Freight Master Planning

Annex A of the Handbook 'Navigating Transport NAMAs'

TRANSfer Project – Towards climate-friendly transport technologies and measures

The concept

Freight land transport (road and rail) accounts for one third of the global transport energy use and trucks consume 90 % thereof (IEA, 2009). The total amount of freight moved is projected to increase due to population and economic growth as well as developments in the production and distribution system (*e.g.* wider distances for sourcing and distribution, spatial concentration of production) (IEA, 2009).

The national government can outline a freight development strategy to manage the increasing freight transport activity. Shippers choose the mode of transport mainly according to economic-efficiency, transport duration, reliability and simplicity of operation. High energy and CO_2 mitigation effects can be achieved if freight transport is shifted from road to rail or domestic shipping. The CO_2 emissions per tonne-kilometre of road freight transport are approximately four to five times higher than in waterborne transport and even up to seven times higher as for rail freight transport (McKinnon *et al.,* 2010). National governments can foster an orientation towards low-emission freight transport, by introducing pricing mechanisms that reflect the external costs of transport. Thus, low-carbon modes will obtain an economic advantage over other modes. However, rail networks, inland waterways and shipping routes often cannot cover the first and last meters ('last mile' problem). Thus, intermodality is a key to energy efficient freight transport.

> **Elements of freight master planning:**
>
> - Introducing road pricing for goods vehicles;
> - Providing grants for intermodal freight logistic centres;
> - Developing a national freight logistic platform.
>
> *For more details on the elements' characteristics see Box 1.*

Table 1: GHG reduction matrix of freight master planning

	Avoid	Shift	Improve
Direct effects		☑ Encourages carriers to shift to energy efficient modes by increasing the costs of road freight transport ☑ Facilitates intermodality in freight transport	☑ Increases vehicle utilisation ☑ Emission-based road pricing favours fuel efficient vehicles
Indirect effects	☑ Enables a more efficient organisation of freight transport (reduces empty returns), which leads to reduced trips		
Rebound effect	⊠ Better freight transport organisation can lead to reduced costs, which can have an adverse impact on the transport activity (*e.g.* products or raw materials from further away become cost competitive) ⊠ Road charges that are limited to highways induce evasion traffic		
Complementary measures *(to achieve full mitigation potential)*	☑ Alterations of supply chains and localised sourcing	☑ Sustainable fuel pricing (see Factsheet '*Sustainable Fuel Pricing*')	☑ Vehicle fuel economy standards for heavy duty vehicles (see Factsheet '*Promotion of Energy Efficient Vehicles*') ☑ Freight vehicle policy (see Factsheet '*Freight Vehicle Policy*')

On behalf of

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

Box 1: Possible elements of freight master planning

Introducing road pricing for goods vehicles

The price of freight transport determines the transport volume and its organisation. Based on an empirical analysis, Bjorner (1999) estimates the price elasticities in freight transport. A 10 % increase in truck transport costs reduces the transport volume (tonne-kilometres) by 4.7 %. Truck traffic (truck kilometres) is even estimated to be reduced by 8 % as vehicle capacity is used more efficiently and some freight is shifted to other modes.

Furthermore, price differences between modes affect the modal structure of freight transport. Luk and Hepburn (1993) find that an increase in the price ratio between road and rail of 10 % leads to a shift to rail transport of about 4 % in the short run and of about 8 % in the long run. Particularly freight travel by trucks is often underpriced as public expenditures for road and highway infrastructure is not internalised and thus not reflected in the cost of road freight transport. Road pricing for trucks increases the costs of road freight transport and thus incentivises a shift to rail or waterborne transport. Germany implemented road pricing for trucks as a kilometre charge on highways. On-board units in trucks enable automatic accounting and the charge is graded according to the vehicle emissions. Similarly, the Swiss heavy vehicle fee uses on-board systems to record vehicle mileage of trucks (Balmer, 2003).

