GreCOR
GREEN CORRIDOR
Oslo - Randstad

The Interreg IVB
North Sea Region
Programme

Investing in the future by working together for a sustainable and competitive region

GreCOR – Green Corridor in the North Sea Region

European Union The European Regional Development Fund

Title GreCOR – Green Corridor in the North Sea Region

Publishing date December 2014

Publisher Trafikverket.

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Layout Ramböll AB.

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Executive summary

GreCOR – Green Corridor in the North Sea Region – is an Interreg IVB North Sea Region project that started 1 January 2012 and will end in June 2015. GreCOR promotes the development of a co-modal transport corridor in the North Sea Region. Important in this collaborative approach, is that it ads additional benefits: the corridors to secondary networks and hubs; regional hinterland around the Green transport corridor between Oslo and Randstad area (Amsterdam, Rotterdam, The Hague and Utrecht).

This pilot project will show the possibilities to use longer trains. This case has focused on the path between Örebro (Hallsberg) and the harbour of Gothenburg. The assessment made is that this pilot is interesting because of the possibilities to implement the structure on other relations in Europe with connections to major ports and terminals.

The pilot is a collaboration project between Swedish transport administration, Port of Gothenburg, AP Terminals and TM Rail.

The testing train consisted of 25 six-axis train cars with an average length of 28 meters. Train including engine was 722 meters long.

The benefits of operating a train that is 100 meters longer, is significant. The effect of running a longer train in comparison to a normal length train makes a big difference. Not having the extra train length of 100 meters might not necessarily result in the usage of an additional train but instead, the usage of road transports. The longer train gives significant results and the benefits of the test train are as follows:

Yearly benefit of the test train	Freight train with normal length 630 m	Lorry (18 m)
Operating cost	0,15 MEURO	0,7 MEURO
Environmental impact	0,0 MEURO	0,2 MEURO
Sum	0,15 MEURO	0,9 MEURO
Lowered CO2-emission	4,4 ton/year	470 ton/year

This pilot project should be seen as a way to improve the long distance freights on rail and sea internationally. Furthermore, the pilot should include mapping of similar relations in Europe. The infrastructural capacity in major cities should be high lightened.

There are no significant technical problems to add length to a train regarding rolling materials and terminals, provided the locomotive can manage the cargo and the speed is maintained. However, the infrastructure must be adjusted and possibly upgraded to suit 750 meter trains, especially the bypass tracks.

The capacity of the terminals will increase since a greater volume of gods may be handled without adding extra trains. This will improve the terminals efficiency, more gods handled per square meter.

An interesting question is, how large will the benefits be at the terminals, to have a 100 meter long train? Furthermore, it is interesting to assess how the large area they need, corresponds to the same number of lorries, and to reach the same efficiency as when handling freight trains. The target is to be able to load simultaneously as many containers as possible. That is without affecting the terminal production. The need should be adaptable so that if necessary, certain containers, should have a short lead on the terminal.

Content

Work Package 7

Introduction to Pilot No. 6 Increased Train Lengths for Freight Transport

What is a Green corridor?

Green Corridors is a European Commission initiative aiming at strengthening the logistics industry's competitiveness and create sustainable solutions.

- Sustainable logistics solutions with documented reductions of environmental and climate impact, high safety, high quality and strong efficiency.
- Integrated logistics concepts with optimal utilization of all transport modes, so called co-modality.
- Harmonized regulations with openness for all actors.
- A concentration of national and international freight traffic on relatively long transport routes.
- Efficient and strategically placed trans-shipment pointes, as well as an adapted, supportive infrastructure.
- A platform for development and demonstration of innovative logistics solutions, including information systems, collaborative models and technology.

Background

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The Green Corridor Oslo–Randstad

The corridor is a multimodal connection between major cities along the way, Oslo–Gothenburg–Malmo–Copenhagen–Hamburg–Amsterdam–Rotterdam (Randstad). The cargo that flows in the corridor is a complex combination of different modes of transports, such as, rail, road and sea transport. Sometimes the cargo goes all the way along the corridor, but most often it is transported in a part of the corridor to the destined market or the point for shipment. Several major ports are located along the corridor such as Gothenburg, Helsingborg, Malmo, Copenhagen, Hamburg, Amsterdam and Rotterdam. The corridor, with its hinterland connections, is very important for cargo flows in the whole North Sea region and for a huge number of companies and many millions of citizens. The idea of GreCOR is to improve the cargo flows in a sustainable

direction so as the transports make as small impact on the environment and climate as possible.

