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Financing of a sustainable freight transport: Requirements and conditions for a future development of freight transport – a systematic analysis based on a comparison of countries

Summary

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Financing of a sustainable freight transport:

Requirements and conditions for a future development of freight transport – a systematic analysis based on a comparison of countries

Summary

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1 Introduction

The ongoing growth in freight transport calls for clearly defined framework conditions for ecological freight transport policymaking. Ecological requirements, shippers' needs, and the related requirements for Germany as a logistics centre need to be harmonized, by means of the following: explicit sustainability and climate protection goals; guidelines for development of the road-rail modal split; and priorities for the expansion strategy of the freight transport infrastructure. In this context, financing models play a key role for both funding as well as the related polluter-pays principle-based fee/charge system.

In light of current developments and challenges in the freight transport sector, the report mainly seeks to do the following:

Develop a future-oriented road and rail freight transport financing model that is oriented toward sustainability, climate protection goals, and modal shift goals in Germany – for which a key element is the lessons that have been learned in other countries (i.e. cross-country comparison).

Analyse and assess the economic impact of the elaborated financing models and instruments, in terms of the extent to which they meet German climate and modal shift goals. Both the overall economic impact (in terms of employment and added value) and the monetized environmental impact need to be addressed.

To this end, the report builds on the groundwork concerning sustainability and climate protection goals: the German strategy for sustainable freight transport, current debates on financing, climate and mobility scenarios, and the lessons learned in other countries. Finally, the impact of the target scenario is compared to that of the reference scenario, and the degree of target attainment of the two scenarios (the degree to which they are likely to achieve the relevant ecological, transport and economic goals) is assessed. For purposes of assessing goal attainment, a target system comprising transport, ecological and economic goals is first defined. This system factors in the current quantitative goals of the federal government and the UBA as well as auxiliary qualitative goals.

2 Comparison of four European countries

Using a comparative analysis of the financing systems of Germany, Switzerland, France and Sweden, along with selected financing instruments, the elements and success factors of a sustainable freight transport financing system were identified. The results of this comparison were then used as a basis to design the target scenario.

These results show that the degree of sustainability of a given financing system is largely determined by policy objectives and economic motivations. In prioritizing economic sustainability (i.e. long term financing and economic viability of the transport sector) it emerges that the full-cost model used in Germany, Switzerland and France is far superior to the Swedish approach. But the reverse finding is reached if a liberal free market perspective is applied. The Swiss model appears in the most favourable light of a policy if shifting to rail transport is regarded as the primary sustainability goal. As for which system is best from an economic standpoint, this is a question to which there is no clear answer. To address this issue, it is necessary to first define a system of goals for the development of a sustainable transport sector. Apart from financial instruments, regulatory factors (e.g. weight limits, bans on night and weekend truck transport, social policy provisions concerning matters such as rest periods) have a major impact on freight transport as well.

Our assessment of the instruments and measures from various countries allowed for the definition of the following **elements and success factors for a sustainable freight transport financing system**:

- Orienting financing instruments toward a full cost approach and the inclusion of external costs.
- Truck toll, depending on distance travelled and on a sliding scale according to environmental criteria.
- Incentives aimed at reducing road transport fuel consumption.
- Robust infrastructure financing for combined road and rail transport, and for rail routes.
- Rail route usage fee incentives, e.g. for noise abatement, nuisances, rail wear, capacity restrictions.
- Global road-rail financing instruments for the elements of the financing system that are not needed for infrastructure financing. This approach can be particularly useful when it comes to getting companies to shift from road to rail transport.
- Earmarking tax revenue for transport outlays enhances planning certainty (continuity) and flexibility. One way of accomplishing this is through proprietary transport infrastructure funds.
- The rail freight transport sector accounts for a particularly large share of the freight volume in countries where the fee/charge burden is disproportionately high for the road transport sector and/or where the rail transport sector is highly subsidized. The structure of a given country's industrial sector, as well as the political clout of trade organizations (e.g., of the car and rolling stock industries), can also have a major impact on the importance of the road and rail freight transport sector.
- When it comes to successful implementation of policies aimed at promoting a shift from road to rail transport, social and political acceptance plays a crucial role.

3 Scenario development

Using the insights gained from the comparison of the four countries, in conjunction with proposals and ideas from studies and the political debate, scenarios for a future financing model are outlined. In this process, two scenarios – a reference scenario, along with a target scenario for 2030 – were designed, which were then compared with each other. These scenarios centre on a financing model for Germany's transport infrastructure. The main focus of the financing model is the funding system, as well as, in particular, financial regulations and infrastructure.

