Labelling – A Path Towards Energy Efficiency in Freight Transport?

Nikolaus Fries, ETH Zurich – IVT

Conference paper STRC 2007

STRC

7th Swiss Transport Research Conference
Monte Verità / Ascona, September 12. – 14. 2007

Labelling – A Path Towards Energy Efficiency in Freight Transport?

Nikolaus Fries
ETH Zurich
Institute for Transport
Planning and Systems

Phone: 044 633 31 09
Fax: 044 633 10 57
email: fries@ivt.baug.ethz.ch

September 2007

Abstract

This paper presents an innovative research approach for improving sustainability of the freight transport chain. The research proposes to actively sensitise shippers to environmental concerns by introducing a new energy efficiency label in transport logistics. This label would be given to transport solutions that meet certain environmental and energy efficiency criteria. Today, shippers' transport mode decision is based mostly on quality and cost criteria, rather than on environmental impacts. The energy efficiency label would allow shippers to more easily consider environmental impacts in their choice of a specific transport mode and thus to meet the consumers' demand to assure environmental friendliness throughout the entire life-cycle of the product.

The research consists of four main steps. First, a shipper survey will be completed to evaluate the relevant factors in a shippers' transport mode choice decision. The goal is to determine, what positive impact the proposed label could have on encouraging shippers to consider the environment in their transport mode choice decisions. Second, a framework for the labelling scheme will be proposed and environmental certification criteria will be developed for various specific label categories. Third, case studies of freight shipments will be drawn from the shipper survey to be benchmarked with the certification criteria and classified according to the labelling scheme.

This research picks up an innovative approach currently discussed among forwarders. The results will directly contribute to higher energy efficiency in the freight transport sector and, at the same time, will provide important new information on development of the emerging market for sustainable freight transport.

Keywords

Freight transportation, Eco-labelling, Energy efficiency, SP survey

1. Introduction

In recent years, freight traffic around the world has seen a constant growth, which was more or less proportional to the EU's GDP. Since GDP and freight transport demand have not yet been successfully decoupled, this trend is expected to continue for at least another 20 years. A recently published report expects German freight transport's operational performance to even double until 2050 [PROGTRANS 2007].

Growing transport volumes and distances imply increasing energy consumption and environmental impact of freight transport. In order to reverse this trend, i.e. to reduce greenhouse gas emissions and to raise energy efficiency in transport, the European Commission explicitly promotes in its 2006 Action Plan for Energy Efficiency a consequent development towards a more efficient use of each transport mode [EU 2006a].

It is clear that political action will be needed to help bring about more efficient transport, but discussions go on about the best instruments and policies for achieving this goal. This paper describes one potential instrument, an environmental labelling concept for freight transportation. Labelling represents an innovative "soft" steering instrument, i.e. by just providing information on energy consumption and environmental impact the rules of the free market remain untouched.

The paper begins with an introduction to the problem of freight transportation's environmental impact in Europe followed by an overview of different steering instruments available to tackle the environmental problem of freight transport. The paper's third part describes the idea and concept of an environmental label for freight transportation. The fourth part presents the methodology used to benchmark freight transport chains and to evaluate the potential of an environmental label to increase energy efficiency and reduce environmental impacts of freight transport. The final section presents conclusions and recommendations for future research.

2. Energy Consumption and CO_2-emissions of Freight Transport in Europe

The transport sector accounts for 30% of today's total EU energy consumption [EU 2006b] and has become the largest emitter of greenhouse gases (responsible for about 21 % of the EU 15's total volume [EEA 2007]). The continuous growth of GHG emissions (increase of 51 % between 1990 and 2003 [EEA 2007]) has not ended, and an increasing discrepancy can be observed between transport and other key sectors that show a decreasing trend. The data for Switzerland shows a similar situation with 32 % of the total energy consumption in 2005 consumed by the transport sector. Transport's share of GHG emissions (29% of total emissions in 2005) is slightly higher than in the EU 15 [BAFU 2007].

In Switzerland road freight transport is responsible for about 20 % of the 15.6 Mio t of CO_2 emitted by the transport sector in 2004, while the sum of rail (freight plus passenger) and waterway transport add up to not more than 1.4 % of transport's total CO_2-emissions [BFS 2007]. Since the averaged environmental efficiency of rail and waterway freight transport (2.9 and 3.5 kg CO_2 per 100 ton-kilometres (tkm) respectively) is significantly higher than the one of road freight transport (between 7.8 and 9.6 kg CO_2 per 100 tkm [DB 2007]), a modal shift off the road would help to limit further growth of GHG emissions in the transport sector. The 20% of emissions caused by roadway freight provides a good target for implementing policy measures designed to reduce overall reductions, although measures affecting passenger transport by private cars will also be necessary.

3. Steering Instruments for Reducing Environmental Impacts

The general legal framework in most European countries allows governments to implement a wide range of steering instruments to support the achievement of public goals, such as the reduction of GHG emissions. Steering instruments can be categorized from “soft” to “hard” according to their regulative impact on the market as follows [FAHRNI 2007]:

- Information and labelling;
- Operational directives (e.g. environmental management systems);
- Economic instruments (subsidies, prepaid financing fees, incentive taxes);
- Limits (e.g. for emissions);
- Bans.