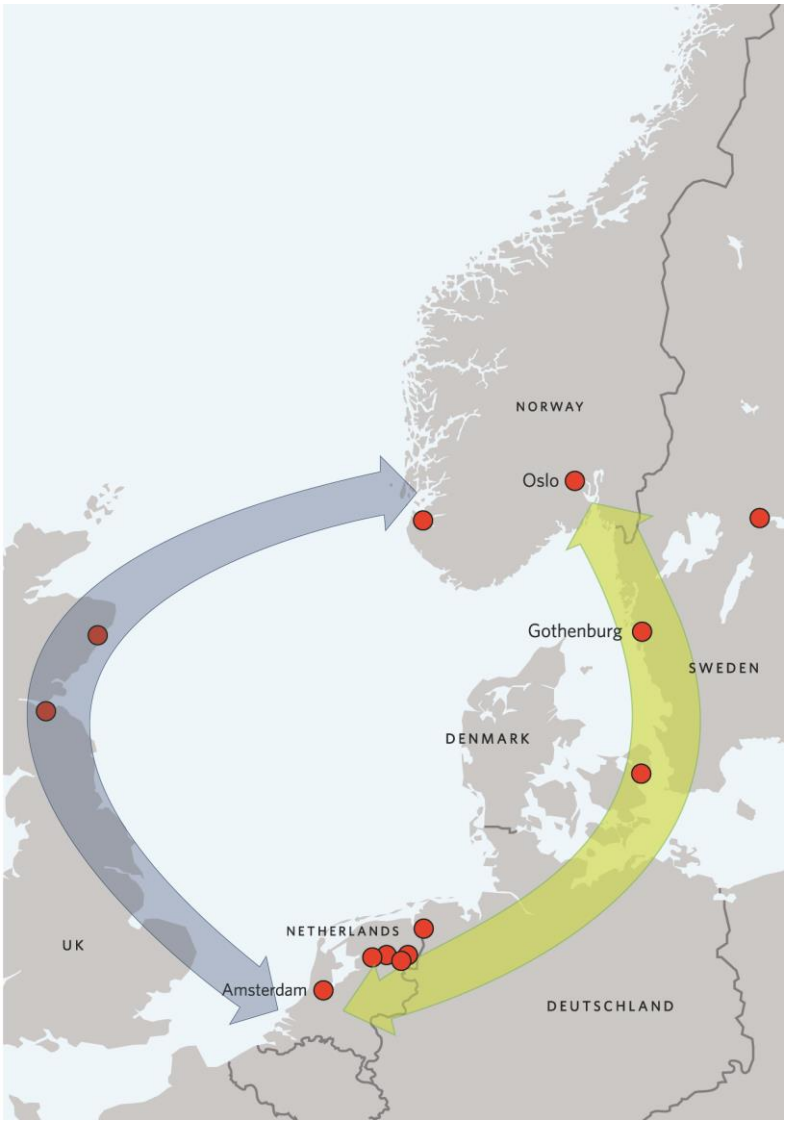


Figure 1. Map of the Corridor including locations of all project partners.

GreCOR has 13 partners and a total budget of 3.7 M€. The overall aim is to improve knowledge about the logistic needs and conditions and develop a strategy for the further promotion of environmentally friendly transports in the corridor. GreCOR focuses simultaneously on infrastructure and logistics for "greening" of transport and to make the region more competitive. The activities in GreCOR and the strategy will be a contribution to the EU objectives for transport as expressed in the White paper from 2011 "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system"

The work in GreCOR was performed in seven work packages.

Purpose & Aim

GreCOR will promote the development of a co-modal transport corridor in the North Sea Region. Important in this collaborative approach, is the focus on secondary networks and the hubs, and the regional hinterland around the Green transport corridor Oslo–Randstad from a co-modal perspective.

