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Green Corridor Manual (Draft)

- Key Performance Indicators (KPIs) and policy measures in green transport corridor establishment

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Title:	**Green Corridor Manual (Draft) - Key Performance Indicators (KPIs) and policy measures in green transport corridor establishment**
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Summary

This report is the final delivery in a series of reports within the EWTC II WP3B Manual project. The main purpose of this report is to sum up the work and main findings of the project on green key performance indicators together with policy and incentives for establishing a sustainable green transport corridor. The complete work, including all relevant background information, is presented in three separate sub-reports available from the EWTC II web site, please refer to www.ewtc2.eu.

The common operational indicators used in transport and infrastructure management have to be supplemented by a set of indicators reflecting the sustainability dimensions. Through a process involving literature studies, expert panels in workshops, interviews and test evaluations, a limited number of indicators were selected to be the KPIs for green corridor assessment. The following indicators were decided:

Economic efficiency and service quality performance

Total goods volumes
On time delivery
Corridor ability and capacity

Environmental efficiency

Total energy used
Greenhouse gases emitted, CO2e
Engine standards
ISO 9001 dangerous goods
Alternative fuels filling stations

Social efficiency[1]

ISO 31 000
ISO 39 000
Safe truck parking
Common safety rating systems
Fenced terminals

These indicators were put to a test in a set of case studies with the purpose of trying out the KPIs in evaluating a selection of components or transport flows. The case studies confirmed the expected difficulties in retrieving data regarding economic related data and the lack of information in the field of social issues. The implementation of the environmental management systems during the last 10 years made it relatively easy to obtain environmentally related information.

The implementation and operation of a green transport corridor should be made with the application of incentives and regulating policies. A literature review on the subject was complemented with interviews and an expert panel workshop where a short list on required and desired incentives and policy measures were discussed. The work is concluded in the following summary:

- Agree on harmonized KPI operational data reporting systems and emission calculation methods.

- Agree on setting a transport mode specific baseline on i) emission levels, ii) energy use iii) social conditions and iv) economic performance for a green corridor transport service that are significantly better than compared to a regular transport service. The actors that meet these levels get a certificate or permit to run in the green corridor and receive the benefits.

- Do not regulate which technical/organisational solution that the actors should use in order to meet the green corridor requirements – leave it up to the experts to find the most cost efficient way to meet sustainability in the production of transport services.

[1] If a more detailed social efficiency indicator is required, KPIs such as sick leave, employee turnover, temporary agency workers and average salaries could potentially measure this performance. An aggregation of these issues could be captured by availability of trade unions and transparent agreements regarding work conditions. The suggested risk management systems relate to internal and external parties. In addition the number of traffic accidents could be added for a more direct KPI.

- Point out a “prioritized list” to the authorities of where in the corridor the infrastructural bottlenecks are.
- Develop a commonly accepted requirement specification for a suitable ICT system that the business agrees on.
- The members of the corridor partnership can be active in the political debate and be a part of forming the coming incentives to steer the transport sector into a sustainable direction.

The Green Corridor manual

The aim of the EWTC II Task 3B – Preparation of a generic Green Corridor Manual is to produce a green corridor manual as a set of recommendations and guidelines on how to implement a green corridor according to the EU freight agenda and as promoted by the EU Baltic Sea Strategy. A definition for a green corridor will be proposed through a comparative analysis of several policy and guidance documents at EU, international and national levels. The task will also propose a set of Key Performance Indicators (KPI) and incentives and regulations for more efficient, high quality, safe, secure and environmental friendly transport facilities and services in the East West Transport Corridor (EWTC).

The process will, inter alia, include identification and reduction of obstacles to the green corridor function of the EWTC, study visits to the hubs (ports, terminals and freight centres), and inputs from other tasks in the project. The manual will list indicators and measures with their potential impacts, together with a governance model for the development of a stepwise deployment of a green corridor. The manual will also look into and elaborate on different options for the certification of green transports, which is of great interest for the transport market.

The results will serve as a practical implementation and test of the EU concept from the Baltic Sea Region (BSR) perspective, and also serve as the first guideline on the development of a Green Corridor concept within the EU. The complete East West transport corridor involves the Europe-Asia link and non-EU countries. The main focus of the task will however be from the BSR perspective. The task will consider inputs from other tasks in the EWTC II project, which to some extent may cover the non-EU part of the corridor.

A special task force, involving the stakeholders responsible for deployment, will strengthen the down to earth approach. Joint activities in close collaboration with the Scandria and TransBaltic projects, will be coordinated, in line with the written agreement between the projects to support the development of the manual. Benchmarking of the results on the BSR level towards possible blueprints will be done in cooperation with the Scandria and TransBaltic projects. European and national experts in this field will be consulted and invited to workshops and seminars to get as broad as possible input to the final proposals.

Conclusions from this task will be applied to establish the revised EWTC Action Plan.

Green corridor manual objectives:

- Contribute to a decoupling of freight traffic and economic growth, i.e. a general decrease of traffic, while transport is increasing
- Constitute recommendations and guidelines for practical implementation and deployment of the corridor concept from a BSR perspective
- Should be a handbook for organizations and companies, which start up, develop and maintain transport corridors, as well as a tool for the EWTC partnership to implement a green corridor
- Should have a business perspective supporting the development of new business processes in the corridor and collaborative initiatives to co-modality
- Provide a business driven and process oriented management system to achieve seamless intermodal transport chains of cargo flow in the corridor
- Create a framework of general business models used in intermodal transport to facilitate analysis and identification of new business opportunities
- Propose awarding and steering mechanisms for more environmentally friendly transport facilities and services in the corridor

This report also takes starting point in the "Draft report - Purpose, definition and vision for Green Transport Corridors" available on the EWTC II website.

Methodology

The project was carried out by the application of the following methods and tools:

Literature screening

Literature screening has been performed much like a literature study, except for the limited scope in documentation and reporting. The screening had a clear focus on extracting the information relevant for the object of study and did not, like a literature study, describe the total knowledge published in the field. The literature screening was based on a search for publications by using the Internet and library search engines, as well as a review of on-going projects and research activities on the topic.

Data 'mining'

The data and information requested for the calculations and assessment of selected KPIs was retrieved by literature screening, statistics publications, Internet searches, interviews, and available business information. Collecting accurate and up to date data is often cumbersome and an important part was the expectation that the relevant key-partners in the EWTC II project would contribute with data and information, in order to support the completion of the project. It was anticipated that the focus of the data collection would be on present status of on-going transport systems and related traffic operations.

Workshops

Three workshops were organised in order to discuss the results reached in the different subtasks of the project, where different experts and partners were invited to give their opinions and view on the selection of study objects (task 3a), as well as the results and findings of the work tasks. The different workshops were a vital part of each task, as they both gave input and also a thorough discussion on the selection of the KPIs and measures in order to reach the selection that would be suitable for the EWTC II project.

For the organisation of the workshops, it was necessary to have a broad network of interesting, suitable stakeholders and experts involved in the different processes. The workshops were interactive, in order to achieve the best possible results to further the processes in the project. This means that different workshop methods were used, in order to achieve the expected results. The main method was World Café Rounds, where the specific issues were discussed in smaller groups and thereafter the results from each group were presented towards the other participants. Further, we also had back casting exercises, where the results of the analyses were presented visually towards the other participants.

The task included finding the interesting stakeholders and experts that could give the best possible input and expertise in the workshops and the task of getting their interest in taking part in the discussions. To ensure the best-possible outcome of the workshops, thorough work was put into building up an interesting agenda that was suitable to the aims for each workshop, in an equal mix of interesting presentations, discussions rounds and visualisation of results, where input to the specific task would be reached. In this we consulted the EWTC II steering group.

Interviews

In order to ensure that the different parts of the projects got the necessary input from concerned stakeholders, some interviews were carried out. The number of interviews was considered as regards to the input needed in connection to the specific task.

The interviews were made as mail surveys and telephone interviews, in order to save time. When starting the specific task, the necessary input was described and thereby also the specific open questions that were put forward in a short questionnaire towards a specified list of stakeholders, and this list varied across the different tasks.

The questionnaire was followed-up by telephone calls, in order to ensure that the stakeholders would deliver the input needed, as this was not the highest priority for them.

KPI criteria for green corridors assessment

Background and purpose of the KPI development

This part of the project is based on a clear initial intention from the corridor partnership to develop and suggest relevant and useful Key Performance Indicators (KPIs). The indicators should be closely linked to practical transport logistics operation, rather than delivering a theoretical report. Hence, the aim has been to assess relevant and practical KPIs that can influence transport logistics services in a sustainable direction.

Essentially, the core logic of transport logistics operation is to obtain economy of scale, meanwhile service fulfils market requirements in the supply chains, i.e. delivering:

- the right goods
- at the right time
- in the right place
- in the right condition
- at the right cost

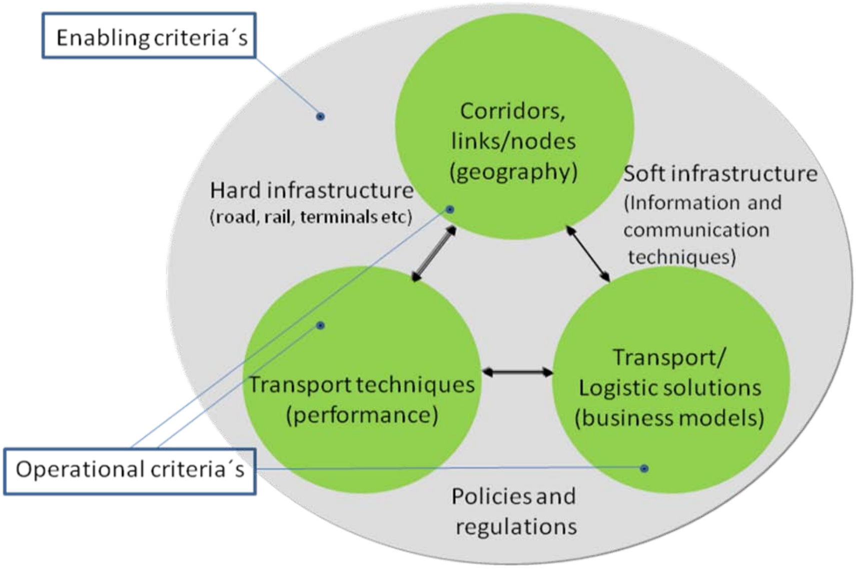
The consequence of this basic logic is a general desire to meet customer service demands; meanwhile cargo flows are consolidated at an economic optimum, which thereby induces increasingly larger modes of transport in large-scale transport solutions. The introduction of larger transport modes however, gives a second order effect as they reduce flexibility. This leads to market risks if transport demands decreases.