The Federal Transport Infrastructure Plan (BVWP) *Verkehrsprognose 2030* (2030 transport sector projection) was used as a reference scenario. Inasmuch as detailed transport data is available for this projection concerning both of the years in question here, i.e. 2010 and 2030, the BVWP scenario provides a good basis for quantitative comparison.

The target scenario is largely based on the goals defined at the beginning of the study – namely that the aim of the financing model is to help bring about ecologically sustainable and economically efficient freight transport. The main focus here is on the following: securing financing for the freight transport infrastructure; shifting from road to rail freight transport; reducing freight transport greenhouse gas emissions. The target scenario is based on the following **principles**:[1]

- Strengthening rail freight transport, particularly for combined transport, by expanding the combined transport infrastructure (via transhipment terminals in particular) and the rail network.
- Expanding the user-pays financing system, and making the freight transport fee/charge and financing system more oriented toward the polluter pays principle than is currently the case; this can be accomplished through measures such as expansion and differentiation of truck tolls.
- Stable medium and long term financing of the transport infrastructure.

1 Incorporation of the air-transport system into the concepts discussed here concerning an economically sustainable modal shift (in terms of environmental goals) is realized separately in a document entitled Anforderungen und Rahmenbedingungen für eine zukunftsorientierte Entwicklung des Güterverkehrs – eine systematische Analyse auf der Grundlage eines Ländervergleichs – Komponente Luftverkehr (FKZ 3713 45 101).

- Incorporating external costs into the fee/charge system; making financing instruments more environmentally oriented.
- The focus for the road network should initially be on road upkeep, and then on road improvement, and finally on building new roads.

In the following, the key findings, measures and instruments of the three dimensions of the target-scenario (financing, infrastructure and regulation) will be described.

Financing system

- Expansion and differentiation of truck tolls. Expanding truck tolls to include the entire road network, and including lighter-weight trucks and external costs (including cost differentiation) would increase road transport costs and generate additional revenue amounting to around six or seven billion euros annually. These revenues should primarily be earmarked for road upkeep (including the backlog of upkeep referred to in the Daehre report). Some of the target-scenario measures were already implemented via the 2015 reform of truck tolls.
- Earmarking a portion of truck toll revenue (by folding in environmental costs) for subsidies for combined transport. As is the case with the EU infrastructure costs directive, external environmental costs (air pollution, and above all climate costs) should be folded into truck tolls, and a portion of this additional revenue should be used to promote sustainable mobility and to develop alternative infrastructures. Specifically, these funds should be used to finance the intermodal transport infrastructure for combined traffic (terminals etc.).
- Raising route prices and greater differentiation of these prices. This would involve a moderate but noticeable increase in route prices, in the interest of expanding the scope of user financing in the rail sector, for freight transport in particular. In addition to this, creating incentives via additional environmental differentiation steps according to elements such as energy source (and the carbon emissions thereof).
- Stepping up financing in accordance with the railroad service and financing agreement (LuFV). This would involve addressing the backlog of upkeep activities referred to in the Daehre report, as well as long term financing for the rail infrastructure. The government has already decided to expand the scope of this agreement (LuFV).
- Rail infrastructure fund. Establishing a fund for rail infrastructure financing (upkeep, expansion, new rail lines, currently non-funded operating and upkeep costs) could potentially provide long term financing for infrastructure outlays, offset outlay fluctuations, and thus promote planning certainty. This fund would derive its financing mainly from LuFV revenue (i.e. general federal revenue).
- Subsidizing combined road and rail freight transport, as well as conventional rail transport. This would involve a substantial increase in investment grants for combined-traffic transhipment facilities (terminals in particular), as well as for rail transhipment facilities (for wagonload freight traffic and unit trains) for purposes of financing the expansion of the intermodal transport infrastructure.

Infrastructure facilities

- Efforts to expand rail freight transport routes (particularly transit routes) should be intensified, and total rail freight transport capacity should be increased by around 60 to 70 per cent (UBA 2010). Such measures would require investments amounting to around €11 billion over the next 12 years, i.e. around €900 million annually (UBA 2010).
- Prioritizing road upkeep over road improvement and construction of new roads. Here, upkeep should be given top priority; whereby road expansion and building new roads should not deviate from the reference scenario. In other words, expanding the existing road infrastructure and buil-

ding new roads should unfold exactly as described in the BVWP projection (i.e. implementation of all priority measures, as per BVWP 2003).