GreCOR works in close collaboration with public and private stake-holders, and its overall aim is to improve knowledge about the logistic needs and conditions; develop and implement the first green corridor in the North Sea Region in a strategic policy setting. However, the partners in the project collaborate on the bases of competence, mutual interest and actual need for improved green transport solutions. Therefore the partnership is spread all over the North Sea Region and not concentrated only to the physical corridor Oslo–Randstad.

The main idea of the project is to influence the green corridor consisting of infrastructure and transport development in the area. Furthermore GreCOR aims to:

- Improve knowledge about the logistics needs and conditions in the corridor.
- Test innovative logistics solutions through the development of pilot projects.
- Promote the development of sustainable transport in the North Sea Region.
- Focus on the role of the hubs and the regional "hinterland".
- Understand and develop the logistics utility creation in a green corridor taking a co-modal perspective.

EU and TEN-T

The EU White Paper has a vision for 2050, the overall objectives are among others, that:

- 40 percent of aviation fuel demand will be met by sustainable fuels with minimal carbon emissions and shipping emissions should be reduced by at least 40 percent.
- 50 percent of passenger traffic and freight traffic between cities at medium distances (over 300 km) should be removed from the roads and instead go on rail and waterways.
- Within the TEN-T network, the goal is to run 740 m long trains 2030. In Sweden new rail infrastructure in constructed for the goal length 750 meters.

Transport political goals in Sweden

The government has defined an overall goal for Swedish transport policy. "The overall goal for Swedish transport policy is to secure a socio-economically efficient and long term sustainable transport solution for citizens and businesses in the whole country."

The transport systems structure, function and use should contribute to give everyone basic accessibility with good quality and usability as well as contribute a force for development in the whole country. The transport system should be equal i.e. respond equally to the transport needs of women and men.

To achieve the goal of the Swedish government, the following are proposed:

- The quality of commercial traffic is improved and strengthens international competitiveness.
- Accessibility is improved within and between regions as well as between Sweden and other countries.

Goals for rail traffic to and from Gothenburg harbour:

- The filling ratio of the trains should be increased to 80 %.
- Proportion on rail, compared to lorry, is maintained at today's level 50 %.
- 750 meter long trains are assumed to be able to operate to an increased extent starting year 2020.

Furthermore the ongoing extension of the shunting yard (container handling in between the harbour and railroad) will get an increased capacity (from 5 to 6 tracks that together can manage carriages equivalent to 3 full-length 750 meter freight trains).

Delimitations and focus of this pilot project

There is a general desire within the EU, considering the EU White Paper, to move goods from road to rail and sea. A part of this operation is promoting more effective terminal connections and warehousing capabilities.

Multiple railway companies wish to operate using longer and heavier trains as they obtain locomotives with improved performance. For instance the new locomotives can

increase the train weight from 1600 gross tonnes under normal circumstances using RC-engines to about 2000 gross tonnes. There is also a desire to operate using 750 meter long trains.

The general goal for the Gothenburg harbour, to increase the filling ratio of the trains to 80 %, is included in this pilot. The area for this pilot is chosen considering the market interests in the region.

This pilot project will show the possibilities to use longer trains on Västra stambanan (Stockholm-Gothenburg). This case has focused on the path between Örebro (Hallsberg) and the harbour of Gothenburg. The assessment made is that this pilot is interesting because of the possibilities to implement the structure on other relations in Europe with connections to major ports and terminals. The pilot states an example of the relative improvement of an increased degree of filling of the trains.

The pilot is a collaboration project between Swedish transport administration, Port of Gothenburg, AP Terminals and TM Rail.

Expected results

The documentation is showing the benefits of longer trains, how this project can be realized, logistical problems, and more. GreCOR focuses not only on the corridor itself, but also on how the transports are being generated from the catchment area around the corridor, and the origin and destination of the transport flows. GreCOR will:

- Improve knowledge about transport flows
- Formulate international agreements on a high policy level
- Test innovative and logistics solutions through the development of pilot projects
- Improve collaboration with stakeholders based on national strategies and connect them to NSR perspective
- Reduce transport/freight related emissions
- Make NSR attractive to business sector

Methodology

The GreCOR project contains a number of activities:

- Inventory and analysis for Green Corridor development
- Best practices and business model development for the hubs
- Creation of a real time market place, integrating transport knowledge from different sources (PITS)
- National/regional strategies and liaison group
- A number of pilot projects
- Process Evaluation

With focus on the project process and lessons learnt from this, describe factors enabling or hindering success.