In order to reflect green transport and corridor performance, there is a need to include KPIs for both operational aspects, as well as enabling aspects i.e.:

1) Operational aspects such as corridors location and operation, transport techniques, and business models

2) Enabling aspects such as infrastructure, legal requirements, standards, ICT, organisation etc.

The complexity of operational aspects and its relation to enabling aspects is described in the figure below:



The different criteria's that drives green corridors performance

The intention is to identify, describe and assess relevant monitoring sustainability KPIs for the green corridors manual.

The inclusion of the full ranging sustainability approach in this manual requires a definition of sustainable transport logistics. At present there is no existing, commonly accepted definition of sustainable transport logistics (profit, planet and people). This project has used the below presented simple matrix, describing this complex and much debated concept.

Sustainable transport logistics	Economy (Profit)	Right products/service High productivity Right quality
	Environment (Planet)	Low environmental impact High safety standards
	Social (People)	High security standards Good working environment Social responsibility

The sustainable transport logistics matrix, transport logistics and environment – an overview 2011 (www.conlogic.se)

Data capturing has been much debated during the development process. Easy accessible data is a prerequisite for successful introduction of KPIs. The data sources should primarily be existing business supporting systems:

- Accounting systems
- Business and operationally driven electronic data interchange, EDI where needed data is added to existing communication structure e.g. Edifact messages etc.
- Operational databases

The output of this process is a selection of relevant key performance indicators that describe sustainable transport logistics performance in green corridors. The output includes operational performance and enabling corridor indicators.

The selection is moreover somewhat different between the identified key stakeholders. The process of selecting indicators has been a delicate and pragmatic balance of relevance and access of data. It is furthermore clear that this selection will change over time, as data obviously will become more easily available in the future. When possible, the indicator is presented as an absolute value, as well as a relative value.

Implementation and application of the proposed KPIs were carried out through case studies in the project in order to:

- Verify the KPIs and their relevance
- Identify accessibility of data
- Determine their user friendliness and usefulness

There is strong connection with the EU funded project SuperGreen. The project included coordination with SuperGreen and this has been done on different levels at several occasions throughout the project period, in order to compare results. SuperGreen is presently developing relevant key sustainability performance indicators for green corridors.

Developing relevant indicators requires coherent system boundaries of the analysed transport system in relation to the aim of the analysis. Addressing the long-term infrastructure development requirements, in comparison to the needs of transport logistics services efficiency should probably use very different system boundaries. As a rule of thumb when comparing different systems, “the smaller the system, the better” could serve as general guidelines in order to obtain a manageable analysis.

Synthesis of the investigations and findings

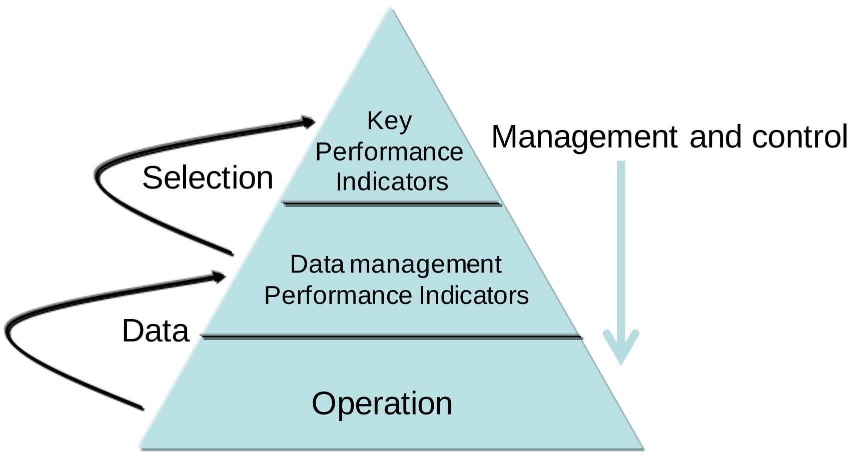
The key finding of the above model is the very different time frame needed for different indicators. Infrastructure bottlenecks obviously have a complete different time frame than increasing the load factor in a shuttle train, and still they are related.

From a controlling management KPI perspective, we furthermore need to separate between corrective actions and long-term preventive actions. Moreover we need to differentiate between absolute and relative performance if we are to measure true performance development.

In summary, this leaves us with a fairly complex model for each operation and enabling area. For managerial usefulness among relevant stakeholders there is a need for simplification.

Important general conditions and considerations in key performance indicators development are:

- Operational control of goods flows through key performance indicators has always been a common way of managing performance in transport logistics services. This experience needs to be included in the operational indicators. (See figure below)
- There are difficulties to capture relevant data with sufficient accuracy, with reasonable effort in order to not put all resources into data capturing itself.
- The system boundary of captured data must be well defined and constant over time when measuring improvements or relations to other corridors.
- Selected KPIs must be manageable in practice and not over ruled by legislation or other external factors.
- Performance indicators may change behaviour of organisations and people within the process being managed by KPIs. Reward systems may amplify this potential but also add a potential risk of sub-optimization.
- Key performance indicators can be counterproductive in relation to the original objective, due to poor performance indicator design. If relevant KPIs are established, they may initially serve the purpose well, but may over time become out-dated. Hence there is a need to continuously evaluate their functionality.
- There is a need for both operational and enabling key performance indicators with totally different time frames, and significant trade-offs between short and long term ambitions. These two groups of indicators influence each other, but need very different design.



Assessing KPIs should be based on a minimum of input, relying on easy accessible and accurate data, in order to present robust relevant key performance indicators.

Selection of key performance indicators

Key corridor stakeholders

Transport corridors involve several stakeholders. For this specific study, developing relevant key performance indicators we focus on four main stakeholders that are more directly involved in the overall performance. These stakeholders are:

- Corridor service provider
- Transport service provider
- Transport shipper
- Infrastructure provider (regional or national government)

The corridor service provider plays a very special and sometimes limited role in managing a somewhat virtual corridor based on goods flows transported by different operators, on different modes and parallel infrastructure, managed by primarily shippers and transport service providers. This stakeholder could be a commercial logistic control tower, a terminal operator, regional government etc. The role of the corridor provider is to enable a smooth and efficient goods flow although they may have relatively small direct control of the physical flows and solutions. The way the corridor provider can have an impact is through sticks and carrots that lead to behavioural changes among shippers and transport providers, which in turn leads to an efficient corridor. Access to operational logistics data will probably only be possible through confidential reporting. The proposed indicators for the corridor provider today include operational data. This may be unrealistic if the operator of physical goods flows judges this as business confidential data.

The transport service provider (e.g. forwarder, haulier) has an essential role in developing and offering efficient transport solutions that fulfil market (shipper) requirements. The use of KPIs is very common among transport providers and they have fairly good access of input data. The weak spot is freight forwarders use of various subcontracting transport operators, thus loosing direct operational control.

The transport shipper (cargo owner) requires lead times and other relevant services from their transport providers. Very fragmented shippers logistics demands may hinder the transport provider coordination that can improve the overall sustainability performance. Much of the suggested KPIs have its origin in the transport provider. This means that reporting systems must be in place from the transport provider, including sub contracted transport operators.

The infrastructure provider acts long term and has a crucial role to play in the development and offering of efficient goods flows. The infrastructure provider offers enabling factors for transport logistics operation. Data for the enabling performance indicators will most likely be fairly accessible.

Overview of the selected KPIs

Essential in the KPI design, linked to the identified key stakeholders is the grouping of indicators into:

<u>Operational indicators</u>
Aiming at optimizing on-going transport flows with regard to their overall sustainability performance. If possible these performance indicators may be aggregated on a corridor level. These indicators are relevant for the:

- Corridor provider, as the sum of all transport provider's sustainability performance and stipulated minimum criteria's for users of a corridor.
- Transport provider, as the sum of one transport provider's sustainability performance and stipulated minimum criteria's for subcontracting providers e.g. haulers etc.
- Shipper, as the sum of goods flow data and their sustainability performance.

<u>Enabling indicators</u>
The idea is to monitor these data in a corridor dashboard where the aim is to optimize long term development with regard to sustainability performance and thereby also hindering the risks of various sub optimizations. The enabling indicators are relevant for infrastructure holders and corridor providers.

Performance areas	
Economic efficiency and service quality performance	**Indicator areas**
	Total goods volumes
	On time delivery
	Corridor ability and capacity
Environmental efficiency	**Indicator areas**
	Total energy used
	Greenhouse gases, CO_2e
	Engine standards
	ISO 9001 dangerous goods
	Alternative fuels filling stations
Social efficiency	**Indicator areas**
	ISO 31 000*****
	ISO 39 000*****
	Safe parking
	Common safety rating systems******
	Fenced terminal

Operational	
Enabling	

***** If a more detailed social efficiency indicator is required, KPIs such as sick leave, employee turnover, temporary agency workers and average salaries could potentially measure this performance. An aggregation of these issues could be captured by availability of trade unions and transparent agreements regarding work conditions. The suggested risk management systems relate to internal and external parties. OHSAS 18001, occupational health and safety management system specification could also be an alternative.

****** In addition the number of traffic accidents could be added for a more direct KPI.

Motivation of the selected KPIs

Economic efficiency and service quality - operational performance
Total transport volumes, aims at describing market relevance, i.e. the service meets market needs with regard to transport time, reliability and frequency. Increasing transport volumes should mean market attractiveness.

On time delivery, describes the arrival time in relation to transport timetables. A key element with regard to on-time delivery is a uniform provider and shipper entity for measuring lead times and its arrival time with relevant precision.

Economic efficiency and service quality - enabling performance
Corridor capacity, relates to a set of enabling indicators, best described in a separate dashboard.

Environmental efficiency - operational performance
Total energy use, aims at describing the general environmental efficiency. Indirectly it also describes an efficient traffic flow. In addition this indicator, if based on fuel consumption, enables the calculation (if needed) of SO_2, given the legal fuel conditions or the actual quality used.

Greenhouse gases (carbon dioxide, methane and nitrous oxide) describe impact on climate, as well as indirect the ratio of renewable fuels being used.

Engine standards (also includes after treatment devices) describes indirectly the emissions related to impact on health and nature. This indicator indirectly includes the traditional regulated emissions to air, such as NOx, PM, and HC.

A relevant environmental issue is noise, but due to difficulty to measure this performance this element was left out from the selection of KPIs.

