FINAL EVALUATION REPORT
GÖTEBORG

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Abbreviations

BAT	Best Available Technology
CBG	Compressed Biogas
CNG	Compressed Natural Gas
CO	Carbon Oxide
CO_2	Carbon Dioxide
EGR	Exhaust Gas Recirculation
FEAT	Fuel Efficiency Automobile Test
HC	Hydrocarbons
HD	Heavy-Duty (vehicle)
LMC	Lundby Mobility Centre
Mk	Miljöklass (Environmental requirements for fuel and vehicles)
MSW	Municipal Solid Waste
NGV	Natural Gas Vehicle
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
PM	Particulate Matter
SFS	Svensk författningssamling (Swedish National Law)

A INTRODUCTION

A.1 General remarks

The Evaluation Report for Göteborg provides an overview of the TELLUS demonstrations in Göteborg and the objectives and milestones that were set for each measure. It also includes a broader City evaluation taking the city perspective into account. The evaluation has been carried out according to the methodology elaborated in the TELLUS Evaluation Plan.

The Evaluation Report is divided into four parts: Part A; Introduction, Part B; Evaluation on Demonstration Measure Level, Part C; Evaluation on City Level and Part D; Final Conclusions.

The report starts with an analysis of the TELLUS landscape in Göteborg, the actors and objectives of evaluation. It explains which measures were planned and the deviations that took place during the TELLUS lifetime. There is a description of the geographical context as well as a map of the different demonstration measures and the integration into the local transport policy.

Part B consists of an evaluation of the local demonstration measures. All of them have carried out an evaluation including process evaluation, results, conclusions, scenarios and recommendations.

Part C consists of an evaluation on City Level and describes the general approach with the objectives and the contribution to the TELLUS objectives. It also includes Ex-post evaluation for 2006 where the basis are the TELLUS Key Indicators and Ex-ante evaluation for 2010.

Part D summarises the report and gives an overview of the most important results and conclusions of the TELLUS measures in Göteborg.

A.2 TELLUS Landscape in Göteborg

1 Demonstration measures

1.1 Status and type

At the beginning of TELLUS, Göteborg participated with five different demonstration measures representing five different work packages. After two years into the project, measure 7.6 was cancelled because of a political decision and was replaced by two new measures: demonstration 12.7 “Introduction of clean vehicles in public and private fleet” and measure 12.8 “Introduction of clean waste collection vehicles”. In Table A.2-1 the demonstration measures and the status of implementation are presented.

Table A.2-1. TELLUS demonstration measures in Göteborg

Name of demonstration measure	Type of demonstration measure	Strategy	Policy	Implementation
5.7 Environmental Zone for heavy duty vehicles	Concept development and implementation	Further design and enlargement of the existing environmental zone, introduce an on-site measurement system	Stimulate the incorporation of Euro IV engines, new results from on-line emission measurements	Delayed by political decisions and all parts of the measure are not implemented within TELLUS.
6.6 Incentives for purchasing of CNG/CBG heavy duty vehicles	Concept development and implementation	Heavy trailers and distribution vehicles will be exchanged for CNG/CBG vehicles	Decrease emissions of NOx and particles from heavy traffic	The objectives changed to introduce 2-3 heavy CNG trailers and 10-15 distribution vehicles. Implemented according to plan
7.6 Environmentally optimised river shuttle	Concept development and implementation	Plan and build an environmentally optimised river shuttle	Demonstration of new technology, decreasing emissions	Stopped by political decisions and replaced by measures 12.7 and 12.8
9.5 Incentives for improving the load factor in inner city freight transport	Concept development and implementation	Design and introduce incentives for increased load rates in an inner city zone	Reducing the number of distribution vehicles in an inner city area	Implemented according to plan.
10.5 Consumer driven goods management from a mobility centre base	Concept development and implementation	Promote smarter mobility solutions to suppliers	Increase the efficiency of transport of goods and people in a development area	Implemented according to plan.
12.7 Promoting the introduction of clean vehicles in public and private fleet	Concept development and implementation	Affect suppliers´ methods in purchasing clean vehicles. Develop methods for the promotion of clean vehicles.	Introduction of clean cars	Started Feb 2004 and replaced measure 7.6. Implemented according to plan.
12.8 Introduction of clean waste collection vehicles	Concept development and implementation	Introduce a new type of CNG/CBG heavy vehicles for waste collection	Introduction of clean heavy-duty trucks/working machines	Started Feb 2004 and replaced measure 7.6. Implemented according to plan.

1.2 Geographical context

Demonstration measures 5.7 “Environmental Zone for heavy duty vehicles”, 9.5 “Incentives for improving the load factor in inner city freight transport” and 10.5 “Consumer driven goods management from a mobility centre base” were area based and measures 6.6 “Incentives for purchasing of CNG/CBG heavy duty vehicles”, 12.7 “Promoting the introduction of clean vehicles in public and private fleet” and 12.8 “Introduction of clean waste collection vehicles” were site-based. Demonstration 7.6 “Environmentally optimised river shuttle” was corridor-based. As shown on Map A.2-1, there are, however, geographical synergies between the projects that improve the effects.

The already existing Environmental Zone for heavy-duty vehicles covers presently the south shore and the city centre. With the enlargement proposal within measure 5.7, the Zone aimed to include the north river shore area.

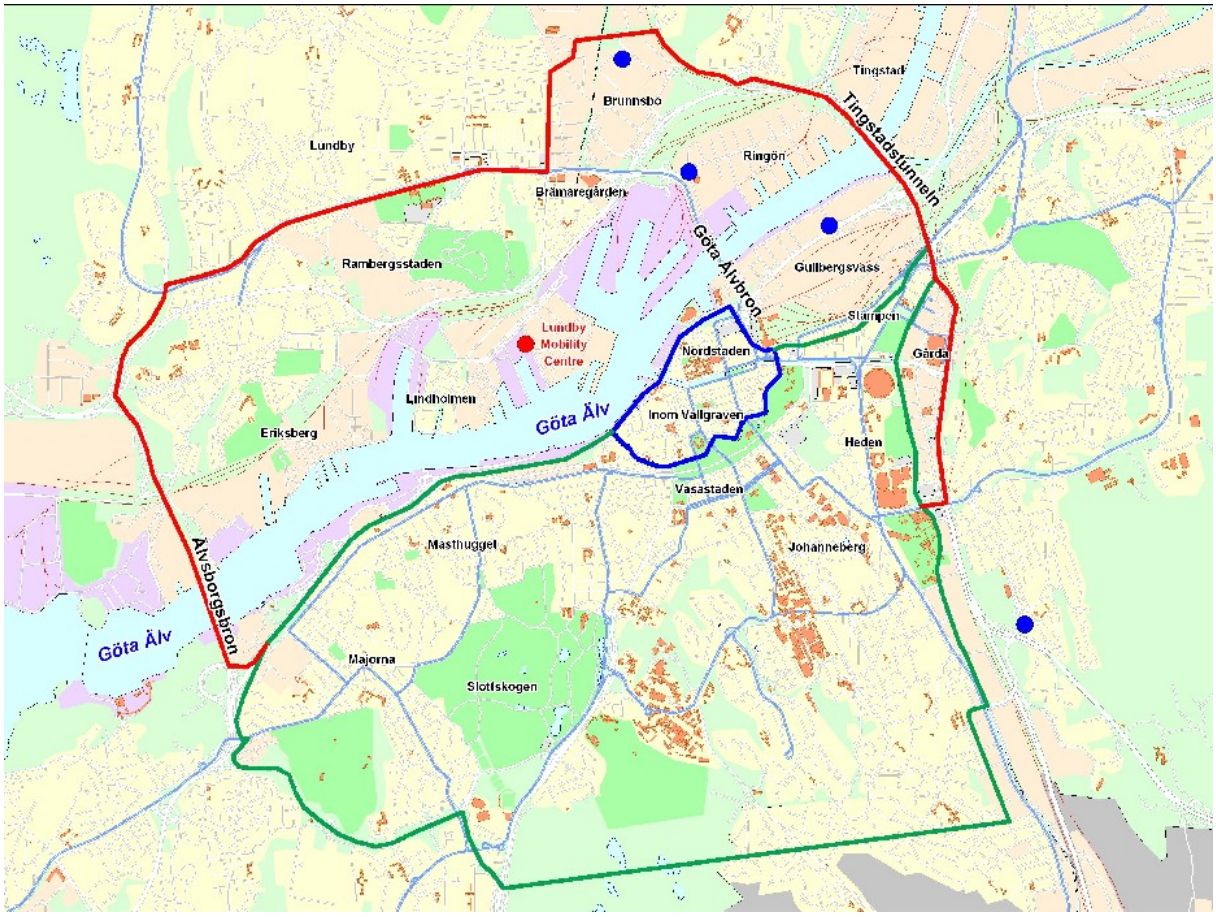
In the central old part of the city, it is necessary to reduce the number of distribution vehicles to decrease congestion and emissions. Measure 9.5 focuses on this small and very critical city centre area. The approach developed in this pilot project can also be used in the north shore area and other critical parts of the city in the future. In this area, also the waste collection vehicles run on a daily basis.

The Mobility Centre is placed on the north shore of the river in a former industrial area that is now under strong redevelopment. A constant stream of companies and people are moving there, which is the reason for placing the Mobility Centre in this area. The focus for the Consumer driven goods management within measure 10.5 is this area.

The major transit road to the outer harbour, where all heavy traffic to the harbour passes, runs through this area. The north shore is for this reason one of the areas where it is predicted that the European Air Quality Norm for nitrogen oxides may be breached. This road was from the beginning of TELLUS the target for demonstration 6.6 where CNG/CBG vehicles were supposed to be introduced. When broadening the measure objective to also include distribution vehicles, the geographical scope also got wider. The distribution vehicles, and also the heavy ones, run mostly in the central parts of the city. Thus, after the broadening of the measure, it can also be considered to be partly area based.

Both measure 12.7 and 12.8 are site based as all the vehicles introduced within these measures operate in the whole city centre.

Due to the growing number of workplaces, schools and apartments on the north shore, the public transport needs to be developed and it is necessary to make use of the river. The new river shuttle within measure 7.6 was supposed bind together the north shore and the city centre, and decrease the public transport pressure on the other passages over and under the river. However, since it was stopped, there will be no impact here.



Map A.2-1. Geographical impacts of demonstration measures in Göteborg

2 Thematic clusters

The demonstration measures can be clustered according to the thematic field they address. The clustering will allow the comparison of the demonstration measures, their implementation and outcome as well as their evaluation results with the measures of the same cluster carried out in the different TELLUS cities.

Table A.2-2. Thematic Cluster of TELLUS measures in Göteborg

	Demonstration measure	Promotion of clean vehicles	Pricing strategies	Increasing attractiveness of PT (ticketing, information)	Distribution of goods	Innovative mobility services	Access restrictions	Parking management	Others
5.7 Environmental zone for heavy duty vehicles							x		
6.6 Incentives for purchasing of CNG heavy duty vehicles		x							
7.6 Environmental optimised ferry shuttle									x
9.5 Incentives for improving the load factor in inner-city freight transport					x				
10.5 Consumer driven goods management from a Mobility Centre base						x			
12.7 Introduction of clean vehicles in public and private fleet		x							
12.8 Introduction of clean waste collection vehicles		x							

3 Integration into Local transport policy

Göteborg has a tradition of being an *environmental proactive city*. The city has the advantage of being both a strong purchaser and an authority, but it has also an informative and communicative role. The City of Göteborg stands in for the idea that it is important to use all its different roles for the development of sustainable transport solutions for the future and this in a broad collaboration with as many partners as possible.

The Traffic and Public Transport Authority has the overall responsibility for the coordination of all traffic-related issues in Göteborg and the main task for the Authority is to provide the means for efficient, safe and sustainable mobility in Göteborg. One of the most important goals is to create prerequisites for mobility for the inhabitants in the city that are good for the individual as well as for the society and the environment. During 2004 the draft for a revised Sustainable Transport Strategy was introduced and was ready during 2005.The strategy determines the goals for year 2010 and in order to reach them, all the proposed measures and strategies have to be implemented.

The Sustainable Transport programme focuses on five different areas, with the same objectives as many of the TELLUS quantified objectives:

- Reduce the demand for transportation;
- Shift focus towards more sustainable means of transportation;
- Provide efficient transports;
- Support new technologies in the vehicles;

- Apply physical protective measures.

The strategy to reach the objectives contains among other things the following:

- Influence attitudes of the road-users;
- Improve public transport;
- Co-ordinate distribution;
- Increase environmental qualities for vehicles and fuels;
- Co-operation with other large cities within the EU.

In order to further develop the work already performed in the city, it is evident that collaboration between the private and the public sector is of importance to get a broader perspective. In TELLUS Göteborg this mix of private and public sector has been developed and contributed to a better integration.