A ban is a very hard steering instrument, because it means a restriction of free trade. Although it is simple to communicate and to execute, a ban may cause conflicts with international trade laws, especially if it is not harmonized on an international level. Therefore its application must be clearly justified, e.g. by a risk of severe health damage. Concerning harmful substances, in Switzerland bans have come into force for substances depleting the stratospheric ozone layer (i.e. CFCs) and (with few exceptions) for cadmium in plastics.

Limits are not as restrictive as bans but reduce the possible field of application for affected products. They are used to avoid damage to endangered objects or goods, such as air, water or soil. As against bans, limits do not directly influence certain products or processes but rather affect their impacts and emissions. They are therefore less likely to get into conflict with trade laws.

Economic steering instruments comprise subsidies, prepaid financing fees and incentive taxes. Subsidies are an effective measure for an initial support of newly developed technologies that show promise for achieving a certain goal but yet cannot compete in the free market. An example can be a new bogie able to significantly reduce noise emissions of rail cars. However, subsidies do not follow the polluter pays principle and may lead to a distortion of competition if not eliminated at the right moment.

In contrast to subsidies, prepaid financing fees (e.g. for waste disposal or recycling) follow the polluter pays principle. However, they are difficult to apply unless the levying is possible through a limited number of manufacturers. At any rate, the levying process requires a considerable effort for control and administration.

Similar problems arise in the case of incentive taxes, but they are a flexible and easy to implement instrument for encouraging e.g. the consumption of certain products. Incentive taxes may be useful, if bans or limits are not possible to implement.

In contrast to the described groups of steering instruments, operational directives and labelling systems are instruments to be implemented voluntarily by the specific target groups. The successful introduction of an environmental management system for example leads to a certification of the company according to the respective standard (e.g. ISO 14001). Compared to labelling systems, operational directives often demand that the certified companies follow rather strict guidelines, which may lead to reduced economic freedom of action and often imply strong financial efforts for implementation and certification procedures.

Labelling systems as a means to provide additional information to the consumer are the least restrictive steering instrument, since no direct consequences arise from buying and consuming a labelled product. Unlike all other instruments a labelling system influences only the demand without changing the offer (i.e. the product itself). Consumers' demand is affected by providing additional information on specific issues that are often not considered by the purchaser (e.g. the environmental impact of a product or process). The advantage is that the rules of the free market remain untouched and distortion of competition is avoided. However, since it is an entirely voluntary instrument, a labelling system risks to not leading to the intended goal or at least not within the required period of time. In such cases, its combination with other instruments (e.g. an economic steering instrument) can be an effective solution.

4. Eco-Labelling in Freight Transport

The idea for an environmental label on freight transport chains has arisen based on interviews with logistics experts. They state that in several cases environmental concerns are considered in the process of freight transport planning. For certain companies this is even a core issue throughout the entire value creation chain. So far no systematic information is available on what impact environmental issues have on transport mode choice in freight transport planning. Therefore, a labelling system is being tested to measure the actual impact of such issues and to evaluate whether this instrument can be an effective means to support the modal shift towards more environmentally efficient transport modes.

4.1 Experiences with Current Labelling Systems

The question arises, whether eco-labels are really an appropriate response to today's environmental problems. According to MORRIS 1997, the most commonly used arguments in favour of labelling systems are the following:

- Since consumers are not actively gathering environmental information about products, a recognizable and reliable label can help to fill this gap;
- Labels can improve the image (and thus the sales margins) of producers and encourage them to account for their production's environmental impact;
- Eco-labels help to raise consumers' awareness of environmental issues and problems.

However, several studies [ERSKINE ET AL. 1996], [MORRIS 1997], [ZARILLI ET AL. 1997] have identified a number of drawbacks of labelling systems. These include: the risk of lacking objectivity and the arbitrariness in determining and updating the certification criteria, the lack of estimated demand for certified products, and the shortness of the label's validity period before its revision, which is especially problematic for capital-intensive industries, such as transport.

What do we know so far about the demand for eco-labelled products? GALLASTEGUI 2002 states, that "unfortunately it is still not clear what are the main characteristics determining 'green' consumerism […because…] environmental consciousness does not necessarily affect purchasing behaviour directly." A number of exogenous factors affecting consumer-awareness, as identified by HEMMELSKAMP ET AL. 1997, are: consumer satisfaction (environmentally friendly products must meet consumers' basic criteria, such as price, performance, quality), social values (these may result in behaviour influencing environmental impact), reliable identification of the product, cost, and availability.

Experiences from established labelling systems in the transport sector are scarce. A study recently published by PETERS ET AL. 2006 at the ETH Zurich reveals the impact of the Swiss energy efficiency label ("Energieetikette") on car purchasing behaviour. The study, based on a broad consumer survey, concludes that the label has had no significant influence on the buyer's decision to choose a particular model, although they tend to appreciate additional information on the label and are generally willing to accept measures to reduce CO_2-emissions. Among the measures proposed for reducing emissions, bonus-penalty-systems are much wider accepted than higher fuel prices.