How it works and intended effects:

- Increases the costs of road freight transport;
  - ➔ Promotes more efficient vehicle utilisation and reduces empty return traffic;
  - ➔ Can encourage a shift to more efficient modes for freight transport.
- Lower costs for low-emission trucks;
  - ➔ Incentivises the use of less polluting vehicles.

To be considered for implementation:

- Considerable cost for the technical implementation;
- Framework conditions (*e.g.* overall economic efficiency of road and rail transport, reliability, simplicity of transport procedures);
- Effect: the German government estimated that the introduction of a road-user charge for trucks would lead to a 6 % shift from road freight transport to alternative modes (McKinnon *et al.,* 2010).

Responsible actor: Ministries of transport

Providing grants for integrated logistics centres

Integrated logistics centres — also known as “Freight Village” — enable goods movement between two or more forms of freight transport, most often between road and rail. These centres have easy and quick access to highway or railway terminals, which attracts industries and trade companies to settle near the freight village. Thereby, vehicle kilometres and CO_2 emissions are reduced. Furthermore, goods are consolidated in the logistics centre, which increases the transport efficiency and leads to additional CO_2 mitigation (IEA, 2001). Besides promoting eco-friendly transport, logistics centres reduce local air and noise pollution, reduces road traffic volume and increases a region’s competitiveness.

How it works and intended effects:

- Enables easy transfer between different modes;
  - ➔ Supports a shift to more efficient modes.
- Facilitates the consolidation of goods;
  - ➔ Reduces the amount of trips.

To be considered for implementation:

- Intermodal logistics centres often require some start-up investments (*e.g.* capital subsidy for private freight village operators) and political support;
- Logistics centres can be profitable in operation especially if they provide additional services (*e.g.* warehousing, repacking, labelling).

Responsible actor: Ministries of finance and taxation

Developing a national freight logistic platform

A national freight logistic platform helps lower emissions and increase fuel efficiency in freight transport. Such a platform can trigger and support voluntary emission reduction among the freight transport industry. It brings together shippers, carriers and other transport related organisations. For instance, the US SmartWay programme combines several approaches to reduce emissions in freight transport:

- It provides information about new vehicle technologies and their potential to reduce emissions and to save fuel.
- The programme provides financial incentives to purchase fuel-saving or emission reduction technologies.
- A tool enables carriers to calculate the fuel economy and emission rates of their fleet and the platform enables them to publish the results.
- Shippers can easily choose the carrier based on its environmental performance.
- Shippers can use a special tool to quantify emission reduction potential of reduced miles and weight of their freight transport or of switching modes.
- The participating companies are rated based on their fuel efficiency and environmental performance.

The shippers and carriers participating in the programme benefit from fuel savings and they derive a market advantage from improving their environmental performance due to the high visibility of the SmartWay brand (USEPA, 2011).

How it works and intended effects:

- Supports a better organisation of freight transport;
  ➔ Reduces the freight transport activity.
- Assesses the environmental performance of different transport options;
  ➔ Encourages a shift to efficient modes.
- Promotes the use of emission reduction technologies;
  ➔ Reduces the emissions per vehicle kilometre.

To be considered for implementation:

- Typically, the platform is well accepted by the freight industry;
- To be successful the platform needs sufficient institutional capacity to serve all participating companies;
- Participating companies of the US SmartWay platform reported that they saved USD 6.1 billion of fuel costs, cut their CO_2 emissions by 16.5 million tonnes and additionally reduced emissions in nitrogen oxides and particulate matter;
- The UK Freight best practice programme was very cost-effective at GBP 8 (≈USD 12) of public funds per tonne of CO_2 saved.

Responsible actor: Environmental ministries

GHG mitigation effect and co-benefits

The CO_2 emissions produced by road transport and combined road/rail transport on 19 European routes were compared by IRU and BGL (2002). The study found that emission savings of more than 50 % are possible on certain routes if freight is shifted to rail for part of the course. However, the emission performance of the combined road/rail route varies largely between the courses. In Europe, the railway networks are electrified, thus the electricity mix determines the emission reduction potential. In countries where most of the electricity comes from fossil-fuel power stations, the emission reduction potential by intermodal rail/road transport is rather low. Furthermore, the load factor and train length determine the emission reduction potential. Nevertheless, the study showed that, on 13 of the 19 investigated European routes, an emission reduction of at least 20 % could be achieved by combined road/rail transport compared to solely road transport.

