmental requirements (EURO class) on new trucks have long been in place, corresponding requirements for sea transport are more recent (e.g., the Sulphur Directive (2012/33/EU) that came into force in 2015).

3.1. Policies to enhance freight transportation on rail and shipping

Freight modal shift from road to rail and shipping is one of three overall priorities in the “National freight transport strategy” that was adopted in 2018 (Swedish Government, 2018c). The strategy sets the overall policy focus for freight transport and logistics to fulfill the Swedish transport goals, contribute to a competitive business sector, and promote a modal shift of freight transport from road to rail and sea transport. As such, it constitutes the umbrella for the Swedish freight modal shift policy instruments. In contrast, modal shift is downplayed in the infrastructure plan 2022–2037 which sets the long-term planning horizon for infrastructure maintenance, investment, and public procurement. The plan should contribute towards fulfilling a set of transport policy goals, among them reducing the climate impact caused by freight transport. In the ex-ante analysis accompanying the plan, modal shift is estimated to only play a minor role in contributing to the achievement of the CO2 reduction target (Swedish Transport Administration, 2020d). In conjunction with the introduction of the national freight transport strategy, three policy instruments targeting the modal shift of freight from road to rail and sea was introduced in Sweden. The mix of climate transport policies in Sweden for road, rail and sea are summarized in Table 2, where the three modal shift specific policies are marked in bold.

3.1.1. Rail

The quality of rail infrastructure has deteriorated over time, also in comparison to the developments in other countries. The railway is struggling with capacity constraints, particularly between the three main metropolitan areas – Stockholm, Gothenburg, and Malmö. The problem is aggravated by the many combi-terminals located close to larger cities or nodes, where freight transport is competing with passenger transport over several distances. (Transport Analysis, 2016). Environmental compensation for freight transport on rail was introduced with the dual objective to strengthen the competitiveness of rail and contribute to modal shift from road to rail. The first round of environmental compensation for rail was directed to operators during 2018–2020 (Swedish Government Förordning, 2018). Around EUR 56 million was paid out. The prolonging of the compensation scheme for 2021–2025 was approved in 2021 (Swedish Government, 2021). A yearly budget of EUR 40 million has been set aside. The compensation\(^4\) is based on either the difference in total costs (production, capital, and operating costs) between road and rail transport, excluding infrastructure costs, or differences in external costs based on the EU Handbook on the external costs of transport (CE Delft and European Commission, 2020).

The compensation is paid out every six months to the rail operator. The sum is based on the operator’s proportion of the total freight ton-kms performed on rail by all operators that have applied for compensation. In essence, this means that the compensation is a general subsidy to freight transport by rail, regardless of previous transport solutions. That the compensation should incentivize freight mode shift rests on the requirement in the EU state aid rules that transport buyers should

\(^2\) To collect firsthand information, focus group discussions (Parker and Tritter, 2006) were carried out in 2018 with 16 stakeholders representing Sweden’s large logistics service providers.

\(^3\) The comparison is actually not straightforward as the methods differ. The Swedish figures are based on a tank-to-wheel approach whereas the European Handbook is based on a well-to-tank approach. This means that the European approach includes a larger part of the life-cycle of emissions, which explains some of the difference discussed in the text.

\(^4\) In the first round, the compensation was set to EUR 0,0034 per ton-km (Swedish Transport Administration, 2015) and in the current compensation scheme, it is set to EUR 0,0084 per ton-km (Swedish Transport Administration, 2021).
One of the solutions, for example, derives from a research project on environmental compensation only plays a minor role in this decision.