In the EU the directive 1999/94/EC on the availability of consumer information on fuel economy and CO_2-emissions in respect of the marketing of new passenger cars was adopted in 1999. This directive requires clearly displaying information to customers relating to the fuel economy and CO_2-emissions of new passenger cars offered for sale or lease in the EU. Based on these requirements seven member states (Austria, Belgium, Denmark, the Netherlands, Portugal, Spain and the UK) have introduced a label with a rating system to display the information in a way that is easier to understand than simple numerical values. A study carried out by the German automobile club ADAC [ADAC 2005] has analysed the effectiveness of the EU directive on the development of energy efficiency and CO_2-reductions in each member state. The principal findings are that environmental criteria generally do not belong to the most relevant criteria for the selection of a new passenger car – a statement that matches the Swiss results of PETERS ET AL. 2006. Furthermore the report concludes that it is not possible to assess the effectiveness of the directive's provisions by analysing the actual development of the member states' CO_2-emissions. Even if in certain states, significant reductions were realised one year after the implementation of the directive, no general trend can be identified proving that the reductions were actually caused by the directive.

In this context the German Aerospace Centre has delivered a report on the 2003 review of the commitment of car manufacturers to reduce CO_2-emissions [DLR 2004] focussing on the reasons for the reductions achieved between 1995 and 2003. The authors underline that the main causes are technical improvements, especially advanced combustion technologies for diesel engines. Also among the non-technical influences political measures (e.g. taxes) have more impact on car buyers' decisions than just additional environmental information. Nevertheless the ADAC report underlines that the combination of information and financial measures can help to significantly reduce CO_2-emissions. This argument bases on the detailed analysis of the energy efficiency labelling systems in Denmark and the Netherlands, where tax incentives (in the Netherlands) and motor tax (in Denmark) respectively were directly coupled with the label categories (i.e. lower tax levels for vehicles ranked in higher label categories). Even after the elimination of the Dutch tax incentive measure (due to budgetary reasons) the market share of vehicles ranked in higher categories remained higher than before the introduction of the label. A reason may be that car buyers made positive (financial or qualitative) experiences with their new model bought during the tax incentive period and thus stuck to the same model when buying the next car.

A review of national experience and impacts of fuel-economy labels in the USA, Sweden and South Korea can be found in WAHNSCHAFFT ET AL. 2001. They state, that, driven by yearly readjusted energy efficiency standards (CAFE), in the USA the average fuel efficiency of cars has risen from 18.7 miles per gallon (mpg) in 1978 to 26.3 mpg in 1985. GREENE 1998 calculated the total fuel savings during that period to some 55 billion gallons, equal to roughly US$ 70 billion (at a 1995 level of the US$). In Sweden, however, a fuel economy information program had no significant effect on car buyers' decisions. Reasons may be, that a large fraction is enjoying company car benefits or that buyers decide strongly based on habit, thus tending to stick to the same model they have. The Korean results are somewhat contradictory, because, according to the results of an empirical survey [KAMA 1999], more than 70% of the potential car buyers consider fuel efficiency an important criteria for car choice, while statistics show, that between 1992 and 1998 average fuel efficiency levels have not increased significantly.

However, it must be underlined that these results concern labels for the information of end-consumers of passenger cars. The proposed label will not be communicated to end-consumers but is a means of information and certification between companies in the freight transport and logistics sector (i.e. logistics service providers and shippers). Transport mode decision-making processes of companies follow not the same rules as the one of individuals.

4.2 Label Design and Area of Application

There are three basic types of labels [MORRIS 1997]: Type 1 labels indicate a product's environmental impact and are meant to promote more environmentally friendly consumption behaviour. These voluntary labels are normally government supported and are subject to third party certification programs. Products, but also production processes are certified including the entire life cycle. Examples are the EU eco-label or the German label "Blauer Engel". Type 2 labels consist of un-certified environmental claims made by manufacturers, importers or distributors that refer to special product attributes, such as "CFC-free". Type 3 labels use pre-set indices and provide quantified, independently verified product information. According to Markandya (1997), in [ZARILLI ET AL. 1997], this label type is rarely found in the environmental field due to a lack of experience.

Type 1 labels (commonly referred to as "eco-labels") can be further characterized by the following attributes [UNCTAD 1994]:

- The labels' implementation is voluntary and controlled by third party supervisors;
- The certification includes the environmental impact of the product together with its entire life-cycle;
- External experts determine product categories and certification criteria, which have to be publicly available;
- After successful certification the label may be used for a fixed period of time only.

The proposed label can be classified as a Type 1 labelling system. The product certified in this case is the process of freight transportation of a certain shipment from origin to destination. Certification of the entire life cycle of a transport process means that not only the environmental impact and energy consumption of the proper process of moving the shipment but also the underlying processes (such as fuel or electricity production, vehicle and infrastructure construction and maintenance etc.) are considered.

The label design is adapted from the existing Swiss energy label "Energieetikette" which has so far been implemented in the private car, household appliances and lighting sectors. The label comprises seven categories (A-G) with category D in this case corresponding to the average environmental impact of all freight transport processes in Switzerland (interior, import/export and transit) with at least 50 km transport distance. The categories can be flexibly adjusted to meet the goal of the seventh part of all certified transport solutions to be ranked in category A (best value). This will guarantee that the entire bandwidth of the label will be used and that potential for further increase in environmental efficiency will exist at any time. For calculating the correct category for each transport solution, the method of "ecological scarcity" will be used as described in section 5.3.

