Green Corridors Criteria
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Förord

Rapporten behandlar det högaktuella området Gröna Korridorer. Ämnet i fokus är kriterier för att mäta effekten av projekt med mera. Mätningar underlättar beslut om och kvalitetssäkrar GK-projekt. Mätningar kan också vara till hjälp för att utvärdera projekt och initiativ.


Kenneth Wålberg
Projektledare Gröna Korridorer
Green Corridors Criterias

Green corridors, including links and nodes, aims at enabling large scale transport solutions through sufficient infrastructure and supporting regulations in order to accomplish economic development through efficient transport logistics regarding:
- cost
- environment
- quality
- traffic safety
- vulnerability risks

This criteria report presents criteria’s for the environmental performance of multimodal transport services. To summarise, the report suggests what key performance indicators should be used (focusing on Energy use, CO₂, NOₓ, SOₓ, and PM). Furthermore, an idea for a methodological approach for evaluating projects ex ante and ex post is proposed. To follow such a process is important for applications, projects etc to be treated in a common way.
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1. Introduction

Effective and reliable transportation of goods is necessary for competitiveness, growth and welfare. Transportation brings positive effects to society and its citizens. The drawback of transportation is its negative effects on health, environment and climate. The challenge is therefore to bring the negative effects to a minimum and, simultaneously, stimulate the positive effects of trade and freight transportation. This challenge has put transportation and logistics high on the sociopolitical agenda as well as in the procurement principles of many industries that requires transport services with low negative environmental impact.

There are many measures needed in order to improve goods transport’s general environmental performance. Large scale solutions, generally lowers the relative negative impact and increases productivity i.e. profitability through cost reduction and increased income, hence enables the introduction of new cleaner techniques leading us forward. In the EU logistics action plan this conceptual principle has been introduced under the name of "Green Corridors". The Swedish Logistics Forums supports the EU Commissions ideas and ambitions and are consequently promoting Green corridors. The objectives of the Swedish initiative are:

• To demonstrate efficient transport solutions by joining forces to upgrade ongoing transport efforts
• To promote the development of Green Corridors in EU transport policy based on common definitions and criteria’s
• To establish international partnerships that can lead to Green Corridors to and from the Nordic region

1.1 Objective

The objective of this report is to discuss and propose relevant and robust environmental criteria’s that can help us to select, compare and evaluate green corridor projects. This framework of criteria’s is necessary when certain projects are to be qualified and maintained as a green corridor project. The criteria’s can be used, ex ante, when setting up new projects or ex post when evaluating ongoing and completed projects. The input data for these two analyses would be similar but involve different degrees of uncertainty. The evaluation criteria’s are furthermore important in the undertaking of performance improvement activities. Measuring performance should be accompanied by competence regarding interpretation of the results, its potential and the realism in implementing the ideas in real full scale corridors. External verification of results may be necessary if commercial and other societal benefits (i.e. subsidies, tax reductions etc) are involved.

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1 Today’s transport techniques are significantly cleaner with regard to health and environment compared to older transport techniques.
In the long run it would be a major advantage to be able to compare and evaluate projects around the world using the same standardized method. This report could be seen as a first step towards using the same method on a, at least, European level. Therefore, it is important to communicate and dialogue the findings here with other projects and initiatives sharing our interest in the field.

### 1.2 A process oriented approach

Green corridors involve a set of various aspects affecting its performance. Corridors implies a smoothly flow of cargo at large scale, hence a vulnerability exposure as a brake down potentially would cause severe problems. Green implies a specified ecological performance that needs to be evaluated according to specified guidelines. A major contribution to good environmental performance is large scale transport solutions i.e. a close relation to the corridor.

Evaluation performance needs very specific guidelines on methodology and accurate input data used. The evaluation can be based on environmental impact assessment (e.g. emissions etc) or mitigating activities (e.g. number of Euro 5 engines etc). In order to develop over time, the performance criteria’s also needs to develop over time according to general technical and organizational progress. This would lead to a need for criteria’s continuous improvements.

