



# Freight Vehicle Policy

Annex A of the Handbook 'Navigating Transport NAMAs'

TRANSfer Project – Towards climate-friendly transport technologies and measures

## The concept

The energy intensity of trucks is a function of the vehicles' fuel efficiency and their load (see Factsheet 'Freight Master Planning'). In Europe, the fuel economy of trucks has been improved significantly before 1990, but regulations for air pollutants (nitrogen oxides and particulate matter) hampered efficiency improvements in the last 20 years (some instruments to reduce emissions in air pollutants led to increases in fuel consumption (Dünnebeil and Lambrecht, 2011)). Nevertheless, many technologies that offer fuel economy improvements, such as advanced design of the engine and vehicle chassis, have already been developed and tested. A wide diffusion of these technology provides a huge potential to reduce the fuel consumption of trucks and thus to mitigate CO<sub>2</sub> emissions from freight transport (IEA, 2009).

Similar to passenger cars vehicle fuel economy standards, differentiated vehicle taxes, scrappage programmes or vehicle labelling can push a diffusion of fuel efficient trucks. However, benchmarking and regulating the fuel economy of trucks is rather difficult. Trucks have often specialised designs as they have to fulfill a variety of functions. Moreover, engine, chassis and trailers are manufactured by different companies. Recently, governments

### Elements of a freight vehicle policy:

- Implement fuel economy standards for trucks;
- Scrappage programmes for trucks;
- Support fuel efficient retrofits;
- Introduce eco-driving programmes for commercial vehicles;

*For more details on the elements' characteristics see Box 1.*

tried to improve the fuel efficiency of trucks by implementing vehicle standards and by improving information for freight operators (IEA, 2009).

Besides vehicle and engine technology, the driving style contributes substantially to the fuel consumption per truck-kilometre. Eco-driving training for transport companies can reduce their energy consumption and offer CO<sub>2</sub> mitigation potential. Since fuel costs constitute a large proportion of transport costs, companies have an interest in improving the fuel efficiency of their vehicle fleet.

Table 1: GHG reduction matrix of a freight vehicle policy

	Avoid	Shift	Improve
<b>Direct effects</b>			<input checked="" type="checkbox"/> Reduces the fuel consumption and GHG emissions per vehicle kilometre
<b>Indirect effects</b>			<input checked="" type="checkbox"/> Supports R&D for energy-efficient truck technologies
<b>Rebound effect</b>	<input checked="" type="checkbox"/> Fuel economy improvements lead to reduced cost of vehicle use and can lead to an increase in transport activity		
<b>Complementary measures</b> <i>(to achieve full mitigation potential)</i>	<input checked="" type="checkbox"/> Freight master planning (see Factsheet 'Freight Master Planning')	<input checked="" type="checkbox"/> Sustainable fuel pricing (see Factsheet 'Sustainable Fuel Pricing') <input checked="" type="checkbox"/> Freight master planning (see Factsheet 'Freight Master Planning')	<input checked="" type="checkbox"/> Decreasing the carbon intensity of fuels (see Factsheet 'Decreasing the Carbon Intensity of Fuels') <input checked="" type="checkbox"/> Alternative fuels (see Factsheet 'Alternative Fuels')

On behalf of

The maximum truck weight is another important factor influencing the GHG emissions from truck transport. A 40-tonne trail truck needs twice the fuel per vehicle kilometre as a small truck with a vehicle weight of 12 tonnes, but fully loaded the larger truck needs three times less energy per tonne-kilometre. In Germany, the use of primarily 40-tonne trailer trucks has reduced the fuel efficiency of freight transport (Dünnebeil and Lambrecht, 2011). Currently, several countries discuss the introduction

of larger trucks of up to 60 tonnes. Besides safety concerns and barriers with regard to the road infrastructure, a widespread introduction of such trucks can even have negative effects on the overall transport emissions as they can induce a shift from rail and water-borne transport (IEA, 2009).

Besides lowering the fuel consumption per vehicle kilometre, alternative fuels (see Factsheet 'Alternative Fuels') can also improve the environmental performance of freight transport vehicles.