As mentioned above, the proposed label is not an end-consumer label, i.e. it will not be visible on any final product. The label will be given to any land transport process offered by a transport logistics provider to a consigner. According to literature (e.g. [BOLIS ET AL. 1999], [VELLAY ET AL. 2003]) shippers' most important criteria in transport mode choice are quality (especially reliability/punctuality) and price. Note that differences exist between the individual criteria included in the quality aspect, such as transport time, reliability, frequency and flexibility. In this context an eco-label will help the shipper to additionally consider environmental aspects of freight transportation. An effective way to establish this label would be to directly integrate it into existing product labelling systems (such as the EU eco-label for household appliances as defined by the "Energy Labelling Directive" 92/75/EC) thereby putting more weight on freight transport's environmental impact in a product's life cycle. By this means both, manufacturers and consumers, can profit from an eco-label on freight transportation: the manufacturer (in his role as a shipper) gains cost-free additional information on a market where product (i.e. transport mode) choice is strongly driven by habit; the consumer of the labelled product profits from a higher expressiveness of the label.

The labelling system's geographic area of application is – in a first step – limited to transports (at least partly) on Swiss territory with the option to later extend it to other European countries. Considered are all commercial freight transports excluding mail and parcel services with a minimum shipment volume of 5t over a minimum distance of 50 km between origin and destination using road (light and heavy duty vehicles), rail, barge or some kind of intermodal transport. Transports may be interior (in Switzerland) or border crossing connections (import/export/transit).

The lower boundaries for transport volume and distance were set, because we assume that for transports over less than 50 km no real alternative exists to road transport. This assumption is based on the Swiss transport statistic according to which 98 % of the volume of all local transports (max. 20 km distance) is shipped by truck and van respectively. For transports between 20 and 80 km road transport still has a share of 91%.

4.3 Combination with other Steering Instruments

The example of the EU directive 1999/94/EC has demonstrated that labelling systems as stand-alone measures based on information and certification bear the risk of not bringing the expected effect (e.g. of a transport mode shift off the road) [ADAC 2005]. It may therefore be advisable to test a combination of the labelling system together with a bonus-penalty-system as introduced successfully in the USA in 1975 (CAFE standard together with a mandatory fuel economy label) [WAHNSCHAFFT ET AL. 2001] or in the Netherlands (from 2002 to 2003). Taking the label design as described above, the idea is to apply a reallocation mechanism depending on the label categories, i.e. to give a financial bonus to all transport solutions ranked in the label categories A-C, where A-labelled transports would get a higher bonus than C-labelled ones. In return transports ranked in categories E-G would be imposed a fee, which would be used to finance the bonus payments.

Such a combined system would have a direct impact on the actual transport price paid by the shipper. Low-cost transport solutions with a bad environmental efficiency would now become more expensive, while prices for more environmentally friendly transports with higher production costs would actually decrease. The planned values of the bonus and penalty payments have been derived from the US tax credit system for heavy-duty hybrid vehicles [ACEEE 2007] and are listed in table 1. Relative values are used that refer to the incremental price of the specific transport. The incremental price is defined as the difference between the actual price per ton-kilometre (tkm) and the average price per tkm of all transports of the respective commodity group multiplied by the transport's tkm.

Table 1 Values for the Bonus-Penalty-System

Label Category	Credit (as % of incremental transport price)
A	+40
B	+30
C	+20
D	-
E	-20
F	-30
G	-40

5. Approach for an Environmental Benchmark of Freight Transport Chains

5.1 Review on Environmental Impacts of Freight Transportation

A great deal of research has already been completed on environmental efficiency in freight transport with respect to the impact of single transport modes. A report of the EU project PACT (Pilot Actions for Combined Transport) [UIRR 2003] contains a list of research projects on energy consumption and CO_2-emissions in freight transport and their main results.

FH PFORZHEIM ET AL. 1999 developed a guideline to help German companies integrate transport environmental impact into their environmental business plans. Using the TREMOD model calculated CO_2-emissions were 147.3 g/tkm for road (average truck size) and 32.2 g/tkm for rail traffic (emission ratio 1:4.5).

IFEU ET AL. 2002 compared CO_2-emissions of intermodal and road transport using a number of typical and currently served European connections plus one fictive and one short distance connection. Energy production and pre-and-post-haulage were included in the calculation. The energy consumption of each transport mode was determined using input data such as the transport route, usage of train capacity, pre-and-post-haulage distances, transport units in use etc. The main influencing factors are train capacity usage, shipment weight, pre-and-post-haulage distance and the country-specific energy mix. In six cases emissions were more or less equal for road and intermodal transport. On seven connections emissions from intermodal transport were between 50 and 80% of road transport emissions and less than 50% on six other connections.

The PACT project conducted several case studies. In order to determine the CO_2-reduction potential, the study first evaluated the total energy consumption of each case for road-only and intermodal transport, from which CO_2-emissions were then derived. By comparing the emissions of both transport modes the annual CO_2-saving potential was calculated. The results gave a saving potential per kilometre of 23% (rolling motorway) to 60% for unaccompanied intermodal transport compared to road-only transport.