4 Actors of Evaluation in Göteborg

The Local Evaluation Manager in Göteborg, together with an external consultant, has carried out the evaluation on City level in cooperation with the local demonstrator contacts. The demonstrator contacts have been responsible for the evaluation of their local measures and each of them has carried out the evaluation in various ways (see Part B). There has been a continuous dialogue with the Local Evaluation Manager and the demonstrator contacts to secure a good quality of the evaluation. Regular local meetings, twice a year at least, have been held. In addition a special scenario meeting was held in 2005 to agree on a common methodology and time frame.

B EVALUATION ON DEMONSTRATION MEASURE LEVEL

B.1 Approach

Part B contains the evaluation reports on measure level. In order to provide for comparability, the evaluation of every measure adheres to the same report structure:

The introduction gives a brief reference to the type, strategy and policy context of each measure as well as an overview of the demonstrator and, if applicable, modifications to the original plan or strategy.

The description of the demonstration measure outlines the original demonstration design as stated in the Description of Work, the transport plan context and the different level objectives as provided in the Evaluation Plan. It also includes a brief description of the situation before TELLUS and the innovative aspects of the demonstration measure.

The third chapter of every report contains the actual implementation process of the measure as undertaken throughout its life cycle.

Chapter 4 provides results of the evaluation, in particular with regard to the impact evaluation. Every chapter is sub-divided into first, a description of the evaluation methods, and second, the impacts themselves clustered around the evaluation areas that apply to the measure.

The conclusion chapter gives an overall assessment of the demonstration measure. The conclusion of the process evaluation aims at stating drivers and barriers that either promoted or else hindered the implementation and/or success of the measure. The drivers and barriers refer to both, events and circumstances directly related to the measure itself, or else framework conditions, which turned out to play an important role. What is more, this chapter also includes the resume with an overview of the grade of achievement of the objectives.

Scenarios have been developed for all measures, except 7.6, which was cancelled, with the aim of estimating the likely impacts of the measures for the time frame 2006-2010 if implemented on a larger scale. The scenarios are based on optimistic, but still realistic and achievable, assumptions.

Finally, recommendations based on the results of the evaluation and lessons learnt by the actors are given in the final chapter.

B.2 Demonstration Measure 5.7 – Environmental zone for heavy-duty vehicles

1 Introduction

In urban areas, particularly near city centres, vehicle traffic is one of the major sources of air pollution, noise and congestion. Traffic laws in Sweden (SFS1998:1276) allow communities to ban heavy diesel-powered trucks and buses over a certain age in urban areas that are particularly sensitive from an environmental point of view.

Environmentally-sensitive areas

An Environmental Zone is an area of a city where certain traffic restrictions apply due to the area being particularly sensitive to certain types of disturbance or harmful effects. There is no precise legal definition of an environmentally sensitive zone. The three largest cities in Sweden, however, define such an area as follows:

An environmentally sensitive area

- Contains many apartment buildings;
- Has streets that are heavily used by pedestrians and cyclists;
- Contains buildings that are particularly sensitive environmentally;
- Contains parks or green areas that are easily harmed by the environmental effects of traffic, and is also exposed to problems of pollution and noise.

The primary aim of declaring an area to be an Environmental Zone is to improve the local environment within that area.

The Environmental Zone was introduced in Göteborg in 1996 to reduce the environmental impact of heavy traffic. The current Zone encompasses the central areas of Göteborg, a total of 15 square kilometres.

Innovative aspects

The Environmental Zone is an important element of the environmental initiatives by the city of Göteborg, aimed at improving the air quality for those who live in the city. The Environmental Zone is a vital tool for Göteborg in its efforts to reduce the number of emission-related cancer cases, make life easier for asthmatics, reduce the quantity of particles in the urban environment, etc. In addition, Swedish cities have been required to meet the environmental quality standards stipulated by the government. Göteborg views the Environmental Zone concept as an important element in attaining these standards. The Swedish environmental quality standards are Sweden's legal environmental implementation of the standards of the EU for air quality.

2 Description of demonstration measure

2.1 Demonstration design

The demonstration was intended to evaluate the existing Environmental Zone. The aim was also to develop a new proposal with new criteria for vehicles entering the Zone and to develop a proposal for an expansion of the Zone and to test an on-board measurement for NOx. This demonstration should also increase the communication between the Traffic and Public Transport Authority, the local transport industry and the Industry Ministry. In addition to this, clear and visible signposting of the existing zone was also one of the intentions of the demonstration.

2.2 Transport Plan context

The main task of the Traffic and Public Transport Authority is to provide the means for efficient, safe and sustainable mobility in Göteborg. One of the most important goals is to create facilities for mobility for the inhabitants of the city that are good for the individual as well as for society and the environment. In 1995, the first Sustainable Transport Strategy for Göteborg was introduced, but this is currently under revision, and the new strategy will determine the goals for 2010. Two very important goals within the strategy are that focus should be shifted towards more sustainable means of transportation and use of new technologies in vehicles should be supported.

Heavy-duty vehicles are a major reason for poor air quality and noise in the city centre of Göteborg. To achieve the goal of lower emissions from traffic, it is necessary to regulate heavy-duty vehicles in central areas of Göteborg.

The aim of measure 5.7 was to reduce emissions and noise from heavy-duty vehicles, thus contributing to the Transport Plan for more sustainable means of transport.

2.3 Objectives

Immediate objectives

- Evaluation of the existing Environmental Zone in Göteborg;
- Development of a proposal with new criteria for the vehicles entering the zone;
- Development of a proposal for the enlargement and design of the zone;
- Verification and evaluation of the new proposals of the Environmental Zone regulations and enlargement;
- Increased communication with the local transport industry.

Intermediate objectives

- Better air quality and reduced noise;
- Increased co-operation with the transport industry.

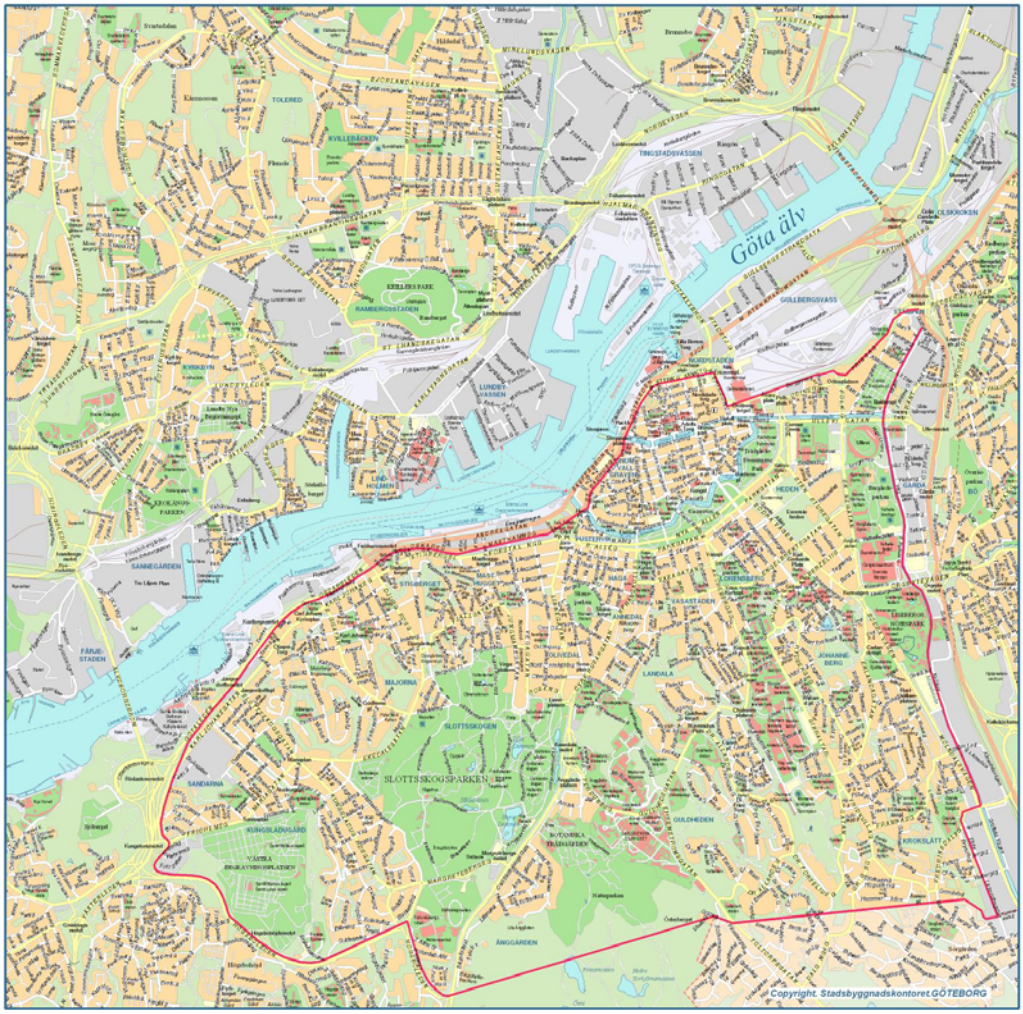
Ultimate objectives

- Reduce air pollution and noise to levels below national and EC directives;
- Reduce NOx emissions from heavy traffic;
- Improve public-private co-operation;
- Achieve extensive political and public awareness for TELLUS.

2.4 Ex-ante evaluation and situation before TELLUS

Environmental aspects

The Environmental Zone was introduced in Göteborg in 1996 to reduce the environmental impact of heavy traffic. The Zone encompasses the central areas of Göteborg, a total of 15 square kilometres. About 100,000 people work in the area, and an equivalent number reside there. The number of heavy vehicles driving locally in the Environmental Zone is about 3,400, and they cover approximately 8.4 million vehicles kilometres within the Zone.



Map B.2-1. The Environmental Zone established in 1996.

The Environmental Zone has led to reduction in:

- Particle emissions from heavy vehicles by 15-20 %;
- Hydrocarbon emissions from heavy vehicles by 5-9 %;
- Nitrogen oxide emissions from heavy vehicles by 1-8 %;

in the first year after the Zone was established.

Implementation aspects

When the Environmental Zone was introduced in 1996 the regulations covering it were based on the Swedish environmental classification system, meaning that foreign vehicles were exempt from the Environmental Zone requirements. On 1st January 2002, the local traffic regulations in Göteborg were amended in accordance with the National Traffic Policy. The new local regulations imply that a diesel-powered vehicle with a total weight of over 3.5 tonnes can travel within the Environmental Zone for a period of 8 years after the date of initial regis-

tration. In addition, there are exemptions that allow further years of operation if the vehicle is fitted with exhaust gas filter systems. These new regulations accordingly cover all vehicles regardless of their country of registration. Statistics show that approximately 95 % follow the rules, and less than 1 % of the vehicles are foreign.

Attitude aspects

The attitude towards the Environmental Zone among affected haulage companies is, in general, relatively positive, (attitude survey February 2003). The introduction of the Zone resulted in substantial financial consequences, but once the investment is made, the company will have competitive advantages. Complaints mainly involve the fact that the regulations should be extended to apply to foreign vehicles as well and that monitoring should be tightened up.

The haulage companies are also asking for help in reducing problems that are currently an obstacle to more environmentally friendly driving, including unnecessarily long and complicated routes and lack of loading zones. Geographic expansion of the Environmental Zone is not expected to present any major problems, while, on the other hand, attitudes are somewhat less positive about the Environmental Zone possibly being expanded in the future to apply to all road deliveries and all type of transports.

2.5 Base-line study of attitudes

In February 2003, a survey of affected haulage companies and suppliers was carried out. The purpose of this survey was to provide a picture of the affected companies' views on the Environmental Zone both as it is at present and the potential developments being discussed. Since the survey was intended as a form of "zero measurement", it also included questions on how the introduction of the Environmental Zone had affected the individual companies.

The companies included in the survey were, in part, haulage companies who drive within the Environmental Zone, and also major suppliers with their own vehicles. In order to reach relevant companies, a selection of 440 haulage companies was made in Göteborg municipality and the surrounding municipalities. A questionnaire was sent out to all of these by post, and those who did not return their completed questionnaire within one week received a phone call giving them the opportunity to respond to the questions by telephone. Of the original haulage companies selected, 240 were dropped, mainly because they did not drive within the Environmental Zone. By the end of the survey response had been received from 136 haulage companies, which is equivalent to a response rate of 68 percent.

A selection of 115 companies was made from among major suppliers in the same way, of which 50 turned out to be relevant to the survey. In this group, interviews were conducted with 33 companies or 66 percent. The response rate is regarded as acceptable within both groups.

The attitude towards the Environmental Zone among affected companies is, in general, posi-

tive. A summary of the survey results has been printed in Swedish and English. The survey about the acceptance of the valid regulations has been sent to 440 haulage companies in the city of Göteborg and the surrounding municipalities (the survey results are accessible on the web site www.trafikkontoret.goteborg.se).

