

POLICY MEASURES TO ACHIEVE GREEN CORRIDORS AND GREEN FREIGHT TRANSPORTS

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ABSTRACT

Creating “Green Corridors” is one measure taken by the EU as a step to form a more sustainable freight transport sector. There are only a limited number on incentives implemented today to steer the freight transport sector towards sustainability. The findings from the implementation of economic incentives in Europe, i.e., CO₂-tax and road user charging are encouraging and are important steps towards achieving a substantial change towards sustainability but it is not likely that this will be enough to reduce the emissions of CO₂ in absolute measures from the freight transport sector. A combination of positive incentives, agreements, taxes and regulations are needed or to make a green corridor attractive enough for the actors in transport sector. The authorities need to harmonise rules and regulations along the corridor and remove bureaucracy and infrastructural bottlenecks. The most efficient policies that they can implement are measures that ensure the punctuality and accessibility in the corridor. In return must the transport actors use a significantly better environmental technology level in the corridors than is used today. They must also work together to increase the load factor in the system by increasing the transparency and offering free capacity to other actors in the corridor. The scope of this article is to identify and develop concepts for regulatory frameworks and efficient policy measures and incentives for realizing a successful implementation of a Green Corridor.

Keywords: sustainable, freight transport, policies, economic incentives, green corridor

BACKGROUND

Governmental intervention in the freight transport sector is not a new phenomenon. McKinnon (2010) describes the historical development of policy measures and regulations in the freight transport industry with the statement that over the last thirty years most of the quantitative regulations that were established to control the supply of freight transport capacity have been removed. It has been replaced by qualitative controls designed to maintain operating standards and professionalism in the freight industry. Now when the interest for environmental issues has increased governments see policy measures as a means to curb this development.

“It is ironic that while liberalization measures have been facilitating the growth of freight movement, governments have been intensifying their efforts to reduce the impact of freight movement on the environment.”
(McKinnon, 2010, p 342)

Establishing “Green Corridors” is one of the efforts that are made by some of the EU member states to reduce the impact of freight movements on the environment. In the EWTC II Green Corridors Manual - draft Definition (Tetraplan, 2011, p 2) is the following definition of a green corridor used:

“Green corridors deliver transport solutions that are more economically, ecologically & socially viable than other (non-green) corridors. The transports within the corridors are efficient, and when possible the optimum transport mode is used. Hence a large proportion of the goods transported within the corridors often are international or other long distance transport, through intermodal transports, with use of freight trains, inland waterways, modular road trains, trucks using alternative fuels, trucks with the best Euronorm, or other efficient and more environmentally-friendly transport modes between the transshipment points. At the trans-shipment points, the goods will be shifted to local trucks in an efficient manner in regard to time and costs, to be distributed to the receivers.”

The transport corridor between Vilnius-Esbjerg via Klaipeda/Kaliningrad, and the Blekinge and Öresund regions in Sweden is an important link between east and west in the Baltic Sea Region. Private stakeholders, authorities and universities have taken a joint initiative to strengthen the corridor. The project “East-West Transnational Transport Corridor” (EWTC) aims to strengthen the corridor through a wide range of activities dealing e.g. with development of an overall strategy for the corridor, infrastructure improvements, intelligent transport solutions, new solutions for business and logistics and strengthened transport research co-operation (Hultén et al., 2006). The importance of using policy measures and other regulatory measures and incentives to promote the realisation of a “Green Corridor” was stated early in the EWTC project. The present knowledge has been compiled and an

analytical study has been carried out within the EWTC project (EWTC, 2012) with the aim of pointing out the most crucial policy measures and incentives that are needed to make a Green Corridor a successful concept, attractive to all actors in the transport industry and a step in the right direction towards a sustainable transport system.

The scope of his article is to identify and develop concepts for regulatory frameworks and efficient policy measures and incentives for realizing a successful implementation of a Green Corridor.