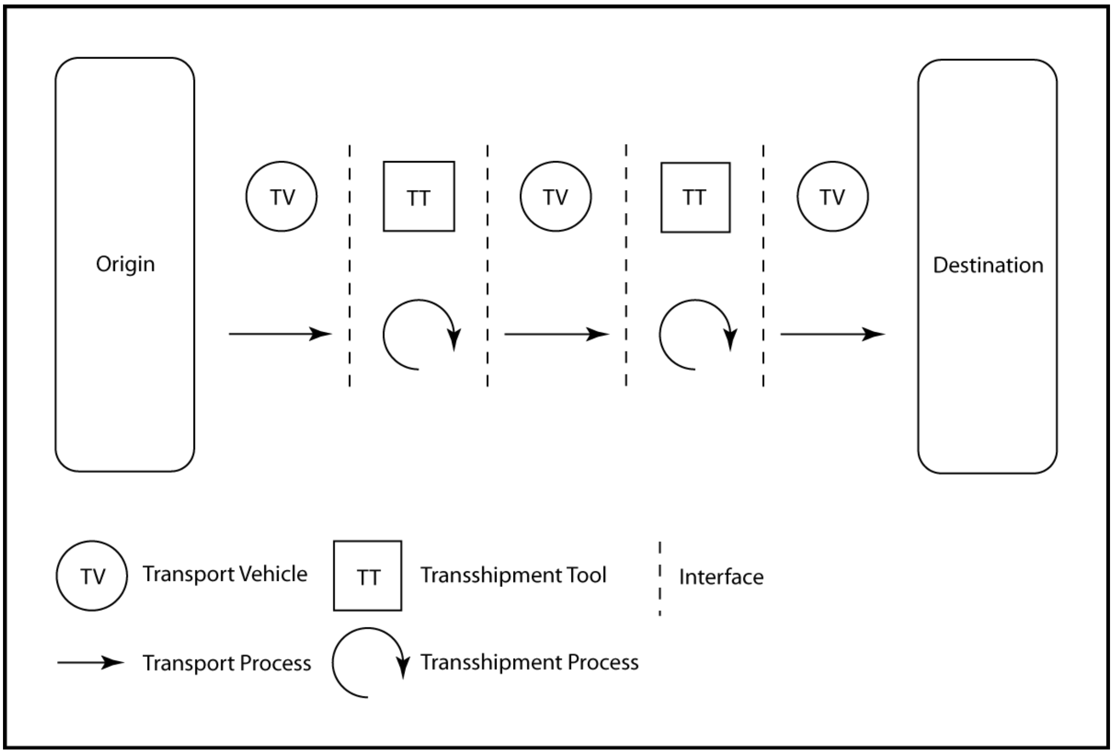
These results demonstrate that there is a significant potential for increasing environmental efficiency by shifting transport volumes from road to rail (or barge). However, an important precondition is the efficient use of rail transport, because the environmental competitive advantage strongly depends on train capacity usage and rail operators' internal production processes.

5.2 The Functional Transport Chain Model

Compared with results presented in literature the environmental efficiency of each transport mode may strongly differ as the case arises. It is therefore necessary to create a more detailed benchmarking system able to analyze specific transport solutions depending on origin and destination, on route choice as well as on shipment size. The results of the environmental benchmark will help to classify the analyzed transport in the described labelling system.

A microscopic modelling approach has been chosen to analyze each transport chain in detail. The functional representation of a transport chain is illustrated in Figure 1.

Figure 1 Functional Representation of the Transport Chain



Source: adapted from SVINARSKI 2005

Each transport chain can be described as a connection between origin and destination, which is established by a variable number of intermediate processes (i.e. transport and transshipment processes). The number of intermediate processes depends on the organization of the transport chain. We differ between monomodal and intermodal transport chains, where monomodal chains may be operated using direct door-to-door services or services via intermediate hubs (e.g. railway shunting yards or distribution centres for road transport). Transshipment processes can therefore take place either between units of the same transport mode or between units of different modes.

In this case the functional model is used to split a transport chain in its different components and thus to benchmark each component separately before aggregating the single results to derive a benchmark value for the whole transport chain. Against the background of transshipment processes having a considerable impact on the overall environmental efficiency, this approach allows differing more precisely between monomodal door-to-door and intermodal transport. By modelling the single processes separately it will furthermore be possible to clearly identify those processes that are responsible for an unfavourable benchmark result and thus to derive improvement measures.

5.3 The Method of Ecological Scarcity

For benchmarking the single processes of a freight transport chain the method of "ecological scarcity" [BRAND ET AL. 1998] was chosen. This method allows the weighting of environmental impacts of products, processes or entire organizations. For application input data is required in the form of an inventory. The method's output (i.e. the resulting environmental impact) is presented in a quantitative form using the unit of eco-points ("Umweltbelastungspunkte" – UBP).

The goal of the method is an optimization in terms of national and international environmental goals ("distance-to-target method"). As in any ecological impact assessment method the damage potential (not the actual damage) of the object to be analyzed is weighted. The application of the artificial unit of eco-points allows cumulating the single emission sources to an aggregated value of environmental impact thus enabling the user to directly compare the impact of e.g. road and rail freight transport.

For the actual benchmark so called "eco-factors" are calculated for each impact. This factor, which is a measure for the ecological damage potential of a certain impact source, is defined as follows [BRAND ET AL. 1998]:

$$\text{Eco-factor} = 1\ EP / F_K * F / F_K * c \qquad (1)$$

with EP "eco-point"

F current annual flow of an impact source

F_K critical annual flow of emissions in a given region

c 10^{12} / year (conversion factor)

This formula first weights a certain emission relative to the critical flow of this emission (as defined by environmental goals) and second weights this result with the relation between current total flow and critical flow. Thus for each emission (e.g. CO_2) a preset normalized "eco-factor" is used for the benchmark.