In this pilot project we also have used following added method:

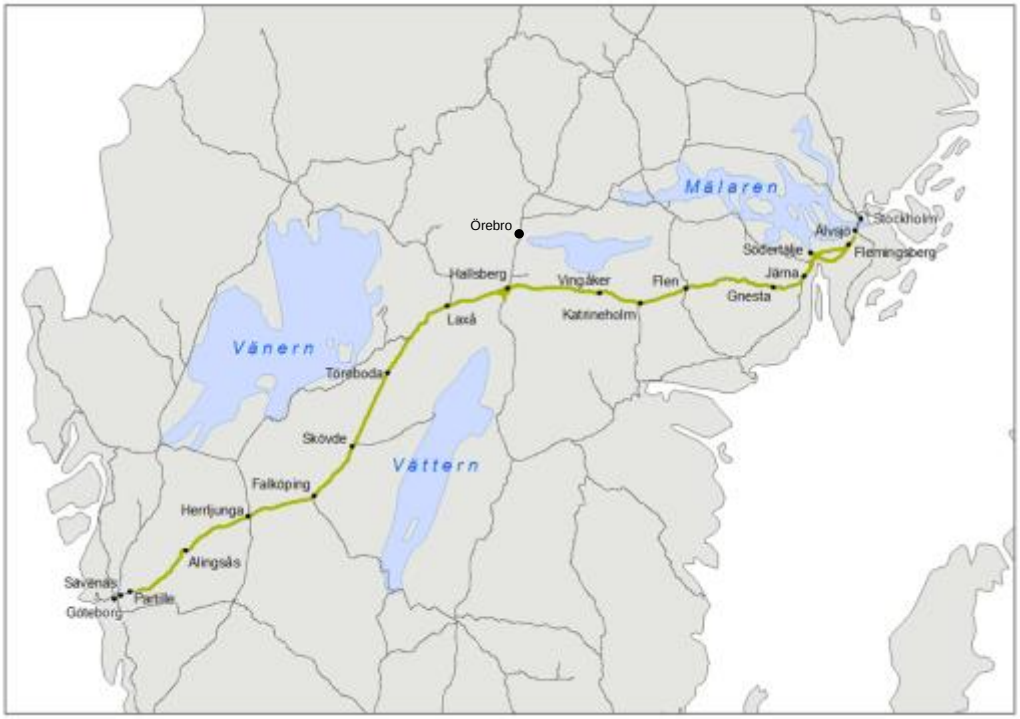
- Test a train round trip in existing infrastructure
- Collect operative data from the trip
- Interview the train operator, terminal operator and infrastructure manager
- Do a cost benefit analysis

Approach to the allocation of new hands at the various actors:

- Freight Customers/Forwarders
- Transport operators
- Logistics Service Providers
- Infrastructure manager/planners
- Terminal holders
- Society and environment

Today's infrastructure – Västra stambanan

Västra stambanan is one of the most important railways in Sweden and connects the two biggest cities in Sweden, Stockholm and Gothenburg. It is a very important line for the freight traffic, connecting Hallsberg to cities along the line. Hallsberg is the location for the biggest shunting yard in the country and the harbour in Gothenburg is the biggest harbour in Scandinavia.



Västra stambanan is traversed by a large number of freight trains. The Hallsberg–Gothenburg section sees the most traffic while the Hallsberg–Katrineholm section sees the least. The products dominating the flow of goods are steel products, paper, timber, wood products, food, scrap iron/ore and chemicals.

Västra stambanan within Västra Götaland is the section of the line that has the most freight traffic, about 50 freight trains per weekday. Freight trains largely operate during the night and late evenings. Important terminals and harbours are:

- The intermodal terminal in Älvsjö, Katrineholm, Örebro and Gullbergsvass in Gothenburg
- The shunting yard in Hallsberg and Gothenburg
- The terminals in Skövde and Falköping
- The harbour of Södertälje and Gothenburg.