3 Implementation Process

The development of the existing Environmental Zone in Göteborg comprises two elements. One element is to geographically expand the existing Zone. This involves Göteborg alone. The other element is to change the regulations for vehicles allowed to drive within the Environmental Zone. The latter will be undertaken together with the other Swedish cities with existing Environmental Zones (Stockholm, Malmö and Lund).

Within the demonstration measure NOx-reducing long-route EGR (Exhaust Gas Retrofit equipment) system has been tested, as well as development and validation of an onboard measurement system for heavy vehicles.

3.1 Part one – geographical expansion of the existing Zone.

To be able to continue the work on expanding the Zone area, the definition has to cover places of work. The co-operating cities have jointly developed a new definition of a special environmentally sensitive area in 2004. This definition is to be used in the proposal for the enlarged Environmental Zone.

A special environmentally-sensitive area is an area which contains parks, green areas, dwellings, streets with many road-users, sensitive buildings, places of work, and areas which are exposed to noise and emissions or where there is a risk of the European Commission Air Quality Norm not being fulfilled.

The new definition means that it is possible not only to include areas where large numbers of people live, but also areas where people work or locations near traffic routes. This definition allows Göteborg to include the Lundby area of the north river shore in the Environmental Zone. This area is a former industrial and shipyard area, which is now being developed into a business, science/university and housing area.

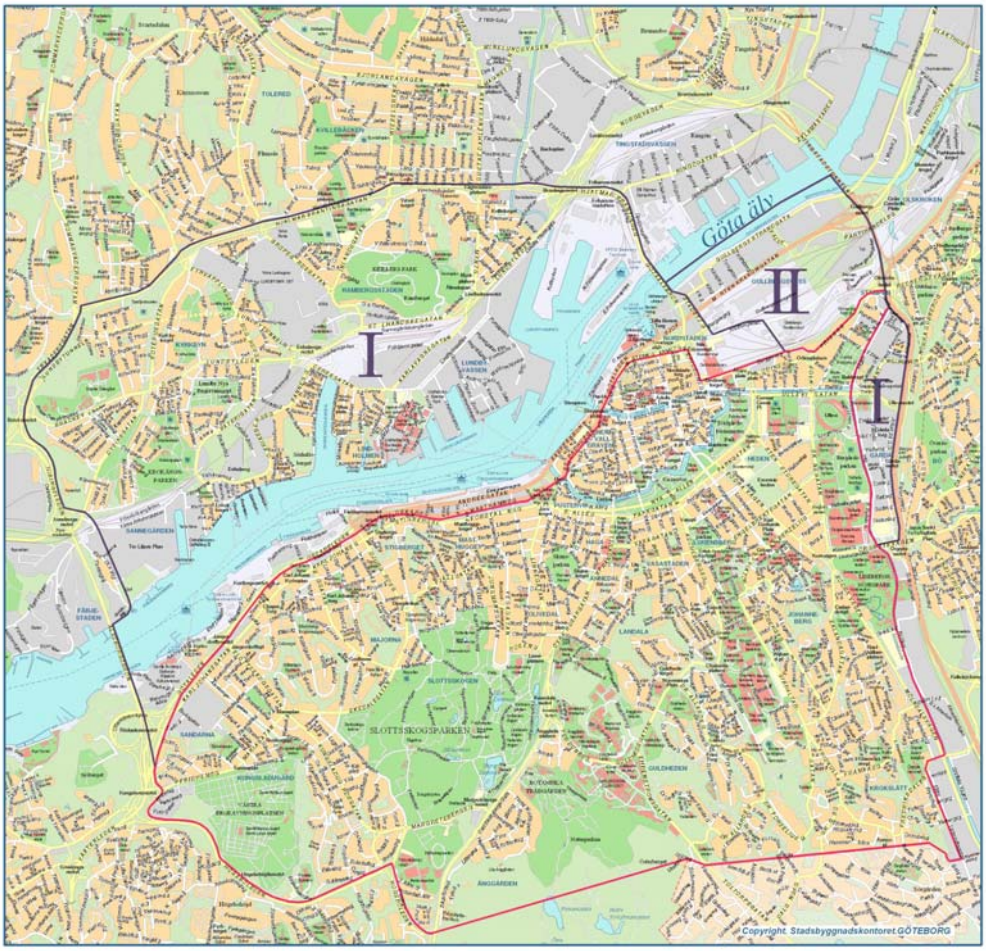
Map B.2-2. Map of the first proposal for an expanded Environmental Zone

Public Acceptance and Public-Private Co-operation

Acceptance by the affected parties is essential. After several small meetings with affected parties and a large meeting on 10 January 2005, the proposal was changed in order to meet the demands halfway. One area (Ringön) was excluded. It was proposed that the expansion of the Zone was to be implemented in two steps: area (I) to be included from 1st July 2006 and area (II) to be included 1st January 2010 because of the detailed development plan.

Exemptions and supervision

Transit traffic to the ferry berth within the expanded Environmental Zone was not to be included in the regulations. Close co-operation with the Traffic Police has facilitated supervision of transit traffic.



Map B.2-3. The final proposal for the expanded Environmental Zone

3.2 Part two - New criteria in the Environmental Zone

The development of new criteria for entering the Environmental Zone is undertaken in co-operation with Stockholm, Malmö and Lund.

Co-operation between the cities and public acceptance

There have been difficulties in reaching an agreement about the basic regulations for the Environmental Zone. The different cities have had different drafts. The investigation of cost/benefits, of a comparison between the two different proposals for the new criteria, required extra information, and the supplementary investigation was completed in September 2003. The two different drafts (one based on age and one based on emissions) were sent to affected parties for consideration in May 2004. Most of the affected parties did not have any strong opinion regarding either of the drafts. The drafts were further developed and combined, producing a new draft with the best elements from each proposal. This draft was presented to the affected parties at both small meetings and a large meeting on 20th January 2005.

The final proposal, which the four Swedish cities have agreed on, means that non euro-classed vehicles are allowed to enter the Zone, provided they are no older than 6 years. The exceptions to this rule are based on vehicle emission. If the vehicles are euro-classed they will be allowed to enter the Zone even if they are older than 6 years, but there will be a limit for each euro-class. Euro IV are allowed for 9 years and Euro V are allowed for 10 years. It will mean that all types of vehicles are allowed, but the cleanest vehicles are allowed for a longer period.

3.3 On-board measurements

One element of the demonstration was to carry out field tests on two different vehicles for approximately 2 months in Göteborg. The aim was to increase understanding of the degree of reduction from the NOx-reducing long-route EGR system, as well as the development and validation of an onboard measurement system. A delay concerning these NOx on-board measurements was due to reorganization of the company EN Sverige AB into The ETG (emission technology group). The report on the on-line emission testing was completed in June 2004.

The equipment produced for mobile measurement of NOx emissions from “Heavy Duty” diesel vehicles consists of a NOx sensor (with built-in lambda sensor), a pressure sensor, a speed sensor, a PC logger and the relevant accessories. These instruments were fitted to two buses operating in Göteborgs Spårvägar’s (Göteborg Tram) regular traffic. The equipment seems to function well for its purpose, but could be fine-tuned and developed further.

3.4 Emissions from transit traffic

The transit traffic was measured with a FEAT-instrument at a street in the city centre, Kanaltorgsgatan. 25 measurements were made for heavy transit traffic. As there was a low share of heavy vehicles at the place for measurements the measurements are not fully representative.

Picture B.2-1. FEAT measurement at Kanaltorgsgatan.

3.5 Signposting

32 information signs have been sited on every street entering the Zone. Five information signs have been put up with reference signs at rest areas beside the access roads to Göteborg for vehicles arriving from up-country.

Picture B.2-2. Signs at the access roads and one of 32 information signs

4 Results

4.1 Evaluation methods

Air quality

Indicators: NO_2

Unit: µg/m³

Method: Air pollution is measured by a main measurement station placed on a roof in the city centre. There are also four other measurement stations in the city that uses the DOAS-technique (Differential Optical Absorption Spectroscopy). It is a distant analysis technique available for measurements of NO_2 and NO. The molecules absorb light in the UV area. The system consists of a light source (usually xenon) and in the opposite end of the measurement section there is a receiver.

The light is divided with the help of a lattice. The spectra is being developed into digital signals and compared with reference spectra for NO_2 and NO. There are also 3 mobile stations. From these measurements, calculations are made.

Reduce NOx emissions from heavy traffic

Indicators: NOx emissions

Unit: kg/year

Method: On-board measurements. Calculations from traffic flows and the technological levels on the vehicles.

Achieve extensive political and public awareness for TELLUS

Indicators: Media response

Unit: Number of articles and events

Method: The number and coverage of articles in the media, and the events organised by the demonstration measure are analysed and evaluated in a descriptive way. The local measure leader carried out this analysis at the end of the TELLUS project in 2005.

Improve public-private co-operation

Indicators: Attitude

Method: Surveys and interviews with private hauliers to see whether the collaboration with the municipality has improved. The surveys and interviews were carried out by the local measure leader in the beginning and at the end of the project.

4.2 Impacts

Evaluation indicators

Table B.2-1. Evaluation indicators

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement (TELLUS month)
Environment	Pollution/Nuisance	Emissions	NOx emissions	kg/year	Measured and calculated values	1)Measurements by the National Authorities and 2) Local vehicle measurements (on-board measurements,)	1) M 12, M 24, M 36, M 48 2) M 22
		Air quality	NO_2	µg/m³	Calculated value	Local Environmental Authority and local stations of measurement	M 12, M 24 , M 36, M 48
	Resource consumption	Change in areas	Enlargement of Zone area	km^2	Measurement of the zone enlargement, calculations	Local WP Leader	M 42
Society	Awareness	Political and public awareness for TELLUS	Media response	Number of newspaper articles about the Environmental Zone	Quantitative, collected	Local WP Leader collects material and analyses at the end of the project	Continuously with analysis M 42
	Acceptance	User acceptance	Attitude	Acceptance rating	Surveys and interviews	Local WP Leader	M 14, M 42

Pollution/nuisance - Emission

The NOx emissions are calculated values, the figures are to be found in “Trafikarbete och NOx-utsläpp inom Göteborgs Stad 2000-2010”.

Table B.2-2. NOx emissions in Göteborg

Year	NOx emissions from road traffic in Göteborg In tons	NOx emissions from heavy traffic in Göteborg excl Environmental Zone In tons	NOx emissions from heavy traffic within the Environmental Zone in Göteborg In tons
2002	2,350	1,027	60.1
2003	2,183	981.9	61.4
2004	2,028	946.4	62.2
2005	1,864	906.6	59.5

The new engine technology together with the regulations has been a success factor to decrease the emissions in Göteborg.

On-board measurements

The field tests with the two buses produced different results. Based on various algorithms, logged measurement data and a number of graphs showing NOx emissions in various phases during the analysis period, it has been possible to calculate the final result. NOx emissions from one vehicle were reduced by approximately 36 % and from the other by around 18 %.

The difference in the percentages measured is the result of many different factors. One of the important factors is that the control and mapping of the EGR system were designed following testing as per the Braunschweig bus cycle and thus are not 100 % optimized for various routes/services, vehicles/engines and the various driving styles of different drivers, which is hugely important for NOx reduction. ETG has subsequently developed an adjustment algorithm based on a so-called “closed loop,” which can be assumed to compensate for these variations.

Naturally, these factors may have contributed to the result that NOx purification on different vehicles varies. The measurement method may also have been a factor in this, and it could be refined and developed further.

Emissions from Transit Traffic

Due to the limited data from the transit traffic measurements at the Kanaltorgsgatan, the results are divided into Euro classes. In the figure below shows Kanaltorgsgatan (NST), Gullbergsmotet (GBM), Brantingsmotet and St Eriksgatan (STE+BRM)

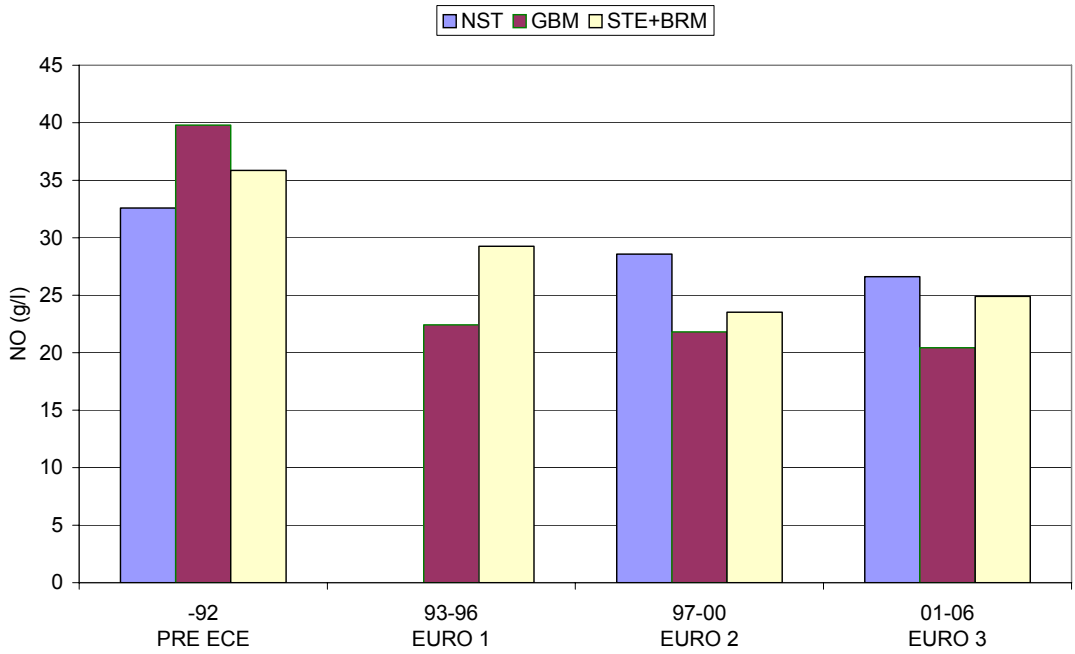


Figure B.2-1. Emissions from transit traffic. The average NO-emissions for heavy lorries divided into emission requirements.