A similar study investigated the best combination of different transport modes for freight transport between Bangkok and Hat Yai in Thailand (Hanaoka *et al.*, 2011). The aim of the study was to find an optimal intermodality to minimise energy consumption, transport time and shipment charge. It was found that the best result could be achieved if the share of truck-only transport is reduced from 95 % to 45 % and intermodal-rail and intermodal-waterway transport make up for 11 % and 44 % respectively. A 25 % reduction in energy consumption could be achieved compared to the current situation.

Proper freight management including a shift to efficient modes for freight transport can realise several co-benefits:

- Reduced road infrastructure maintenance costs[1];
- Decrease in air pollution (especially a reduction in particulate matter from diesel engines)[2];
- Reduction in noise pollution;
- Less fatal accidents[3];
- Less land consumption for road infrastructure;
- Reduced transport costs for companies;
- Reduction in external costs of rail freight transport compared to truck transport (Forkenbrock, 2001).

[1] Heavy duty vehicles cause great wear and tear on the road surface due to the heavy axle weights (McKinnon *et al.,* 2010).

[2] A study in Switzerland estimated that the external health costs of air pollution caused by heavy vehicles amount to EUR 260 million (≈USD 330 million). The damages to buildings (*e.g.* due to soiling of the fronts) amount to EUR 220 million (≈USD 280 million) (Balmer, 2003).

[3] Heavy duty vehicles (HDV) are more frequently involved in fatal accidents than cars. In 18 % of the accidents with HDV involvement people were killed or seriously injured. (McKinnon *et al*, 2010).

Towards implementation

The measure targets logistics companies, carriers and shippers who can improve their transport management and vehicle fleet. Furthermore, logistics platforms that include certification schemes for good environmental performance of carriers and shippers intend to encourage all companies to improve their freight transport concept.

Key stakeholders

- National ministries of transport:
  Responsible for the national road infrastructure and the highway system; can implement a national charge on road use for heavy duty vehicles;
- National ministries of finance and taxation:
  Responsible for the allocation of financial resources, can provide funding for intermodal freight logistics centers; furthermore, responsible for vehicle taxation and can implement distance-based vehicle fees;
- National ministries of environment:
  Hold the information about emission factors, environmental performance and technological advances; can provide guidance for the freight transport industry by initiating a national freight logistic platform.

Table 2: Potential barriers to implementation and countermeasures

Barriers	Options to overcome
Lack of financial resources to invest in intermodal logistics centres and rail infrastructure	■ Combine with revenue generating measures (*e.g.* road pricing) and earmark the generated resources for railway and intermodal improvements;
Inflexible and incompatible railway infrastructure	■ Harmonise rail systems across regions and countries to create an interoperable rail network; ■ Increase competition in railway transport (consider privatisation of the railway network);
Lack of knowledge and financial resources for the technical implementation of road charges	■ Implement heavy vehicle road pricing as public-private partnership (PPP) (such as the German road pricing system for trucks);
Strong opposition from the industry against road pricing	■ Combine road pricing with improvements in other modes of transport and intermodal centres; ■ Strong political leadership; ■ Highlight that, in case of large amounts of international transit transport, foreign trucks benefit from the national infrastructure at the expense of the national budget.

Success factors

- Provide sufficient rail infrastructure capacity and intermodal logistics centres (in countries like Germany one bottleneck for rail freight transport is the limited availability of intermodal facilities and the lack of railway capacities);
- Ensure that the electricity for the rail network is produced mainly from low-carbon energy sources (*e.g.* renewable energy);
- Encourage intermodal logistics companies to combine different transport modes and offer a package solution to their customers;
- Ensure easy and quick access to freight logistics centres;
- Inform consumers about freight transport emissions and available certificates or labels so that companies that use low-carbon logistics obtain a market advantage.