- Stepping up expansion of the intermodal transport infrastructure for combined transport, as well as transhipment terminals for conventional transport. This would mainly involve doubling combined transport transhipment capacities by 2030. Massive investments would be needed for this, amounting to around €200 million annually (i.e. around €2 billion over a ten year period). It would also be necessary to provide discrete financing for regional transhipment terminals (and to a lesser extent, feeder tracks) for conventional transport.

Regulations

The focus in terms of regulation is on improving efficiency, reducing fuel and energy demand), and improving market access and other framework conditions. The main instruments in this regard are as follows:

- Establishing tighter emission limits for new road freight transport vehicles.
- Implementing either (a) limit values for minimum vehicle efficiency (e.g. consumption, and possibly for electric vehicles as well); or (b) monetary incentives for efficiency improvement, via a bonus-malus-system or keying vehicle levies to carbon emissions.
- When it comes to route allocation for rail transport, freight transport should at a minimum be on an equal footing with regional traffic, and should be prioritized on selected routes.
- At a higher level, measures such as expansion of urban environmental zones and subsidizing green urban logistics make sense.

An in-depth analysis of the following matters is undertaken via a concurrent study (entitled *Klimaschutzbeitrag des Verkehrs bis 2050*): regulatory policy, market access, market regulation – and in particular engine technology development (IFEU, INFRAS, LBST 2016).

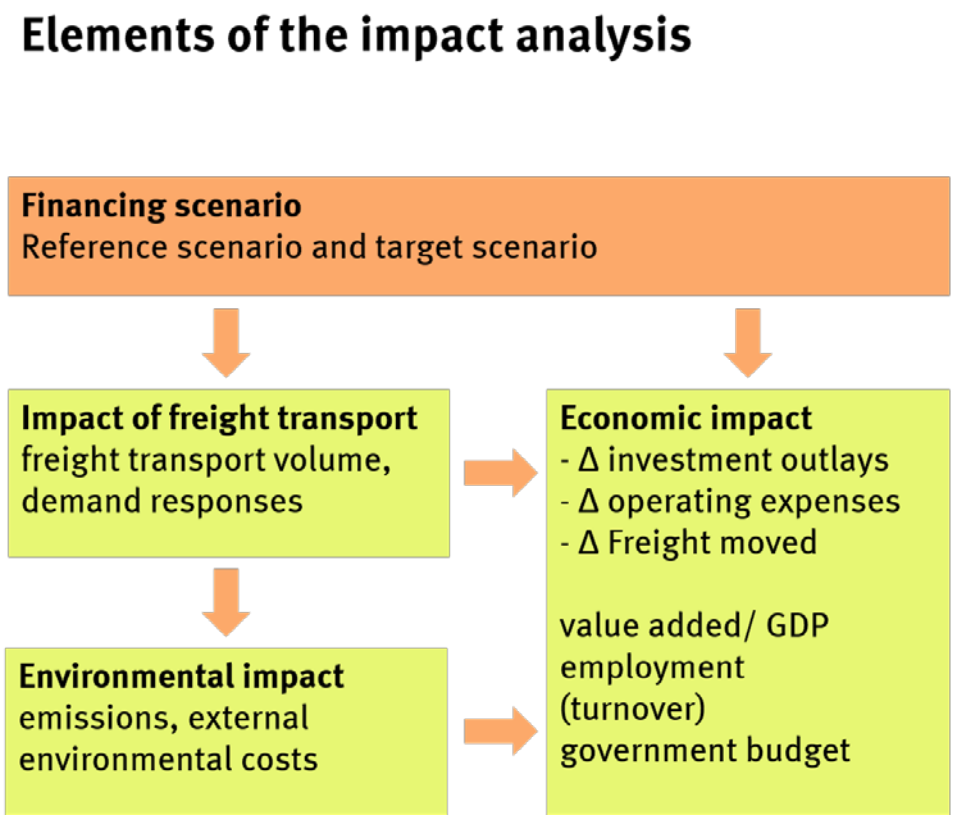
The ecological, economic and transport effects of these three models were investigated via an impact assessment that centred around the mechanisms by which the various models occasion specific types of consumption patterns, in the freight transport sector, that have a positive ecological impact and at the same time induce no negative economic effects.

4 Impact study

(a) Method

An exhaustive impact study was carried out for both the reference scenario and the target scenario. This analysis addressed transport, economic and environmental effects. The graphic below illustrates the structure of the impact model, including the key result parameters.

Figure 1: Structure of the impact model and impact study



The next three sections summarize the findings of the transport, economic and ecological impact study, and discuss the differences between the two scenarios that were investigated.