In principle there are two aspects that need follow up, hence performance indicators. Firstly there is a general need to follow up the platform, *the green corridor* being the enabler of good transport logistics operational performance. Secondly the operational performance, *green transport services* need separately indicators. This report focus on the operational green transport service performance, but without a sufficient platform good operational performance will be difficult to obtain.
Performance Improvements programmes
Baseline/benchmark Capacity (Corridor)
Methodologies & data
Conditions -Legal - processes
Activity based performance
Impact based performance
Vulnerability
Risk assessment
Strategies
Objectives
Activities

Figure 1. Green corridors involve several aspects regarding performance follow up. In the long run it would be a major advantage to be able to compare and evaluate projects around the world using the same standardized method. This report could be seen as a first step towards using the same method on a, at least, European level. Therefore, it is important to communicate and dialogue the findings here with other projects and initiatives sharing our interest in the field.

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The criteria’s must furthermore, on a continuous basis undergo modification describing general baseline improvements. Ongoing projects environmental evaluation should include a relevant baseline KPI’s\(^2\) such as use of fossil resources, various emissions etc. Improvements due to organizational and technical improvements should be taken into account through a regular annual follow up. Thus the benchmark baseline is likely to gradually decrease over time regarding allowed emission levels. Analyzed Green corridor projects needs to improve equally much in order to remain within defined criteria’s.

Other projects on evaluation criteria’s
The development of relevant criteria’s will most likely develop over time and be influenced by other initiatives. The intention of this report is to actively interact with all parties working in this field, such as the EU-project Supergreen\(^3\) thereby ensuring a sound set of criteria.

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\(^2\) Key Performance Indicator

\(^3\) (http://www.supergreenproject.eu/) “The purpose of SuperGreen is to promote the development of European freight logistics in an environmentally friendly manner. Environmental factors play an increasing role in all transport modes, and holistic approaches are needed to identify ‘win-win’ solutions. SuperGreen will evaluate a series of ‘green corridors’ covering some representative regions and main transport routes throughout Europe.”
2. **Working group**

The working group responsible for this report has consisted of:

- Catherine Kotake, Swedish Transport Administration
- Mats Boll, Volvo AB
- Magnus Swahn, Conlogic AB
- Rikard Engström, Swedish Transport Administration
- Gerhard Troche, KTH – Royal Institute of Technology
3. Reference pillars

In order to discuss measurement criteria’s for a logistics solution it is necessary to have a clear idea of the solutions content, i.e. Green Corridors. One drawback is that neither the term “green” nor the term “corridor” is well defined in a common way in Europe. One consequence is that there is a huge spread in different projects characterizing themselves or being characterized by others as green corridor projects. In this context we therefore emphasize four general pillars for the coming evaluation criteria’s.

Simple and Clear
The indicators and criteria must be as simple and clear as possible. This will make it easier for the owners of the project and ideas to make their project fit well into the ambitions in the overall green corridor initiative. To have simple and clear criteria furthermore makes it easier and fairer when comparing projects with each other and over time.

Measurability
The indicators and criteria used should, as far as possible, be measurable. This is necessary for the same reason as mentioned above. However, it should be understood, that it is possible that indicators/criteria that are not directly measurable (at least not in an unambiguous way). Measurable criteria’s might therefore need to be supported and complemented by a qualitative evaluation analysis.

Verification
In order to reduce the risk of bias or subjective performance results there should be a built in process of verification by a second opinion. The verification could be carried out by a second or third part auditor. If the ambition is third party verification there is a need to relay on a neutral evaluation program such as ISO. A practical option could be the Product Category Rules, PCR (ISO 14 025), thereby enabling third party verification. A more simple solution is to develop stand alone criteria’s that could be verified by selected auditors from the industry. In annual reports the corridors and the verifications and suggested, motivated, changes could be presented.

Credibility
It is important that the indicators and criteria’s are highly credible (trustworthy) and reliable yet not more complicated than necessary and achievable. Indicators that are too complicated or technical might be difficult for users to understand and interpret and less communicative. Ideally the indicators are also usable for benchmarking from a time-perspective.

Ideally the indicators should be agreed upon by scientific experts and all types of stakeholders. However, definitions and how/what to measure in the area of green freight transports are not fields of unanimity! Differences exist between countries, industries and persons. It is probably more important that the indicators and the ways of measuring are widely accepted than they are totally scientifically accurate. A second-best measurement having a high credibility might therefore be used.
4. Categories of Green Corridor projects

Green Corridors could be divided into three main categories of projects that interact and complement each other. In total these categories promote the view of logistics/transports as a system of integrated services and properties aiming at increased efficiency and a reducing negative ecologic impact. A corridor project can be composed of a mix of the different project categories or one specific project category.