Air quality

The Environmental Administration in Göteborg has four local stations of measurement. The NO_2 emissions are measured and calculated. The figures are to be found at the homepage of the Environmental Administration, www.miljo.goteborg.se.

Table B.2-3. NO_2 levels

Year/station	Femman	Järntorget	Haga	Gårda
2002	27.2	25.0	34.3	-
2003	27.1	27.9	42.2	46.5
2004	25.0	26.9	41.5	47.0
2005	23.9*	24.4*	40.0*	46*

The values are an average for each year; the measurements are carried out every month. * an average of 8 months January until August.

Resource consumption - Change in area

The existing Environmental Zone is approximately 15 square kilometres. The proposal of the enlarged Environmental Zone is calculated to be app. 13 square kilometres. If the proposal gets political acceptance and is implemented it means an enlargement of 87 %.

Society

Awareness - political and public awareness of TELLUS

The media response has been good. The Environmental Zone has been mentioned in articles in trade magazines, local newspapers, research magazines etc. The research and the development with the Environmental Zone are often mention together with the action programme for reaching the Air Quality norms published by the Country Administrative Board

Awareness – user acceptance

The Base-line study of attitudes from 2003, shows that the users in general are positive to the Environmental Zone, (chapter 2.5).

A follow-up study of attitudes of the affected haulage companies and suppliers was carried out in spring 2005. The results from this study are not fully comparable to results from the base-line study. The selection in the follow-up study is a bit wider and contains both transport with heavy vehicles and transport with light commercial vehicles

The companies included in the survey were, in part, haulage companies who drive within the Environmental Zone, and also major suppliers with their own vehicles. In order to reach relevant companies, a selection of 300 companies was chosen in the Göteborg municipality and the surrounding municipalities. A questionnaire was sent out to all of these by post, and those who did not return their completed questionnaire within one week received a phone call giving them the opportunity to respond to the questions by telephone. By the end of the survey the response rate was 66 %.

A special selection of 45 companies was chosen from the affected companies the Traffic and Public Transport Authority have been in close contact with. The response in this special group was 75 %. In both groups the response rate is regarded as acceptable.

66 % of the interviewed persons did thought that the Environmental Zone has had a positive effect on the air quality in Göteborg, compared to 58 % positive in the base-line study. Many affected also wants the supervision to increase. Less than a third think that they are very or good informed about the future plans for the enlarged Environmental Zone and only 8 % think that they have had possibility to affect the proposal for the enlarged Environmental Zone. Among the asked companies 55 % did think they were badly or not at all informed about the future plans for the new regulations within the Environmental Zone. There is also a connection between how well informed they are and how positive they are. In the special group 48 % thought that they had possibility to affect the proposal for the enlarged Environmental Zone and 23 % that they had possibility to affect the proposal for the new regulations.

5 Conclusions

Legality and technical barriers

Increased co-operation between the (Swedish) cities and the Industry Ministry has been established. This has resulted in a final proposal for the regulations, which has been developed together with the Industry Ministry.

The existing regulations have two problems that need to be solved, and this is also why it is so important for the cities to implement the proposed regulations as soon as possible. One problem is the legality of the existing regulations because of some questions from the EU commission in 2002, and the other is lack of technical scope.

There has been a request from the EU commission concerning the legality of the exemptions from the regulations in the Environmental Zone. The regulations for the Environmental Zones in Swedish cities are not allowed to contain any details that could infringe on free trade between members of the EU. The EU commission is investigating the regulations of the Environmental Zone and if the regulations can be seen as a hindrance to the solidarity rules, the legality of the Zone may be questioned. This also made it very important to co-operate with the Industry Ministry.

There are also technical difficulties in continuing with the existing regulations because of exemptions to the regulations. The exemptions allow vehicle owners to drive for an additional 4-6 years if the vehicle is equipped with an approved retrofit. This kind of retrofit will be an integral part of newly produced vehicles because otherwise it would be difficult to meet Euro 4 or Euro 5 emission requirements; and installing another retrofit equipment on the same vehicle will then not be possible. The proposal for the new regulations will not allow any kind of exemptions for retrofitting of vehicles.

The final proposal, which the four Swedish cities have agreed on, contains some exemptions. These exemptions are based on technical regulations, which officially cannot be enforced by a municipality. The close co-operation with the Industry Ministry has resulted in a proposal to amend national traffic legislation. The proposal for changes in the national legislation has been sent for consideration to 16 affected parties in September 2005.

Changes to national legislation take time, and this has meant that the new regulations could not be implemented by 01-01-2005, which was the planned date. The delay will probably be 18 months (01-07-2006). Information meetings for politicians have been held in September 2004 and February 2005.

Political barriers/drivers

Politicians were informed about the proposal for expansion of the Environmental Zone in March 2004, and a decision was made to send the proposal to 21 affected parties. 18 of these sent in a response. In September, the politicians were informed about the responses

from the affected parties. The politicians were informed about the changes to the proposal for an expanded Environmental Zone in February 2005. Due to strong standpoints from external interested parties, the political decision has been delayed for approximately eighteen months. This also means delayed implementation of the expanded Zone.

Since it is very important to have the same regulation in the four Swedish cities there are also difficulties to have the political support from each city. If there are problems to get political support in one of the cities it delays the process in the other cities.

Strong lobbying is used towards the politicians for getting the transport companies' point of view. It has resulted in large delays and deviations from the original timescale.

6 Scenarios

Together with particularly the demonstration measures TELLUS 9.7 and TELLUS 10.5 the impacts of the Environmental Zone could be up-scaled until 2010.

The Environmental Zone will be enlarged and the criteria for entering the Zone will be changed as the purpose was in TELLUS 5.7. This means that the Environmental Zone will be used as a base regulation. Within the Environmental Zone other types of regulations can be used. The Traffic and Public Transport Authority will develop possibilities to regulate the load factor. Only vehicles with a high load-rate are allowed to entering the Zone. To make this possible a strong lobbying is necessary to make a change in the national legislation. Together with the transport industry the regulation for the load factor will be developed. The co-operation with the transport industry will result not only in restrictions but also in incentives to increase the load factor. The Traffic and Public Transport Authority will also together with the tradesmen in the city centre open up for the possibility to affect the purchaser. This is also an important step in the delivery chain to make everyone aware of the problems and to make them understand the important of collected goods delivery.

To reach the air quality norm for NO_2 it is also important to reduce the number of old private cars especially the one without a catalytic converter. The development of the Environmental Zone could also include a restriction of the oldest private cars. A regulation for the private cars could be implemented in 2009-2010. This also needs a change in the national traffic legislation.

7 Recommendations

Within a city centre vehicle traffic is one of the major sources of air pollution. It is in the interest of the municipalities to reduce air pollution as much as possible. The emissions from traffic effects peoples' health and therefore the costs for the emissions are high for the society. A regulation of the heavy traffic can give lots of benefits in reduced emissions. To implement an Environmental Zone is a good start from which the regulations can be up-scaled as in the case of Göteborg.

A good lesson learnt is to involve affected parties as soon as possible, but also to include different kind of experts (do not forget experts in leadership and development-process). A study (Miljözon- en världsnyhet från Göteborg, Ecoplan) shows that the people involved at an early stage are the ones most positive. It is also very important to have a realistic timescale. This kind of development takes time. Changes in legislation on national level are often combined with lots of lobbying and it is a time consuming work.

B.3 Demonstration Measure 6.6 – Incentives for purchasing of CNG/CBG heavy duty and distribution vehicles

1 Introduction

In the City of Göteborg there is a large quantity of distribution transport and transport through the city. An increase in the quantity of both distribution and transit transports is predicted, which will cause major problems for the city and the traffic planners, from both a health and a congestion aspect. To be able to comply with the European Air Quality Norms, which will be legally binding from January 1st 2006, it is necessary to decrease the emissions from heavy traffic. The solution to the traffic congestion and the increased traffic pollution is a mixture of mobility management and technology, where this demonstration focuses on the latter.

This demonstration measure aims at improving the air quality of the city of Göteborg by decreasing emissions of NOx and particles for heavy traffic and distribution by creating opportunities for environmentally sound transport. The objectives of the measure are to promote alternative fuel technology and influence the private sector to choose CNG/CBG vehicles. This choice should be easy to make as CNG/CBG is a cheap fuel, but the NGVs are unfortunately more expensive than conventional (diesel) vehicles.

The demonstration measure is managed by FordonsGas Sverige AB. FordonsGas Sverige AB builds and operates fuel stations for CNG and CBG in Sweden. They also work with influencing vehicle owners to choose CNG/CBG vehicles instead of conventional vehicles. This measure targets the private sector since there is a lower awareness of CNG/CBG in this sector compared to the public sector.

Picture B.3-1: FordonsGas fuel station.

2 Description of demonstration measure

2.1 Demonstration design

The objective of the measure 6.6 is to decrease emissions of NOx and particles from heavy and distribution traffic in downtown Göteborg by influencing private companies to choose "green" HD and distribution vehicles instead of conventional units. From the start in 2002, the demonstration measure was intended to encompass the major transit road to the outer harbour, as all the heavy traffic to the harbour passes through this area and it was predicted that the European Air quality Norm for NOx could be breached. The demonstration was however later broadened in geographical terms as well as to include distribution vehicles.

The major activities have been to:

- Promote the alternative fuel technology;
- Introduce 2-3 large and 10-15 lighter distribution vehicles in collaboration between three other partners in the city of Göteborg;
- Co-operate with the Traffic and Public Transport Authority in Göteborg and the private sector.

Innovative aspects

The measure has encompassed the following innovative aspects:

- A targeted project aiming a decrease of NOx within the central areas of the city;
- Implementing fast fuel system for alternative fuels (CNG) for heavy and distribution vehicles;
- Targeted activities on CNG/CBG transports;
- A project that will act as a financial catalyst in introducing CNG to the heavier segment of the transport fleet, and also in distribution vehicles;

Involved parties from 2004

The measure is managed by FordonsGas and involves the three partners DHL, Green Cargo and Gatubolaget. They have all different roles in the measure but they all have the same goal. The goal has been to promote "green" vehicles on the market and to increase the knowledge about NGVs and CNG within their respective organizations. A short description of each partner is found below.

FordonsGas is the leader and initiator of the demonstration measure. FordonsGas distributes CNG in a network of gas fuel stations. Its role has been both strategic and operative. The strategy has been to influence and involve the main parties in the complete transport chain, from vehicle manufactures, retail sellers, infrastructure of CNG/CBG, logistics and transport companies as well as end customers.

DHL offers their clients the possibility to buy almost carbon dioxide free transports with a product concept called “Green Tonnage”. These transports are performed by the CNG/CBG heavy vehicles (Mercedes Econic, 18 tonnes) since they are fuelled with biogas in accordance with the green gas principle. The result is transports with a reduction of up to 94 % CO_2 emissions as well as low emissions of NOx and particles.

GreenCargo AB offers their clients the possibility to buy almost carbon dioxide free transports. FordonsGas and Green Cargo have set up a measure together with one of their most important customers, KappAhl. The result is one clean CNG/CBG heavy vehicle (18 tonnes, Scania). By this initiative KappAhl has become a strong driving force in improving Green Cargo’s transport service into a cleaner distribution.

This demonstration measure and the new distribution vehicle are publicly beneficial for both Green Cargo and KappAhl. The measure itself shows how actors that offer varying services and products can collaborate in the chain of value within the transport sector to change the direction from conventional distribution to new creative methods.

Gatubolaget is specialized in transports within the Göteborg region. They offer distribution vehicles, rental cars, car-pooling and act as a workshop resource. Gatubolaget has been in touch with vehicle manufacturers in order to buy 10-15 lighter CNG distribution vehicles in various sizes and from various manufactures.