ISO 9001dg (dangerous goods), being in place indicates the proactive and preventive systematic work carried out with regard to risks of dangerous effluents and emissions. This indicator includes the cargo safety aspects.

Environmental efficiency - enabling performance
Alternative fuel filling stations aims at describing the ability to supply fuels with less content of fossil carbon. This is an enabling factor best described in the corridor dashboard.

Social efficiency – operational performance
ISO 31 000, Risk management being in place indicates the proactive and preventive systematic work being carried out with regard to various security risks. This indicator includes the cargo security aspects.

ISO 39 000, Risk management being in place indicates the proactive and preventive systematic work being carried out with regard to traffic safety risks.

If a more detailed social performance regarding direct performance related to corridor operators, KPIs such as sick leave, employee turnover, temporary agency workers and average salaries could potentially measure this performance. The suggested risk management systems could relate to internal and external parties.

Another KPI, measuring more direct performance would be number of road accidents. In order to minimize new data capturing traffic safety is only measured as an enabling factor through EuroRap.

Social efficiency - enabling performance
Fenced terminals with access control, is linked to minimizing all safety and security risks connected to goods flows. This is an enabling factor best described in the corridor dashboard.

Safe truck parking, aims at minimizing security risks (thefts and violence) linked to long distance haul transport by road. This is an enabling factor best described in the corridor dashboard.

Common rating systems, relate to different market driven and common evaluation systems being developed for increasing security and safety in the transport system. Present examples are TAPA, EuroRap, ship vetting etc.

A comparison with KPIs within SuperGreen

The project has had close contact with the EU project SuperGreen throughout the project period, in order to compare results of the work with selecting KPIs and collecting data. Originally the SuperGreen project proposed some 18 KPIs whereof some were expressed in absolute and relative numbers. From this extensive list a more compressed version was suggested by the project. In our opinion this tough reduction of KPIs was good but may have led to a somewhat too short list of indicators.

Performance areas	**EWTC**	**SuperGreen**
Economic efficiency	**Indicator areas**	
	Total goods volumes	Relative transport cost [€/tkm]
		Frequency (number of services per year) [number]
	On time delivery	Reliability (on time deliveries)[%]
		Transit time [hours]*
	Corridor ability and capacity	
Environmental efficiency	**Indicator areas**	
	Total energy used	
	Greenhouse gases, CO_2e	Carbon dioxide; CO_2 [g/tom]
	Engine standards	Sulphur oxide, SO_X [g/1000 tkm]
	ISO 9001 dangerous goods	
	Alternative fuels filling stations	
Social efficiency	**Indicator areas**	
	ISO 31 000**	
	ISO 39 000**	
	Safe parking	
	Common rating systems***	
	Fenced terminal	

***** Alternatively, average speed in km/h

****** If a more detailed social performance regarding direct performance related to corridor operators, KPIs such as sick leave, employee turnover, temporary agency workers and average salaries could potentially measure this performance. The suggested risk management systems could relate to internal and external parties. OHSAS 18001, occupational health and safety management system specification could also be an alternative.

******* In addition number of traffic accidents could be added for a more direct KPI.

Essential differences between EWTC and SuperGreen are:

1) EWTC case studies indicate difficulty to capture economic data. Therefore the EWTC proposal is to only measure economic performance as goods volumes and on time delivery. The latter will need transport timetables in order to measure deviation rates. SuperGreen still includes economic data.

2) In accordance with the presently developed CEN-standard, the EWTC propose energy use and GHG emission in a well to wheel system boundary. In addition the EWTC only measure regulated emissions as engine performance as emission standards. Sulphur oxide is not part of EWTC as this is regulated by legislation and scarcely something where the transport sector would over perform in relation to legislation. Especially as this would increase cost. SuperGreen does not include energy and all GHG. SuperGreen also includes sulphur oxide.

3) In order to cover the full range of sustainability there is a need to include social KPIs. These social aspects should include performance regarding the corridor stakeholders, but must also include concern of third party being affected by the corridor. SuperGreen does not directly cover social aspects at all.

Specification of selected KPIs

Specification of KPIs for the transport service provider

Transport Service Provider		
Performance area	**Absolute**	**Relative**
Finance - operational	Total goods volume [Tonne]	Total goods volume [Tonne/year]
	On time delivery [n]	Deviation ratio [%]
Finance - enabling	Corridor ability/capacity scorecard [1/0]	n/a
Environment - operational	Total energy use [MJ, KWh]	Energy tonne-kilometre ratio [MJ:KWh/tkm]
	Green house gases, CO_2e [Tonne]	Green house gases, CO_2e [g/tkm]
	Engine standards [n]	Engine standards distribution [%]
	ISO 9001 DG [1/0]	n/a
Environment - enabling	Alternative fuels filling stations [n]	Alternative fuels filling stations [n/1000 km]
Social - operational	ISO 31000 [1/0]	n/a
	ISO 39000 [1/0]	n/a
Social - enabling	Fenced terminal use [1/0]	n/a
	Safe parking use [1/0]	n/a

Indicator	**Unit**	**Data needed**
Total goods volumes	[Tonne]	Goods volumes transported
On time delivery	[n]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) Number of on time delivery
On time delivery	[%]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) Number of on time delivery Number of journeys
Corridor ability and capacity	[1/0]	Public monitoring of dash board
Total energy use	[MJ, KWh]	Total energy use for the transports
Relative energy use	MJ/tkm KWh/tkm	Total energy use for the transports Tonne-kilometre for the transports
Greenhouse gases, CO2e	[Tonne]	Total GHG emission for the transports
Greenhouse gases, CO2e	[g/tkm]	Total GHG emission for the transports Tonne-kilometre for the corridor
Engine standards	[n]	Total number of vehicles/vessels in use Engine environmental classification per mode of transport
Engine standards distribution	[%]	Total number of vehicles/vessels in use Engine environmental classification per mode of transport
ISO 9001dg	[1/0]	Certification third party audited
Alternative fuels filling stations	[n]	Number and type of fuels provided in corridor
Alternative fuels filling stations	[n/1000 km]	Location, number and type of fuels provided in corridor
ISO 31 000	[1/0]	Certification third party audited
ISO 39 000	[1/0]	Certification third party audited
Fenced terminals used	[1/0]	Policy decision and monitoring system
Safe parking use	[1/0]	Policy decision and monitoring system

Specification of KPIs for the transport shipper

Shipper		
Performance area	**Absolute**	**Relative**
Finance - operational	Total goods volume [Tonne]	Total goods volume [Tonne/year]
	On time delivery [n]	Deviation ratio [%]
Environment - operational	Total energy use [MJ, KWh]	Energy tonne-kilometre ratio [MJ:KWh/tkm]
	Green house gases, CO_2e [Tonne]	Green house gases, CO_2e [g/tkm]
	Engine standards [n]	Engine standards distribution [%]
	ISO 9001 DG [1/0]	n/a
Social - operational	ISO 31000 [1/0]	n/a
	ISO 39000 [1/0]	n/a

Indicator	Unit	Data needed
Transport volumes	[Tonne]	Total goods volumes shipped
On time delivery	[n]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) Number of on time delivery
On time delivery	[%]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) Number of on time delivery Number of journeys
Total energy use	[MJ, KWh]	Total energy use for the shipments
Relative energy use	MJ/tkm KWh/tkm	Total energy use for the shipments Tonne-kilometre for the shipments
Greenhouse gases, CO2e	[Tonne]	Total GHG emission for the shipments
Greenhouse gases, CO2e	[g/tkm]	Total GHG emission for the shipments Tonne-kilometre for the shipments
Engine standards	[n]	Total number of vehicles/vessels in use Engine environmental classification per mode of transport
Engine standards distribution	[%]	Total number of vehicles/vessels in use Engine environmental classification per mode of transport
ISO 9001dg	[1/0]	Certification third party audited
ISO 31 000	[1/0]	Certification third party audited
ISO 39 000	[1/0]	Certification third party audited

Specification of KPIs for the corridor service provider

Corridor Service Provider		
Performance area	**Absolute**	**Relative**
Finance - operational	Total goods volume [Tonne]	Total goods volume [Tonne/year]
	On time delivery [n]	Deviation ratio [%]
Finance - enabling	Corridor ability/capacity scorecard [1/0]	n/a
Environment - operational	Total energy use [MJ, KWh]	Energy tonne-kilometre ratio [MJ:KWh/tkm]
	Green house gases, CO_2e [Tonne]	Green house gases, CO_2e [g/tkm]
	Engine standards [n]	Engine standards distribution [%]
	ISO 9001 DG [1/0]	n/a
Environment - enabling	Alternative fuels filling stations [n]	Alternative fuels filling stations [n/1000 km]
Social - operational	ISO 31000 [1/0]	n/a
	ISO 39000 [1/0]	n/a
Social - enabling	Fenced terminal use [1/0]	n/a
	Safe parking use [1/0]	n/a

Indicator	**Unit**	**Data needed**
Transport volumes	[Tonne]	∑ Transported goods volumes in corridor
On time delivery	[n]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) ∑ Number of on time delivery
On time delivery	[%]	Timetables, departure and arrival time Common definition of right time (+/- minutes or days) ∑ Number of on time delivery ∑ Number of journeys
Corridor ability and capacity	[1/0]	Public monitoring of dash board
Total energy use	[MJ, KWh]	∑ Energy use for the corridor
Relative energy use	MJ/tkm KWh/tkm	∑ Energy use for the corridor ∑ Tonne-kilometre for the corridor
Greenhouse gases, CO2e	[Tonne]	∑ GHG emission for the corridor
Greenhouse gases, CO2e	[g/tkm]	∑ GHG emission for the corridor ∑ Tonne-kilometre for the corridor
Engine standards	[n]	∑ Number of vehicles/vessels in use ∑ Engine environmental classification per mode of trans-port
Engine standards distribution	[%]	∑ Number of vehicles/vessels in use ∑ Engine environmental classification per mode of trans-port
ISO 9001dg	[1/0]	∑ Certification third party audited
Alternative fuels filling stations	[n]	∑ Number and type of fuels provided in corridor
Alternative fuels filling stations	[n/1000 km]	Location, number and type of fuels provided in corridor
ISO 31 000	[1/0]	∑ Certification third party audited
ISO 39 000	[1/0]	∑ Certification third party audited
Fenced terminals used	[1/0]	∑ Policy decision and monitoring system
Safe parking use	[1/0]	∑ Policy decision and monitoring system

Outline of dashboard for enabling factors

The enabling factors relate to the traditional hard infrastructure (road, rail, fairways and terminals) and the soft infrastructure refers to information and communication techniques. Furthermore it refers to policies and regulations. All together these aspects are well-known, crucial factors for efficient, smooth and seamless transport logistics services. They are all linked to the overall capacity, accessibility and performance in a transport corridor.