1) **Corridors (links and nodes)**
   A corridor project is a geographic sub-corridor of the defined main European Green corridors or a corridor that support those. It is based on the needs of an efficient transport infrastructure, both in a physical and/or communicative aspect.
   A corridor project promotes collaboration between transport modes and optimal use of respectively transport mode including transport nodes (hubs, cross docks etc).
   It can be both a national and cross-border corridor.

2) **Transport techniques**
   Projects related to transport techniques encompasses features and properties of various types of equipment used in transport operation. The main focus is on the different transport modes, transport/load units and transfer/reloading of goods between different modes. Examples are techniques related to trucks, trailers, railway engines, rail wagons, ships, port handling, containers, packaging, cranes, stackers etc.

3) **Transport logistics solutions**
   Refers to complete solutions which integrate different partners and stakeholders who mutually form a business case promoting efficiency and decreased ecologic impact.
   It is in general terms a complete freight logistic/transport setup that fulfill a product owner delivery demand and is often connected with a new business model.

*Figure 3. Based on relevant and supportive pillars of policies and regulations corridors”, transport techniques and transport logistics solutions can be developed.*
5. **Aim of key performance indicators**

The aim of the proposed key performance indicators is to efficiently evaluate the overall environmental performance for a freight flow in a corridor from sender to consignee carried out by an operating organization.

The evaluated transport system includes all modes of transport and terminal handling in the transport chain.

At this early stage several indicators are proposed but we strongly advice a minimum of KPI’s. Output of credible KPI is commonly based on a number of input data that needs to be captured. Increasing the need for input data in evidently increases uncertainty and measuring costs.
6. Discussion and selection of indicators

Over time, the environmental interest of the society has evolved from a strong focus on local health effects towards more regional impacts on the environment. Today there is a very strong focus on global climate change and the use of finite and fossil resources. Thus, evaluation model for transport logistics environmental performance follows the same development path.

Environmental performance calculations in order to determine the environmental impact of transport used to focus on the emissions with negative impact on health and environment. These emissions have gradually come under regulatory legislation and thereby being gradually reduced through more stringent legislation on cleaner fuels and combustion engines. By legislation and technical solutions reducing these emissions in combination with a growing concern on climate change, the performance calculations are increasingly focused on the emissions of green house gases, GHG.

<table>
<thead>
<tr>
<th>Relative numbers</th>
<th>Local (PM, HC)</th>
<th>Regional (NOx, SOx)</th>
<th>Global (GHG)</th>
<th>Energy (Fossil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute numbers</td>
<td></td>
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</table>

Figure 4. Overview of relevant and measurable environmental areas. Energy use, carbon dioxide and regulated emissions can be measured and calculated at a fairly high level of accuracy. Quantifying noise and other aspects is more complex and is not within the scope of this report. Presenting performance moreover needs to include absolute and relative data in order to fairly present overall performance as well as capturing total growth.

The measurability of different environmental aspects varies, hence the performance indicators seldom reflects all the negative effects occurring from industrial activities. For the transport sector other relevant environmental aspects (negative external effects) would be noise, land use, impact on biodiversity etc. Due to problems to measure and establish common values for their impact, these aspects and emissions are generally included through estimations on their external costs. Using external costs for assessing environmental performance will however not be part of this article for evaluating environmental performance of transport services.

In addition to the increased climate change focus there is a strong focus on how the transport logistics industry on a global basis is to 96% dependent on fossil fuels. The issue is strongly linked to the expected decline of oil production, peak oil. Reduced oil production capacity will most likely lead to an increase of transport fuels price and thereby an increased demand of alternative fuels. Considering the critical high dependency on fossil fuels and the corresponding emissions of green house gases there is a need to measure and monitor the transport sectors use of fossil fuels from a life cycle perspective.

As today’s transport logistics system is based on transport techniques that gradually is being updated with cleaner techniques corresponding to economic resources it is still relevant to include all use of resources as well as the emissions affecting local health, regional biotopes
and the global climate system. The conclusion is that environmental performance assessment should still include all emissions and use of transport fuels. Due to uncertain values on costs for other external effects these aspects are excluded in this model.