METHODOLOGY

Multiple sources of evidence are used in this study. A search for research findings from basically positivistic principles has been made in a literature review and in interviews with experts. This has been combined with a qualitative search for evidence in a process of iterative stakeholder involvements. The importance of combining positivistic research findings with qualitative measures like stakeholder expertise and experience for understanding complex problems is highlighted in Schwanen et al. (2011) where the authors argue that a successful development of new technologies requires that they become integrated in relevant industries and markets, match regulations, rules and standards and to fit with existing social norms and beliefs. Thus, the practitioners' expertise, not only from the transport industry but also from authorities, is important for a successful implementation of a new concept like a green corridor.

The initial literature search was performed using Google Scholar and the Summon as search tools. Summon gives access to more than 145 million resources including, e.g., TRID, SAE Digital Library, Technology Research Database.

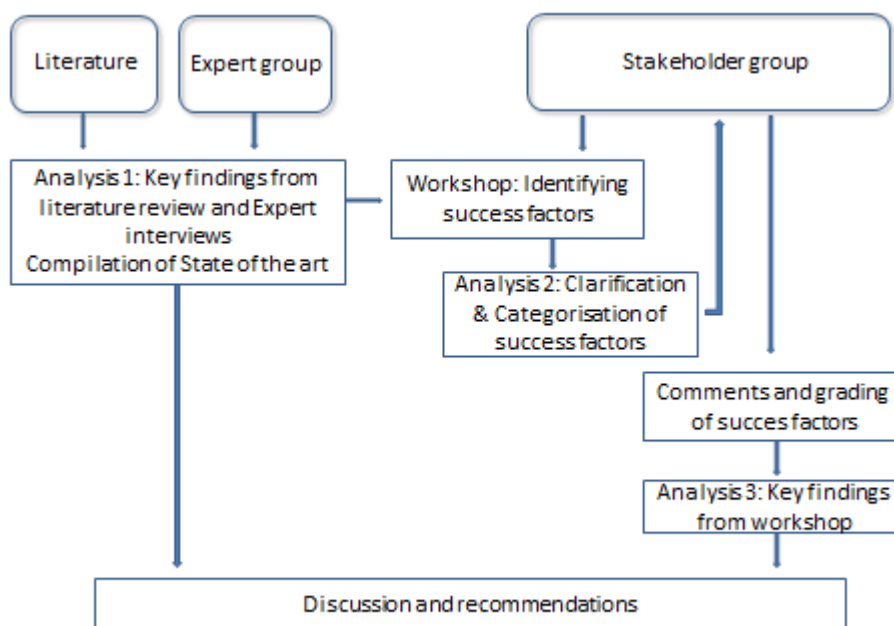


Figure 1 - The research process

In parallel to the literature study an interview with 5 experts in the area of transport policy research was conducted in order to ensure that the present knowledge base and the state-of-the-art of the research field, as well as relevant references, ongoing projects and initiatives in the area, was covered. Although the answers from the interviewed experts were coherent, the answers have been compiled and are shown anonymously.

The results from the literature review and the interviews were compiled and used as input to a workshop with a stakeholder group of 20 participants from 5 countries in the Baltic region representing the transport industry, authorities and academy. The workshop was inspired by the “Backcasting” methodology (Holmberg & Robèrt, 2000). As forecasting is the process of predicting the future based on current trend analysis, backcasting starts with defining a desirable future and then works backwards to identify policies and programs that will connect the future to the present. The workshop participants were asked to imagine that we all meet in 25 years from now to celebrate the great success that the green corridor concept has turned out to be. The reason for this approach is to release the participants at the workshop from the narrowing factors of what is seem possible to achieve in the present situation, with the present political- and economic situation and just think out beyond their personal concepts and ideas on what is reasonable and just discuss what needs to be done! The stakeholder group were asked to identify:

- Which are the success factors?
- What activities have led to these success factors?