(b) Transport effects

In terms of total transport volume and freight moved, there is little difference between the reference and target scenario. In the target scenario, total freight moved (tkm) is 2 per cent lower than in the reference scenario owing to transport charges; whereas total transport volume (t) is the same in both scenarios. If freight transport intensity (tkm per euro of GDP_{real}) is 2 per cent lower in the target scenario relative to the reference scenario, it is nonetheless 8 per cent higher than the current level. Hence no decoupling of transport and economic growth is occurring, although there are sharp differences between the various modes of transport. Rail freight moved in the target scenario is 25 per cent higher than in the reference scenario, but is 9 per cent lower than road freight moved. This results in a substantial modal shift from road to rail transport (and to a minor extent to inland shipping). The rail share in the target scenario for 2030 is 23.4 per cent, making it more than 5 per cent higher than for the reference scenario. Thus the target scenario results in a substantial shift from road to rail freight transport.

Table 1: Overview of transport effects

	2010	Reference 2030	Target 2030	Diff. between ref. and 2030 target
Transport volume (in millions of tons)				
Total freight transport	3,710	4,360	4,360	**+/-0%**
Freight moved (billions of tkm)				
Road	437	607	550	**-9%**
Rail	108	154	193	**+25%**
Inland shipping	62	76	79	**+4%**
Total freight transport	607	838	822	**-2%**
Modal split (based on tkm, in %)				
Road share	72.0%	72.5%	66.9%	**-5.6%**
Rail share	17.7%	18.4%	23.4%	**+5.0%**
Freight transport intensity (in tkm / € GDP_{real})				
Total freight transport	0.279	0.307	0.301	**-2%**

c. Economic impact

All in all, relative to the reference scenario, the cluster of measures defined for the target scenario has little impact on the macroeconomic variables employment and value added. Employment in the target scenario is only around 0.03% higher than in the reference scenario (see Table 2). Based on 2010 employment figures, this represents just under 11,000 people joining the workforce. Based on 2010 added value, the 0.07 per cent higher value added in the target scenario relative to the reference scenario represents just under €1.6 billion. However, substantial differences occur in the road transport sector, where employment and added value are 5 per cent lower in the target scenario relative to the reference scenario. However, it should be emphasized that this represents not an employment or added value decrease relative to today's levels, but rather a lower growth rate than in the reference scenario. In light of the projected increase in freight transport growth, both employment and value added are expected to be higher in 2030 than today. On the other hand, rail freight transport sector employment and added value in the target scenario are one third higher than in the reference scenario. Employment and added value are somewhat higher in the target scenario than in the reference scenario for rail freight transhipment, storage and other logistics, and the construction industry (the latter owing to rail and combined traffic infrastructure expansion). Employment and added value in the remaining sectors for the target scenario are higher in the target scenario, by virtue of the general budgetary resources that will be freed up as the result of higher levels of user-pays financing in the transport sector.

In terms of the aggregate figures for all freight transport sectors, employment in the target scenario is 0.9 per cent lower than in the reference scenario (which in 2010 would have represented 9,500 full-time equivalents). However, aggregated added value for all freight transport sectors in the target scenario is 0.8 per cent higher than in the reference scenario (which in 2010 would have amounted to €400 million in additional added value). The differences between these effects are attributable to the following: (a) employment is lower in the rail freight transport sector and added value is higher, relative to the road freight transport sector; and (b) demand for transport in the 2030 target scenario is lower – and thus freight transport sector turnover is somewhat lower than in the reference scenario. According to the target scenario, the beneficiaries of the cluster of measures are, apart from the government and the general public, the construction industry – which profits from higher investments in the rail freight transport infrastructure. For this sector, employment and added value are each 1 per cent higher in the target scenario relative to the reference scenario.

Table 2: Overview of economic effects (overall impact of primary drivers and income equalization effects).

Industries	Difference between reference- and target scenario (2030) in per cent	
	Employment	Added Value
Road freight transport (transport for hire or reward and own account transport)	-5%	-5%
Rail freight transport	+33%	+33%
Rail freight transport infrastructure and freight transhipment, storage, other logistics	+1%	+2%
Building and civil engineering	+1%	+1%
Other industries	+0.04%	+0.04%
Total for all industries	**+0.03%**	**+0.07%**

(d) Environmental impact

As Table 3 shows, the target scenario has a clearly positive impact on all environmental parameters. The measures defined for this scenario would reverse the current trend for greenhouse gas emissions, in that in lieu of a further increase in carbon emissions between 2010 and 2030, a substantial decline in such emissions would be achieved for this period. The target-scenario greenhouse gas emissions are 18 per cent lower than in the reference scenario and 17 per cent lower than for 2010. This decrease is caused not only by direct transport effects (shifting from road to rail transport and a slight fall-off in freight moved), but also by implementation of the technology and regulatory measures described in the report, which lead to more widespread use of ecologically sustainable engine technologies, and a decrease in greenhouse gas emissions (per vehicle kilometre).