During two periods, 2018–2019, about 22% of the total funds were handed out to LKAB, the company dominating ore transport when or how the price adjustment should become manifest. Indeed, the evaluation of the compensation scheme shows that the expectations of transport buyers of lower prices have not been met (Swedish Transport Administration, 2020e). From the interviews with operators in the evaluation, it is possible to identify suggestions for three alternative incentive schemes, deemed to have a more promising effect of incentivizing freight modal shift: i) targeted compensation to freight segments with pre-identified potential to shift to rail — preferably as an exemption from rail fees during the first 5 years, ii) publicly procured rail freight carriers and a central freight forwarding agent at the Transport Administration to ensure load optimization and to consolidate smaller freight volumes, iii) a broader compensation scheme that also covers digitalization efforts for both operations and logistics planning. One of the major revisions of the compensation scheme 2021–2025, was to exclude the eligibility of ore transport – a segment which is almost exclusively transported on rail. During 2018 and 2019, about 22% of the total funds were handed out to LKAB, the company dominating ore transport. The rest of the design remained largely the same.

In the current Swedish infrastructure plan (2018–2029), a so-called business pot of SEK 1.2 billion has been set aside to accommodate rapid and targeted measures for freight transport needs on rail. The measures can, for example, include minor capacity improvements or the introduction of a new switch on the railway to enable a more effective flow. The idea is to work closely with the business sector to identify where these types of measures can yield a large effect and benefit the competitiveness of both business and the railway sector. If these measures are targeting digitalization and logistics planning, they could strengthen the effect of the compensation scheme, at least to continue maintaining the share of rail freight.

There are a few examples of Swedish grocery companies that have shifted part of their transport from truck to rail. It is likely that the environmental compensation only plays a minor role in this decision. One of the solutions, for example, derives from a research project on horizontally integrated transport chains, where the potential to coordinate loads from the grocery company ICA onto the steel company SSAB’s rail transport was studied.5

3.1.2. Shipping

Sweden’s long coastline favors shipping, which is dominating international trade movements. The Port of Gothenburg is the largest port in Scandinavia, handling around 60% of Sweden’s containerized goods flows. During two periods, 2018–2020 and 2021–2022, Sweden has offered a so called “eco-bonus” subsidy to sea transport with an annual budget of EUR 50 million (Swedish Government, 2018b). Shipping companies can apply for the bonus to improve existing or new maritime transportation routes that can be shown to generate a shift of freight from road to sea transport. The instrument is aimed at directly affecting the relative competitiveness of sea transport, by reducing costs during the program period. After three years the project should be commercially viable. Since 2021, a second eligibility criterion is to have a documented agreement with commodity owners or forwarders on using the transport route. The compensation can be used to cover operating costs and equipment for transfer services. If the applied amounts exceed the total budget, all project budgets are cut by the same proportion. This implies that the companies that fulfill the requirements for receiving the eco-bonus face uncertainty with respect to the actual amount of subsidy to be paid out. Due to issues with legal clearance during the first eco-bonus period, the application period was rushed and only two out of five applications met the eligibility criteria. None of the projects reached commercial viability before the end of the first period. For the second eco-bonus period, four of five applications were approved. One example of the projects is the co-operation between Ports Lake Malaren, Ports Stockholm, Hutchison Ports Stockholm, and the shipping company Wallenius Marine that started up a shuttle to move freight away from road in the Stockholm region to inland waterways. The projects have not yet been evaluated.

The main eligibility criterion for the eco-bonus is that the estimated (or as reported) total environmental cost associated with the new/improved sea transport route is lower than for the alternative by road. The estimated environmental performance is calculated using the NTM Calculation Tool administered by a Swedish NGO, using the unit values in the Swedish CBA guidelines (Swedish Transport Administration, 2020a). The amount of compensation is based on the difference in the non-internalized marginal costs of greenhouse gas emissions and air pollution between road and sea (estimated to be EUR 0.012 multiplied by the total ton-kms of shifted freight. The design implies that there is little incentive to further reduce environmental impact once the eligibility criteria is reached. Moreover, there is no requirement on evaluating the actual emissions reductions from the new route. As pointed out by Viertl et al., (2019), the emissions calculations of different transport chains are largely affected by the guidelines and emission factors. In their study, they compare the results of using Sweden’s national guidelines for cost–benefit analysis (ASEK) and the European guidelines (Ricardo) to evaluate the external costs of two alternative freight transport options. Both methods result in smaller estimated external costs for a combined road and shipping option compared to direct shipping, using both ASEK and Ricardo values and considering internalizing taxes and fees. This also holds when the direct shipping option complies with the most stringent environmental regulations. Because of