All success factors, concepts and ideas that were identified and agreed on by the participants at the workshop were later further analysed, merged together and categorised by the workshop process leaders into a compiled list of success factors and activities for creating a successful implementation of a green corridor. The compiled and categorised results were sent back to the stakeholder group for comments and they were also asked to grade the factors importance for a successful implementation of a green corridor on a scale from 1-6 where 1 means “not important at all” and 6 means “of highest importance”. 7 replies, representing 10 of the participants, came in. The findings from the workshop and the graded success factors was then analysed together with the findings from the literature review and interviews and constitute the basis for the results of this study.

ANALYSIS

Key findings from the literature review

There are only a limited number on economic incentives implemented to steer the freight transport sector towards sustainability. Several trials have been made especially in the city distribution sector where more than 100 projects have been carried out with the aim of trying to increase the load rate and reduce the traffic in the cities. With single exceptions from cities with sensitive historical city centres or cities with extreme congestion situations, none of these has been successful. The projects have not been implemented after the pilot tests are over and the separate project funds are used (Lindholm, 2008). One of the most important reasons for this is a lack of strong business models, that the positive incentives offered by

the authorities were not enough profitable for the involved companies to change their products or services in a long-term perspective.

For long distance freight transport, distance-related vehicle charges have been implemented in five of the EU member states and in Switzerland. The implemented incentives have shown some effects on the logistic strategies and distribution patterns in the freight transport sector. Reductions of vehicle kilometre in the range of 5-10% are reported (Liechti & Renshaw, 2007) and simulations show that a modal shift from road to rail up to 13% reduced vehicle kilometre road transport can be expected in Sweden (Cardebring & Lundin, 2007), but the potential is very much dependent on the price of road transport. The effects on emissions of CO₂ are dependent on how the electricity is produced. In Switzerland, that basically have hydropower, corresponds the reduction of 5-10% vehicle kilometre to a reduction of 6-8% of CO₂ and NO_x. A combination of Road User Charges and CO₂ taxes can in Sweden, with about 95% fossil free electricity production, mean a total estimated potential of CO₂ savings to 10-15% (Lundin, 2007).

The transport sector is not very sensitive to increased fuel prices, so incentives like CO₂ taxes have not shown to be effective to reduce transport activities. Most transport companies have contracts that allow them to increase the price of their services if the fuel price increases. McKinnon (1998) show that the price on fuel must be about 7-8 times higher than today before we can see a significant change in centralisation strategies. This indicates that the freight transport system is very robust and that we can't expect a drastic change in the demand on transport services due to a single measure like CO₂-tax or distance related vehicle charges.

On the other hand, CO₂ based taxes are very efficient on the passenger transport sector. As an example from a simulation of the effects on the Swedish transport system, it is reported that the total CO₂ emissions from the transport sector will decrease with 11% with the introduction of a set of policy measures in the so called EET- plan (Efficient Energy- and Transport systems) where increased fuel price (about 50% higher) and higher CO₂-based vehicle taxes on passenger cars (increased to 2,8 €/gram CO₂ on vehicles over 120 g/km) and Road User Charges for heavy vehicles (0,8€/vkm) are the dominant measures. While the emissions from the passenger transport sector will decrease with 34% in this scenario the emissions from the freight transport sector will instead increase about 40%, due to the increased demand on transport. Without the plan the total CO₂ emissions would increase with 11% 2006-2020. A Road User Charge alone will according to this simulation decrease the demand on road freight transport from 23% to 20% counting in vehicle kilometer. Thus without the RUCs would the increase in CO₂ emissions be even higher (National Road Administration, 2009).

The same study shows that investments in infrastructure as a mean to reduce CO₂ emissions have limited effects. For the whole transport sector will the decrease of CO₂ be about 0,15 % and for the freight sector about 2% while the CO₂ reduction for the whole EET plan is 11%.

The present trend in Europe is that the time-based Vignette road user charge is on its way to be discarded for a distance-based RUC. This means that several countries within the present Euro vignette system will probably leave the cooperation (Forss, 2011). Zurba (2011, page 4) states that:

“On the authority level of the EU countries, it is necessary to prepare the required legal, economic and direct regulatory mechanisms for the implementation of the EU transport policy legislation. It is very important to know how these mechanisms for the implementation of the sustainability principle and orientation of the green transport corridor are or will be implemented.”