2.2 Transport plan context

The main task for the Traffic and Public Transport Authority is to provide the means for efficient, safe and sustainable mobility in Göteborg. One of the most important goals is to create possibilities for mobility for the inhabitants of the city that are beneficial for the individual as well as for the society and the environment. In 1995, the first Sustainable Transport Strategy for Göteborg was introduced but is now under revision and the new strategy will determine the goals for year 2010. Two very important goals in the strategy are that the focus should be shifted towards more sustainable means of transportation and that new technologies in vehicles should be supported.

The increased heavy and distribution traffic is a major problem for the traffic planners, both from a pollution, from a health, and also from a congestion aspect. Already, many substances exceed the air quality norms that will be legally binding from 2006. The solution to the traffic congestion and the increased traffic pollution is a mixture of mobility management and technology. This demonstration measure focuses on the latter, and shows how an alternative fuel will aid the city in reaching the European Air Quality norms.

2.3 Objectives

The objective of this measure is to decrease emissions of NOx and particles for heavy traffic and distribution traffic in the city of Göteborg. One way to meet the quality norms for NOx is

to influence the transport companies to switch to alternative fuels such as CNG/CBG.

Immediate objectives

- Targeted activities on CNG/CBG transports;
- Subsidies to the first 10 buyers of trucks or the first buyer of 10 trucks;
- Implement fast fuel systems of alternative fuels for heavy vehicles (CNG/CBG).

Intermediate objectives

- Decrease emissions of NOx and particles for transit heavy traffic in the major transit roads in the city to the port of Göteborg;
- Introduce CNG/CBG to the heavier segment of heavy duty vehicles;
- Heavy haulage in transit is exchanged for CNG/CBG vehicles.

Ultimate objectives

- Reduce air pollution and noise to levels below national and EC directives;
- Reduce NOx emissions originating from heavy traffic;
- Improve public-private co-operation.

Contribution to TELLUS objectives

- Reduce air pollution and noise to levels below national and EC directives;
- Reduce NOx emissions originating from heavy traffic;
- Improve public-private co-operation.

2.4 Ex-ante evaluation and situation before TELLUS

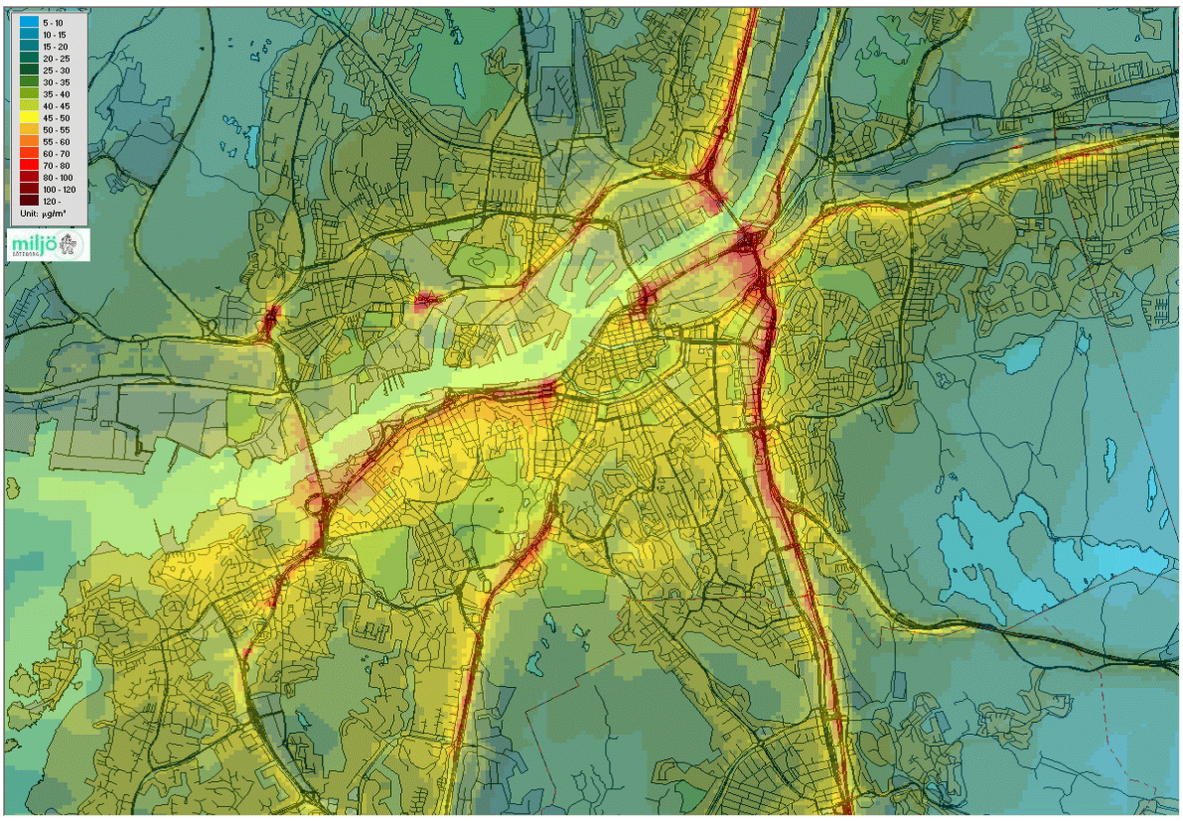
In many European cities most of the clean vehicles are owned by the public sector, and there is a lack of experience and understanding of how to encourage private companies to purchase CNG/CBG vehicles instead of conventional vehicles. Only a handful of privately owned companies have tested and owned CNG/CBG heavy vehicles. In order to speed up the introduction of clean vehicles it is important to involve buyers of logistics and transports at the private companies.

The awareness and interest in CNG/CBG for heavy duty and distribution vehicles has been low in the private sector contrary to public organizations. CNG/CBG was one of the alternative fuels that was prioritised in order to reach the municipal environmental goals. Public organizations have shown an interest in vehicles within the heavier segment. With these circumstances and based on a request from the organization Port of Göteborg, the demonstration measure was formed.

In order to reach a change and break-through it has been shown that it is important that the infrastructure of an alternative fuel is built and to secure the CNG distribution to the public fleets. At the same time it is important to try to influence the private sector. In order to meet the oncoming market demands, the capacity of the fuel stations and the provision of adequate supplies are regarded as important preconditions for changing the use of fossil fuels to alternative fuels.

Problem area

The illustration below shows how and where Göteborg will have the highest load of NO_2 in 2006. The red signifies the limit value 60 mg/m^3, which is too high according to the European Air Quality norms. The yellow are the limits for European Air Quality norms, which is 40 mg/m^3. These limit values enable the measure to encompass the whole of Göteborg city and clearly illustrates why distribution vehicles are a good starting point to decrease emissions.



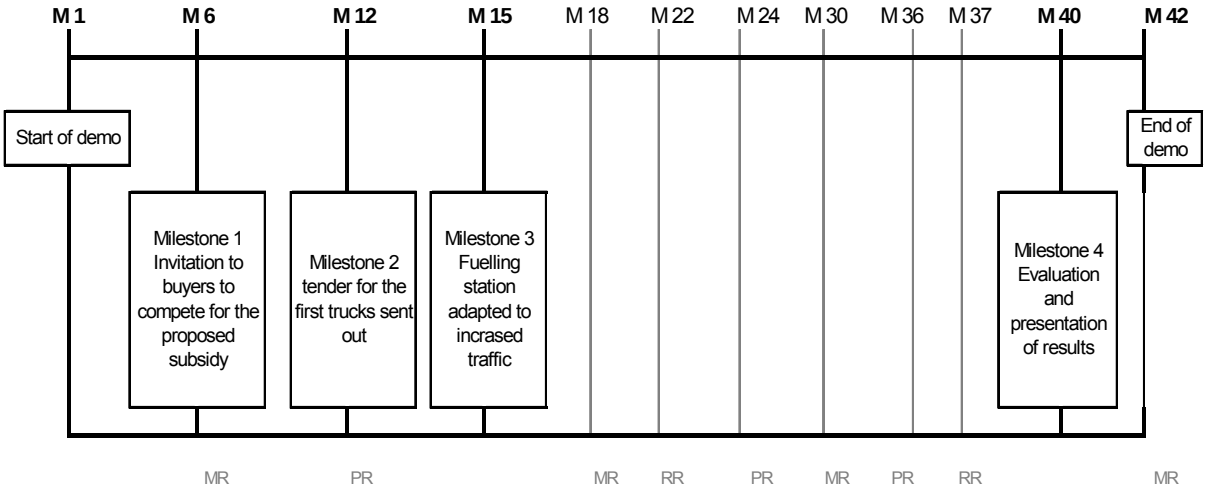
Map B.3-1. Status of NO_2 air quality in Göteborg

3 Implementation process

The measure has been carried out in a number of steps. The original milestones and time schedule were set according to the planned implementation. After a few changes the actual milestones and time schedule were updated. Deviations from the plan are described in chapter 3.3.

3.1 The planned implementation

The solution to the traffic congestion and the increased traffic pollution is a mixture of mobility management and technology development. This measure focuses on the latter, and shows how an alternative fuel will aid the city in reaching the European Air Quality norms. The measure had a number of tasks with the aim to influence the private sector to increase the number of clean heavy-duty vehicles. In the measure, subsidies were paid out to the first 10 buyers of heavy or lighter local distribution vehicles.



MR Management Report
PR Progress Report
RR Result Report

Figure B.3-1. Time schedule

3.2 The actual implementation

The actual implementations have been:

- Four partners have collaborated to introduce 2 large and 16 lighter distribution vehicles in the city of Göteborg;
- A CNG fuel station has been built at Deltavägen in Göteborg instead of in the port area;
- The geographical area was expanded to include the whole of Göteborg instead of just transits to and from the port. The city distribution transports were included.

Milestone and time schedules have been updated during the implementation process. The new milestone and time schedule was set:

- Month 6: Invitation to buyers to compete for the proposed subsidy;
- Month 12: Tender for the first trucks sent out;
- Month 15: Fuel station adapted to increased traffic;

- Month 32: Introduction of the first vehicle;
- Month 40: Evaluation and presentation of results.

3.3 Deviations from plan

The reason for the deviations from the plan was the administration of subsidies. From the beginning it was intended that FordonsGas was to purchase the vehicles themselves but FordonsGas is not part of the transport and logistic sector, they are the distributors of CNG/CBG. This has lead to several changes and deviations. Resources were transferred in an amendment from FordonsGas to the three new partners. The most important deviations have been the enlargement of the measure as a whole. Hence, an opportunity was taken to advance the awareness actions. Concrete additional tasks within the measure have been:

- Direct contact and marketing activities to selected target companies;
- More activities involving clean vehicles manufactures;
- Involving the whole chain in the transportation and logistic chain that is manufacture, distributors, operators and end- customers.

Table B.3-1. Deviation and rationale of changes:

Issue	Deviation	Rationale
Amount of vehicles	Introduce 2-3 large and 10-15 lighter distribution vehicles.	Difficult to find purchasers in the heavier segment.
New milestone 6.6.4	Added new milestone, introduction of the first vehicle month 32.	New partners in the project who purchase and use the vehicle themselves.
Budget shift Other specific cost	Three new partners Gatubolaget, GreenCargo and DHL in the project. The cost category ”Other specific cost” finances them.	FordonsGas thought they could disburse the subsidy for the vehicles without purchasing the vehicles themselves.
Extended range of vehicles	Change from heavy trailer to all distribution vehicles that are commercial and able to be delivered today.	The vehicle manufactures have had quality problems. They have given us insecure details of when they are able to deliver and introduce the heavy vehicles.
Extended route	Include distribution in Göteborg in the objectives instead of only transit traffic to the port of Göteborg.	Congestion of distribution traffic is also a problem. Vehicles do not only have one route. To use the vehicles effectively they drive them in different routes.

3.4 Barriers and drivers

The barriers and drivers have been:

Barriers

- Lack of refuel stations for clean fuels;
- Lack of suitable vehicle models;
- High purchase costs and a weak second hand market;
- Lack of real long-term political commitments on tax reduction and infrastructure investments.

Drivers

- New attractive high-tech clean vehicle models available on the market;
- Reduced tax on private use of company cars and possible local incentives;
- Increased awareness of greenhouse effect and the dependency on oil;
- Environmental requirements in public procurements of transport services.