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5 Horizontal collaborations for increased transport effectiveness | CLOSER (lindholmen.se)
6 The eco-bonus scheme has been extended to 2024.
7 https://www.transportmeasures.org/en/about-ntm/
their significance, the authors stress the importance of regularly updated guidelines and emission factors. Instead, in Stelling et al. (2019) modal shift from heavy trucks to shipping in southern Sweden is found to reduce CO₂ emissions by 4–11%. The calculations are based on average figures per mode, where CO₂ emissions per ton-km for road transport are about two times larger than for sea transport. This figure is in line with the average CO₂ emissions per mode and ton-km presented in Table 1. However, Johansson et al. (2021) show that the CO₂ emissions per ton-km largely differ between vessel types. For tanker, bulk, and dry cargo vessels, the values are about 50% lower than the average and for ro-ro and ro-pax vessels about 50% higher. As many goods are likely to shift mainly to the latter categories, the use of average ton-nm-values for vessels implies an overestimation of potential emission reductions (c.f., discussion about averages and marginal costs in GE Delft and European Commission (2020)).

Transport Analysis (2019) has suggested that a general and extended eco-bonus, directed at any actor working to shift transport to more energy-efficient modes, should be introduced. The general eco-bonus is suggested to include unimodal sea and rail transport and services, as well as multimodal transport and services, offered by a single company or a combination of companies. Moreover, investments in terminals and other infrastructure necessary to enable reloading are suggested to be eligible for the bonus. That could, for example, include solutions that alleviate the handling of the increasing share of unaccompanied freight (semi-trailers and containers without drivers). It is also suggested that the environmental incentives are broadened to also include emission reductions attributable to technical innovations and/or savings in energy use.

To promote short sea shipping and inland navigation, Sweden has also installed a national promoter (2019–2024). The purpose is to establish a dialogue with the principal owners of ports and other relevant stakeholders to increase the competitiveness of shipping and increase port capacity. In Sweden, national promoters have been used previously to create mandates for change (Swedish Agency for Public Management, 2014). The national promoter for the initiative ‘Fossil-free Sweden’, mobilizing different sectors within the sector towards climate action, is an example. The role brings about an opportunity to find common ground in situations with conflicting interests. Success in the role depends on the ability of “being the right person at the right place at the right time”. At the same time, there is a risk that the work ends in the development of different strategies and roadmaps, since the mandate for additional measures to enable implementation lies elsewhere (Governo, 2019). The Swedish Agency for Public Management (2018) has studied how strategies are used in Sweden as a soft policy instrument. They find that strategies are often used to indicate a desirable direction or path of development in complex policy areas. The ambition can be to legitimize planned policy instruments or accelerate coordination and cooperation between actors. However, the study finds that strategies seldom concretize objectives that could be used to measure results.

Indeed, the national promoter has released a roadmap including 62 action points. To circumvent the problem of responsibility, the governmental agency with mandate for taking the action further is identified and listed. For example, the road map proposes that large infrastructure investments should enable modal shift. This requirement was levied on the public-private investment in an extension of the Gothenburg Port fairway initiated in 2020. The Swedish state finances 50% of the extension (SEK 2.5 billion) given that the port promotes short-sea shipping. Whether this will have an effect is difficult to follow up, as these requirements are not specified further.