As the author points out, there will be winners and also those who lose on the implementation of different regulation mechanisms and policy incentives. It is important to try to foresee who these are and predict what effect it might have on the market and on the different actors. If this work is done properly there is a possibility to ease the negative effect for those actors who will see their market position threatened and give them time to change and adapt to the new market situation that will come. It is crucial to get acceptance for these environmentally induced incentives and to avoid contra productive lobby activities to prolong the necessary change towards sustainability.

There are several examples in the literature on how to structure and categorize policy measures for the transport sector (McKinnon, 2010) (IEA, 2009) (OECD/ITF, 2010), (Dorherty & Hoyle, 2009) (Helmreich, 2010) (CIVITAS, 2010). Based on the results from the literature review the policies and incentives relevant for the freight transport sector, and green corridors in particular, has been summarised and categorized in four different groups:

Table 1. Categorisation of policy measures and incentives affecting a Green Corridor

<p>Economic incentives Increases the cost on transport. The purpose is mainly to promote a higher load rate and a more energy efficient transport or to promote the use of better environmental technologies.</p>	<ul style="list-style-type: none"> ➤ Fuel/CO2 tax ➤ Vehicle tax ➤ Road User Charging ➤ Congestion charges ➤ Emission trading
<p>Legal incentives Regulations that hinder unwanted intensive transport activities in sensitive areas and where many people are exposed to noise and other disturbances. Dispensations from some of these regulations and directives give better accessibility for the transport business.</p>	<ul style="list-style-type: none"> ➤ Regulations on entering Environmental zones / Environmental protected areas ➤ Emission directives on engines, Euro classes ➤ Regulations on vehicle size, weight, length etc. ➤ Time restrictions ➤ Regulation on allowed amount of traffic ➤ Standardization and harmonization

	<ul style="list-style-type: none"> ➤ Other directives
<p>Supporting incentives Investments in infrastructure, especially in congested “bottlenecks” and ports/terminals are important for the lead times and punctuality for the transport industry. The infrastructure investments should be adjusted to the needs from the freight transport sector.</p>	<ul style="list-style-type: none"> ➤ Infrastructure investments ➤ ICT/ITS investments ➤ Investments in trans-shipment points (hubs) ➤ Priority lanes for HGVs and other equally efficient transport solutions ➤ Less bureaucracy and faster handling times at customs offices and borders ➤ Prioritized land use planning
<p>Voluntary incentives Agreements to ease the implementation of better environmental technology, or open for others to use or trade free capacity in order to increase the systems load rate. These can be implemented by the transport business itself or with the help or support by the authorities.</p>	<ul style="list-style-type: none"> ➤ Heavy ecodriving ➤ Alternative fuels ➤ Implementation of environmentally adapted technology ➤ Information Broker System ➤ Freight rolling stock exchange ➤ Freight bourse ➤ Advice and share good examples ➤ Accreditations/Certification

Key findings from the interviews

The logistic system is very robust in the sense that very little will happen to the logistic strategies, i.e., transported volumes, centralisations of warehouses and production, outsourcing, distribution patterns, etc., if the price on fuel, CO2 taxes or road user charges are introduced that are in line with the estimated external costs from freight transport. It is other things that are much more costly in logistics, e.g., warehousing, capital costs, and other factors like punctuality, reliability and speed are more influencing on how the logistic system are designed and the patterns of distribution that are chosen. An unmotivated and unintelligible tax or policy are often misleading and will risk a sub optimisation of the whole system and not beneficial for the environment or the economy.

CO2 is rather easy to measure and there is a big focus on greenhouse gases today. However, there are a number of other environmental impacts that should be prized that is not done today, e.g., noise, congestion, accidents and local emissions. If these were to be priced it would probably lead to an increased use of larger but less vehicles and break the present trend towards more and smaller distribution vehicles and vans in urban distribution. It would be better if more external costs than CO2 were to be internalized. Local emissions should be regulated and priced locally as it is very much dependent on how many people that were affected.