### Box 1: Possible elements of a freight vehicle policy

#### Implement fuel economy standards for trucks

The fuel efficiency of new trucks varies considerably (5 % to 15 %) between different manufactures, even if they produce the same type of vehicle for similar purposes (IEA, 2009). Until now, in most countries the incentives for vehicle manufactures to improve the fuel economy of trucks are little.

Japan was the first country that implemented fuel economy standards for heavy-duty vehicles. Based on the "Top-Runner Program" that regulates the fuel efficiency of light-duty vehicles since 1999 (see Factsheet 'Promotion of Energy Efficient Vehicles'), a fuel efficiency standard for heavy-duty vehicles was implemented in 2006. The standard is differentiated according to vehicle weight categories and requires manufacturers to increase the fuel efficiency of new trucks by 12 % compared to 2002 efficiency levels till 2015 (IEA, 2009). To meet the challenge of designing a standard that satisfy the variety of vehicle types, fuel consumption is obtained from a computer simulation model based on driving cycles.

#### How it works and intended effects:

- Increases the fuel economy of new trucks;
- Promotes rapid technology uptake;
  - ➔ Reduces GHG emission per truck-kilometre of new vehicles.

#### To be considered for implementation:

- The instrument is cost neutral;
- The fuel economy test procedure for trucks need to reflect the variety of vehicle types;
- Vehicle manufacturers need some time to apply new technologies and adapt their vehicle design;
- Timescale for the effect depends on the fleet turnover rate (trucks usually have a relative long life span).

*Responsible actor:* Environmental ministries

#### Scrappage programmes for trucks

Trucks have a long life span, which hampers the fleet turnover towards more fuel efficient vehicles resulting from continuous technological and design improvements. Furthermore, the average fuel efficiency of trucks declines as they get older (IEA, 2009)

Especially in developing countries, where many vehicles are imported when they are already five to ten years and are retired much later than in developed countries, an increase in the truck turnover rate can enhance the fuel efficiency of the national truck fleet. A scrappage programme provides financial incentives to truck owners if they replace their old vehicle with a newer, more fuel-efficient one.

The emission effect of a scrappage scheme depends on (ESMAP, 2002):

- The emission levels of the vehicles scrapped and of the replacement vehicles;
- The residual life of the vehicles scrapped;
- The annual vehicle kilometres travelled by the replacement vehicles.

#### How it works and intended effects:

- Increases the truck turnover rate;
  - ➔ The average fuel efficiency of the national truck fleet is increased.

#### To be considered for implementation:

- Fuel efficiency improvements of new trucks were low over the past 20 years (e.g. in Germany new trucks gained only about 6 % fuel efficiency in the last 15 years);
- Ideally, the scrappage incentive is based on the actual fuel consumption or GHG emissions of the vehicles scrapped;
- Fuel economy standards can ensure that scrappage programmes succeed in mitigating GHG emissions.



**Support fuel efficient retrofits**

In addition to vehicle and engine improvements for new trucks, retrofit technologies are available that can improve the fuel efficiency of the existing fleet. Examples of retrofit technologies are:

- Low friction engine lubricants
- Low rolling resistance tyres
- Aerodynamic improvements (e.g. side skirts, gap fairings)
- Auxiliary power units
- Automatic tyre inflation systems

Most of the single fuel economy measures can achieve fuel savings between 1 and 10%. So a set of small improvements can lead to significant fuel savings. However, the effects are not cumulative. Some measures reinforce each other, whereas others are counteracting (McKinnon *et al.*, 2010; IEA, 2009).

Many of the retrofit technologies are not implemented either because they are not observed by the market or because freight operators lack the resources to retrofit vehicles. Even though most retrofit technologies pay back within a few years, small companies require shorter payback periods (IEA, 2009). The government can support retrofitting of trucks by providing information about available technologies, their fuel economy improvement potential and payback periods. Furthermore, governments can offer tax exemptions for energy saving devices.

**How it works and intended effects:**

- Encourages carriers to purchase fuel efficient retrofitting technologies;
  - ➔ Increases the fuel efficiency of the existing truck fleet.