In the base forecast an increase to about 60 freight trains each day on the Laxå–Gothenburg section is expected.

The marshalling yard in Hallsberg.

The intermodal terminal in Örebro. Photo: Marie Hansson/Sveriges Radio Örebro

The freight rail commuters (block trains between dryports/other harbours and the harbour of Gothenburg) play a major role in the logistic pattern. Goods in these commuters are dominated by (about 85 %) containers to or from destinations outside Europe, mainly through direct port calls.

The following maps show the location of existing loops, side of the main tracks and if the tracks can handle trains of desired length. Furthermore the funded loops can be found on the same map.

Katrineholm–Hallsberg-Skövde

Skövde-Gothenburg

Facts service on the railway Västra stambanan

For instance the new locomotive can increase the train weight from 1600 gross tons under normal circumstances using RC-engines to about 2000 gross tons.

There is also a desire to operate using 750 meter long trains.

Västra stambanan within Västra Götaland is the section of the line that has the most freight traffic, about 50 freight trains per weekday.

Impact Evaluation

Functional goal – accessibility

- The quality of commercial traffic is improved and strengthens international competitiveness.
- One parameter comprises the trains expected arrival time in Gothenburg and the total transport time.
- Accessibility is improved within and between regions as well as between Sweden and other countries.
- One parameter comprises the ruggedness of the railway system and the number of departures to reach the demand.

Goals for rail traffic to and from Gothenburg harbour

- The filling ratio of the trains is 80 %.
- 750 meter long trains are assumed to be able to operate to an increased extent starting year 2020.
- One parameter is to identify train spots in the timetable to find gaps for 750 m trains.
- Another parameter is to identify trains which really use these spots.

Results and Analysis

Test run, September 25th, 2014

The test run started at the intermodal terminal in Örebro, which can be operated by electrical locomotives. The train drove the distance Örebro to Gothenburg harbour and return. The rail on this distance has double tracks except a seven kilometre path in Gothenburg leading up to the harbour. The total distance is 287 kilometres.

The shunting yard in the harbour of Gothenburg is electrified but the tracks to the terminal must be operated by a diesel locomotive.

The testing train consisted of 25 six-axis train cars with an average length of 28 meters. Train including engine was 722 meters long. Total train weight from Örebro to Gothenburg was 1180 tonnes and from Gothenburg 1312 tonnes. Total energy consumption was 1447 kWh off, which 207 were fed back into the grid.

Train departure from Örebro (southbound) at 10:22 with a planned passing in Stenstorp. Arrival at the harbour of Gothenburg was at 15:14. A one hour stop was planned in Sävenäs.

The return trip (northbound) departed at 20:50 and arrived in Örebro at 01:16.

A preparation was made by the Swedish Transport Administration to add an appropriate schedule that did not come into conflict with other train services. The ability to bypass trains is limited because all bypass tracks do not have sufficient length.

Outcome:

Southbound:

- No problems were encountered between Örebro and Sävenäs. Delays arose at Sävenäs because of track maintenance overrunning schedule. The train arrived at the harbour of Gothenburg 38 minutes late.
- Shunting, unloading and loading in the harbour of Gothenburg were despite this performed without problems.

Northbound:

- Departure from the harbour of Gothenburg was delayed by 11 minutes because of problems at Sävenäs caused by a passenger train. This caused single track usage on one section. The testing train had to wait in a queue. The train departed from Sävenäs 74 minutes late with an arrival in Örebro 76 minutes late. When the train was finally allowed on the line the timetable was held during the remainder of the section.
- Conclusions from this test are that vulnerability peaks around Gothenburg. The remainder of the trip to and from Örebro worked well in both directions. Despite delays arising APM and TM Rail were content with the test as a whole. The delays meant no problems for the end-user.

The 722 meter long freight train from Örebro arrive Harbour of Gothenburg. September 25th, 2014.

Cost benefit outcome

A cost benefit outcome has been customized for the specific testing train. The alternative would be to transport the cargo difference between a normal length container train and the testing train on a lorry.

Cost benefit analysis is a general method for measure the socio economic benefit for an investigation included public financing.

The cost benefit economic assessment in this case has been made based on the calculated values used by the Swedish transport administration, Trafikverket (ASEK 5.1).