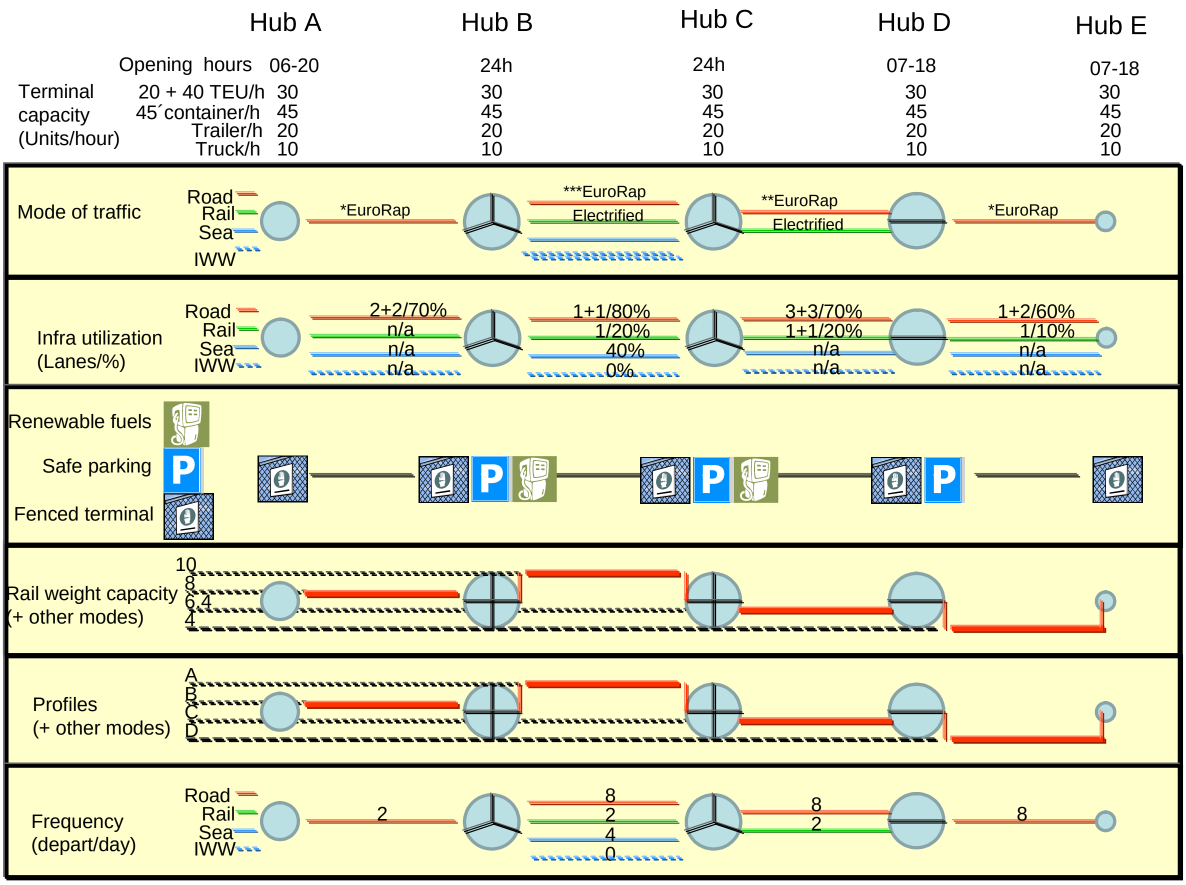
The challenge is to select a limited number of KPIs that represents these performances in the relevant time frame (long-term). There is a huge difference between operational (short-term) KPIs and these enabling (long-term) KPIs. The aim of the dashboard is to connect short-term KPIs to the enabling KPIs and thereby stimulate improvements with regard to capacity, accessibility and performance. Moreover, the dashboard illuminates the need to eliminate crucial bottlenecks that may occur outside the nearby region. This supports the fundamental idea of creating sufficient corridors for goods transport, not focusing on isolated hubs or regions.

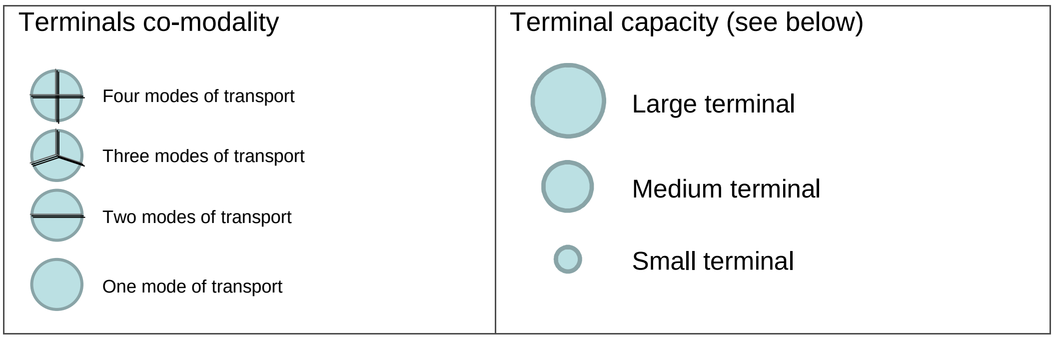
Merely by introducing an overall dashboard for a full transport corridor makes it evident that all stakeholders along this distance need to cooperate in order to improve total performance. There is no use in outstanding performance in one transport link or hub, if upstream and downstream links or hubs perform less good or even worse, is incompatible. Enabling this more holistic approach may enable investments outside the local region in favour of overall transport corridor performance improvements.

In order to present and monitor the enabling factors behind the green corridor concept, also being fairly qualitative, we propose a simple labelling system for the corridor itself (dash board). The combination of operational control through relevant KPIs and the enabling factors presented in a uniform dash board will give a good overview of total performance. Below is an early outline proposal of various factors that could be included as enablers, characterizing capacity, redundancy and performance. This idea needs further development through input from relevant stakeholders among infrastructure holders, terminal providers etc.

In order to develop this new labelling idea we propose a process together with an advanced illustrator, combined with further in depth interviews with experts. The experts should represent all relevant modes of transport as well as various types of hubs. The long-term objective should be to establish a standard on how to express and communicate the enabling factors for transport corridor performance in a dashboard.

Draft outline of a corridor dashboard (tentative proposals)





Terminal capacity

- Opening hours
- Transit time
- Max number of lifts between rail and road
- Max number of container lifts
- Max number of arrivals and departures
- Max size of trains/vehicles/vessels

Guidelines to the application of the KPIs

The purpose of a KPI analysis is to monitor a specific activity, in order to either i) establish knowledge of the present status, ii) identify processes in need for attention, iii) observe on-going changes over time, iv) to compare different systems, or v) as a base for making prognoses of possible developments. The primary use of KPIs in relation to green transport corridors is in this work understood as a tool to assess and monitor the status or development of the separate sub-activities/processes within the corridor in terms of their degree of sustainability. The focus is thus not to find a KPI representing the entire corridor or all operations within. The following text is intended as a support for a corridor operator engaging in the process of setting up a KPI based monitoring system focused upon sustainability issues.

Step 1: Purpose and intended use – goal statement

The first issue to resolve before starting the analysis is the purpose of the KPI analysis, i.e. what is the question at hand to be answered? Are we looking for a sustainability index for a larger part of the corridor operations in order to monitor a general development? Are we looking for the components (links, operators, nodes) where the degree of sustainability of the operations is particularly low? Are we interested in a follow up of investments in infrastructure or new technology or the effects of changes in legislation or practices? Are we interested in on-going activities or do we look for the potential effects of future changes, e.g. developments in volumes, number of operators and transport options, future technology developments or new practices? Or is the purpose a selection (or all) of these issues? Whatever the corridor provider has in mind, the purpose of the KPI system should be explicitly expressed in a well-defined goal statement.

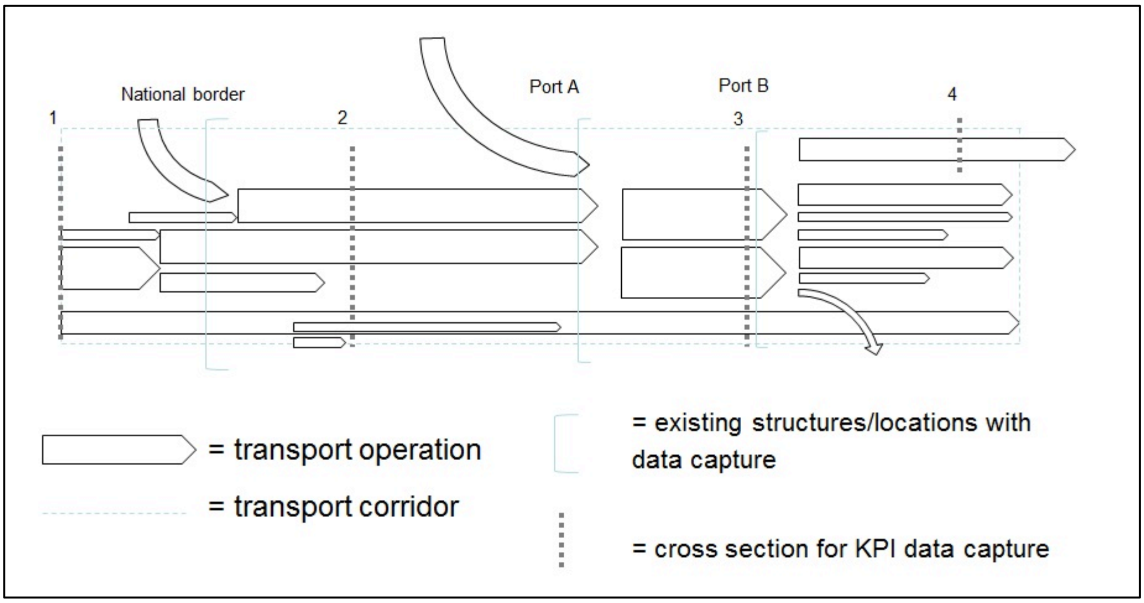
The goal statement should also contain a description of the intended use of the result of the KPI-analysis in order to meet the stated goal. A well formulated description of how the result will be used in the further work and communication will guide in the selections of objects to study or assess relevant KPIs, as well as in the allocation of relevant resources to carry out the task.