An environmental assessment of a carried out transport service estimates the environmental performance based on a number of assumptions, models and activity data. The performance outcome can be described in absolute or relative terms. The absolute measurement indicates actual impact on the environment from a transport activity while relative data describes the environmental efficiency of the transport activity. For goods transport services the activity could be one single transport link or a transport chain from shipper to consignee. The absolute performance indicators are commonly expressed as amount of used resources such as [MJ, kWh, litre, and kg] for the activity and corresponding amount of emissions from the activity. For transport services this is air borne emissions from combustion, but also leakage and wear [kg, ton]. Leakage occurs unintentionally but unfortunately also as deliberate actions.

The relative performance indicators are based on the absolute indicator in relation to accomplished benefit, expressed as transport work [g/tonkm], time unit [litre/h] or economic turnover or result [kg/monetary unit, EUR etc.].

In order to ensure comparability the proposal is to relay on criteria’s developed within the European standard on transports energy use and emissions of green house gases. NTM⁴ is furthermore developing product category rules (PCR) for transport services from which environmental product declaration (EPD) can be established for specific transport solutions. PCR/EPD includes all modes of transport and includes energy, green house gases and general regulated emissions. The PCR structure is based on the ISO 14 025.

![Figure 5. Overview of the environmental calculation](image)

### 6.1 System Boundaries

Typically, when calculating the environmental impact of a carried out transport service is to include the resource consumption of inputs, primarily fuel and electricity consumption and corresponding emissions generated by the transport activities. The extent of resource use and emission activity is determined by the system limits set for environmental assessment. According to various studies supportive and indirect activities of transport service can

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⁴ Network for transport and environment, www.ntmcalc.org
constitute a significant part of overall resource consumption and transport emissions\(^5\). With a system boundary that includes support and indirect activities more environmental factors and resource use are added. This will generally make the estimation more extensive and complex. Below is a comprehensive breakdown of the various relevant systems boundaries, excluding each subsystem’s upstream and downstream system.

**Figure 6. System boundaries**

*System boundary A*, including traffic and transport related activities regarding engine operation for the propulsion and equipment for climate control of goods, and losses in fuel tanks and batteries. This includes the traffic-related terminal handling, i.e. when goods do not leave their vehicle/vessel.

*System boundary B*, which includes the supply of energy from energy source to the tank, battery and electric motor (trains). This system boundary is the system together with system boundary A that is the minimum required for performance comparisons between different modes of transport.

*System boundary C*, traffic infrastructure operation and maintenance

*System boundary D*, vehicle, vessel, load units production

The above system boundaries should not be seen as mutually inclusive or exclusive, but rather as a sub-sample that can be added or subtracted from, depending on the environmental assessment. Altogether, there are some important rules which must be fulfilled for the choice of system boundary:

1) When assessing environmental performance, the results should monitor the included system boundaries
2) Comparison of different transport solutions must be done with comparable and relevant system boundaries
3) When comparing the same transport system over time, this must be done by using the same system boundary.

Comparing different propulsion and energy supply systems

\(^5\) Environmental assessment of passenger transportation should include infrastructure and supply chains. Mikhail V Chester & Arphad Horvath, 2009, University of California.
Environmental assessment of passenger transportation should include infrastructure and supply chains. Mikhail Comparing different propulsion and energy supply systems system boundary.

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System boundary D

System boundary C

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System boundary B

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Operation

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Tanks and batteries. This includes the traffic-related terminal handling, i.e. when goods do not

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improvement from year one to year two).

* To be used for calculating locally effecting emissions from the direct proximity of vehicle/vessel or when comparing the relative development of one specific transport operational system over time (i.e. one trucks

In all three cases of traffic operation, the transport fuels for vehicle/vessel propulsion have been preceded by upstream processes that enable the delivery of electricity or fuel. This means that the whole upstream processes for all systems must be included for a fair comparison.