3.2. The wider mix of climate policies in the Swedish transport sector

As illustrated in Table 2, where Sweden’s implemented, planned, and contemplated future mode specific climate transport policies are shown, the range of policies is wide. However, the most recent tendency has been on mitigating the external costs associated with each freight mode, rather than on modal shift as such. Taxes and fees have remained relatively constant for trucks over the last ten years. For sea and rail transport, fees have almost doubled during the same period, in line with the effort to internalize social marginal costs related to sea and rail transport (Johansson et al., 2020). Some tax designs, and tax exemptions, are politically motivated to affect the competitiveness of different modes or sectors within the industry. Sea and rail freight transport in Sweden are, for example, exempted from energy and carbon taxes. Similarly, energy and carbon taxes are lower for diesel which is the main fuel used for truck transport.

The Eurovignette directive (Directive 2011/76/EU) regulates the way taxes and fees can be levied on heavy vehicles. In Sweden, Denmark, the Netherlands, and Luxemburg a time-based eurorvignette is levied on heavy trucks, whereas in Germany, Austria, and the Czech Republic, for example, the eurorvignette is distance-based (Transport Analysis, 2020b). The European Commission has disregarded time-based eurorvignettes as cost-inefficient, as they are not directly linked to the external effects of road wear, noise pollution, and traffic security. Amendments to the directive are under negotiation. The current proposal is that all user charges should shift to distance-based charges (European Parliament, 2021a).

Permit for trucks of higher bearing capacity class (BK4 allowing 74 tons instead of 64 tons) was introduced on about 11% of the public road network in 2018. The share of roads which allow heavier trucks has successively expanded. In 2020, the share was around 20% of the public roads, but the share is expected to increase to 40% by 2025 (Swedish Transport Administration, 2020c). Allowance for even longer vehicles (from 22.25 to 34.5 m) has been proposed on Swedish roads in 2021. Transport by longer and heavier road vehicles reduces emissions per ton-km, as fewer vehicles are needed to transport the same amount of freight. However, the overall impact on the transport system is not established. The empirical question is to what extent emission reductions from road transport are offset by induced traffic and freight shifting to road from sea and rail. In other words, the increased transport efficiency of road transport may induce some unwanted modal shift for long-distance freight transport. On the other hand, given available combi terminals, it may promote more multimodal freight transport. The difficulty of determining these effects is demonstrated in a study by Vieth et al. (2018) on mode distribution and the environmental emissions resulting from a previous dimensional reform, allowing longer and heavier vehicles on part of the road network. The authors found a high degree of incorporation of the longer and heavier vehicles in the fleet, resulting in higher road freight efficiency (fewer vehicle-kms needed for a given amount of ton-kms). However, the authors could not find that the dimensional reforms were associated with adverse environmental impacts for the overall freight transport sector during the period of study.

In a recent study by Pinchasik et al. (2020), focusing on the Nordic countries, the effects of combining eco-bonuses for sea and rail transport on modal shift and environmental outcomes (in terms of CO₂, NOₓ, and PM emissions) are simulated compared to a reference scenario for 2030. The authors use national freight models to simulate different scenarios based on four policies that could stimulate modal shift: eco-bonus for sea, eco-bonus for rail, increased road tax, and the accommodation of longer and heavier freight trains. The authors also model the effects of combining these policies, as well as harmonizing policies across Norway, Denmark, and Sweden. They find that the eco-bonus scheme for rail induces a modal shift from road in ton-kms which is about four times larger than in the scenario with eco-bonus for sea transport. In both scenarios, it is mostly long-distance freight that shifts from road. Moreover, the rail eco-bonus implies small environmental benefits, whereas the sea eco-bonus results in small increases in CO₂, NOₓ, and PM. The difference in environmental outcomes is explained by the high degree of electrification of rail transport and trucks, contributing to lower NOₓ and PM emissions relative to most ships. A combination of
policies and harmonization across countries is found to strengthen effects on modal shift in some scenarios, but the magnitude depends on transit traffic and effects on border-crossing. Most scenarios imply reduced CO$_2$ emissions, particularly those scenarios where modal shift to train is strong, However, the authors stress that even with strong policy instruments in place, CO$_2$ reductions are never larger than 3.6% compared to the reference scenario for 2030. The authors conclude that modal shift policies can only contribute marginally to fulfilling climate objectives; maximizing modal shift is not necessarily the same as maximizing climate benefits.