In this report the presentation and discussion will be based on the ambition to use KPIs to accurately describe the performance of on-going activities. Where no direct physical connection exists between the object of study and a process generating KPI data (e.g. electricity generation for train operations), the calculation will aim at describing the share of a generated KPI data for which the object of study should be held accountable or responsible when reporting data for on-going operations.

Step 2: Selection of objects of study

Based on the purpose and focus of the study as described by answering the questions above, the next issue to resolve is the selection of objects to monitor and how to set up useful system boundaries for the data inventory. The heterogenic nature of transport corridors, both in terms of physical and technical structure as well as in variations in volumes and nature of the transported cargo, makes it useless to suggest a fixed methodology to apply in all types of KPI-analysis. Instead a basic knowledge of the operations within the corridor should be the starting point for the application of a number of basic steps described below.

It will be virtually impossible to assess all operations within the entire corridor. The corridor itself will usually be defined in a broad and general manner making it difficult to identify all the transport operations and cargo flows that should be included. Even if clarity over this matter would be achieved, and the entire corridor were to be chosen to be monitored, the resources needed to address the data demand and calculation task would in that case rapidly outgrow what could be accepted as reasonable for the purpose. There will therefore in most applications be a need to wisely select a number of operations and cross sections within and across the corridor upon which the KPI-analysis should focus. As a model for the discussion on this issue, consider the following schematic picture of the cargo flow, in one direction, of a transport corridor. The transport activity in the corridor is pictured as being made up of a number of consecutive and parallel traffic and terminal operations.



Schematic picture of a transport corridor

Note that cargo might enter and exit the corridor at several locations and that a shipment might have origin and destination inside, outside, and on the border of the corridor. The dashed lines 1-4 indicate possible cross sections at which data for KPI assessment can be collected. Point 1 measures all cargo leaving the starting point of the corridor, point 2 measures all flows through a geographical cross section of the corridor (e.g. a mountain region with limited number of rail and road routes), point 3 measures at a dominating terminal (e.g. a port) through which a majority of the cargo is transferred and point 4 measures a specific transport operation (e.g. defined train or road operator). Several other selections and types of measuring points can be identified.

The selection of measuring points in the corridor must be made with the following aspects in mind:

- The purpose of the analysis – e.g. do we want to scan the entire corridor for the most non-sustainable operations in order to focus upon development work? Do we want to monitor the development over time in central processes/transport links along the corridor? And so forth.

- Select cross sections with few parallel operations – this reduces the number of operations to monitor in order to understand e.g. changes in volumes

- Find the largest and over time most stable flows, usually rail or sea operations and road operations connected to large industries/organizations

- Transport operations run by organizations that are able to and willing to share operational data must be in focus. Organizations that are already engaged in reporting e.g. trade and transport statistics could be preferred.

- Identify existing systems for data collection already in operations at operators (transport and terminals) and infrastructure suppliers, e.g. haulers vehicle monitoring systems, electronic waybill systems, terminal passage control systems, road toll systems, and customs and trade statistics.

- One could have a focus on including transport operations with known difficulties in terms of meeting sustainability criteria, e.g. operations with small profit margin, high dependency upon fossil fuels, engines with high emission levels or problematic working conditions.

- Include transport operations with known problems concerning imbalances in cargo volumes, this in order to focus on transport efficiency potentials.

For the reasons mentioned above it is suggested neither to embrace the entire corridor nor an entire cross section when selecting the object for a KPI-assessment.

Step 3: Selection of KPIs to evaluate

The process of selecting a set of KPIs to evaluate in order to assess the degree of sustainability is explained in the previous section. The complete understanding of the sustainability of the corridor or its components will be hard to achieve, since sustainability itself is a continuously developing concept and a field for much on-going research. The suggested sets of KPIs should therefore continuously be evaluated and developed, in order to maintain its relevance. A selection of KPIs to be applied should be made in relation to the purpose of the study and adopted to the operations within the objects of studies. The number of filling stations offering non-fossil fuels should for example only be used when assessing infrastructure such as roads, ports and rail systems. For the processes where cargo is relocated by a transport process the KPI should be made in relation to the produced transport work, instead of the total volumes handled, see the figure above for available options.

Step 4: Setting system boundaries for the analysis

Once the object of study is identified and the KPIs to evaluate are chosen a number of system boundaries should be selected, this in order to structure and limit the data collection. A wise selection enables comparison between consecutive KPI-assessments, since the captured data will be less prone to changes outside the scope of the KPI. The following dimensions are suggested as a baseline when defining the system boundaries for the study:

<u>System boundary - Transport service and technical structure</u>
The transport service must be described and defined in order to make it possible to select the relevant operations of physical/technical structure, vessels and vehicles (road/rail) that should be included. As an example, for a rail transport from a port to an inland rail terminal, the transport service could be described as follows:
Example:

Description of the operation
Traction of five 700 meter trains per 24 hours with loaded rail wagons, total average gross weight 1300 tonnes / net weight of 700 tonnes, by
1) diesel shunting locomotive (type, size, fuel consumption) from port rail terminal to (long distance) dispatch/shunting rail terminal – 3 km followed by
2) *line haul by electrical locomotive (type, size, electricity consumption) from (long distance) dispatch rail terminal to end destination – 790 km*.
No return trip is included.

We should thus, in this example, not include any empty positioning of the locomotives or rail wagons, nor any related transport tasks performed during or in connection to the described transport. E.g. any shunting activities at the dispatch rail terminal are excluded, as well as loading and unloading operations.

A road transport could be described as follows:
Example:

Haulage of 65 tonnes per day between factory plant A by three different truck units (type, size, fuel consumption to be specified) pulling one semi-trailer 360 km to port P. Returning to A on the same route with empty semi-trailer.

The operation of an intermodal rail terminal could be described as follows:
Example:

Operation of 2 reach stackers (type, size, fuel consumption, production performance) engaged in switching 110 000 Intermodal Transport Units (ITUs) per year between rail, road and storage in container/trailer yard. All lifts and movements connected to the transfer of ITUs are to be included in the operational data.

In all these examples other tasks and operations might be carried out by the vehicles and equipment engaged. Fuel consumption, economic data and emissions related to such external activities should be excluded from the analysis. The general rules of Life Cycle Assessment should be applied in the allocation between the different types of activities, in order to find the correct data related to the processes within the scope of the KPI study. Physical relations between processes and environmental performance data are preferred (e.g. environmental performance data connected to heating of a warehouse should be allocated between the cargo stored in the warehouse in proportion to the mass or volume, in combination to storage time). If there is a problem with allocating a correct share of the operational data to the defined activity, system expansion should be considered, i.e. to include the other relevant activities in the scope of the study (e.g. facilities for workers, such as locker rooms, cantina etc. within the warehouse building).

The setting up of system boundary in terms of technical system requires the analyst to describe which parts of the technical system deployed/engaged in the transport operations to be included in the inventory.
Example:

Are stand-alone temperature control systems on trailers and containers to be included or not? Should only the main engine in a vessel be inventoried or should all supporting systems such as auxiliary engines and boilers be included?

A common issue to be resolved is the allocation of environmental performance data between transport services produced simultaneously by one vehicle or vessel. One illustrative example of this is the RoPax ferry. The allocation between passengers, cars and cargo vehicles can be made by the application of different methodologies, all yielding significantly different results for the same operation. The analyst needs to select an allocation methodology, which at the same time reflects the resources required for the different tasks, at the same time as the allocation method can be described/explained and justified. It is wise to also consider the availability of the data needed to carry out the allocation calculation, this since more complex methods tend to rapidly increase the demand for specific information of the structure and operation of the vessel, as well as detailed operational data (capacity utilisation, consumption and use of resources) from the operator (which is usually hard to obtain!).

<u>System boundary - physical structure and geographical coverage</u>
This system boundary clarifies which technical and physical parts of a transport system to include in the analysis. The physical boundary is partly set by the selection of the transport operation to be analysed. The corridor itself is usually defined by a certain geographical limit and in many cases these limits will operate as system boundaries to a specific operation as well. The geographical coverage describes the borders within which the activities are to be described and

from which data will be retrieved.
Example:

Should the operation of the port be included in the data for a transport with a ship?
Should all operations in the entire port be included or should only a selection of terminals/quays be considered?
Should the operation of the shunting yard be included in the calculation for a transport with a train?

An important exception where traffic related data outside the geographical border of the corridor must be considered is the generation of electricity. Grid supplied electricity should be assessed based on an appropriate methodology as presented by standard LCA methodology. Several approaches exist and it is of great importance that the selected method is clearly stated, in order for the receiver of the information to assess the information.

It is important to recognize that the selection of method has a potentially very large impact on the result of the study. One must also remember that the selection of method should relate to the purpose and intended use of the inventory data. The suggestions made below are based on the ambition to correctly and efficiently calculate the environmental performance data that should be connected to an on-going operation in the transport corridor. This is an accounting and reporting assessment and the aim is to identify the resource use and emissions to air for which the operation under investigation should be accountable (or responsible). This data can therefore not be used to answer other questions such as 'what is the effect on the total emissions from the electricity sector (*ceteris paribus*), would the transport volumes in the corridor by electric rail traction double?' or 'how much will the total national CO2 emission change in the coming year in connection to a major modal shift from road to rail in the corridor?'. Questions like these require the application of other methods[2].

The following two methods are commonly encountered, although further variants are to be found in LCA literature and textbooks, see references in step 6 below and Kåberger (1998)[3], Frischknecht (1998)[4].

- Production specified delivery – If the electricity is supplied on a de-regulated electricity market the electricity user is free to choose supplier. On most de-regulated markets suppliers offer delivery contracts with specifications of which type of electricity generation technology (or mix thereof) the supplier engage in order to balance the electricity consumption for the specific customer. When such a contact exists should the environmental performance of this electricity generation (mix) be used in the analysis. This is the most cost efficient method available for an accurate assessment of the environmental performance of electricity use and is in line with the guide provided in the recent standard on 'Methodology for calculation and declaration on energy consumptions and GHG emissions in transport services[5].