The method considers substances with a high ecological relevance. The substances are measured at the transition point between nature and anthroposphere. On the one hand the ingoing resources (i.e. primary energy) and on the other emissions in the air, ground/ground water and surface waters are considered by calculating specific "eco-factors" for each substance. The critical flows are determined based on scientifically profound and politically binding environmental goals (i.e. in most cases legitimate immissions boundaries). In other words the "eco-factors" represent the political and legal rating of the ecological relevance of the single pollutants.

In this project the necessary inventory data will be taken from the "Ecoinvent" database, which provides detailed information on road and rail freight transport processes including all subordinated processes (e.g. production of fuel and electric energy). Data on (intermodal) transshipment processes are currently not available. Therefore further research will be necessary to model this separate process of the transport chain.

The method of ecological scarcity was chosen, because it is a well-established and generally applicable method that meets most aspects of the general requirements for impact assessment methods as defined by the Society of Environmental Toxicology and Chemistry (SETAC) [UDO DE HAES 1996]. The method's field of application is not limited to industrial products or processes but also allows the analysis of services (e.g. in the sector of transport logistics). A further advantage is that the method is currently being updated including a review of all "eco-factors" and expected to be ready for application by the end of 2007 [FRISCHKNECHT ET AL. 2006].

6. Setup of the SP-Survey

In order to analyze the applicants' reaction to the proposed labelling system and to estimate its effectiveness as a steering instrument, a survey among shippers and logistic service providers (i.e. freight forwarders) has been designed. Using case studies, the goal of this survey is to test what impact the additional label information has on transport mode choice compared to price and quality criteria.

6.1 Survey Methodology

Stated Preference (SP) surveys are often used to determine demand elasticities. An advantage of the SP technique, compared to conventional methods, is that it allows data to be collected from both real and hypothetical situations. The basic SP approach is to present interviewees with a choice of alternatives in several different situations and allow them to choose their preferred alternatives.

In this research the Stated Choice method (a special specification of the SP method) will be applied. Using this method the person answering the questionnaire (mostly the companies' manager responsible for logistics) must make a decision out of a number of alternatives presented to him.

The persons to be interviewed must be higher-level representatives of a company's transport logistics department and must have the competence to make transport mode decisions. Thus (in case of shippers) only such firms can be considered that have not outsourced their transport logistics management but are directly responsible for transport chain organization. If this is not the case, the adjacent logistic service provider must be interviewed instead. Given the complexity of the experiment (the decision process in freight transport mode choice depends on several parameters and assumptions) we decided to conduct telephone interviews supported by an online questionnaire rather than to send written questionnaires to shippers and logistic service providers to be completed independently.

6.2 Survey Design

The Stated Choice experiments are based on real-life transport cases. The interviewee will be asked to describe two typical transports his or her company is carrying out regularly. These transports must be full load shipments of at least 5t on a single point-to-point connection with a total distance of 50 km or higher (compare section 4.2).

Based on the results of literature review (e.g. [BOLIS ET AL. 1999], [VELLAY ET AL. 2003]), the following criteria were identified that are relevant for mode choice in freight transport (Note that the weighting between each of them may differ significantly as the case arises.):

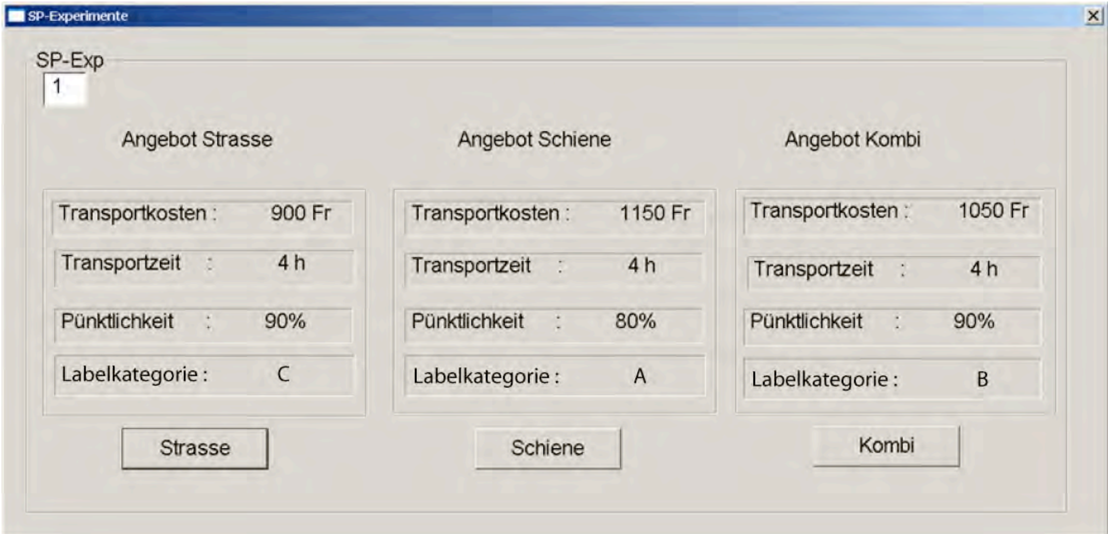
- Price;
- Reliability/punctuality;
- Transport time;
- Temporal flexibility;
- Frequency of service;
- Additional services (packaging, commissioning etc.);
- Safety and security.