3.5 The implementation process

During the first year a methodology was set to be able to involve other parties. The methods used for market development were Public Relations, Sales Promotion and direct support and advisory services to target companies and vehicle retailers. The basis has been direct contacts and information by phone, e-mail, meetings and forums. To be able to involve DHL, Green Cargo and Gatubolaget, the following method has been used:

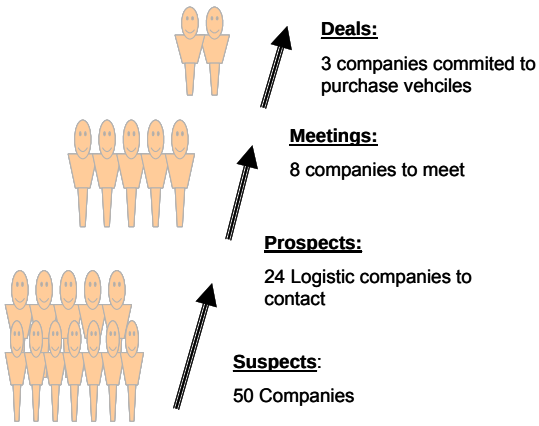


Figure B.3-4 Methods used for implementation

The same method was used to obtain end customers that would participate with Green Cargo, (17 contacted, KappAhl committed to the demonstration) as well as vehicle manufacturers (5 contacted, 3 models of vehicles on the market; Scania, Ford and Daimler Chrysler).

Most of the companies that were contacted, with the exception of some of the producers, had a positive attitude towards alternative fuels and alternatively fuelled vehicles. The larger transport companies were the most interested as well as the end customers that have large transportation needs and that consume a large amount of energy. Although many end customers approve of the idea, they do not want to pay more for the extra service.

The vehicle producers were passive but still wanted information, but no agreements were met. At the time, the Swedish truck manufacturers Scania and Volvo Trucks were not willing to produce CNG/CBG vehicles. They claimed that there were no suppliers for gas cylinders and weak catalytic converters. They also asserted that their production costs were too high due to low volumes. At first, Scania was chosen as a co-operating partner but later switched to Mercedes Benz and their truck Econic.

The third TELLUS year raised the total measure

This year was the success year for measure 6.6. FordonsGas supported their new partners in their marketing and information activities as well as running their own activities, events and seminars. Meetings with different actors in the transportation chain, such as vehicle manufacturers, were held and prioritised. All involved partners signed an agreement to commit to the demonstration and started their own internal processes.

Due to a lack of demand of CNG/CBG heavy vehicles from the market, heavy vehicle manufacturers decided to close down production temporarily. Both Green Cargo and DHL had several meetings and discussions with Volvo, Scania and Daimler Chrysler in order to convince them to continue producing CNG/CBG heavy distribution vehicles. Even in the light distribution vehicle segment there were problems finding suitable vehicles. Gatubolaget had been in touch with many vehicle manufacturers before ordering their vehicles. They have had meetings with Opel, Daimler Chrysler, Ford, Volkswagen, Renault, Iveco and Fiat.

Green Cargo process

There have been several project meetings with GreenCargo and their customer, the clothing company KappAhl. KappAhl has shown a high interest and is a strong driving force to improve Green Cargo's transportation to a cleaner distribution.

There have been several meetings with Green Cargo and Scania in order to convince Scania to produce a CNG/CBG heavy distribution vehicle. Finally, a Scania P114 was delivered in January.

Gatubolaget process

Gatubolaget in Göteborg and their business unit Technical Service have purchased 10 lighter distribution vehicles with assistance from TELLUS. Two of these vehicles were delivered at an early stage. Gatubolaget then placed an order for another 8 light distribution vehicles.

Two Ford Transit vehicles and another 6 Mercedes Sprint, which were delivered in February/

March.

Gatubolaget has produced an action plan for marketing and events. They have informed municipal companies and other organisations about their business and the new vehicles as well as the fuel station infrastructure.

DHL process

DHL has had several meetings with discussions about how to produce and market the product “Green Tonnage” with assistance from TELLUS. They have also arranged sales conferences in order to train their personnel in selling the product “Green Tonnage”. DHL has had several contacts with haulage operators to inform about TELLUS, the subsidies and other incentives, opportunities and CNG/CBG vehicles. A lot of effort has been made to convince their haulage operators to buy CNG/CBG heavy distribution vehicles. In order to stimulate the haulage operators to invest in CNG/CBG heavy vehicles, DHL decided to offer those who invested in green vehicles a compensation of an additional 4 percent.

DHL initiated together with FordonsGas, haulage contractors and Daimler Chrysler, an event where Daimler Chrysler presented their selection of heavy-duty vehicles. This resulted in a quotation to one of the haulage contractors of 1heavy-duty vehicle.

Due to a long delivery time there was a risk that the vehicle would not be delivered during the demonstration period. Therefore DHL has ordered 6 Mercedes Sprint, which is a lighter distribution vehicle. These vehicles will run in DHL's ordinary transport system in the inner city of Göteborg.

Seminars and events

- Breakfast meeting presenting the demonstration and the status of the NOx emissions in Göteborg. FordonsGas together with Business region Göteborg and Danzas (now DHL);
- Launch of fuel station at Deltavägen Göteborg 1st of March 2003. (See number 2 on the Map B.3-2;
- Bio-fuel seminar, Chalmers University of Technology. Focus on the development of CNG/CBG fuel stations in Western Sweden. 20th March 2003;
- FordonsGas was a participant in the Ecology conference in Göteborg 10th of September 2003. This seminar had approximately 5,000 visitors, who represented local, regional and national experts, politicians, organisations, companies, citizens and press. The focus was on the development of CNG/CBG fuel stations in Western Sweden;
- Co-operation in the North Sea countries. FordonsGas presented the development of CNG/CBG fuel stations in Western Sweden. 26th of January 2004;

- A clean vehicle exhibition at the Swedish Exhibition & Congress Centre in Göteborg the 20th of April 2004. This seminar had about 400 visitors who represented local, regional and national experts, politicians, organisations, companies, citizens and press;
- FordonsGas – a sustainable market, a CNG/CBG seminar at the Swedish Exhibition & Congress Centre in Göteborg the 24th of May 2004. This seminar had about 500 visitors who represented local, regional and national experts, politicians, organisations, companies, citizens and press;
- An international clean vehicle exhibition in Stockholm 2-4 of June 2004. This seminar had about 8000 visitors who represented local, regional and national experts, politicians, organisations, companies, citizens and press;
- The European mobility week in September. This event had about 40,000 visitors who represented local and regional experts, politicians, organisations, companies, citizens and press;
- FordonsGas was a participant in of the Ecology conference in Göteborg 5-8 October 2004. This seminar had about 5,000 visitors who represented local, regional and national experts, politicians, organisations, companies, citizens and press;
- Green Cargo participated in the seminar Heavy vehicles & environment, at the same conference, with a lecture about user experiences. The seminar was attended by 75 visitors.

Map B.3-2. CNG Fuel Stations in Göteborg

Quantifiable targets

The quantifiable targets for the measure after the amendment were:

- Targeted activities on CNG/CBG transports. **YES**
- Implement fast fuel systems of alternative fuels for heavy vehicles (CNG/CBG). **YES**
- Subsidies to the first 10 buyers of trucks or the first buyer of 10 trucks. **NO and YES,** Changes were made in the demonstration, 4 partners were to collaborated to introduce 2 – 3 large and about 10-15 lighter distribution vehicles in the city of Göteborg.

Green Cargo AB has bought a Scania 18 tonnes, as planned

Gatubolaget has bought 10 light distribution vehicles; eight Mercedes Sprinter about 3.5 tonnes and two Ford Transit about 3.5 tonnes, as planned

DHL has bought a Mercedes Econic 18 tonnes and six Mercedes Sprinter for distribution about 3.5 tonnes. They planned for two 18 tonnes vehicles.

- It is estimated that some 400,000- 700,000 km's yearly is being shifted from diesel to CNG. This means a reduction of around 5 metric tonnes on nitrogen oxides yearly. **YES,** the estimated target will be met. The above-mentioned vehicles shift from diesel to CBG for circa 500,000 km's yearly. The yearly reduction of NOx is 3.55 metric tonnes yearly.

Milestones and deliverables during the measure

- Milestone 6.6.1: invitation to buyers to compete for the proposed subsidy (month 6) **YES**
- Milestone 6.6.2: tender for the first trucks sent out (month 12) **NO**
- Milestone 6.6.3: fuel station adapted to increased traffic (month 15) **YES**
- Milestone 6.6.4: introduction of the first vehicle (month 32) **YES**
- Milestone 6.6.5: evaluation and presentation of results (month 40) **YES and NO**

4 Results

The evaluation methods and all the achieved results and the impact of the measure results are described in this chapter.

4.1 Evaluation methods

The evaluation method has taken into account the before and after scenario. The following indicators have been used:

- Emissions (NOx and CO_2);
- User acceptance/satisfaction (Drivers and Customer attitude);
- Average fuel consumption;
- Costs (vehicle costs as well as fuel cost).

To evaluate, sold CNG and CBG from the fuel station has been calculated and the emission calculations depend on vehicle type and size, driven kilometres etc. The vehicle dealers have delivered the used emission details. Vehicle drivers as well as customers have been interviewed.

Table B.3-2. Values used for calculation in the evaluation for a few vehicles in the measure:

Emission	**Scania**	**Econic**	**MB Sprint – Petrol 314**	**MB Sprint – CNG 314**	**Transit – Diesel 2.0 TDCI**	**Transit - CNG**
Energy consumption per 10 km (kWh)	-	-	10.99	12.47.	7.43	8.43
CO_2 g/km	952	952	301	208	201	216
CO g/km	-	-	0.623	0.842	0.24	0.92
NOx g/km	8,4 (x 0.6)	8,4	0.037	0.011	0.63	0.048
HC g/km	-	-	0.90	0.061	-	0.0815

Sources: NTM, Scania, Daimler-Chrysler Sverige, TUV Rheinland Group, VCA Carfueldata

4.2 Impacts

The following areas, categories, impacts and indicators have been used in the evaluation:

Table B.3-3. Evaluation areas

Evaluation Area	**Evaluation Category**	**Impact**	**Indicator**
Environment	Pollution/Nuisance	Emissions	NOx emissions
Energy	Resource Consumption	Consumption/use of CNG	Average fuel consumption
Society	Acceptance	User acceptance	Drivers´attitude
			Customers´attitude
Economy	Cost-related	Costs	Cost of haulage

Environment

Emissions of NOx in a city have negative health and environment impacts. The measure has its focus on distribution transport, which is largely responsible for NOx emissions. NOx emissions are reduced in this measure. The reduction is:

- Gatubolaget's 10 vehicles have decreased NOx emissions with 6 kg. 6 kg is a low

figure and the reason is that the vehicles have been running during just a short period of time. CO_2 emissions are reduced with 2 tonnes;

- Green Cargo's Scania has reduced NOx with 57 kg and CO_2 with 16 tonnes. This vehicle has been running for a half year, which can explain the NOx reduction;
- DHL's vehicles have reduces the NOx emissions with app. 20 kg and CO_2 with 28.8 tonnes;
- FordonsGas fuel stations have reduced the NOx emissions with 5 tonnes. The evaluation is based on the fact that the CNG is exchanged from both diesel and petrol vehicles. This result has a positive effect on the whole of Göteborg's NOx status. The CO_2 emissions are decreased by 640 tonnes.

The low NOx reduction derived from the vehicles is due to the fact that the vehicles have been driven for just six months or less. Only a two or three vehicles been driven for a year. The fuel stations serve more than just TELLUS vehicles. All partners are calculating their emissions in different ways. This is a reason for deviations between the partners.

Energy

Energy consumption has been based on fuel consumption. All partners believe that their vehicles will be used in traffic more the coming months and years. The figures that are given have been calculated up to now.

- Gatubolaget's 10 vehicles have been driven totally 10,000 km. The CBG consumption is 10,550 Nm^3, which is 1.06 Nm^3/10 km. For these models the fuel consumption is quite low;
- Green Cargo's Scania has been driven 24,850 km. The CBG consumption is 8,500 Nm^3, which is 3.42 Nm^3/10 km;
- DHL's Mercedes Sprinters have been driven 14,400 km and 36,000 tonnage km. The CBG consumption is 1.28 Nm^3/10 km. The larger Econic has been driven 4,800 km and 33,600 tonnage km. The CBG consumption is 5 Nm^3/10 km.

Society

The views of the customers and drivers are important. The customers formulate the demands and the drivers are those operating the vehicles. When a change is made, these actors are important to involve at an early stage.

The Customer attitude is in general positive. In this measure the customers are in cooperation with the transport companies. KappAhl has been a strong driving force all through the measure and are very satisfied with the CBG vehicles and that their product does result in reduced CO_2 emissions and much lower NOx emission compared to if the distribution would have been diesel driven. They use this in their marketing and in their environmental reporting.

DHL has a production demand from their customers whom has purchased Green Tonnages. Their customers are satisfied and use the positive effects in their environmental reporting.

The drivers feel that there is a difference when filling the vehicles with CBG/CNG. They have to plan their route in beforehand as the infrastructure has not yet reached the same level as that for petrol and diesel. Gatubolaget's drivers have a much higher competence. Gatubolaget is unique when it comes to competence regarding CNG/CBG driven vehicles.