An obvious example of the differences in outcome in environmental calculations with different system boundaries is how tail pipe fossil fuel carbon oxides from diesel combustion

Figure 7. Transport and energy systems

6.2 Propulsion and fuel supply of the transport system

For comparison of different transport systems, based on different propulsion systems and energy supply systems it must be done with comparable system boundaries. The following aspects need to be considered:

1) Electric motor; Electric power for vehicle/vessel propulsion directly linked to electric distribution grid through pantograph. Electricity is generated at optimum production plant (production costs and market situation) simultaneously with consumption.

2) Plug-in electric motor; Electric power for vehicle/vessel propulsion through accumulators (batteries) is generated at demand or at optimum production plant and time (production costs and market situation).

3) Combustion engines; Transport fuels for vehicle/vessel propulsion with combustion engine is being produced at demand or at optimum plant and time related to production costs and market demand.
in vehicles or vessels is lower in comparison of another calculation that also includes refining and distribution of fuels6.

### 6.3 The transport production system

An essential part of a transport chain is the terminals (ports, airports, etc), which are used in order to obtain an efficient transport system through increased resource utilization. Overall, transport operations are basically carried out by the same logic regardless of traffic mode where small flows of goods are handled with smaller vehicles and vessels while the freight flows in the long haul are handled by large vehicles and vessels. The goal is always to achieve economic and energy scale advantages.

![Figure 8. A transport chain often includes several terminals (nodes) and transport services (links)](image)

Cargo terminals have different characteristics depending on the mode of transport. The total resource use and emissions of terminals and warehouses in the whole transport chain is usually small in relation to transport. For a completely accurate and comprehensive assessment of environmental effects, terminals handling should be included with the same system boundary as for the corresponding transport service. If terminal handling is excluded on the grounds that they constitute a negligible portion (cut-off rules) of the whole transport chain this must be clearly stated in the reported results.

### 6.4 Allocation of environmental burden

One area of ongoing discussion is how large proportion a shipment should include of total traffic resource use and emissions. The general description of this is that all resource use and emissions of vehicles and vessels must be allocated to the transported goods (and passengers in a combined shipment). Allocation should be done by the delimiting factor of that specific transport system, i.e. weight, volume etc. Allocation must also include resources and emissions for the positioning of empty laden trips. Relevant principles for allocation of empty trips differ between various transport systems.

The allocation is obviously even more complex with transport that includes both goods and passengers. Different keys for allocation can be used but should be based on what actually drives the environmental impact of the analyzed transport mode. It is furthermore important to allocate support functions correctly. Additional equipment required for cargo and passengers should be allocated on the user of this equipment. In aviation, where a significant proportion of freight is carried in passenger aircraft (belly freight), galley, flight attendants etc should be allocated on passengers. The same applies to any load carriers (pallets) that may be required for air transport of cargo. This tare weight should be allocated to the cargo. Combined

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6 NTM Fuels
transport service of freight and passengers occur on a regular basis within air and ferry transport. Within road and rail transport this is not equally frequent.

A very practical and important implication of allocation is that increasing the load factor of freight and passengers leads to reduced relative emissions. Load factor is a well known crucial factor for good performance. As seen in the figure below it presents how high resource utilization leads to more goods that can share the negative environmental impact. Since the total fuel consumption and emissions do not increase equally much with increased utilization, the relative emissions are reduced by increased utilization.

![CO2 performance of a trailer with a Euro 4 tractor](image)

*Figure 9. The difference of relative performance at different load factors in a trailer.*

### 6.5 Practical evaluation transport services

In order to assess the environmental performance of transport services a general model based on explicit and default data is available enabling follow up of environmental performance. Below is some of the default data presented that is part of the NTMCalc\textsubscript{Goods} basic model for overall evaluation of goods transport services.

In order to assess specific vehicle and vessel models the NTMCalc\textsubscript{Goods} basic model will be supported by an additional spreadsheet where default values are being imported and specific well documented solutions are added to the calculation. It is crucial that calculation based on real world data can be verified.