**To be considered for implementation:**

- Low-cost opportunity for fuel efficiency improvements in trucking;
- Effects can be realised within a short timeframe;
- The public costs are low;
- The success of the measure depends largely on the willingness of vehicle fleet owners and vehicle retailers to invest in fuel saving improvements.

*Responsible actor:* Ministries of transport, Ministries of economics and technology

**Introduce eco-driving programmes for commercial vehicles**

The driving style plays a crucial role in a vehicle's fuel efficiency (McKinnon *et al.*, 2010). In eco-driving trainings, the drivers learn to optimise their gear changing, to maintain steady and efficient speeds, to avoid rapid acceleration and deceleration as well as to reduce unnecessary vehicle weights. Especially for frequent drivers such as professional truck drivers and public transport drivers, eco-driving training pays off. In some countries truck simulators are used to train drivers of heavy-duty vehicles (IEA, 2009).

On average, eco-driving programmes reduce the fuel consumption by 5 to 15%. However, these short-term effects decline over time if there is no support beyond the initial training, as drivers tend to change their driving style back. With further feedback, fuel savings of about 10% can be sustained (IEA, 2009).

The national government can promote eco-driving by tailored campaigns and information. Furthermore, they can develop partnership programmes with fleet operators and fund eco-driving trainings. In addition, national governments can integrate eco-driving into driving school curricula and driving tests for commercial vehicles.

Eco-driving is not only useful for truck operators, but also for private drivers or engine drivers.

**How it works and intended effects:**

- Awareness of fuel-saving styles of driving is raised;
- Drivers are trained to reduce their fuel consumption;
  - ➔ Increases the fuel efficiency of vehicle operation of both old and new vehicles;
  - ➔ Reduces emissions per vehicle kilometre.

**To be considered for implementation:**

- Participation and own initiatives from fleet operators likely, since they can benefit from cost savings of fuel efficient vehicle operation;
- The costs of eco-driving programmes are rather low, but significant emission reduction effects can be achieved;
- Driving training has an immediate effect on the fuel consumption and the whole vehicle fleet can be addressed.

*Responsible actor:* Transport ministries

**GHG mitigation effect and co-benefits**

The IEA (2009) estimates that the efficiency of road and rail freight transport can be improved by 20% till 2050. Cooper *et al.*, (2009) investigated several energy efficient truck technologies. With moderate rolling resistance improvements (resistance reduction from 0.0068 to 0.0055) fuel consumption and CO<sub>2</sub> emissions of a 3.5 tonne truck are reduced by 6%. Additional fuel savings (8%) can be realised by moderate aerodynamic improvements (reduction in the coefficient of drag from 0.63 to 0.50). More advanced rolling resistance and drag reductions can even lead to CO<sub>2</sub> reductions of 10.6%.

Several studies investigated the effect of training in eco-driving. It was found that its GHG emissions reduction potential is very high if the policy is successfully implemented and the drivers maintain the improvements in driving style over time.

In 2004, the first effects of a Dutch eco-driving programme were evaluated. The programme ‘Het Nieuwe Rijden’ run between 1999 and 2010 and addressed individual drivers, professional drivers and fleet owners. Different types of actions were carried out to achieve efficiency improvements in vehicle operation: *e.g.* subsidised eco-driving training courses, communication and promotion campaigns, integration of eco-driving in the driving school curricula and financial incentives for fuel saving in-car devices. Between 1999 and 2004, the programme reduced that total fuel consumption of road transport in the Netherlands by 0.3 to 0.8% and led to overall emission reductions of 0.1 to 0.2 million tonnes of CO<sub>2</sub>. However, the emission reduction effect remained behind the target of CO<sub>2</sub> emission reductions in the range of 0.4 million tonnes till 2005.