Economy

The cost for the vehicles has still a large impact when purchasing a CNG/CBG vehicle. The Econic is more expensive by 50,000 Euro compared to a conventional Econic. Scania costs 30,000 Euro more and Mercedes Sprinters cost 8,000 Euro more. Mercedes Sprinter is smaller compared to both Econic and Scania, which explain the higher price. The size of the Sprinter is therefore more accessible and easier to exchange compared to the other two.

4.3 Impacts

The demonstration measure has reached good results. The results are discussed in the following section.

The amount of CNG/CBG distribution and heavy vehicles has increased in private companies and within the public. This project has affected the increase with 12 CNG/CBG vehicles in different models

The 12 vehicles are of different models and used for different purposes. 1 Scania (the last one on the market), 1 Mercedes Econic, 8 Mercedes Sprinters and 2 Ford Transit Heavy duty and distribution vehicles do not increase the same way as cars and other categories. See figure B3-5:

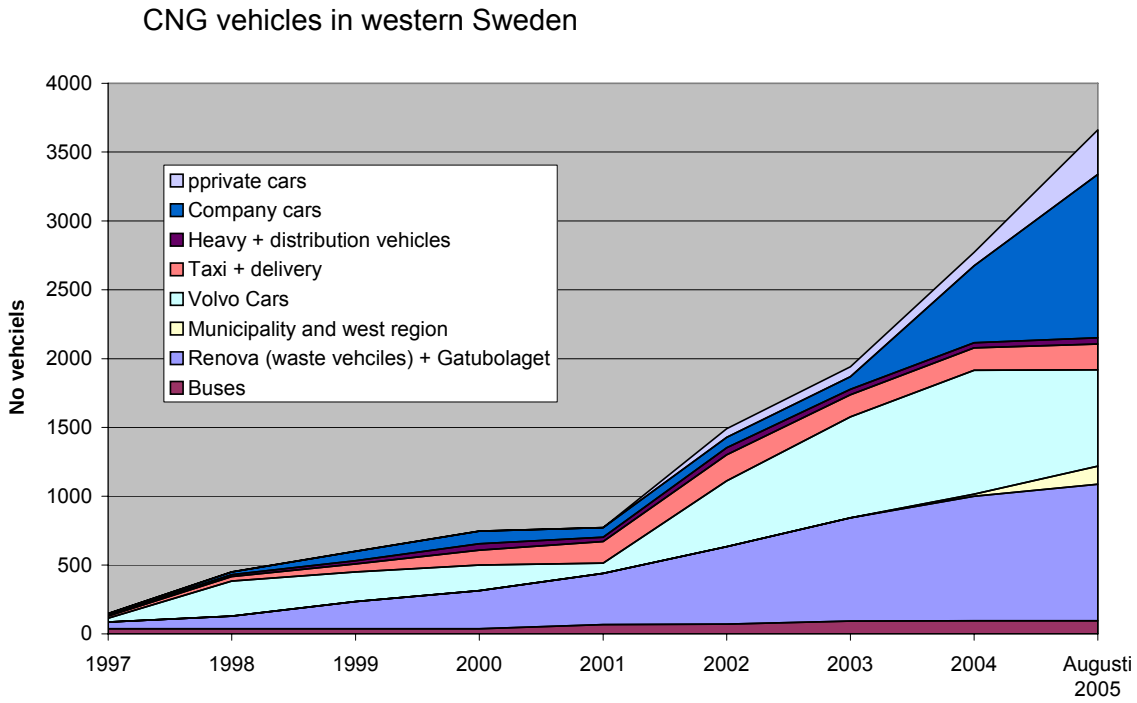


Figure B.3-5 Number of CNG vehicles in western Sweden

The picture clearly shows, that there has been no increase of these vehicles during the last years. Still, the partners within the demonstration see a potential for these vehicles. The causes for a non-existing break-through are several factors:

- Not enough models on the market for distribution;
- The date of delivery is too long. The 2 Fords has taken 13 months from order to delivery;
- No Swedish brand like Volvo and Scania within the heavier distribution segment. This means that many owners have to change supplier and most often are they bonded to their supplier;
- The model Mercedes Econic is the only vehicle in the heavier distribution segment and it is new to the purchasers and more expensive compared to the Swedish brands and the purchaser gets a waste distribution vehicle, which they are not used to. Other values are that the service is not the same since the vehicle retailer have maintenance at a few locations of Sweden only. The vehicle is also new for the maintainers, which is a risk for the purchasers;
- The second hand value is uncertain;
- When the vehicle manufacturer update their models it takes nearly a year or two before it is possible to get it as a CNG vehicle;

- The vehicle retailer does not have any clean vehicles for demo or in storage, which is a problem for purchaser. They have to wait before testing the vehicle;
- In Sweden there is a difference in the legislation compared to other parts in Europe regarding CNG and CBG vehicles. The difference is that in Europe the demand for the gas tubes is –30 degrees Celsius and in Sweden it is –40 degrees Celsius. This makes it difficult for the vehicle manufactures to export vehicles to Sweden. For example Ford Transit and Fiat have distribution vehicles do not market these in Sweden.

Green-Cargo's Scania is a convertible, i.e., it is possible to revert it to a conventional diesel vehicle although a problem with this the vehicle is that is not optimised on the alternative fuel.

Diesel shift to CNG/CBG up to 500,000 km yearly

When the vehicles have been driven a couple of years it is possible to reach a yearly exchange to CBG up to 500,000 km (Scania and Econic ca 50,000 km each and the Ford and Sprinter 25,000 km each. This affects the city air quality in a very positive way. When the measure is up scaled and at least 1,000 vehicles in distribution will be operated by CNG/CBG fuel, Göteborg will have a good city air quality.

The new CNG fuel station in Göteborg delivered 660,000 Nm^3 CNG since it was opened in March 2003 compared to other new stations this is 50% above average.

The reason for the high delivery rate is the location of the station. The station is located close to major highways, the city and is situated in an industrial area with a high transport demand. The infrastructure demands are that the locations for the fuel stations are nearby major roads and that there is more than one fuel station in the city. The capacity of the station must be high to be able to provide the customer good value. The station can give service to heavy vehicles and lighter distribution vehicles as well as cars.

The nitrogen oxide emission is reduced.

In this demonstration, the 12 vehicles and the fuel station have reduced nitrogen oxides by almost 5.5 metric tonnes. The nitrogen oxide emission is affected in a positive way when choosing CNG and CBG as fuel. Nitrogen oxides decrease with 4-5 times compared to conventional fuels.

The renewable consumption has increased since the vehicles are partly driven by CBG

The share of renewable CBG is increasing due to local initiatives and production as well as a customer driven demand. CBG is CO_2 neutral. That means that the net emissions are zero. FordonsGas can offer all their customers CBG instead of CNG thanks to the Green Gas principle. (See figure B3-6: CBG production and Green Gas principle,).

Shortly, the green gas principle means that both natural gas and biogas is injected into same gas grid. When the customer buys green gas the amount is injected into the same grid. All partners in demonstration 6.6 buy fuel according to the green gas principle.

At present, all new stations that FordonGas build are pure biogas stations. This means that 50 % of all gas sold today is biogas and 50 % is fossil natural gas.

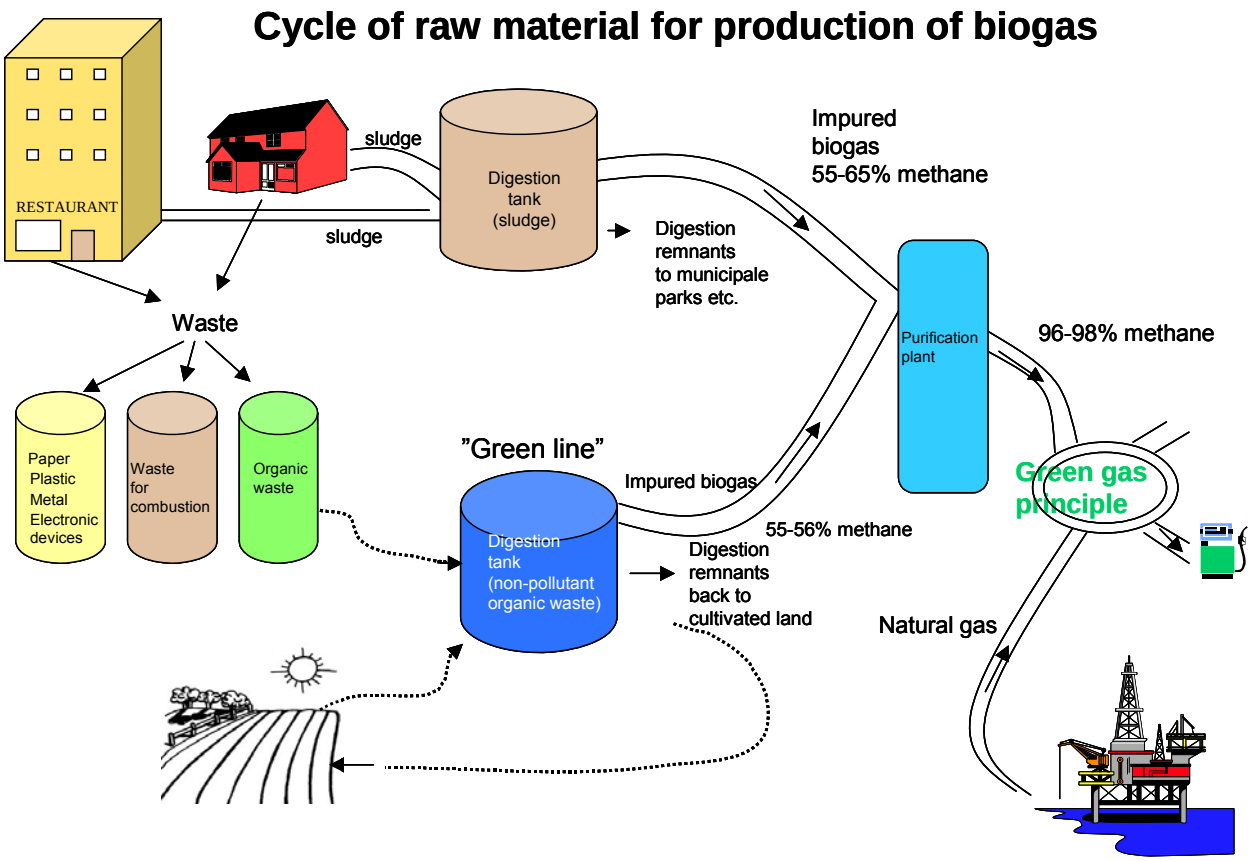


Figure B.3-6 CBG production and Green Gas principle

DHL has a similar product they offer their customer –Green tonnage. This means that their customers can buy CO_2 neutral transports. The positive effect is an increase in the demand for renewable biogas.

The emission of fossil carbon dioxide has therefore decreased.

The share of renewable CBG is increasing due to local initiatives and production as well as a customer driven demand. CBG is CO_2 neutral. That means that the net emissions are zero.

A higher competence in heavy duty and distribution vehicles and CNG/CBG fuels is obtained at companies and their employees.

There is still a quite low level of awareness about the vehicles in the chosen vehicle segment. The demonstration 6.6 has sped up the competence in the transport chain regarding these vehicles and fuels. The public sector has higher competence compared to the private sector. Alternative fuels like CNG and CBG are used by public transport and waste vehicles. This awareness has not yet reached the private sector. The haulage contractor has the lowest competence if one looks at the transport chain from vehicle retailers, haulage contractors, and transport companies to customers. The privately owned purchaser of transports does not demand clean transports in their procurement in the same extent as the public sector. A result of TELLUS, is that the customer interest in clean transports is higher now than before the measure started. This is due to a dialogue that has started with the customers, which in turn leads to an increase of competence. In a long-term perspective, the customer sees this as an opportunity to profile the company with regard to emissions and trade.

All partners agree that one of the most positive effects is the networking that TELLUS been able to offer. The networking has provided a method for spreading information about vehicles and fuels within the organisation. The network has supported the demonstration both within the organisations as well as externally. The whole chain of transport has been involved which is necessary for a demonstration like this to function and be able to reach results.

Because of TELLUS the partners have been able to act internationally which has lead to an increase in the number of available distribution vehicles. DHL is a major international company that procures on a European level.

5 Conclusions

Projects with a customer driven demand will have the most probable possibility to succeed. The success factors are co-operation and collaboration. All stakeholders are required to create a breakthrough in clean vehicles and fuels. Stakeholders are authorities, official bodies, ministries, energy enterprises, fuel distributors, vehicle industry, private sectors with small and large companies, suppliers and customer's customers, non-profit organizations etc. Non-existing co-operation and a traditional viewpoint with regard to fuels have been risk factors for the measure.