Relative to the reference scenario, in the target scenario air emissions for nitrogen oxide and particulate matter are lower, by 10 per cent and 6 per cent respectively. However, as a result of the technological developments in this arena, already in the reference scenario nitrogen oxide and particulate matter emissions decline by around 75 per cent between 2010 and 2030. As with greenhouse gas emissions, the target scenario reverses the current trend for final-energy use in the freight transport sector – a 5 per cent decrease relative to 2010. Final-energy use in the 2030 target scenario is 10 per cent lower than for the reference scenario.

While, relative to 2010, total environmental costs for freight transport already decline by just under 25 per cent by 2030 in the reference scenario, by dint of the cluster of measures defined in the target scenario, however, annual environmental costs in the run-up to 2030 decrease by an additional nearly €1.8 billion (13 per cent) as compared to the reference scenario.

Table 3: Environmental impact for all freight transport

	2010	Reference	Target	Diff. between reference- and target scenario
Greenhouse gas emissions (in millions of tons CO_2-eq)	59.0	60.0	49.2	**-18%**
Nitrogen oxide emissions (1,000 t NOx)	304.8	76.0	68.5	**-10%**
Particulate emissions	9.19	2.46	2.31	**-6%**

	2010	Reference	Target	Diff. between reference- and target scenario
(1000 t particulate matter)				
Final-energy use (in PJ = billions of peta-joules)	668	701	632	**-10%**
Environmental costs (billions of euros)	17.2	13.1	11.4	**-13%**

All figures pertain to for aggregate freight transport (road, rail and inland shipping)

5 Assessment of the scenarios

Once the quantitative results of impact modelling were obtained, a comprehensive general assessment was carried out for the two scenarios, using the following criteria as a basis:

- Degree of environmental target attainment (quantitative): greenhouse gas emissions, final-energy consumption
- **Degree of transport target attainment:** modal split, freight transport intensity
- **Ecological compatibility:** contribution to reducing negative environmental effects
- Economic efficiency:
- **Macroeconomic impact:** impact on employment and on value added for the overall economy
- **Financial sustainability:** meeting the financing needs of the transport infrastructure
- **Logistics and transport sectors:** risks and opportunities for the various transport sectors and for Germany as a logistics location
- **Efficiency incentives:** promoting incentives aimed at improving transport efficiency and innovation
- **Polluter-pays principle:** contribution to optimized implementation of the polluter-pays principle
- **Feasibility and acceptance:** opportunities and impediments as regards implementation of the relevant measures

Although the assessment was mainly qualitative, a visual aid was used in the form of a simple three-stage scale (– , o , +) indicating whether a given scenario is to be regarded as meeting the relevant criteria positively, negatively, or neutrally. For purposes of comparison, the 2010 figures were used; for quantitative goals the defined targets were used. The results of assessing the reference and target scenario are shown in Table 4.

All in all, it can be said that the quantifiable effects of the target scenario are fairly similar to those of the targets. This in turn shows that the transport targets are very ambitious – which means that the environmental goals are somewhat more likely to be reached than the transport goals.

When it comes to the ecological criteria, the target scenario fares better than the reference scenario. In terms of the environment, there are major differences between the two scenarios, with the overall degree of target attainment for the target scenario being high. The only domain in which the target scenario does not come out on top is for the decoupling of economic growth and freight moved (freight transport intensity).

Although the results are somewhat less homogeneous for economic efficiency, here too the target scenario results tend to be better. One of the areas where the target scenario is particularly superior to the reference scenario is for meeting transport infrastructure financing needs. The impact on the

economy as a whole (added value, employment) is fairly similar for both scenarios, i.e. slightly better than for 2010. Comprehensive economic impact modelling revealed that from a macroeconomic standpoint the target scenario leads to slightly greater employment and value added than the reference scenario. This outcome is largely dependent on the impact of improved transport-cost coverage on financial resource in other sectors. From an economic viewpoint, basing prices on the polluter-pays principle always improves economic efficiency, which is why financial resources will be freed up in other sectors that can be used in a more focused fashion. However, in light of the model and input-data uncertainty to which both scenarios are subject, their results in terms of employment and added value effects are fairly similar to each other.