<table>
<thead>
<tr>
<th>Trucks</th>
<th>Aircrafts</th>
<th>Trains</th>
<th>Ships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pick-up (diesel)</td>
<td>Intercontinental freight</td>
<td>Electric (EU) dedicated</td>
<td>5 types of General cargo</td>
</tr>
<tr>
<td>Van (petrol)</td>
<td>Continental freight aircraft</td>
<td>Electric (EU) wagon load</td>
<td>Reefer</td>
</tr>
<tr>
<td>Van (diesel)</td>
<td>Regional freight aircraft</td>
<td>Electric (EU) combi train</td>
<td>4 types of Dry bulk</td>
</tr>
<tr>
<td>Light lorry/truck</td>
<td>Intercontinental passenger (belly)</td>
<td>Electric (Country) dedicated train</td>
<td>4 types of Tankers</td>
</tr>
<tr>
<td>Medium lorry/truck</td>
<td>Continental passenger (belly)</td>
<td>Electric (Country) wagon load train</td>
<td>5 types of Container ship</td>
</tr>
<tr>
<td>Heavy lorry/truck</td>
<td>Regional passenger (belly)</td>
<td>Electric (Country) combi train</td>
<td>2 types of RoRo</td>
</tr>
<tr>
<td>Tractor + “city-trailer”</td>
<td></td>
<td>Diesel dedicated train</td>
<td>2 types of RoPax</td>
</tr>
<tr>
<td>Lorry/truck + trailer</td>
<td></td>
<td>Diesel wagon load train</td>
<td></td>
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<tr>
<td>Tractor + semi-trailer</td>
<td></td>
<td>Diesel combi train</td>
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<tr>
<td>Tractor + MEGA/heavy-trailer</td>
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<td></td>
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<tr>
<td>Lorry/Truck + Semi-trailer</td>
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</tbody>
</table>
In conclusion we propose a pragmatic approach to this complex area suggesting a simple approach.

- Measure and monitor total and relative energy use and emissions to air based on system boundary A and B.
- Establish minimum relative performance levels for qualifying a project as a Green Corridor (g/tonkm) in order to classify different projects relative environmental performance on a general level. This should include:
  1) Energy use, GHG, SOx, NOx and PM
  2) Minimum requirements on supporting systems
- Address uncertainty in calculation according to a simple NTM model that in brief means a sensitivity analysis.

Overall, the performance indicators would only include the specific corridor and not include impacts on related systems that may be negatively affected.

6.6 Handling technical and organisational improvements

Due to technical and organizational improvements within transport logistics the environmental performance is likely to improve over time. In order to evaluate and benchmark performance the general baseline for fulfilling specified requirements needs to
become more stringent over time as illustrated in the figure below. The figure aim at describing the principal concept of evaluating Green corridors projects including the concept of co-modality strives for efficient and reliable services, making best use of available modes of transport separately or in combinations. Thus evaluation criteria should evaluate and compare projects independently of the mode(s) of transport used.

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![Figure 11](image1.png)

Figure 11. Over time the requirements might become more stringent as technical development etc improves.

6.7 Measuring problems and data capturing

Depending on input data accuracy the output performance uncertainty will vary. In order to address this issue and promote accurate assessment, the idea is to include a sensitivity analysis for some key performance indicators. In order to fulfill specified requirements the performance indicator maximum value must not exceed the baseline established by a certain green corridor. Projects monitoring their performance according to a specified baseline could consequently increase their relative emissions if they increase they minimize their uncertainty.

![Figure 12](image2.png)

Figure 12. Two separate projects fulfilling required performance indicator with different uncertainty in their performance calculation.

Our proposal is to use a simple sensitivity model developed by NTM and available on their homepage. This model assumes no interaction between various uncertainty factors, which in reality is a fact. The problem is however how to include this complexity fairly simple. The
NTM-model assumes that the different variables are independent to solve this problem in a simple way.

If the assessment of KPI includes a large sensitivity gap its maximum value must not exceed the baseline level. This means that reduction of the sensitivity gap gives a benefit of allowing a higher average performance level.

The table below describes the areas covered, the unit of measurement and the attached data capturing needs. As can be seen fuel type and fuel consumption are some of the critical variables.