In their interim evaluation of the national freight transport strategy, Transport Analysis (2020c) recognizes the difficulty of assessing the effects on attaining transport policy objectives, competitiveness, and modal shift as there are no a priori stipulated effect-chains or milestones to evaluate against. Overall, they find that the strategy is well received within the freight sector and that it serves as a basis for coordinating actors within freight transport. At the same time, they highlight the need for further clarification of roles and responsibilities for implementation of the strategy. The conclusions are harsher in the evaluation of the similar modal shift objectives in Norway (Norwegian National Audit Office, 2018). They conclude that the Norwegian government both lack sufficient information to design effective policy instruments and has implemented too few measures. The Swedish Transport Administration has committed to specifying key performance indices to allow the evaluation of modal shift realizations (Swedish Transport Administration, 2020b). The work includes specifying modal shift objectives and developing a method to carry out impact analyses of policies that consider modal shift effects. At the same time, the agency stresses that modal shift policies are embedded in wider transport policy mixes and that their contributions to realizing changes in modal split is intrinsically hard to disentangle.

As can be inferred from Figs. 2 and 3, the success of Sweden’s policies aimed at achieving freight modal shift is questionable. While total ton-kms of transport work has fallen by 9% between 2010 and 2020, GHG emissions have fallen quite dramatically over this time; mainly for road freight, where there has been a 38% reduction in GHG emissions per road ton-km. Over this period, however, there has been only a very small change in modal split, that has been brought about as a result of Sweden’s policies (road +5%, rail +1%, sea –6%). This is also predicted to remain the case into the future.

4. What is the role for modal shift policies?

Whether a policy instrument is effective is evaluated in relation to the policy objective. The effectiveness depends on the extent to which the policy accurately targets the intended actors, as well as affect their incentives to act in the desired way, and their opportunities to change behavior (Holguín-Veras, 2002; Le Pira et al., 2017). Whether a policy is efficient from a social point of view, depends on the degree to which it induces individual actors to make choices that better align with society’s overall interests, including, for example, climate, environmental, and health concerns. From an economic theoretical point of view, and in line with the polluter pays principle, policies designed to internalize the external costs of respective transport modes would steer towards a more efficient transport system with respect to both modal distribution and transport demand. In this context, this implies policies that do not favor any mode, but rely on price signals to steer actors towards efficient technology development and implementation. The introduction of modal shift as a policy objective, rather than one of many policy instruments, is hence inefficient from a societal point of view. The planned revision of the energy tax directive, where taxes are suggested to be based on environmental performance of fuels rather than on mode specific levels and exemptions is a step in the right direction (Cullinane and Yang, 2022; Christodoulou and Cullinane, 2022). The same is true for the proposed inclusion of sea transport in the EU ETS (Christodoulou et al., 2021; Wang et al., 2021) or a similar global system (Garcia et al., 2021).

At the same time, even though general economic policies, such as the carbon tax, are promoted as a cornerstone in transport policies, full-scale implementation is seldom feasible in the intermediate future due to
political constraints and multiple interacting market failures (Mandell et al., 2014; Rodrik, 2014). An increasing literature is scrutinizing the usage and effect of policy packages to achieve climate objectives (Axsen et al., 2020; Bhardwaj et al., 2020). It is pointing at the need for a mix of strong and well-integrated policies, combining general and more targeted instruments, to realistically achieve climate targets. Most climate policies within the freight transport sector are directed towards reducing greenhouse gas emissions within the following areas: total freight ton-kms (demand), system infrastructure/modal choice, energy intensity (related to vehicle design), and fuel carbon intensity (low-carbon fuels) (IPCC, 2014; EEA, 2021b). Often, the two first are lumped together into a category of its own – modal shift – thus creating a “three-legged” transport climate policy mix. One way to explain this policy focus is that it rests on a simple formula where total greenhouse gas emissions (gCO$_2$e) is a function of the transport demand (km), fuel efficiency (MJ/km), and fuel carbon intensity (gCO$_2$e/MJ) (Bhardwaj et al., 2020). Common policies within each leg are summarized in Table 3.