ITS is important also for regulation and policy making. There is a need for accurate data to get acceptance and understanding of the effects of different measures. The information must be free and open! As an example, a freight bourse would be an efficient tool. Free capacity must be made available to the market if the efficiency in the transport system shall have a possibility to increase.

There are very few examples on implemented incentives and policy measures or research done in the area. There are mostly experiences from urban freight and on passenger transport but not much examples except for Road User Charges and CO₂-tax for long distance freight transport. There are examples of subsidies on alternative fuels or different kinds of subsidies to attract businesses and logistic centres to a city or region, but the results are often contra productive for the whole transport system in the long run. More studies are needed on who will be affected and how. How does different measures relate to each other? Is one measure a prerequisite for another? Does one measure act in a contra productive way towards another? None of the interviewed has heard of any new innovative ideas on policies or incentives in the freight transport business that is not dealt with in this study.

There is a need for both carrots and sticks, both positive and negative incentives to be successful in creating a green corridor. Examples on suggestions from the experts were that maybe a voluntary scheme is a way to go forward, a green label, which gives you certain advantages towards your competitors? Perhaps different membership levels depending on your environmental performance?

Key findings from the workshop

A summary of the findings from the workshop showed that the categories of success factors were the most important once for a successful implementation of a green corridor are:

- There is a Self-sustaining corridor where there is a good business case for all interested parties, i.e. transport buyers, transport producers, municipalities and regions.
- There is a well-functioning and efficient infrastructure system in the corridor including terminals and hubs, harmonized standards and regulations along the whole corridor
- There is a well-functioning, open and harmonized ITS/ICT system along the corridor.
- There is a common understanding for sustainable freight transport sector, and a common methodology for measuring KPIs.

For the transport industry and its customers is robust and reliable accessibility and time related factors like delivery precision, lead time and high security of much more importance than transport cost, fuel prices or different taxes aiming to increase the price on transport services. For this reason is it necessary that a system supposed to attract actors to use a green corridor contain measures that give the actors these positive effects, i.e., infrastructure and terminals in the corridor that have high capacity and well maintained, a well-integrated and open ICT system, and finally a non-bureaucratic and smooth document handling system at customs and borders. In return they will probably be willing to invest in environmentally

Policy Measures to Achieve Green Corridors and Green Transports
BLINGE, Magnus

sound technology and open up for improving the load rate through cooperation and open freight rolling stock exchanges and freight bourses.

The results of the grading of compiled and clarified success factors (1 to 20) by the stakeholder group are shown in Table 2.

Table 2 Results from the weighting of the identified success factors.

Which are the success factors?		Summarised weighting For creating a Green Corridor (1- 6)
A There is a Self-sustaining corridor where there is a good business case for all interested parties, i.e. transport buyers, transport producers, municipalities and regions.		
1	Economically attractive for trp buyers to use a GC	4,9
2	Economically attractive for trp companies to use a GC	4,7
3	Free access to infrastructure and terminals	4,0
4	Cooperation in the trp sector between modes	4,4
5	Multi-stakeholder freight initiatives	3,6
6	Freight stock exchange, Power comes with the cargo	3,7
B There is a well functioning and efficient infrastructure system in the corridor including terminals and hubs, harmonised standards and regulations along the whole corridor		
7	Revenues from the internalisation of external costs goes to infrastructure investments	4,4
8	Same priorities to the GC: in all member states has achieved a high standard of infrastructure capacity	5,3
9	Improved efficiency in the interface of intermodal transfer	4,8
10	Safety and security	4,2
11	Improved land-use/infrastructure planning	3,9
12	Achieved regional economic development thanks to GCs	4,4
C There is a well functioning, open and harmonised ITS/ICT system along the corridor.		
13	Revenues from the internalisation of external costs goes to ITS/ICT investments	3,8
14	ICT / ITS infrastructure is sufficient to handle the need for the GC	4,6
15	Open Access to relevant information, Information Broker System	4,3
D There is a common understanding for sustainable freight transport sector, and a common methodology for measuring KPIs.		
16	Cont. Improvement on env. Factors of corridor performance	4,7
17	Higher load factors for all trp modes (better than average)	4,5
18	Fair and harmonised pricing of transport including external costs	4,5
19	Standardisation of calculation methods, KPI's and Eco-labels	4,1
20	A common way to measure punctuality, Use and access to transport planes	3,6

The analysis of the workshop gives the following recommendations on positive incentives and input on which actors that are identified as the most important drivers to implement the needed success factors.