That said, the target scenario results in clear differences in these two growing sectors: employment and added value for road transport are lower than in the reference scenario and are thus considerably higher for rail freight transport.

In the target scenario, a major step is being made toward optimized implementation of the polluter-pays principle, in the following two ways: (1) User-pays financing has been strengthened across the board (higher road transport fees/charges based on ton-kilometrage; increased rail transport fees/charges; reduced financing from tax revenue). (2) The degree to which external costs are folded into truck tolls has been increased. The target system may encounter obstacles when it comes to its feasibility and acceptability. While the envisaged financing instruments are altogether modest and are largely consistent with the recommendations of the Daehre commission, expanding the scope of truck tolls by increasing the degree to which external costs are folded into them could be problematic. This obstacle could be surmounted by amending the EU infrastructure costs directive. However, there are obstacles as regards the feasibility in the reference scenario as well. In particular, the current underfunding of the transport infrastructure could jeopardize the expansion projects entailed by the scenario.

Table 4: Comparative assessment of the reference and target scenarios (relative to 2010)

Criteria		Reference scenario	Target scenario
Degree of target attainment for the environmental and transport domains	Greenhouse gas emissions Goal: reduction to 2005 levels by 2020 (±0%)	(–) Target not reached by 2030 Emissions increase by 2 %.	+ Target reached. Carbon emissions substantially reduced by 17 %.
	Final-energy consumption Target: 10 % reduction by 2020, relative to 2005	– Target missed by a substantial margin. Consumption up 5 %	(+) Just short of the target. Consumption slightly down by 5 %.
	Modal split Target: Rail accounts for 25 % of all transport, by 2015	– Target missed by a substantial margin. Rail in modal split up only slightly, to 18 %.	(+) Just short off the target. Modal split for rail amounting to more than 23 %, but substantially higher than in 2010.
	Freight transport intensity Target: 5 % reduction by 2020, relative to 1999	– Target missed. Large (10 %) increase, no decoupling.	– Target missed. Large (8 %) increase, no decoupling
Overall ecological compatibility		(–) Climate / Energy targets missed by a substantial margin. Air pollution and environmental costs clearly trending downward.	+ Positive. Substantial reduction in carbon emissions, air pollution, energy consumption and environmental costs.
Economic efficiency	Macroeconomic impact	(+) Positive (GDP up by 1.1 % annually, as per VVP 2030, incl. for the freight transport sector)	+ Positive, slightly higher growth than in the reference scenario (according to modelling).
	Financial sustainability (meeting financing needs)	(–) Short and medium term financial needs not met	+ Sustainable transport financing needs met in the long term
	Opportunities for Germany as a logistics location and for the German transport sector	+ Strong growth in the freight transport sector.	(+) Reduced growth in the road freight transport sector; substantial growth in the rail/combined traffic sectors
	Incentives for innovation and transport efficiency	o No particular incentives, except for energy levies	+ Technol. incentives for road freight transport (diff. tariffs, environmental requirements)
Implementation of the polluter-pays principle		o No improvement relative to 2010.	+ Additional user-pays financing: inclusion of external costs etc.
Feasibility, acceptance		o No new instruments, but road network expansion uncertain, and financing unresolved	(–) New financing instruments rather moderate in scope; external costs may be critical factor (EU road costs dir.)

Criteria assessment scale: +: positive; o: neutral; –: negative, all relative to 2010.

6 Overall assessment; recommendations

The analysis of lessons learned in foreign countries, as well as the comparative impact study for the reference scenario vis-à-vis the target scenario that was designed, reveal the existence of considerable potential for the roll-out of measures that could make Germany's freight transport sector and its infrastructure more sustainable. The analysis mainly centred on measures aimed at adaptation of the financing system and of infrastructure facilities. The following measures emerged as cornerstones of sustainable freight transport, in terms of financing and pricing:

- Expansion and differentiation of truck tolls: expanding truck tolls to include the entire road network, including light commercial vehicle (down to 3.5 tons); folding external environmental costs (particularly climate costs) more extensively into tolls. Some of these measures were already implemented in 2015.
- Earmarking a portion of truck toll revenue (by folding in environmental costs) for subsidies for combined transport.
- Increased funding for combined-traffic infrastructure and for private siding, by substantially increasing infrastructure subsidies for transhipment facilities/terminals for combined traffic and for feeder tracks.
- Increased rail infrastructure financing (e.g. via LuFV).