This method included:

Actors	Shorter train	Lorry (18 m)
Freight Customers	B	B
The transport operators	A	A
Terminal operators	B	B
Infrastructure providers	B	B
Terminal holders	B	B
Society and environment	B	A

A = computational benefit

B = evaluated advantage

The following data has been used:

- Numbers of empty containers: 30 %
- Net weight per loaded container (TEU): 7,5 tons
- Service distance both directions: 2*287 km
- Number of service days/year: 250 days

Train	Normal container train	Testing train
Train length	622 meters	722 meters
Capacity, numbers of TEU	86 TEU	100 TEU
Gross train weight	1139 tons	1308 tons
Cargo per train	482 tons	560 tons

The testing train's filling ratio compared to a normal container train is increased by 16 % (approximately 100 meters longer train).

Operational cost	Lorry (18 m)	Test train
Time dependence	26,7 EURO per ton/hour	4,93 EURO per ton/hour
Distance dependence	0,39 EURO per ton/km	0,09 EURO per ton/km

Benefit outcome for the actors

Compare with shorter train

Freight Customers/Forwarders

Customers receive indirect benefits since transport costs are reduced. Further, it works as goodwill to customers because this way of transporting is the greener choice. With the right approach, the total transport will have shorter lead times and quicker delivery of goods. This will benefit freight customers.

The transport operators

This results in a 12 % profit increase. The major cost is the locomotive and staff which is why the marginal costs is proportionately small, since the train manages a larger number of train cars.

To load and unload containers with the same efficiency by lorry compared to freight trains may require more lorries and more staff. The risk is that the local transport will be longer and it takes longer with terminal management. This may cost more for the terminal operator.

The transportation cost of the testing train was approximately 1 Euro less per ton to run on the 600 km distance, round trip. This given, the overall saving is around 600 Euro for the train including cargo.

Based upon 250 service days/year the total cost benefit outcome is as a follows:

Annual savings	0.15 MEURO

Logistics Service Providers

If the track is good enough and is able to handle a train with full length, the benefit for the terminal operator would be to handle fewer trains with equal amount of goods. For example it is possible to share a 740 meter length train on two tracks who can manage total a wagon length of 720 meter**.**

Infrastructure managers

Fewer trains to do the same transport work give a better capacity situation on the railway; this improves the situation for the system as a hole. Västra stambanan is one of the most trafficked lines in Sweden and between Alingsås and Gothenburg the number of trains is more than 250 each day.

Terminal holders

Longer trains mean more concentrated flow of wagons and containers. That means that more logistic capacity is needed, to manage on and off loading. In this case in does not matter because the harbour for Gothenburg has constructed six tracks long enough to manage three trains with full length of 740 meter. The terminal holder can increase the attractiveness by offering a more efficient terminal production.

Society and environment

For the environment there is no significant effect. Some reduction of the energy consumption per tonne-km can still count, which is good for energy economy.

Compare with lorry

Freight Customers/Forwarders

Customers receive indirect benefits since transport costs are reduced. Further, it works as goodwill to customers because this way of transporting is the greener choice. With the right approach, the total transport will have shorter lead times and quicker delivery of goods. This will benefit freight customers.

The transport operators

It is more costly to transport freight on road compared to rail, the longer the distance the costlier. The cost benefit is presented at the end of this section.

Logistics Service Providers

The terminal operator will have greater flexibility to handle a container on a lorry compared to the train. This requires a substantial amount of terminal area due to the number of lorries needed. If not all the lorries coming in at the same time it is difficult to plan activities.

Infrastructure managers

More lorries causes more traffic which adds up congestion in urban areas. This may result in a need for investments in maintenance.

Terminal holders

It is much more effective, in terms of area needed, to handle freight on rail than on road. In this work, connecting infrastructure is included.

Society and environment

One of the greater benefits, using rail instead of road, is environmental. It is possible to measure this benefit in the cost benefit method. The cost benefit is presented at the end of this section.