- If specific delivery contracts do not exist, an average environmental performance can be calculated based on all electricity generated within (and traded in and out of) the electricity

[2] In scenario studies where e.g. the effects of changing transport volumes are to be assessed, the marginal production system response in the relevant electricity market system can be selected for the environmental data. The philosophy behind this method is that all other electricity users are unaffected by the increase or decrease in electricity use caused by the transport activity under investigation, why a response from the electricity generating system should be connected to the analyzed transportation. The appropriate response will differ between market areas and time horizon, but natural gas and coal condense power are the most common systems in most of mainland Europe.
[3] Kåberger et al. (1998), Electricity from a competitive market in life cycle analysis, J. Cleaner Prod. Vol. 6, pp.103-109.
[4] Frischknecht R, (1998), Life Cycle Inventory Analysis for decision-making, Doctoral thesis report, Swiss Federal Institute of Technology, Zurich 1998.
[5] CEN draft standard prEN 16258 by TC320, see www.CEN.eu.

market area, within which the electricity is used. Besides the large number of generation techniques applied in such a study, the production and trading data should be assessed. For a transport operation covering a long geographical distance the data demand for an accurate assessment can rapidly outgrow a reasonable budget. The use of national averages is usually the only feasible solution when this method is to be applied.

- In scenario studies where the effects of changing transport volumes are to be assessed, the marginal production system response in the relevant electricity market system can be selected for the environmental data. The philosophy behind this method is that all other electricity users are unaffected by the increase or decrease in electricity use caused by the transport activity under investigation, why a response from the electricity generating system should be connected to the analysed transportation. The appropriate response will differ between market areas and time horizon, but natural gas and coal condense power are the most common systems in most of mainland Europe.

<u>System boundary - life cycle dimension</u>
The operation of a transport system is supported by a chain of sub systems providing necessities, such as fuel and/or electricity, vehicles, vessels and rail wagons, infrastructure, such as roads, tracks, terminals and fairways, traffic management systems, back office operations, service and maintenance etc. The need for reliance of the results, in cooperation with the amount of available resources for modelling and data acquisition, sets the limits for how broad the life cycle system boundary can be set. The life cycle dimensions should be selected in such a way that the only corridor processes in focus of the study are covered. Road construction and maintenance could e.g. be left out, if the emissions from road traffic are to be monitored with the purpose to measure 1) the effect of the continuous succession of truck engine technology, 2) changes in total cargo/transport volumes or 3) the introduction of biofuels.

The general approach is to limit the number of life cycle processes to include as far as possible, without running the risk of missing out substantial processes.
Example:

The calculation of the economic sustainability might exclude the capital cost if the investment cost is small

The operation of an electric train should include the energy input and emission output from the power plants engaged in the electricity generation considered to balance the outtake of electrical power from the common grid.

<u>System boundary - time</u>
The selection of time period for which the KPI are to be evaluated over must be specified. The data has to relate to a defined time period in order to be interpreted correctly. By choosing 12 months as a base unit, variations due to holidays and season will be controlled. In practical work should, if possible, the same period as used in normal reporting and operation be selected, this since this will reduce the extra work, time and cost needed for data acquisition.

If the KPIs are to be monitored on a more continuous basis, a sampling routine should be described so that singular events or undesired factors are filtered away, e.g. national holidays, effects caused by natural causes (i.e. ash clouds, extreme weather episodes, natural disasters) or anthropogenic events (strikes, social unrest, armed conflicts etc.).

Step 5: Data inventory

Once the scope and boundaries are set up and described the data inventory should start. This is usually the most resource consuming part of the analysis, especially if the analyst is dependent on external sources. The ways to come about data will be situation-specific, however, some general considerations are listed for the support to the analyst:

- Make a preliminary data collection protocol and apply it to 1-3 test data providers. Establish a personal contact with the people given the task to provide the information. This test run will indicate the availability of data and the format and structure of the information made available. The respondents will also indicate any un-clarities in the questionnaire or which further data one should consider, in order to catch the desired information.

- The contact person can also be of help in finding alternative ways to resolve situations where data cannot be released due to commercial considerations. This is often the case when it comes to costs, revenues and cargo capacity utilization for engaged transport operations.

- When no response or data is obtained from an actor running an operation, considered central to the analysis, an assessment should be made based on literature, secondary data sources and expert judgments/assumptions. The relevance and accuracy of this calculated data will of course be limited. Operators are in many cases willing to comment and correct major errors or flaws in calculations presented for their operations.

- Operators are often concerned over the issue of proliferation of their information. Clear statement on how data will be stored, used and destroyed can make operators less reluctant to reveal requested operational data.

Again, data collection is often cumbersome and resource demanding. All efforts should be made to set up relations with all organizations from which data must be collected, in order to calculate the KPIs. Where relations and negotiations offer the possibility demands for data reporting could be worked into agreements and contracts. If possible data collection and transfer should be made automatically between existing computer systems, in order to reach cost efficiency and less errors.

Step 6: Calculations and quality assessment

Based on the data collected, the selected KPIs will be calculated. The calculations are usually limited to simple unit conversions and divisions with respect to the relevant time period. Both absolute and relative KPI-values can be calculated and presented.
In the calculation process methodological questions might arise, such as allocation issues, lack of specific or average data or how to use historic data. The best support to such issues are to be found in Life Cycle Literature e.g. Guinee (2002)[6], Sonneman et al. (2011)[7], ISO 14044 (2006)[8] and or in WBCC and WRI (2004)[9]

The question of quality and accuracy of the result is however much harder to resolve. Data is usually not connected to any error estimates and rarely available at such numbers, so that statistically methods could be applied with any success. A further source of error is the impact on the result caused by the selection of assessment and calculation methodology. Selection of scope, system boundaries and allocation methods are all examples of method choices causing impact on the result. The size of these errors and variations are not possible to resolve, given these problems. The best practice solution is to secure the following steps:

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[6] Guinee J., (2002), Handbook on life cycle assessment operational guide to the ISO standards, Springer Berlin, 2002

[7] Sonneman G. et al. (2011), Global Guidance Principles for Life Cycle Assessment Databases, A basis for greener processes and products ('Shonan Guidance Principles'), UNEP/SETAC Life Cycle Initiative, 2011.

[8] ISO 14044 (2006), Environmental management - Life cycle assessment - Requirement and guidelines, Int. Org. for Standardization, Geneva, Switzerland.

[9] WBCSD and WRI, World Business Council for Sustainable Development and World Resource Institute, The greenhouse gas (GHG) protocol: A corporate accounting and reporting standard. Revised edition. ISBN 1-56973-568-9. 2004.

- Make clear statements and explanations regarding selected scope, system boundaries, methods used and, if possible, the sources of data.

- Limit the number of significant digits in the presented result, in order not to present digits not carrying any relevant information. Present a qualitative judgment or estimation of the possible error sources.

Practical tests of the suggested KPIs - main results

In order to test and evaluate the presented key performance indicators five components of the East West Transport Corridor were selected and evaluated.

The cases were selected in order to cover a broad range of operations in the transport corridor. The enabling dimensions were exemplified by the port of Karlshamn (RoRo operations) and the port of Helsingborg (unit loads), while transport operations were covered by examples from road, sea and rail operations. The cargo owners' perspective was exemplified by one company in the retail business (with road transports between Sweden and East European countries) and one heavy industry in the automotive sector. These examples were considered sufficient, given that the purpose of the study were to explore the application of the suggested KPIs to components of the corridor and not to assess the corridor as such.

The following information can be drawn from the results of the cases:

Energy usage and carbon dioxide emission data was available from all the processes for which data was obtained. The existence of environmental management systems has made this information available both inside and outside most organisations in the transport industry. The availability of transport quality data was not good, which could be a reflection of a lack of monitoring systems for this issue. The lack of widely accepted uniform methods/measures and indicators for the communication of quality data is a probable cause for this. This issue is however of great interest to several actors, not the least customers and cargo owners, why this data probably could be extracted in a deeper dialogue/collaboration with the actors in the corridor.

The main problem encountered in the data collection was the unwillingness to release data, especially concerning economic factors, such as costs and revenues. The main concern is the risk to reveal non-transparent internal production cost and actual degree of load capacity utilisation, both key-information for a customer in future price negotiations. Measuring the economic efficiency by investment, both in absolute terms (Euro) as well as relative investment rate (investment/fixed assets), may be an alternative.

The selected KPIs for the social dimensions do not give a deep understanding of the status of any of the selected processes. There is a need to further develop the understanding of which the key social concerns are in terms of judging the sustainability of a transport process. Thereafter a more illustrative set of KPIs should be selected. Issues such as age profile, gender, educational level, experience/years in the profession, wages for the work force could be considered. In terms of society it could be of interest to monitor how large share of the traffic/operations that takes place in densely populated areas and to what degree the related traffic is operated on congested infrastructure.

It is important to keep in mind that the values presented in the report are not representative for the transport corridor investigated. The main purpose with the study was to evaluate the availability of operational data for the calculation of the selected KPIs. The presented values should not be used for any other purposes.

Given that the identified lack of data concerning quality and social sustainability were to be addressed, the selected KPIs can be used as a reference, both in terms of presenting a status level, as well as when comparing data between different time periods.

Experiences and recommendations for KPI evaluation

Application of KPIs

In the future work of applying the suggested KPIs to processes in a transport corridor, the following aspects should be considered:

- In the data retrieving, a separation between processes handling the goods (reloading, storage) from processes where goods are transported (relocated between addresses) should be made. For both types of processes the total volumes will be of interest, while for the transport processes also the actual transport distance should be investigated. The following data analysis differs in terms of unit for the relative values; per tonne or per tonne-kilometre. It could also be useful to know how many separate movements or shipments the data presented is based upon.
- Given the difficulties in retrieving information regarding the economic aspects of the process, one should consider leaving this issue out of the analysis. An alternative could be to limit the publication of such data, unless an average value can be calculated based on three or more separate data sources. This could make it possible for more organisations to release this data, without running the risk of losing business potentials. Leaving the economic data out of the green corridor definition would be to rely on the rationale behaviour of all organisations active in the corridor. The risk would be to miss signals of economic problems that could lead to a fast cancellation of operations. It is not unrealistic to have environmentally and socially sustainable services with weak economic foundation.
- The time aspect could also be considered (perhaps as an alternative to economic data) in the evaluation of the sustainability. This data is less sensitive and could give an indication of how well the operations are developing. If this data is benchmarked against other similar operations in other corridors, deviations in service levels and sustainability could be illustrated.
- It is important to reduce the cost (in time and money) connected to the data capture, both for the corridor manager and the respondents in the industry. The KPIs should therefore be based on already collected data in e.g. economic, production and environmental management systems. Systems making it possible to create automatic transfer of the data between computer systems should be sought.
- In order for the corridor provider to motivate the communication of operational data for KPI evaluation, some form of advantage or kickback for the respondent should be offered. Perhaps data, such as on-line status (congestion, average speed, incidents affecting the access etc.) of different parts of the infrastructure could be made available in a manner attractive to an operator? Average performance data for the average service provider in a corridor could be useful as a benchmark for different actors in the transport chain? Acknowledging the risk and cost, for any actor in the business, associated with retrieving and communication of economic, environmental and operational data should be considered. A proportional advantage should be offered to the data provider from the corridor manager.
- In the development of an operational system for retrieving and processing data connected to environmental performance of transport operations, on-going work in the area of standardization should be considered. The ISO standard 14033 (Environmental management - Quantitative environmental information) will be a compliment to standard 14031, which both should be consulted. The work of organizations, such as ISO (www.ISO.org), CEN (www.cen.eu) and the Network for Transportation and the Environment (www.ntmcalc.org) should also be assessed, in order to adapt to on-going work in the field of data structure de-

velopment and standardization. This covers work in all three dimensions of sustainability – environmental, economic and social sustainability.