An additional measure would be the establishment of a rail infrastructure fund for the financing of all rail infrastructure expenditures. Consideration should be given, in the medium to long term, to establishment of a general transport fund using revenue earmarked for the financing of rail and road infrastructure facilities (and possibly inland shipping as well). This fund could be used to finance all road and rail infrastructure activities. A general transport fund would necessitate coordinated infrastructure planning for all transport modes, and would improve flexibility and planning certainty for infrastructure financing.

Measures for infrastructure facilities are also needed concomitantly (and in some cases in tandem) with financing measures, which in the scenario described here mainly involve the following:

- Stepping up expansion of rail freight transport routes (in particular for transit), in the interest of achieving considerably greater capacity.
- For road infrastructure facilities, prioritizing upkeep over expansion and new construction.
- Stepping up expansion of the intermodal transport infrastructure for combined transport, as well as transhipment terminals for conventional transport, in the interest of ramping up transhipment capacity.

Over the next 15 to 20 years, expeditious implementation of these and other additional measures could bring about a substantial reduction in the **environmental impact of freight transport** in Germany, mainly as the result of shifting from road to rail transport. A 10 to 20 per cent reduction in total greenhouse gas emissions by 2030 (relative to 2010) appears to be a realistic climate policy goal for the freight transport sector. The goal of reducing the greenhouse gas emissions of all EU transport by 20 per cent in the run-up to 2030 (as per the EU White Paper on transport) could certainly also be used as a target (albeit an ambitious one) for Germany's freight transport sector. In terms of energy policy goals, the goals mandated by the government's energy plan (10 per cent reduction in transport sector final-energy use in the run-up to 2020, relative to 2005) will be narrowly missed, even if the cluster of measures proposed in this study's target scenario is implemented (and if no other measures are taken). Hence in order to reach these goals, greater reductions would have to be made in passenger transport. However, freight transport sector energy consumption can still be reduced in the target scenario, as opposed to the steadily rising energy consumption in the reference scenario as per Federal Transport Infrastructure Plan (BVWP). Thus in terms of energy goals as well, the mandates of the

government's energy plan should be adhered to – although this will entail considerable effort, even if the 2030 deadline is extended.

The **economic impact** of all of the measures that we investigated are positive. Specifically, the target scenario measures result in more stable financing of the transport infrastructure; they also increase the scope of user-pays financing and thus promote more widespread application of the polluter-pays principle. One reason for this is that expanded user-pays financing aimed at promoting application of the polluter-pays principle would be largely financed by foreign players (shipping agents, goods recipients and carriers); and the resulting windfall for the federal budget would exclusively work to the benefit of the German populace. Although shifting from road to rail freight transport will neither drive up unemployment nor reduce added value in the road freight transport sector, it will lead to somewhat slower growth in this sector in the run-up to 2030.

Hence from the standpoint of **sustainability** – particularly ecological sustainability, but also from an economic perspective – the target scenario measures described in the report should be implemented in a timely manner, in the interest of achieving a more sustainable freight transport infrastructure. These measures would help to (a) reduce the environmental impact of freight transport and the freight transport infrastructure; and (b) allow for long term financing of this infrastructure without inducing any negative economic effects such as job losses. Structural change in the freight transport sector would also open up business opportunities for German companies, as such change will likely bring about substantial efficiency optimization in the transport sector.

In order to meet the mandated environmental policy goals, it will be necessary for a portion of freight transport to **shift** from road to rail. And while ramping up the modal split for rail traffic is not an end in itself, it can make a considerable contribution to reducing the environmental impact of freight transport. As our analysis shows, the government's goal of rail freight transport accounting for 25 per cent of all such transport (in terms of freight moved, tkm) is ambitious, but will be well within reach if the necessary measures are implemented. But it is also important to remember that for certain goods and in particular for goods distribution involving short distances, shifting from road to rail freight transport makes little sense and in some cases is unfeasible. In Germany, there is currently considerable potential from an economic standpoint (among ecological and transportational point of views) when it comes to transport shifting for goods conducive to shipment by rail. In recent years, this has already been proven for certain goods segments where considerable shifting from road to rail transport has been prevalent. Hence Germany's goal of rail transport accounting for 25 per cent of all freight transport should be retained, even if the deadline needs to be extended, with the relevant period starting in 2015. Nonetheless, modal split targets should not be the primary goal, but should instead only serve as a stepping stone to reaching quantitative environmental targets. In the event of a very large increase in both road and rail freight transport, even if the transport shifting goal is reached, the environmental goals may well be missed, because the sheer amount of the increase will neutralize the positive impact of transport shifting. Hence environmental policy should focus on quantitative targets in the climate and energy domains, among others – although modal-split targets could serve as a key management instrument on the path to achieving long term environmental targets.