As illustrated by the example of Sweden, policies that are introduced in one of these areas are usually also impacting other areas – particularly so as different modes are often treated separately. By treating climate policies in the transport sector as separate legs, their effects may be smaller than intended, at best, and counteracting CO$_2$e emission reductions at worst. One way to explain why modal shift policies fail to contribute to CO$_2$e emission reductions at a pace in line with policy objectives is that they are insufficiently dealing with the multitude of simultaneous market failures, infrastructure, and institutional barriers. Weber and Rohracher (2012) list several ‘failures’ that are relevant for realizing modal shifts that contribute to achieving climate goals, including:

- Network failures relating to innovation and supply systems that are locked into the incumbent technology. For example, long-term contracts with freight providers with well-established transport chains,

![Fig. 3. Million tons of CO$_2$e emissions by freight mode 2010–2020. Note: Total percentage reductions in CO$_2$e emissions 2010–2020 are 37% for road, 27% for rail, 5% for sea, yielding an overall average reduction for freight transport of 34%. Source: SCB Statistical Database (2022)](image)

<table>
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<th>Table 3</th>
<th>The three-legged policy mix for CO$_2$e emission reductions in the freight transport sector.</th>
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| Administrative | Low carbon standards | Zero-emission vehicle (ZEV) standards | Public procurement  
Infrastructure planning and investment  
Technology standards |
| Economic | Carbon tax | Fuel tax | Energy tax | Subsidies  
Time differentiated taxes and fees |
| Information | Supporting R&D | Supporting R&D | Supporting R&D |

Source: Adopted from Axsen et al. (2020) and ITF (2022).
of this. If the political ambition is to reach a certain modal split target, a policy instrument that is predicted to induce modal backshift is ineffective as it moves the transport sector further away from that target achievement. However, if modal shift is a means to achieving a less carbon-intensive transport sector, modal split constraints are non-binding, and the effect of the policy instrument must be determined in relation to realizing climate objectives. Another problem is that the interpretation of modal shift as an objective invites political trade-offs. The Swedish national freight transport strategy puts the modal shift objective next to competitiveness. Competitiveness and modal shift are not necessarily compatible. The increased competitiveness of railway and sea transport could well result in a higher share of freight on these modes, but that does not necessarily imply that freight has shifted from road – it could be induced traffic. Especially when measuring within national boundaries, it could even be the case that the greater competitiveness of rail and sea transport induce traffic but, at the same time, lead to higher modal shares for road – because of the need for accessing rail and sea. Policies aiming at multiple objectives are not uncommon. Both competitiveness and modal shift are, for example, expressed as objectives in the Norwegian Transport Plan 2018–2029. The Norwegian National Audit Office (2018) found that when faced with political trade-offs, e.g., between an effective road sector and modal shift or between freight and passenger transport, modal shift targets are not prioritized. That there are trade-offs between political goals is not unique to the freight transport sector. However, it is important to recognize that modal shift targets rest on assumptions of relative environmental performance between transport modes that are about to change.