Incentives and measures requested from the authorities

Infrastructure and terminals

- Give the same priorities to the whole Green Corridor. All member states have achieved a high standard of infrastructure capacity.
- Improved efficiency in the interface of intermodal transfer.
- The possible revenues from the internalisation of external costs shall go to infrastructure investments
- Safety and security
- Improved land-use/infrastructure planning

The stakeholder group stresses the necessity for cooperation between the involved authorities along the whole corridor to reach a commonly accepted and high standard on the infrastructure. A chain is not stronger than its weakest link and to achieve a reliable standard

and attractiveness for a green corridor there must be a high capacity and good maintenance on all links, terminals, ports and all parts of the corridor. Infrastructure investments should be adjusted to the needs from the freight transport sector. Good examples are to invest in grade separated intersections instead of roundabouts, increased bearing capacity for heavy trains and trucks and more bypass tracks in the railway system. The possibility to establish attractive intermodal solutions will be important for the success of the corridor and it is important to make necessary efforts to strengthen critical links. A common action between the involved authorities on how to smoothen the time consuming paper work at borders and to remove inefficient bureaucracy and also to work with establishing a joint transport planning procedure within the region.

It was also regarded important that the regional economic developments thanks to a green corridor will be measured and reported as a good example to help other green corridors to develop.

ICT infrastructure

- ICT/ITS infrastructure that is sufficient to handle the need for the Green Corridor.
- Open Access to relevant information, Information Broker System.
- Revenues from the internalisation of external costs shall go to ICT/ITS investments

The stakeholder group agreed on that a well-functioning, robust and open digital infrastructure is a prerequisite for a green corridor. This is as important as creating a robust and flexible physical infrastructure. A first step is to ensure open and reliable access to traffic information and rout planning systems. The authorities can open their APIs (Application Programming Interface; a source code based specification intended to be used as an interface by software components to communicate with each other) and make it possible for all actors to connect their own applications and IT systems and get access to necessary information. There are several bilateral and trilateral applications today that work perfectly, but when a new actor wants to connect, there is often a problem. This barrier can be removed if a commonly accepted and open ICT system infrastructure were developed. The stakeholder group also stressed the importance of good reliability and security in the information chain. It is a lot of information related to the company's business that must be kept secret.

In connection to this open system would an effort to establish an "Internet of Things" be desirable. The Internet of Things refers to uniquely identifiable objects (things) and their virtual representations in an Internet-like structure. Radio-frequency identification (RFID) is often seen as a prerequisite for the Internet of Things.

Other positive incentives

The authorities can also give dispensations from other incentives in the corridor. Examples are:

- Dispensations from vehicle size and weight restrictions.
- Dispensations on night delivery and use of terminals and railways at night-time.
- Prioritized access in ports, terminals, customs, and bus lanes in cities.

- Tougher regulations and restrictions for transport outside the corridors.

The stakeholder group identified a number of other options that the authorities could do to increase the accessibility and punctuality for the actors in a green corridor. It was different kinds of dispensations, primarily to accept higher vehicle lengths and allowing traffic at night-time to avoid congestion problems. The stakeholder group were not against higher environmentally induced fees and taxes but stressed the importance that these must be transferred back to the transport industry by investing in infrastructure and ITS solutions. The measures could also be used as a way to promote the green corridors by charging the high polluting transport solutions and give the same amount in reduction to those who have a comparably low environmental load.