Practical example: Switzerland's Heavy Vehicle Fee (HVF)

In 2001, Switzerland introduced a distance-based heavy vehicle fee (HVF) on the whole road network. The Swiss Ministry of Environment, Transport, Energy and Communication was in charge of the political implementation, whereas the Ministry of Finance was responsible for the technical realisation. In 2002, the net proceeds of the HVF amounted to approximately EUR 500 million (≈USD 640 million). The annual implementation costs, including research, construction, operation and personal, are about 8 % of the gross revenue. Most of the remaining revenues are used for railway projects and improvements in the freight traffic management.

The HVF replaced a lump sum charge on road use, which depended only on the weight class of the vehicle. The new HVF was introduced stepwise. In 2001, a fee of 1 ct/tkm was charged and by 2005 the fee was increased to 1.6 ct/tkm. The fee is imposed on all (domestic and foreign) heavy goods vehicles above 3.5 tonnes. The charge is calculated based on the vehicle weight, the kilometres driven on Swiss roads and the vehicle's emission category. In addition to the introduction of the HVF, the weight limit for trucks was increased from 28 tonnes to 40 tonnes. The HVF and the increase in vehicle weight limit led to a slight reduction in the number of vehicles and the distances travelled by trucks decreased by 6 %. No shift from road to rail transport was observed, since the economic advantage of rail transport was outweighed by the increase in the weight limit for trucks. Furthermore, Switzerland has already one of the highest shares of rail in goods transport. However, further shifts from road to rail are expected under higher fees. The HVF improved the efficiency of road transport in Switzerland mainly by encouraging better organisation, higher vehicle utilisation and an improved fleet composition. All in all, it was estimated that the HVF and the altered weight limit led to an emission reduction of 30 % compared to the old road charge (Balmer, 2003).

Delft, Netherlands – Photo by Jonathan Gómez, 2010

Further reading

- **Balmer U. (2003)** '*Practice and Experience with Implementing Transport Pricing Reform in heavy goods transport in Switzerland*' Implementing Pricing Policies in Transport: Phasing and Packaging, Brussels, 13th – 14th May 2003.
- **Bjorner, T. B. (1999)** '*Environmental benefits from better freight transport management: freight traffic in a VAR model*' Transportation Research Part D, vol. 4, pp. 45–64.
- **Forkenbrock, D.J. (2001)** '*Comparison of external costs of rail and truck freight transportation*' Transportation Research Part A, vol. 35, pp. 321–337.
- **Hanaoka, S., Husnain, T., Kawasaki, T. and Kundahamraks, P. (2011)** '*Measurement of energy-saving effect by intermodal freight transport in Thailand*' World Review of Intermodal Transportation Research, vol. 3, no. 4, pp. 320–337.
- **IEA (2009)** '*Transport Energy and CO_2 – Moving toward sustainability*', International Energy Agency (IEA), Paris.
- **IRU and BGL (2002)** '*Comparative analysis of energy consumption and CO_2 emissions of road transport and combined transport road/rail*', International Road Transport Union (IRU) and Bundesverband Gueterkraftverkehr Logistik (BGL). Available at: http://www.iru.org/cms-filesystem-action?file=PPP/en_Comparative-study-CO2.pdf accessed 4 October 2011.
- **McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds)** (2010) '*Green Logistics – Improving the environmental sustainability of logistics*', Kogan Page, London.
- **USEPA (2011)** '*SmartWay*', United States Environmental Protection Agency (USEPA). Available at: http://www.epa.gov/smartway/index.htm, accessed 4 October 2011.

Contact

E transfer@giz.de
I http://www.TRANSferProject.org

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Editor:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

P. O. Box 5180
65726 ESCHBORN / GERMANY
T +49-6196-79-0
F +49-6196-79-801115
E transport@giz.de
I http://www.giz.de