Even though the development is faster for light-weight vehicles, the faster vehicle turnover and the speed of technological development in the road sector implies that road is predicted to decarbonize faster than other modes. This trend is ramped up with the Fit-for-55 package presented by the European Commission in July 2021, with requirements for a faster transitioning towards decarbonization within the transport sector. The package contains 13 proposals for reforms and new regulations, including incorporating transport and heating in a parallel system within the EU ETS, strengthening of the Alternative Infrastructure Directive with mandatory union-wide standards for charging infrastructure and hydrogen development for different modes, and redesigning energy taxes based on environmental performance (European Parliament, 2021b). Yet, the package is not including any direct modal shift incentives related to shifting freight from road to rail and shipping. The proposed policies have the potential to aid greenhouse gas emissions mitigation within all modes through progress in technical innovations such as increased battery efficiency, electrification and alternative fuel sources, and the automatization of vehicles. However, the road sector is likely to implement these technologies much faster than, for example, sea transport. The relative speed of transitioning towards alternative propulsion methods within different modes will affect the political desirability of realizing a modal shift motivated from a climate point of view.

5. Conclusions

The political ambition for realizing modal shifts from road to sea and rail depend on assumptions about relative environmental performance, and/or other external effects, of different modes. In Sweden, the current official estimation of CO₂eq emissions reductions from shifting ton-km from road to sea is a 50% reduction (Transport Analysis, 2017). This is about to change (Johansson et al., 2021). Regional and local political decisions on infrastructure and promotion of technology development will largely affect future freight transport traffic and modal split. The comprehensive work with the Sustainable and smart mobility strategy (COM(2020) 789 final) carried out within the EU will, for example, have large impacts. Differences between modes in terms of competitiveness and environmental impact depend on the advances in battery technology, alternative fuels, automatization, and digitalized transport solutions. The way information is shared between different actors to optimize the load factor within the transport network will impact both mode distribution and influence market power between shippers and carriers.

The current political and technological development could improve conditions for complementarity between modes and multimodal transport solutions, through organizational innovations and business models taking advantage of load standardization, digitalization, data-sharing, and innovations. Some of these developments are pointing in the direction of increased opportunities for shifting freight to sea and rail on full or part distances. For example, the EU mobility package (EU 2020/1054) includes regulations on driving rest times and cabotage for the road sector and could improve the competitiveness for sea and rail. Yet other trends are pointing towards continued strengthening of the road sector. The proposed strengthening of the Alternative Infrastructure Directive will impact on future investments in alternative fuels for all modes. Even though development towards energy and environmental efficiency is carried out within all sectors, the efforts to improve environmental performance in the road sector is facilitated by the much faster turnover of the vehicle fleet compared to sea and rail. As technology develops, the assumptions about the relative environmental performance and costs of different modes will determine the political ambitions with respect to realizing modal shift.

Despite having a geographical and political focus on the EU and Sweden, the real crux of this work lies with identifying how modal shift within the freight sector could contribute to achieving climate objectives. The experience from Sweden, similar to other national and regional contexts within Europe and beyond, highlights the need to integrate modal shift policies - and analysis - to the broader transport policy framework. This is further emphasized in the following recommendations on freight mode choice policies from the ITF (2022):

- Apply integrated policy approaches to create coherent interventions across freight-transport modes.
- Focus on mitigating external costs associated with each freight mode, rather than on modal shift as such.
- Improve the evaluation of policy interventions’ effectiveness to better inform measures that influence the choice of freight transport modes.
- Create fair competition between freight transport modes.

A successful transition within the transport system towards less climate and environmental impact requires political flexibility based on an integrated mix of stringent policies. Low-carbon fuels regulation and carbon pricing should be the cornerstone of such policy mixes, along with infrastructure investment. Yet, there is little evidence that economic policy instruments could realize large freight modal shifts on their own. The responsiveness to transport costs has been shown to be low on average, implying that price signals from general economic policies need to be, perhaps prohibitively, substantial. Considering modal shifts as a means to realizing climate and environmental objectives, there is even less evidence on the effectiveness of mitigating negative externalities. Societal objectives, such as safety, environmental pollution, health concerns, congestion, etc. may all justify a shift from road transport to other transport modes – as one of several means towards goal achievement. By interpreting modal shifts as an objective in itself, and implementing policies as separate legs and by mode, we risk suboptimizing