The study does not delve to any great extent into the possible potential of longer and heavier vehicles, on the assumption that they would have an unacceptably negative impact on achievement of modal split and environmental targets. If current field studies in this regard reveal the existence of long term potential and possible application domains, they should be clearly delimited in the interest of sustainable freight transport (in particular, spatially), and the resulting positive impact on productivity (as a contribution to financing) should be maximally exploited by means of truck tolls.

The following **recommendations** were elaborated with a view to enabling the transport policy implementation path to result in a more sustainable freight transport infrastructure:

- The financing system and infrastructure facility measures described in the report (which we analysed and assessed extensively) harbour considerable potential, particularly in the short to medium term. Implementation of these measures could improve infrastructure financing certainty and make a considerable contribution to achieving the environmental goals that have been set, particularly in the climate and energy domains.
- Subsidizing rail freight transport, however, could entail an increase in rail noise – and thus would also necessitate funding of noise abatement measures in this domain.
- The measures outlined in the report will not suffice when it comes to meeting long term climate goals for massive carbon emissions reductions from 2050 onward. Hence between 2025 and 2030 at the latest, further measures will need to be implemented, particularly in terms of technology; whereby improved framework conditions are needed as well. The climate goals that have been set for 2050 and beyond cannot possibly be met unless extensive changes are made in the propulsion technologies used for road freight transport. Such measures were investigated in a concurrent UFOPLAN study entitled *Klimaschutzbeitrag des Verkehrs bis 2050* (IFEU, INFRAS, LBST 2016).
- In view of the fact that (a) it will be some time until the aforesaid technological measures are widely implemented; and (b) technical measures will not suffice, in and of themselves, to reach the mandated goals, particularly in the climate protection domain, it is crucial that non-technical measures be implemented expeditiously in the financing system and infrastructure supply. That said, some of the measures discussed in the report such as the following have already been implemented, at least in part: extending the reach of truck tolls to include additional federal highways (Bundesstraßen) and trucks weighing down to 7.5 tons; folding environmental costs for air pollution into truck tolls. Hence the target scenario already factors in the impact of these previously implemented measures. However, further steps are still needed in order for the goals described in the report to be reached. Particularly important in this regard is further extension of the scope of truck tolls to include the entire road network, or at least all federal highways; charging tolls for all trucks (down to 3.5 tons), or light commercial vehicles; extensive inclusion of external environmental costs.
- Key to across-the-board incorporation into truck tolls of the environmental costs entailed by freight transport is amending the EU infrastructure costs directive (1999/62/EC), which defines the conditions under which it is allowable for environmental costs to be folded into tolls. But inappropriately, these costs are confined to air pollution, noise pollution and traffic congestion costs and to the exclusion of climate costs. Moreover, the cap set by the directive for air and noise pollution costs is in some cases considerably lower than the actual estimated environmental costs entailed by road freight transport in Germany, as per UBA *Methodenkonvention zur Schätzung von Umweltkosten* (UBA 2014). In Switzerland, for example, all environmental costs entailed by road freight transport are covered by the heavy-vehicle levy known as the *Leistungsabhängige Schwerverkehrsabgabe* (LSVA). The amount of this levy has been set in such a way that all infrastructure, environmental and accident costs attributable to trucks in Switzerland are covered by the LSVA and other levies such as the petroleum tax.
- Apart from subsidies and outright financing, rail freight transport infrastructure expansion measures are also crucial for the achievement of more sustainable freight transport, particularly as regards transhipment facilities for combined transport. The scope of subsidies should be expanded in a manner that takes into account the lessons learned in other countries as well. Regulatory framework conditions also play a crucial role when it comes to achieving the mandated goals. Ambitious environmental limit values will continue to make an important contribution to reducing the environmental impact of both road and rail freight transport. Moreover, various conditions pertaining to railroad network access, interoperability, and official authorizations make the rail freight transport sector more competitive than road freight transport.

All in all, the report's comprehensive assessment shows that a future-oriented financing model for the road freight and rail freight transport sectors can constitute a major step toward more sustainable freight transport. The target scenario described in the report could make it possible for the existing environmental and freight transport goals to be largely reached, without engendering a negative impact on the economy as a whole. However, the transport policy path to implementation of these measures remains somewhat challenging.