- In terms of the purpose for the KPI analysis, a corridor manager could focus upon describing the present status of the operations within the corridor. A representative strategic sample of operations within the corridor should be monitored, in order to follow up on the development in terms of sustainability goals and targets.
- A last reflection on the issue of KPIs and their usage: KPIs used to analyse if a corridor, or any components of a corridor, fulfil a stated level of performance, in order to be denoted 'green', should be based on data retrieved with as little calculations as possible. This, since all selections of calculation methods carry with them an impact on the final result of the analysis, thus opening up the discussion of which method to use in order not to impose a subjective impact on the result.

Policy measures

The purpose of this study on policy measures is to identify and recommend a set of measures and incentives that will help creating a successful green corridor. A green corridor is a step towards a sustainable freight transport system. It can be regarded as a test bed and a good example on how to build a sustainable transport system. However, shifting the whole transport system towards sustainability and a total reduction of CO2 emissions up to 60-90 % will need more and probably different set of policy measures than the ones that are recommended in this study.

Background and scope for policy measures

There are only a limited number of economic incentives implemented to steer the freight transport sector towards sustainability. Although the results 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 or to make a green corridor attractive enough for transport buyers. On the other hand, most actors in the freight transport sector and in academia do agree on that it is necessary to develop and use efficient policies and incentives to create new markets and innovations and through that, a more sustainable freight transport sector. A combination of carrots and sticks, positive incentives, agreements, taxes and regulations is needed. 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.

Several trials have been made to implement policy measures, 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 have been successful. The projects have not been implemented after the pilot tests are over and the separate project funds are used[10]. One of the most important reasons for this is a lack of strong business models, whereby the positive incentives offered by the authorities were not enough profitable for the involved companies to change their products or services.

For long distance freight transport, distance-related vehicle charges have been implemented in some countries. 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[11] and simulations show that a modal shift from road to rail can be expected that for Swedish conditions means up to 13 % reduced road transport, but the potential is very much dependent on the price of road transport[12]. The effects on emissions of CO2 are dependent on how the electricity production is done. A combination of Road User Charges (RUC) and CO2 taxes can in Sweden, with about 95 % fossil free electricity production, mean a total estimated potential of CO2 savings to 10-15 % if the transport demand is unchanged.

The freight transport sector is not very sensitive to increased fuel prices, so incentives like CO2 taxes have not shown to be effective to reduce freight transport activities. Most transport companies have contracts that allow them to increase the price if the fuel price increases.

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[10]Lindholm M, (2008), A sustainability perspective on urban freight transport: Factors and incentives affecting local authorities in the planning procedure. Chalmers University of Technology, Gothenburg

[11]Liechti M & Renshaw N, (2007), A Price Worth Paying - A guide to the new EU rules for road tolls for lorries, T&E, Brussels

[12]Lundin M, (2007), Structuring and Analysis of the East-West-Corridor via Skåne-Blekinge, EWTC, Publication 2007:WP2_REPORT 6, Publishing date: 13 August 2007 Publisher: Region Blekinge.

McKinnon[13] 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 freight transport services due to a single measure like CO2-tax or distance related vehicle charges.

On the other hand are CO2 based taxes very efficient for the passenger transport sector. The results from a simulation of the effects on the Swedish transport system, shows 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), higher CO2 based vehicle taxes (2,8 €/gram CO2) and RUC (0,8 €/vkm) are the dominant measures. The CO2 savings are in the passenger transport sector while the freight transport sector still increases the emissions due to increased transport demand.[14]

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

Key findings and results

Economic incentives and means of control, e.g., CO2 tax, RUC 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, recognizing and accepting the necessary changes even if it means changed market conditions. New rules and incentives create new markets and is a business possibility for proactive companies that participate in green corridor cooperation.

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. 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 do 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 and terminals, in order to improve the prerequisites for modal shift and using the most suitable transport mode for each transport task. 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

[13] McKinnon A. (1998), Logistical Restructuring, Freight Traffic Growth and the Environment. In: Banister D. (Ed.) Transport Policy and the Environment, E&FN Spon, London and New York, pp. 97-109.

[14] National Road Administration (2009), Nationell plan för transportsystemet 2010–2021, Publication 2009:157, Borlänge

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 NOx have been reduced by 50 % and this has occurred virtually without interruption since the charge was introduced in 1992[15]. There is a similar case from the transport industry in Norway, where a tax on NOx has led to an increased use of LNG (Liquefied Natural Gas) and CNG (Compressed Natural Gas) 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.

To conclude the findings from the introduction of economic incentives, i.e., CO2-tax and distance based road user charges have 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. Thus, these measures must be combined with the other kinds of possible incentives; legal, supportive and voluntary measures to reach a substantial reduction of environmental impacts from the transport sector.

Finally, to be able to get acceptance for these measures it is of utmost importance to have 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 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. Thus international agreements on standardized emission calculation methods and also accepted methods on how to calculate external costs, together with successful business models that create new markets for proactive transport companies, are prerequisites for successful implementation of really "green" green corridors.

Categorisation of policy measures

In the studied literature there are several examples and different ways to categorize policy measures for the transport sector. Based on the results from the workshop and literature review, the policies and incentives relevant for the freight transport sector, and green corridors in particular, have been categorized in four different groups:

- **Economic incentives**
  - Fuel/CO2 tax
  - Vehicle tax
  - Road/fairway user charging environmental performance differentiated
  - Congestion charges
  - Emission trading

These are incentives that increase the cost on transport. The purpose is mainly to promote a higher load factor and a more energy efficient transport, or to promote the use of better environmental technologies.

- **Legal incentives**
  - 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
  - Other directives

[15] Svärdsjö L & Gustafsson B, (2003), Kväveoxidavgiften – ett effektivt styrmedel, Swedish Environmental Protection Agency, Report 5335, Stockholm

Legal incentives are 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. 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.

- **Supporting incentives**
  - 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

Investments in infrastructure, especially in congested “bottlenecks” and ports/terminals are important for the lead times and punctuality for the transport industry. Standardized equipment, containers, terminal equipment, transport carriers, ICT and ITS systems, etc., and a smoother passage crossing borders are other actions that can promote green corridors. Removing these barriers means strong incentives to the involved actors.

- **Voluntary incentives (can be supported by authorities)**
  - Heavy eco-driving
  - Alternative fuels
  - Implementation of environmentally adapted technology
  - Information Broker System
  - Freight rolling stock exchange
  - Freight exchange
  - Advice and good examples
  - Accreditations/Certifications

The transport business can voluntarily, or with the help or support by the authorities, implement better environmental technology to reduce the negative environmental impact from using the transport means, or open for others to use or trade free capacity in order to increase the systems load factor. The business can share good examples and educate the actors in the sector on eco-driving and sustainability issues.

Success factors

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

➢ There is a self-sustaining corridor where there is a good business case for all interested parties, i.e. shippers, transport service providers, 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 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, robust and reliable accessibility and time related factors like delivery precision, lead time and high security are 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 are adjusted to the needs of the freight transport sector and have high capacity and a well maintained, 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 sound technology and open up for improving the load rate through cooperation and open freight rolling stock exchanges and freight bourses.

Incentives requested from the authorities

The results from the workshop show the following recommendations on positive incentives from the authorities involved in creating a green corridor. All incentives are regarded important, but they are presented in an order of considered importance by the experts in the workshop.

<u>Infrastructure and terminals</u>

- **Give the same priorities to the whole Green Corridor. All member states have achieved a high standard of infrastructure capacity.**
  - A common trans-national planning of cross border infrastructure and a high level of operational and maintenance of infrastructure.
- **Improved efficiency in the interface of intermodal transfer.**
  - Open access to infrastructure and terminals
  - Standardized equipment, rules and regulations
  - More capacity on critical nodes
  - Integrated terminals with good hinterland connections and more efficient terminal equipment
- **The possible revenues from the internalisation of external costs shall be used for infrastructure investments**
- **Safety and security**
  - Theft protection and safe rest areas for lorry drivers
  - Improved traffic safety systems for all modes
- **Improved land-use/infrastructure planning**
  - Strong cross-regional and trans-national planning, concentration of flows, possibly also in combination with road user charges
  - Notice the necessity to cooperate between municipalities, regions and countries

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.

The expert group points out 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. 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 was regarded as important issues for the authorities to address.

<u>ICT infrastructure</u>

- **ICT/ITS infrastructure is sufficient to handle the need for the green corridor**
  - Better route planning systems with real time information
  - Implementation of "internet of things"
- **Open Access to relevant information, Information Broker System**
  - Traffic information
  - Transparency in the Supply chain
  - Open for all actors
  - Data security in the information chain
  - Good reliability in the information broker system
- **Revenues from the internalisation of external costs shall go to ICT/ITS investments**

The expert group agreed on that a well-functioning ICT system is a prerequisite for a green corridor. A first step is to ensure open and reliable access to traffic information and route planning systems. However, the most important thing that the authorities can do for the transport business active in the green corridor is to create a robust and open digital infrastructure. This is as important as creating a robust and flexible physical infrastructure. 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.

In connection to this open system, an effort to establish an “Internet of Things” would 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.

The expert group also stressed the importance of good reliability and security in the information chain. A lot of information related to the company’s business must be kept secret.

<u>Other positive incentives</u>

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 limitations and use of terminals and railways in night-time
- Prioritized access in ports, terminals, customs, and bus lanes in cities
- Tougher regulations and restrictions for transport outside the corridors

The expert 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. They 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 impact.

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 exchange, etc.