The green corridor can also be used as a test bed for new technology and new business ideas. It can host pilot projects and implementation tests for example tests on electrification and hybridization of the freight transport sector, alternative fuels for all transport modes, vehicle sizes and platooning, ITS systems Vehicle to vehicle and vehicle to infrastructure communication systems, internet of things, freight bourses, etc.

Incentives and measures requested to be joint activities and cooperation between the transport industry and the authorities.

A Self-sustaining corridor.

- Economically attractive for transport buyers and transport companies to use a GC
- Cooperation in the transport sector between modes
- Free access to infrastructure and terminals
- Forming a freight stock exchange
- Multi-stakeholder freight initiatives

There was a united consensus in the stakeholder group that the possibilities to realise a green corridor is dependent on if the parties participating in running a green corridor all have a sound business case to lean on. The actors in the transport industry must see a sound business model in the concept and the authorities must see that the investments and incentives that they are giving pays off in true and significantly lower external costs for the society. Many of the measures need a trustworthy cooperation between the partners of the transport industry and between the industry and the authorities. There should be harmonised tariffs and favourable incentives towards the actors in the Green Corridor such as differentiated port and other terminal fees. Long term harmonised, fair and stable rules and regulations are also requested. Other examples are training programmes and joint promotion of viable solutions.

Incentives and measures requested from the transport industry

A common methodology for measuring KPIs.

- Continuous Improvement on environmental Factors of corridor performance (KPI's)
- Higher load factors for all transport modes (better than average)

- Fair and harmonised pricing of transport including external costs
- Standardisation of calculation methods, KPI's and Eco-labels
- A common way to measure punctuality, Use and access to transport planes

In order to make a green corridor really “green” and to motivate the authorities to invest in necessary infrastructure and ICT systems the industry’s efforts must meet the expectations on upgrading the environmental standard on technology used in the corridor and a high load rate level. A baseline on technology levels on vehicles and vessels operating in the corridor should be designed by the involved actors. This means to define a set of rules on emission standards for trucks, ships and trains that will require e.g., modern exhaust after treatment devices and alternative fuels, etc to meet the demands. The vehicle and vessels used in the corridor shall also have a high load rate. A freight rolling stock exchange and a freight bourse for available capacity in the system are two other ways to increase the systems load rate. A harmonized measuring and reporting system must be implemented to achieve this.

The stakeholder group recommend that a system is developed that is technology neutral. An agreed baseline level of accepted emission levels per ton freight transported in the corridor shall be defined that is significantly lower than the average transport service in Europe. The transport sector can then choose how to meet these demands, by investing in new vehicles or vessels or with actions to increased load rates, ecodriving or other actions like shift to other transport modes. As previously been pointed out this needs an agreed, accepted and reliable method for reporting and calculating the chosen KPIs for emissions and load rates from the transport sector.

DISCUSSION

Although the implementations of economic incentives in the transport sector are encouraging and important steps, it is not likely that economic means of control based on higher fuel price or distance-related vehicle charges will be enough to achieve a substantial change towards sustainability for the freight transport sector or to make a green corridor attractive enough for transport buyers. On the other hand does most actors in the freight transport sector and in academia agree on that it is necessary to develop and to use efficient policies and incentives to create new markets and innovations and through that a more sustainable freight transport sector. In the necessary transaction towards a sustainable transport system new business opportunities will emerge and a green corridor will be one of the important platforms to develop and test new solutions and business models. But this requires a set of well-designed policies.

European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states. The directive that put pressure on the vehicle industry to reduce emissions from the vehicles has been one of the most efficient actions to reduce the environmental impact from the transport sector. It has shown the impressive capability of the automotive industry to meet the new demands with innovative and cost-efficient solutions.