<table>
<thead>
<tr>
<th>Area</th>
<th>KPI</th>
<th>Data capturing needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy use</td>
<td>kWh, MJ</td>
<td>Total fuel consumption</td>
</tr>
<tr>
<td></td>
<td>kWh/tonkm, MJ/tonkm</td>
<td>Fuel type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel heat value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel production process energy use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cargo carrier unit capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cargo carrier unit capacity utilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shipment weight and volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shipment distance</td>
</tr>
<tr>
<td>GHG</td>
<td>CO₂e</td>
<td>Total fuel consumption</td>
</tr>
<tr>
<td></td>
<td>CO₂e/tonkm</td>
<td>Fuel type, carbon content</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CO₂-conversion factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel production process CO₂e emissions</td>
</tr>
<tr>
<td>Sulphur</td>
<td>SO₂</td>
<td>Total fuel consumption</td>
</tr>
<tr>
<td></td>
<td>SO₂/tonkm</td>
<td>Fuel type regarding sulphur content</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment device (scrubber)</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>NOx</td>
<td>Total fuel consumption</td>
</tr>
<tr>
<td></td>
<td>NOx/tonkm</td>
<td>Fuel type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine combustion performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment devices (EGR, SCR etc)</td>
</tr>
<tr>
<td>Particulate matters</td>
<td>PM</td>
<td>Total fuel consumption</td>
</tr>
<tr>
<td>(combustion)</td>
<td>PM/tonkm</td>
<td>Fuel type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine combustion performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment devices (filters)</td>
</tr>
</tbody>
</table>

*Figure 13. Data capturing needs in respective area*

---

7 Includes main engine and auxiliary engines in use
7. Evaluation criteria’s

7.1 Performance indicators

The table below describes the performance areas and the indicators used to measure the development of what is being in focus in the project evaluated. The table also illustrates that the maximum performance levels must not be fixed over the years. Most likely, the demands on those indicators will become stricter as time passes.

<table>
<thead>
<tr>
<th>Transport service/technique</th>
<th>Performance area</th>
<th>Max performance levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Performance area</td>
<td>Year 2010</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHG total emissions</td>
<td>CO2e [ton/year]</td>
<td>-x tonne CO2e/year</td>
</tr>
<tr>
<td>GHG productivity</td>
<td>CO2e [g/tkm]</td>
<td>x gram CO2e/tkm</td>
</tr>
<tr>
<td>NOx emissions\textsubscript{eq} (e.g. regulated)</td>
<td>NOx emissions[kg/year]</td>
<td>-x kg CO2e/year</td>
</tr>
<tr>
<td>NOx emission productivity</td>
<td>NOx emissions [g/tkm]</td>
<td>x gram CO2e/tkm</td>
</tr>
<tr>
<td>SOx emissions\textsubscript{eq} (e.g. regulated)</td>
<td>SOx emissions[kg/year]</td>
<td>-x kg CO2e/year</td>
</tr>
<tr>
<td>SOx emission productivity</td>
<td>SOx emissions [g/tkm]</td>
<td>x gram CO2e/tkm</td>
</tr>
<tr>
<td>PM emissions\textsubscript{eq} (e.g. regulated)</td>
<td>PM emissions[kg/year]</td>
<td>-x kg CO2e/year</td>
</tr>
<tr>
<td>PM emission productivity</td>
<td>PM emissions [g/tkm]</td>
<td>x gram CO2e/tkm</td>
</tr>
<tr>
<td>Resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requisite criteria’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up systems</td>
<td>Systematic plan</td>
<td>According to guidelines</td>
</tr>
<tr>
<td>Vulnerability/ redundancy plans</td>
<td>Systematic plan</td>
<td>According to guidelines</td>
</tr>
<tr>
<td>Maintenance plans</td>
<td>Systematic plan</td>
<td>According to guidelines</td>
</tr>
<tr>
<td>Corridor service (sum of total transport services included in the corridor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max performance levels</td>
</tr>
<tr>
<td></td>
<td>Performance area</td>
<td>Year 2010</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Sigma)GHG total emissions</td>
<td>CO2e [ton/year]</td>
<td>-x tonne CO2e/year</td>
</tr>
<tr>
<td>(\Sigma)GHG productivity</td>
<td>CO2e [g/tkm]</td>
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<tr>
<td>(\Sigma)NOx emissions\textsubscript{eq} (e.g. regulated)</td>
<td>Emissions[kg/year]</td>
<td>-x kg CO2e/year</td>
</tr>
<tr>
<td>(\Sigma)NOx emission productivity</td>
<td>Emissions [g/tkm]</td>
<td>x gram CO2e/tkm</td>
</tr>
<tr>
<td>(\Sigma)SOx emissions\textsubscript{eq} (e.g. regulated)</td>
<td>SOx emissions[kg/year]</td>
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Figure 14. Performance indicators