In order not to overstrain the interviewee and thus to avoid tampered results, the number of variables should be limited to four or five representative variables. We decided to use the three (generally) most important criteria (i.e. price, transport time and punctuality) plus the label variable, where transport time is defined as the pure transit time without loading and unloading at the origin and destination point. Punctuality is understood as the share of shipments arriving within a given time slot as preset by the consignee. Furthermore, the option to choose an adaptive design for the experiments was abandoned due to the expected complexity of model estimation and to the focus of this research, i.e. to test the impact of the label information on transport mode choice in relation to the three most important "conventional" criteria. If the interviewee considers a single variable as irrelevant for his example, he is expected to neglect it in his choice thus also indirectly providing valuable information on this variable.

The same can be said about the choice of transport modes. Because of certain preconditions (such as infrastructure availability), the interviewee will not always be able to choose between all three modes (road, rail and intermodal transport). However, the choice will remain fix for all experiments to also model inflexibilities of the market: in cases where the shipper is dependent on a certain transport mode he will show no reaction to changing values of any variable. This is necessary information for estimating the effectiveness of the labelling system.

The experiments are composed of a number of different transport offers. These offers (one for each mode) are described by different values of the four variables (see above). In each experiment the interviewee must decide, which offer (i.e. which transport mode) he considers most appropriate for the given transport case (see Figure 2).

Figure 2 Example of a Stated Choice Experiment



The number of necessary experiments per transport case depends on the number of variables (per transport mode) and the number of values they may take. In this case the total number of variables equals to 12 (3 transport modes multiplied by 4 variables per mode). In order to limit the number of possible combinations, we decided to set the number of values one variable can take to three. Still the resulting number of possible combinations is 3^{12} = 531,441. This clearly exceeds the maximum number of experiments. Therefore, a so-called "fractional, factorial design" will be constructed with the goal to find the optimal number of combinations so that the complete design is represented as well as possible. An important aspect during this procedure is to make sure that the values of the single variables are uncorrelated.

The variables' possible values must be realistic and their range must be large enough to cover all (also in the future) possible scenarios. They were calculated as a relative deviation of the actual value stated by the interviewee (price and transport time) and of the benchmark result respectively for the label category. The punctuality values were preset as listed in Table 2.

Table 2 Possible Values of the Variables

Variable	Value 1	Value 2	Value 3
Transport price road	As-is	-10%	+50%
Transport price rail and intermodal	As-is	-20%	+20%
Transport time road	As-is	-10%	+30%
Transport time rail and intermodal	As-is	-15%	+30%
Punctuality (all modes)	80%	90%	98%

After a first run the experiments will be repeated with the same transport case but different values for the transport prices due to the integration of the bonus-penalty-system described in section 4.3. This will allow directly comparing the differences in the interviewee's choice compared to the original setup of the experiment with the label as a pure information element.

The bonus payments and penalties respectively as listed in table 1 will not be shown explicitly in the experiment but integrated in the price element thus resulting in a higher or lower transport price compared to the original value. If we take the example of a shipment of 5 tons to be transported over a distance of 200 km and assume that the solution using road transport costs 300 € and gets a label class "C", then the resulting price would be reduced by 20% of the incremental price (e.g. with an average price of 0.10 €/tkm the resulting price would be 300 € - 0.23 €/tkm * 0.2 * 1000 tkm = 254 €). The advantage of this integrated design is that the experiments remain simple for the interviewee and easy to handle when evaluating the results.

7. Conclusion and Further Research

The project described in this paper is still in progress. We decided to conduct 90 interviews with two transport cases per interview thus achieving a total sample size of 180. First results are expected by early 2008. So far experiences from a pilot survey have been quite encouraging. Depending on the kind of commodity shipped certain interviewees (most of them belong the food industry sector) stated explicitly that environmental concerns would play an active role in transport mode choice decisions. The main reason seems to be the question of a green image to be presented to the end-consumer: a tendency supporting the labelling approach of this project. Furthermore, representatives of the bulk commodity sector mentioned environmental concerns due to the high volumes to be transported over rather long distances. In this market area rail transport with its ecological and productivity advantages can clearly play to its strength.

The results from the detailed survey will show further details and allow a more differentiating analysis of the specific commodity groups. Furthermore, the comparison between the labelling system as a pure source of information and its combination with the proposed bonus-penalty-system is expected to produce interesting results for evaluating the effectiveness of the labelling system as a steering instrument.

Detailed research is still necessary on the detailed environmental benchmark of freight transport chains. An important point of discussion are the system boundaries, i.e. where exactly to cut off the consideration of freight transport's indirect impact on the environment. Also noise is a subject not to be neglected in the context of any transportation activity even though so far there exists no commonly accepted methodology for its integration in life cycle impact analysis [BRAND ET AL. 1998].