Economic incentives and means of control, e.g., CO₂ tax, road user tax etc. should be designed so that they as much as possible reflect the external costs that the transport service causes. They must be neutral and not in favour of any particular mode of transport. Although this is extremely difficult to achieve it is important to work with this issue to get acceptance for necessary changes. A rather common misunderstanding is that neutral means “business as usual” and that the present taxation is the most fair and neutral. It is more realistic to believe that the system we have right now is far from neutral if all external costs would have been taken into consideration, e.g., congestion, barrier effects, noise, emissions to air, water and soil, etc. More research is needed in this area and the transport sector can support this process by participating in a positive way in the political debate and recognize and accept the necessary changes even if it means changed market conditions.

To make this happen it is necessary to reach international agreements. One country or region can be forerunner, but cannot have different rules and taxations compared to its competitors in the long run. But the European transport business can advocate for an international regulation of the transport market into a more sustainable direction by developing a system for internalization of external costs.

It is important that the environmentally induced fees and revenues will not become a fiscal system where the money ends up covering state finances. All fees paid should be transferred back to the business actors in some way, for example as investments in infrastructure. An even more effective and acceptable system for the users is where the transport companies pay according to your amount of pollution and other external costs that they causes, and a get a repayment to the services that they have performed. In this closed system, the environmentally “bad performers” will have to pay to the competitors that are “good performers” and that triggers the willingness to invest in environmentally better technology and increase the efficiency. One example of this is the Swedish “Environmental Charge for Emissions of Nitrogen Oxides from Energy Production Act” that came into action in 1992. The total environmental charge paid into the system is repaid to those liable to the charge in production to each production unit’s share of total useful energy production. The emissions of NO_x have been reduced by 50% and have occurred virtually without interruption since the charge was introduced in 1992 (Svårdsjö & Gustafsson, 2003). There is a similar case from the transport industry in Norway, where a tax on NO_x has led to an increased use of LNG and CNG in ships and where there are examples of ships where the conversion of the ship engines to these fuels were financed by revenues from these taxes.

CONCLUSIONS

A green corridor will never be realised unless there is a Self-sustaining corridor where there is a good business case for all interested parties, i.e. transport buyers, transport producers, municipalities and regions. To make this happen and to initiate new sustainable markets and innovations in the transport sector is it necessary to implement a number of different policies. The findings from the implementation of economic incentives, i.e., CO₂-tax and distance based road user charging (RUC) has shown positive effects on the environment, but far from enough to break the trend of increasing demand for transport services or reduce the

emissions of CO₂ in absolute measures from the freight transport sector. A successful green corridor can only be achieved if a combination of economic; legal; supporting and voluntary incentives is implemented. The results of this study serve as important background information for future research on how necessary policy measures for the freight transport sector can be designed.

The main messages to the authorities involved in creating “Green Corridors” as a successful concept are that there must be harmonised rules and regulations along the corridor and that the nations involved must cooperate to remove bureaucracy and infrastructural bottlenecks. Thus, the most efficient policies that they can implement are measures that ensure the punctuality and accessibility in the corridor, i.e., infrastructure investments that are adjusted to the needs from the freight transport sector, ITS-infrastructure and priority access at borders and terminals. The economic incentives that can be used must as much as possible be related to the external costs that the transport activity causes and must be transferred back to the transport industry in e.g., infrastructure or ITS investments. In this way is the competitiveness for more environmentally sound transport solutions improved on the expense of the more polluting ones.

In return the transport actors must use a significantly better environmental technology level in the corridors than is used today. They must also work together to increase the load factor in the system by increasing the transparency and offering free capacity to other actors in the corridor. The transport sector must also harmonise the methods for calculating the environmental impact from the transport sector and increase the transparency on load rates in the system. They must also accept and recognise environmentally induced economic means of control and policies to regulate and steer the transport sector towards sustainability. The transport sector can be much more proactive and contribute to make these policies sound and to help increasing the efficiency in the sector and not become a plain fiscal source of income for the national budgets.

Finally, to be able to get acceptance for these measures it is of utmost important to have international agreements on standardized emission calculation methods. The emission data can probably never be exact, but it can be accurate enough to measure and follow up the environmental impact and from that be able to calculate external costs. The most important task is to convince the whole sector to calculate the same way and to accept the same set of emission data.

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