The programme cost the government, including the tax rebates on in-car fuel saving devices, between EUR 66 (≈USD 80) and EUR 99 (≈USD 125) per tonne of CO<sub>2</sub> emission reduction. If the tax reductions are excluded, the cost effectiveness ranged between EUR 9 (≈USD 11) and EUR 20 (≈USD 14) per tonne of CO<sub>2</sub>. The end-user even had an economic benefit from the programme. Annual fuel cost savings of EUR 46 – 106 million

(≈USD 58 – 134 million) were achieved, so that the cost-efficiency for the end-user varied between EUR 210 – 418 (≈USD 266 – 530) per tonne of CO<sub>2</sub> (Harmsen *et al.*, 2007).

Freight vehicle policy can realise several co-benefits:

- Economic benefits (in particular fuel cost savings);
- Reduced air pollution (*i.e.* particulate matter and nitrogen oxides) from road transport;
- Less traffic accidents due to the promotion of anticipatory driving in eco-driving trainings.

**Towards implementation**

The measure targets vehicle fleet owners, carries and individual freight vehicle drivers. They can realise emission savings by altering or adapting their vehicle fleet or by improving the individual driving behaviour. Furthermore, truck manufactures are encouraged to invest in research and development to increase the fuel efficiency of new trucks.

**Key stakeholders**

- National environmental ministry: Responsible for the introduction of fuel economy standards for trucks, but might need to cooperate with the ministry of transport or the ministry of economics and technology to develop suitable test procedures for trucks;
- National ministries of finance and taxation: Can design and implement scrappage programmes for trucks as the ministry is responsible for the allocation of financial resources needed for such a program;
- National ministries of transport: Can implement programmes to reduce the fuel consumption in transport through improved driving styles; Have the necessary knowledge to assess technical and design improvements for freight vehicles and can carry out information and advertising campaigns to promote retrofitting of trucks;
- National ministries of economics and technology: Can support further research in freight vehicle technology and provide information about new technologies.

**Table 2: Potential barriers to implementation and countermeasures**

Barriers	Options to overcome
Difficulties to develop test procedures to assess the fuel economy of different truck types	<ul style="list-style-type: none"> <li>■ Follow the model of existing standards and test procedures;</li> <li>■ Cooperate with research institutes.</li> </ul>
Difficulty to reach truck fleet owners with governmental campaigns	<ul style="list-style-type: none"> <li>■ Cooperate with automobile clubs, industry associations and consumer organisations (IEA, 2009).</li> </ul>
Fleet operators do not maintain the benefits of eco-driving	<ul style="list-style-type: none"> <li>■ Incentivise fleet operators to introduce and maintain eco-driving by increasing the fuel costs (<i>e.g.</i> high fuel prices, fuel taxation). Long-run savings usually exceed the costs of encouraging and tracking eco-driving (IEA, 2009).</li> </ul>
Lack of institutional capacity to evaluate fuel saving devices	<ul style="list-style-type: none"> <li>■ Cooperate with research institutions and non-governmental organisations.</li> </ul>

### Success factors

Success factors for increasing the fuel efficiency in freight transport:

- Long-term information for vehicle manufactures;
- Proper enforcement of fuel economy standards for trucks;
- Communicate the advantages of eco-driving (financial benefits, increased comfort and safety);
- Maintain awareness of eco-driving through continuous information and incentive schemes;
- Evaluate the effects of fuel-saving devices carefully and publish the results.

### Practical example: Chile's truck scrappage programme 'Cambia tu Camión'

In 2009, the Chilean government launched a truck scrappage programme called 'Cambia tu Camión' ('Change your truck'). The programme aimed to remove 500 trucks that were over 25 years old, which represented 4.5 % of the trucks on the road that



Shenzen, China – Photo by Christoph Hertel, 2007

exceed this age. 230 of these trucks were to be scrapped in 2009 and the remaining 270 in 2010 (Zarchy, 2009).

It was expected that the first stage of the programme carried out in 2009 would lead to a CO<sub>2</sub> emission mitigation in the range of 10 000 tonnes per year. Furthermore, it was expected that particulate matter would be reduced by 12 tonnes per year and nitrogen oxides by 131 tonnes per year (AChEE, 2010).

The financial incentive for scrappage varied between USD 7 200 and USD 21 700 depending on the size of the truck. In total, the government set USD 7.3 million aside for the programme (Zarchy, 2009).

### Further reading

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