Incentives requested from the transport industry

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 factor. A baseline on technology levels on vehicles and vessels operating in the corridor should be design by the involved actors. This means to define a set of rules on which minimum Euro class on trucks that will be allowed, ships and trains with modern exhaust after treatment devices, like catalytic converters and particulate filters, alternative fuels etc. The vehicle and vessels used in the corridor shall also have a high load factor. A freight rolling stock exchange and a freight exchange for available capacity in the system are two other ways to increase the systems load factor. A harmonized reporting system should be implemented to achieve this.

We recommend that a system should be developed that is technology neutral. An agreed baseline level of accepted emission levels per tonne freight transported in the corridor shall be defined, that is significantly lower than the average transport service in Europe. This is much more efficient and fair than demands on certain vehicles or vessels. The transport sector can then choose how to meet these demands, by investing in new vehicles or vessels or with actions to increased load factors, eco-driving or other actions, like shift to other transport modes. As previously 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.

Summary and suggestions

Recommendations on KPIs

Based on the presented work with green corridor KPI-analysis and governance, the following suggestions are formulated:

The concept of sustainability is multidimensional and therefore difficult to describe in a condensed way. The focus in the sustainability work tends to be rapidly shifting and any method set up to monitor the sustainability status must be agile in its structure.

Important general conditions and considerations in key performance indicators development are:

- Operational control of goods flows through KPIs has always been a common way of managing performance in transport logistics services. This experience needs to be included and integrated in the operational indicators.

- There are difficulties to capture relevant data with sufficient accuracy and reasonable effort, in order to not put all resources into data capturing itself.

- The system boundary of captured data must be well defined and constant over time, when measuring improvements or relations to other corridors.

- Selected KPIs must be manageable in practice and not over ruled by legislation or other external factors.

- Performance indicators may change behaviour of organisations and people within the process being managed by KPIs. Awarding systems may amplify this potential, but also add a potential risk of sub-optimization.

- Key performance indicators can be counterproductive in relation to the original objective, due to poor performance indicator design. If relevant KPIs are established, they may initially serve the purpose well, but may over time become out-dated. Hence there is a need to continuously evaluate their functionality.

- There is a need for both operational and enabling key performance indicators with different time frames, and significant trade-offs between short and long term ambitions. These two groups of indicators relate to each other but need very different design. In order to reflect green transport and corridor performance there is a need to include KPIs for both operational aspects as well as enabling aspects i.e.:

    1) Operational aspects, such as corridors location, transport techniques and business models
    2) Enabling aspects, such as infrastructure, legal requirements, standards, ICT, organisation etc.

The KPIs must be few, relevant and designed according to the identified key stakeholders' needs.

Indicators should be grouped into:

1) *Operational indicators* - aiming at optimizing on-going transport flows with regard to their overall sustainability performance. If possible, these performance indicators may be aggregated on a corridor level.

2) *Enabling indicators* - to be monitored in a corridor dashboard, where the aim is to optimize long-term development with regard to sustainability performance and thereby also hindering the risks of various sub optimizations.

In the application of KPIs to components in a transport chain, the economic and social dimensions are most difficult to inventory. The reluctance from actors to communicate relevant economic data makes it in many cases impossible to monitor this with a KPI. The economic sustainability will probably have to be reflected through secondary indicators, such as development of cargo flows, rate of investments in machinery, infrastructure and rolling equipment or economic data on an aggregated level for the organisations engaged.

The environmental sustainability is easier to monitor by the suggested KPIs covering energy use and emissions. The issue of noise, land use and barrier effects could be sketched out by creating a KPI based on an inventory of how large share of the route that passes through densely populated areas.

A system for data capture in the KPI analysis should, as far as possible, be based on existing data possible to transfer with a minimum of manual operations.

Recommendations on incentives and policies

A green corridor will never be realised unless there is a sound business model for all actors involved. To make this happen and to create new markets and innovations in the transport sector is it necessary to implement a number of different policies. A successful green corridor can only be achieved if a combination of economic; legal; supporting and voluntary incentives is implemented.

The main messages to the authorities involved in creating “Green Corridors” as a successful concept are that there must be harmonised rules 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 that attracts the actors in the transport sector to use a green corridor 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, ICT/ITS-infrastructure and priority access at borders and terminals.

One good example on how to adjust infrastructure investments to freight transport needs is to invest in grade separated intersections instead of roundabouts, increased axle load for heavy trains and trucks and more bypass tracks in the railway system. The economic incentives that can be used must as much as possible be related to the external costs that the transport activity causes and should be transferred back to the transport industry in e.g., infrastructure, terminals or ITS investments or more direct support to eco-efficient investments in the industry. In this way is the competitiveness for more environmentally sound transport solutions improved on the expense of the more polluting ones.

Increasing CO2-taxes or road user charges for the transport sector as a whole can in this way be used for investments in the green corridor. The result can in this case be twofold; a better efficiency in all of the transport sector and a help to increase the attractiveness of the green corridor.

It is important to stress that improving infrastructure alone does not reduce the emissions in the corridor and does not make it any greener. In return, the transport actors should 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 transport system and increase the transparency on load factors 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 making 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.

A difficulty that must be addressed by the actors is how this can be implemented. How shall it be monitored and reported? How can we be sure that only the certified members of the green corridor use the improved infrastructure? Shall only the certified be allowed to use it, or is it better for the environment if it is open for all actors? Shall the others pay a fee to the Green Corridor? These questions should be dealt with in the discussion on which “carrots and sticks” that will be used in creating a Green Corridor.

The recommendation to the actors involved in realizing a Green Corridor is primarily to ensure that there is a sound business case that motivates the industry to make the necessary investments, to implement technology and other efficiency measures, to create a sustainable transport system. Primarily improving the accessibility and the security that reduces the delays and disturbances in the Green Corridor will do this. A raise of CO_2-taxes and road user charges will have some effects on the transport system. However, lowering the (relative) price on transport services by subsidies or tax reductions in the green corridor will not have the same effect as the motivation to use the green corridor due to the increased reliability and punctuality offered. The transport sector must in return ensure a lower environmental impact in the green corridor.

It is not likely that all the actions shown in this report will be possible to realize. The expert group recommends the following prioritizations for the corridor partnership work with themselves and to recommend the involved politicians and authority representatives to work with.

- Agree on harmonized KPI-operational data reporting systems and emission calculation methods. It is necessary to get acceptance for any economic means of control, or other transactions involving monetary incentives, based on environmental performance.

- Agree on setting a traffic mode specific baseline on i) emission levels, ii) energy use iii) social conditions and iv) economic performance for a ‘green corridor transport’ service that are significantly better compared to a regular transport service. The actors that meet these levels get a certificate or permit to run in the green corridor and receive the benefits.

- Do not regulate which technical/organisational solution that the actors should use in order to meet the green corridor requirements – leave it up to the experts to find the most cost efficient way to meet sustainability in the production of transport services.

- Persuade the authorities to accept the incentives suggested under “Other positive incentives” above. These are easiest and cheapest for the authorities to implement as a start.

- Point out a “prioritized list” to the authorities of where in the corridor the infrastructural bottlenecks are. Stress the importance that infrastructure must be adjusted to the needs from the freight transport sector. Where do you lose most time, or where are the highest risks for delays and disturbances? The results from the workshop can be used as input.

- Develop a commonly accepted requirement specification for a suitable ICT system that the business agrees on. The results from the talks can be used as input for a discussion within the consortium and with the authorities.

- The members of the consortium can be active in the political debate and be a part of forming the coming incentives to steer the transport sector into a sustainable direction. There will be a pressure on the politicians to make the transport sector more sustainable and incentives and regulations are the only tools that they have. It is better to be proactive than reactive to ensure that the incentives that will come also will help to develop new markets and not hindering them. The consortium can clearly point out that an environmentally induced fee, based on the KPIs identified in the project, is acceptable if it's used for infrastructure and ICT investments and if it promotes the environmentally sound solutions in the green corridor.

Annex

List of participants in the workshops

Workshop on Incentives and policies, Malmö, 06-09-2011

Participants:

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Thomas Ney, Region Skåne
Vytautas Paulauskas, Klaipeda Shipping Research Centre

Workshop on KPI criteria´s for green corridors, Malmö, 15-06-2011

Participants:

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Start meeting, Malmö, 03-05-2011

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Tore Almlöf, Municipality of Karlskrona
Vytautas Paulauskas, Klaipeda Shipping Research Centre

List of relevant documents

1. EU - WHITE PAPER: Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system

2. East West Transport Corridor - Strategy and Action Plan, Final Report - December 2007

3. SuperGreen full documentation, www.supergreenproject.eu, Special focus on deliverable D2.2; Definitions of Benchmarks Indicators and Methodology. SuperGreen technical review report, European Commission February 15, 2011

4. Network for transport and environment, NTM, www.ntmcalc.org
- Road transport
- Sea transport
- Rail transport
- Air transport

5. Swedish Green Corridor Criteria's
http://www.trafikverket.se/Foretag/Trafikera-och-transportera/Planera-godstransporter/Grona-korridorer/

6. EcoTransIT Methodology paper, www.ecotransit.org

7. Mobility 2030 - Meeting the challenges to sustainability, full report 2004, World Business Council for Sustainable Development

8. EU Transport in figures
http://ec.europa.eu/transport/publications/statistics/doc/2011/pocketbook2011.pdf

9. Cofret, Draft report summarizing existing methodologies and tools for transport environmental performance assessment, www.cofret-project.eu

10. BE LOGIC, Result reports, www.be-logic.info

11. Accounting principles (business practice). Various transport company's annual reports and KPI reporting (Green Cargo, DHL, Schenker, DFDS)

12. General definitions of sustainable logistics, www.greenlogistics.org

13. Transport logistics and environment – an overview 2011, www.conlogic.se

14. EWTC II - WP4A, Policies and indicators in the greening of EWTC, Vilnius, September 2011

15. Standards
ISO 9001, Quality Management Systems
ISO 9001dg (dangerous goods)
ISO 14001, Environmental Management Systems
ISO 14031, Environmental Performance Evaluation
ISO 14033, Quantitative Environmental Information
CEN draft standard prEN 16258, Methodology for calculation and declaration on energy consumptions and GHG emissions in transport services.
ISO 28000, Security Management Systems for the supply chain
ISO 31000, Risk management Systems
ISO 39001 (draft), Risk management System for Traffic Safety
TAPA, The Association for cargo facility and transport security, www.tapaemea.com
EuroRAP, The European Road Assessment Programme, www.eurorap.org