The sum of the quantitatively expenses

If the cargo were to be transported on roads (the compared alternative) the cost benefit outcome would be as follows:

Expenses	Annual utility (MEURO)
Operational cost	0,7
Environmental impacts (national)	0,2

Calculation methods used in this report are Swedish. The report does not claim that this method should be considered the best or the only. Different countries have different ways of calculating and different prerequisites. However, on this specific path in Sweden, a Swedish method for calculating has been used based upon national prerequisites.

Conclusions

The benefits of operating a train that is 100 meters longer, is significant. The effect of running a longer train in comparison to a normal length train makes a big difference. Not having the extra train length of 100 meters might not necessarily result in the usage of an additional train but instead, the usage of road transports. The longer train gives significant results and the benefits of the test train are as follows:

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Environmental impact	0,0 MEURO	0,2 MEURO
Sum	0,15 MEURO	0,9 MEURO
Lowered CO2-emission	4,4 ton/year	470 ton/year

*) Sweden belongs to the common Nordic electricity market where 1 kWh (kilowatt hour) on average yields about 100 grams of carbon dioxide emissions.

It is interesting to operate with longer freight train. To add the train with a length of 100 meters will increase the profitability with around 12 %. To move over freight from road to rail gives a significant benefit.

Transporting goods by lorry instead of a 100 meter extra-long train (equivalent to the amount of goods) gives a greater cost for the transport operator and is also worse for the environment.

Development potential

It is uncertain if conclusions can be made from only one single test. For increased certainty in the analysis the test needs to be repeated. Testing showed that TM-Rail would have no problems departing from the harbour of Gothenburg later, after the departure of the last postal train between Gothenburg and Stockholm.

The outcome of this pilot test is that the test should be repeated after a new year (when the task of extending the rails in the harbour of Gothenburg is finished), though in a more repetitive manner. It is therefore wished that Trafikverket develops a suggested timetable for Mondays to Fridays according to requests as follows:

Southbound:

As similar as possible compared to running times from Örebro to the harbour of Gothenburg. Preferably with the exact same timetable as today.

Northbound:

The train departed Gothenburg after 23:00 and arrived in Örebro at 04:00.

Other:

- Service in the shunting yard on Harbour of Gothenburg must be studied more closely, as well as the buffer capacity at the Älvsborg and Skandia rail yards.
- TM Rail also wished for a compilation of obstacle clear track length on the Örebro-Gothenburg harbour stretch in both directions.
- Demand for longer trains is an expressed wish from multiple operators.
- Operators want more rail in addition to Västra stambanan to be considered for longer trains.
- To be successful in a long time perspective and to extend rail traffic with longer freight trains further investments are needed in infrastructure regarding improved opportunities for pass overs.
- At Västra stambanan there are sections where the opportunities for passes by 750 meter long trains are too far apart.
- A pre-study regarding Västra stambanan, stretch Gothenburg-Skövde, is in progress.

The testing train	
25 six-axis cars with a total capacity of	100 TEU
Total train length, engine included	722 meters
Section Örebro-Gothenburg-Örebro	574 km
Total energy consumption, both directions	1450 kWh

Air and climatic factors for the testing train			
Parameter	Test train	Shorter train	Lorry (18 m)
Production in greenhouse gas emissions CO2 Equivalent (ton)	0	<0,1	1.9
Energy consumption (kWh/ton)	2.2	2.5	60

Recommendations

International aspect

This pilot project should be seen as a way to improve the long distance freights on rail and sea internationally. Furthermore, the pilot should include a mapping of similar relations in Europe. The infrastructural capacity in major cities should be high lightened.

Technical aspect

There are no significant technical problems to add length to a train regarding rolling materials and terminals, provided the locomotive can manage the cargo and the speed is maintained. However, the infrastructure must be adjusted and possibly upgraded to suit 750 meter trains, especially the bypass tracks.

Logistic aspect

The capacity of the terminals will increase since a greater volume of gods may be handled without adding extra trains. This will improve the terminals efficiency, more gods handled per square meter.

An interesting question is, how large will the benefits be at the terminals, to have a 100 meter long train? Furthermore, it is interesting to assess how the large area they need, corresponds to the same number of lorries and to reach the same efficiency as when handling freight trains. The target is to be able to load simultaneously as many containers as possible. That is without affecting the terminal production. The need should be adaptable so that if necessary, certain containers, should have a short lead on the terminal.