8. References

ACEEE 2007 American Council for an Energy-Efficient Economy: Tax Credits for Heavy-Duty Hybrids. http://www.aceee.org/transportation/hdhybtaxcred.htm; 2007

ADAC 2005 ADAC e.V.: Study on the effectiveness of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2-emissions in respect of the marketing of new passenger cars. Final Report to the European Commission, Directorat-General for Environment; Munich; March 2005

BAFU 2007 Bundesamt für Umwelt; Switzerland's Greenhouse Gas Inventory 1990-2005; National Inventory Report 2007; Bern; April 13, 2007

BFS 2007 Bundesamt für Statistik; Mobilität und Verkehr – Taschenstatistik 2007; Neuchâtel; 2007

BOLIS ET AL. 1999 S. Bolis and R. Maggi: Modelling the Transport and Logistics Choice of a Shipper. Materials of NRP 41, Volume M8; Bern; 1999

BRAND ET AL. 1998 G. Brand, A. Braunschweig, A. Scheidegger and O. Schwank: Bewertung in Ökobilanzen mit der Methode der ökologischen Knappheit – Ökofaktoren 1997. BUWAL Schriftenreihe Umwelt Nr. 279; Bern; 1998

DB 2007 Deutsche Bahn AG; Wettbewerbsbericht 2007; Berlin; 2007

DLR 2004 DLR – German Aerospace Centre, Institute of Transport Research: Preparation of the 2003 review of the commitment of car manufacturers to reduce CO_2-emissions from M1 vehicles - Final report of Task A: Identifying and assessing the reasons for the CO_2-reductions achieved between 1995 and 2003. Report to the European Commission, Directorate-General for Environment; Berlin; December 2004

EEA 2007 European Environment Agency: Transport and environment: on the way to a new common transport policy. EEA Report No. 1/2007; Copenhagen; 2007

ERSKINE ET AL. 1996 C. Erskine and L. Collins; Eco-Labelling in the EU: a comparative study of the pulp and paper industry in the UK and Sweden. European Environment (**6**), p. 40-47; 1996

EU 2006a European Commission: Action Plan for Energy Efficiency: Realising the Potential. Communication from the Commission; Brussels; 2006

EU 2006b European Commission: Mid-term review of the European Commission's 2001 Transport White Paper; Brussels; 2006

FAHRNI 2007 H. P. Fahrni: Protection of the Environment – Legal Instruments and their impact. Federal Office for the Environment (BAFU); Lecture Notes ETH Zurich; January, 2007

FH PFORZHEIM ET AL. 1999 FH Pforzheim et al.: Anleitung zur betrieblichen Erfassung verkehrsbedingter Umwelteinwirkungen: Ein Leitfaden erstellt im Auftrag des Umweltbundesamtes Berlin. Pforzheim; 1999

FRISCHKNECHT ET AL. 2006 R. Frischknecht, R. Steiner, A. Braunschweig, N. Egli and G. Hildesheimer: Swiss Ecological Scarcity Method: The New Version 2006. ESU-services; 2006

GALLASTEGUI 2002 I. G. Gallastegui: The use of eco-labels: a review of the literature. European Environment (**12**), p. 316-331; 2002

GREENE 1998 D. L. Greene: Why CAFE worked. Energy Policy (**26**), no. 8, p. 595-613; 1998

HEMMELSKAMP ET AL. 1997 J. Hemmelskamp and K. L. Brockmann: Environmental Labels: the German "Blue Angel". Futures (**29**) , no. 1, p. 67-76; 1997

IFEU ET AL. 2002 IFEU et al.: Comparative Analysis of Energy Consumption and CO_2-Emissions of Road Transport and Combined Transport Road/Rail. Final Report; 2002

KAMA 1999 Korea Automobile Manufacturers Association: Consumer Attitude Survey on Automobiles. Seoul; 1999

MORRIS 1997 J. Morris: Green Goods? Consumers, Product Labels and The Environment. Studies on the Environment (**8**); IEA; 1997

PETERS ET AL. 2006 A. Peters, P. de Haan and M. Müller: Akzeptanz und Wirkung von Massnahmen zur Erhöhung der Treibstoffeffizienz. Ergebnisbericht im Rahmen des Projekts "Entscheidungsfaktoren beim Kauf treibstoff-effizienter Neuwagen"; Berichte zum Schweizer Autokaufverhalten Nr. 12; ETH Zürich; 2006

PROGTRANS 2007 ProgTrans: Abschätzung der langfristigen Entwicklung des Güterverkehrs in Deutschland bis 2050. Studie im Auftrag des Bundesministeriums für Verkehr, Bau und Stadtentwicklung; Basel; May 31, 2007

SVINARSKI 2005 B. Svinarski: Bewertung see- und landgestützter Transportketten im Ostseeraum – Wirtschaftliche und umweltbezogene Aspekte. Hamburg; 2005

UDO DE HAES 1996 H. A. Udo de Haes (ed.): Towards a Methodology for Life Cycle Impact Assessment. SETAC; Brussels; 1996

UIRR 2003 UIRR: Combined Transport CO_2-Reduction. PACT Program; Brussels; 2003

UNCTAD 1994 UNCTAD Secretariat: Eco-Labelling and Market Opportunities for Environmentally Friendly Products. International Cooperation on Eco-Labelling and Eco-Certification Programmes and Market Opportunities for Environmentally Friendly Products; 1994

VELLAY ET AL. 2003 C. Vellay and G. de Jong: Analyse conjointe SP/RP du choix du mode de transport de marchandises dans la région Nord-Pas-de-Calais. 2003

WAHNSCHAFFT ET AL. 2001 R. Wahnschafft and K. Huh: Effective implementation of fuel-economy labelling for passenger cars: experiences from the USA, Sweden and Republic of Korea. 2001

ZARILLI ET AL. 1997 S. Zarrilli, V. Jha and R. Vossenaar (eds.); Eco-Labelling and International Trade. Macmillan; 1997