7.2 Dissemination of innovation and know how

Innovative activities, solutions and demonstrations are important to overcome structural barriers for the introduction of European Green Corridors initiatives in real life and realise the Green Corridors. The intention here is to apply similar principles as for the Marco Polo Catalyst action principles.
The project will have to monitor their work with regard to these principles in a qualitative model. The solution should short and/or long term address absolute or relative performance regarding environment, financial and social aspects through innovations regarding

- Techniques
- Organizational (logistics)
- Development of new business models

Innovations should in addition be general, hence:
- Applied in other corridors
- Applied international
- If relevant could be a specific local solution

Ideas/projects improving the use and characteristics of green corridors are welcome. Projects that show on solutions that are general to, for instance, other corridors or other parts of the infrastructure have an advantage to other projects.
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                      Fuel heat value 
                      Fuel production process energy use 
                      Cargo carrier unit capacity 
                      Cargo carrier unit capacity utilization 
                      Shipment weight and volume 
                      Shipment distance |
| GHG                 | CO$_2$e CO$_2$e/tonkm | Total fuel consumption 
                      Fuel type, carbon content 
                      CO$_2$-conversion factor 
                      Fuel production process CO$_2$e emissions |
| Sulphur             | SO$_2$ SO$_2$/tonkm  | Total fuel consumption 
                      Fuel type regarding sulphur content 
                      After treatment device (scrubber) |
| Nitrogen oxides     | NOx NOx/tonkm        | Total fuel consumption 
                      Fuel type 
                      Engine combustion performance 
                      After treatment devices (EGR, SCR etc) |
| Particulate matters (combustion) | PM PM/tonkm | Total fuel consumption 
                      Fuel type 
                      Engine combustion performance 
                      After treatment devices (filters) |

Figure 13. Data capturing needs in respective area

---

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8. Use of the criteria

8.1 Suggested process for handling of applications in the field of Green Corridors

Applying and being acknowledged as a Green Corridor project follows three main steps
• Application to the Green Corridor secretariat
• Evaluation and suggestion by the evaluation team
• Decision by the co-modal team.

See picture below.

Figure 15. Process for handling applications

Furthermore, a Green Corridor certified project is required to have a model and process for follow-up of the Green Corridor criteria’s. Each Green Corridor certified project, whether it is part of any specific program or a separate project, is expected to in addition to the Green Corridor criteria requirements have a qualitative project follow-up and external review of basic data and performance of the project.

The model is expected to be based upon
• Follow-up
• Internal review
• External review
• Performance report

See picture below.
It is the responsibility of the project owner to assure that the project criteria’s are followed-up, registered regularly and reported in accordance with the Green Corridor secretariat requirements of content and frequency.

### 8.2 Follow up of existing Green Corridor

In addition to the Green Corridor criteria’s it is required that the project regularly follow-up and report the status of:

- Project schedule
- Financing
- Risk assessment

*Figure 16. Continuous dialogue*
Glossary

Co-modality
“The efficient use of different modes on their own and in combination, which will result in an optimal and sustainable utilisation of resources” (Source: The mid-term review of the White Paper 'Time to decide', 2006, COM (2006) 314 final)

Green
Continuously reductions of the external effects stemming from the logistic solution. Special attention is given to greenhouse gasses. Green as understood here deals with health impacts on living things.

Corridor
A transport corridor is characterised by:
- A concentration of national and/or international goods traffic on relatively long transport stretches
- Efficient logistic solutions where goods can be moved in transport chains consisting of one or several different means of transportation from A to B.
- The corridor is used to move significant amounts of freight.
- The corridor involves efficient terminals and facilities for the users.
- The corridor can be used as a platform for development and demonstration of logistic solutions (information systems, collaboration models and technology for instance)
- A corridor might consist a set of alternative solutions to fulfil a certain transport demand
- Ideally the corridor consist of a harmonised system of rules with openness for all actors
Co-modality

The efficient use of different modes on their own and in combination, which will result in an optimal and sustainable utilisation of resources (Source: The mid-term review of the White Paper 'Time to decide', 2006, COM (2006) 314 final)

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