To summarize, it can be stated that the methods and success factors for a measure of this type are: excellent preparation, the development of communication strategies, spending time on initial research, having ad-hoc contingencies, investing in media canvassing and personal contacts, distributing outline facts and arranging meetings such as direct meetings and seminars, lobbying to stakeholders in a long-term perspective and having economically beneficial incentives. These factors combined with a strong driving and willpower will result in a breakthrough in the vehicle and fuel industry.

Another success factor is when the public sector decides to set demands in public procurements. This has increased the general interest in clean vehicles (all sizes and models). The Swedish government has decided that 25 % of all purchases of vehicles must be clean vehicles starting in 2005. The City of Göteborg has also decided to exchange their municipal fleet vehicles to clean vehicles. Their target is that 90 % of all vehicles should be clean vehicles by the year of 2008.

All these factors and signals have strengthened vehicle manufactures in continuing the development of methane gas vehicles. Almost all European vehicle manufactures offer NGVs today and plan for future expansion. Still, the delivered quantities of NGVs are low; with the consequence that each unit price is high and the final sales cost discourage many transport companies.

Without the measure and its active and intense work to increase awareness, the knowledge about clean vehicles and fuel, would still be quite low. The reality is that the process of influencing the partners with regard to clean vehicles has to mature over time. Other activities that were started before this measure, have also had affected on this measure. This implies that if the measure didn't take place, a limited number of few clean heavy and distribution vehicles would be available on the market. Other activities such as co-operation with retailers, other projects and activities in other cities have contributed in improving the demonstration measure. All activities in the measure have therefore resulted in improvements in and a higher awareness about clean vehicles and fuels. The production of existing clean vehicles has been increased and prices have been lowered.

Economical aspects, cost benefits

Companies with large transportation operation and transport needs can choose clean transports instead of conventional transports. With this measure, they have achieved a financial profit through the de-taxation of clean company cars as well as good will and a high environmental profile towards their customers. However, there are still problems with high purchase prices for biogas cars in combination with a weak second hand market.

Political and administrative aspects

During the course of the measure, the political interest in renewable fuels has increased considerably. This has resulted in a prolongation of the national tax exemption on renewable fuels in Sweden as well as the EU directive on bio-fuels. These clear messages from the politicians have been valuable when communicating clean vehicles to potential purchasers.

5.1 Barriers

- Lack of refuel stations for clean fuels. It is expensive to expand the infrastructure for CNG/CBG. The cost of one station is 200,000- 450,000 Euros;

- Lack of suitable vehicle models. There are not enough models on the market. To be able to reach the required breakthrough, more models are needed;
- High purchase costs and a weak second hand market. The higher price and the uncertain second hand market is a high risk for contractors. The transport contractors are pressed financially already. Transports are too cheap;
- Lack of real long-term political commitments on tax reduction and infrastructure investments. The long-term perspective is necessary to carry out changes.

Other problems are the facts that private drivers and small haulage contractors are financially vulnerable and are consequently difficult to convince about NGVs. The price setting of used vehicles and the indistinguishables of future taxations, rules and laws concerning NGVs are issues that are obstacles in convincing them.

5.2 Drivers

- New attractive high-tech clean vehicle models are available on the market. The activities to make more models available on the Swedish market are important in order to reach a market breakthrough. The purchaser needs a selection of at least one model from each manufacturer;
- Reduced tax on the private use of company cars and possible local incentives such as free parking, are important drivers. Without these there would be very small number of clean vehicles on the street;
- Increased awareness of the greenhouse effect and oil dependency. The oil price is increasing. CBG is produced locally and has low net values of green gas emissions. Another positive aspect is that the business cycle for CBG is not as sensitive as the oil cycle;
- Environmental requirements in public procurements of transport services. This driver is a wake up call for the market. The public procurement requirements and goals are raised. Göteborg has decided to exchange their vehicles in the municipal fleet to clean vehicles. Their target is that 90% of all vehicles, transports and deliveries should be clean vehicles by the year of 2008.

5.3 Objective fulfilments 2006

The objective fulfilment to decrease emissions of for heavy traffic and distribution in the city of Göteborg to at least 70 % succeeds. This is calculated on the set goal of reaching the highest target exchange from diesel to CNG/CBG by 400,000-700,000 km yearly. This measure reached an estimated 500,000 km yearly.

Immediate objectives

- Targeted activities on CNG/CBG transports. **YES**
- Subsidies to the first 10 buyers of trucks or the first buyer of 10 trucks. **YES and NO, changes have been made in the measure: after amendment the objective was 2 heavy distribution vehicles and 10-15 lighter distribution vehicles**, **which has been fulfilled.**
- Implement fast fuel systems of alternative fuels for heavy vehicles (CNG/CBG). **YES**

Intermediate objectives

- Decrease emissions of NOx and particles for transit heavy traffic in the major transit roads in the city to the port of Göteborg. **NO, change in measure. Increased the range to encompass the whole city of Göteborg.**
- Introduce CNG/CBG to the heavier segment of the transport fleet on trucks used for short distant haulage. **YES and NO. Introduction by meetings and forums with the haulage companies as well as heavy vehicles manufactures, but no result. Good results were achieved in the distribution segment instead.**
- Heavy trailers in transit exchanged for CNG/CBG vehicles. **YES and NO. There are two heavy trailers with CNG/CBG. Good results were also achieved in the distribution segment.**

Contribution to TELLUS and Ultimate objectives

- Reduce air pollution and noise to levels below national and EC directives. **YES**
- Reduce NOx emissions from heavy traffic. **YES**
- Improve public-private co-operation. **YES**

6 Scenarios

The up scaling of this demonstration has already begun. This is a positive perspective when considering 2010. This demonstration has all the potential to be adopted by other cities.

The infrastructures of fuel stations consists today of 60 open stations in Sweden and by 2010 there will be 165 stations. This means that one can travel in Sweden without having to plan as much as today. The fuel station infrastructure is driven by the car market and not by heavy distribution. The result is that the number and range of available heavy vehicles is limited on the market. If a computerization is made between buses, waste vehicles and heavy distribution it is visible that the diesel cost has reduced the cost difference between gas and diesel driven vehicles. This could be achieved for the heavy distribution side as well. A truck moves in a different way compared to buses and waste vehicles. At the moment it is

not possible to have CNG/CBG driven heavy-duty vehicles in a logistic company as they are too heavily loaded. The illustration below shows how a logistic company operates:

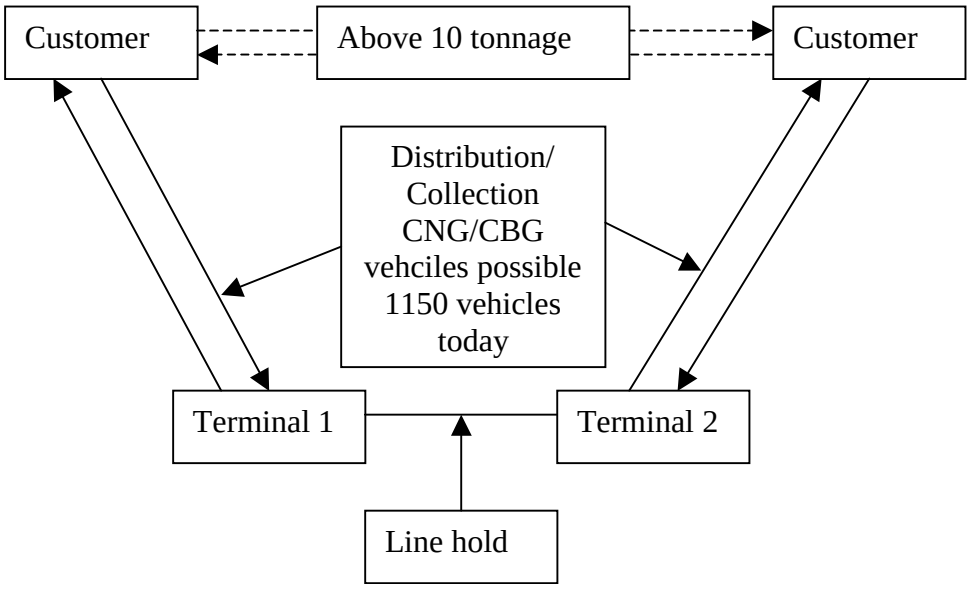


Figure B.3-7 Model of how large companies like Green Cargo and DHL operate and where CNG vehicles are possible to be used in the operation.

The picture describes the DHL operation. If the Göteborg demonstration would be up-scaled, it would signify an increase from 2-8 vehicles to 1150 vehicles. The environmental status would be improved for to CO_2, NOx and particulates. DHL has purchased 70 Mercedes Sprinters for distribution in Europe. Their internal up-scaling has started and has had a positive effect for the distribution segment. This will lead to more models in distribution segment such as Iveco, VW, Mercedes and Ford. Hopefully the French vehicle manufacturers will see the opportunity as well.

Because of the demonstration and similar projects, the interest in fuels application areas has widened. The more expensive oil-fuels (petrol and diesel) are also part of the future results. For example, it was not possible to combine engines like diesel and CNG earlier, (much easier with petrol and CNG) due to differences in techniques. New businesses are appearing such as MGN AB. MGN is a company specialized in converting conventional engines into alternative fuel engines. One example is a Scania P93 (distribution vehicle) now driven by 80 % CNG/CBG and 20 % diesel. In 2010 it is reasonable to believe that this will become the future; converting older conventional vehicles into clean vehicles. Several clean heavy vehicles would be found on the market. The co-operation between the public and private sector is positive and will improve successively. From this point of view, projects like this, is important. The clean vehicle and fuel discussion as a whole is a method to influence communication between and within organizations, both public and private and will have a long-term positive effect on the environment.

7 Recommendations

The success of this measure has been the innovative and holistic thinking that encompasses the complete transport concept and its stakeholders. Several actors are stronger than one.

The infrastructure is necessary for a breakthrough. More fuel stations for biogas are needed and more vehicle models in combination with lower purchase prices are required.

Be open for changes. When a project like this begin, changes will occur during the process as many actors and stakeholders are involved. It is important that the partners are able to make changes without applying for them at EU. This postpones the process and is frustrating for the members.

Prepare the project with extensive research and involve all actors at an early stage. Results will probably be achieved earlier.

The method of communicating the concept of clean vehicles to companies is different compared to communicating the same concept to the public. Business to business is built on direct relationships and takes longer time.

If results are wanted quickly, financial support and co-operation is important as well as having media to write about what is happening.

Have a long-term perspective, the co-operation with all stakeholders, extension of borders, the provision of financial support and the continuance of support for this type of project. Also, to work in conjunction with the vehicle industry so that they implement clean fuel engines in all their models to enable a European and worldwide market for cleans vehicles.

The authorities are crucial when it comes to benefits and taxes. Other incentives are also important. Don't choose one alternative fuel but several. Even though the idea is not the latest news set up demonstration and dissemination projects any way. And don't forget the industrial partners!

It is important to have long-term strategies for incentives to make clean vehicles become an economical option for purchasers and for the expansion of the infrastructure of alternative fuels. It is also crucial to have strategies to influence the vehicle industries to bring more models of clean vehicles to the market.

To increase the clean vehicle fleet, companies require other arguments such as financial rather than environmental. Emphasis is placed on lifecycles rather than purchasing costs. Knowledge about vehicle models and infrastructure of fuels are arguments that work.

Keep up the good networking within the CIVITAS initiative. The networking creates knowledge and competence, the feedback is important for avoiding making the same mistakes again. The project money frees resources as well as money for travel.

This described measure is not only to be regarded as a considered measure, but a necessity to be adopted by other cities. Clean vehicles and fuels are important factors to influence our future to make an environmentally sound life on earth. This measure is not to be imple-

mented in parts of Europe only. The infrastructure and number of models need to be expanded and improved so that it will be as financially beneficial to the industry as conventional vehicles and fuels are today.

B.4 Demonstration Measure 7.6 – Environmentally optimised ferry shuttle

1 Introduction

The northern riverbank

There have been river shuttles running at the river in the centre of Göteborg (Göta Älv) for the most part of the 1900's. While there has been a strong environmental development in public transport on land, the development in the maritime sector has lagged behind.

The north river shore in Göteborg has seen a remarkable development over the past few years: new housing projects, establishment of a university, colleges and high-tech-companies. This has led to a dramatic increase in the number of people travelling to and from the northern riverbank.

The public transport system in Göteborg is based on trams and buses as well as some ferries as complement. There is no existing tramway to the northern riverbank. Tram was considered a non-viable option in the short run for supplying public transport to the northern riverbank.

To meet increased needs of public transportation and to connect the northern river bank with the central areas of Göteborg the aim of this measure was therefore to plan and implement an environmentally optimised ferry shuttle.

2 Description of demonstration measure

2.1 Demonstration design

The demonstration was to introduce an environmentally optimised ferry shuttle from the city centre to the northern riverbank. The shuttle was to be driven by a new CNG or Biogas or equally environmentally positive propulsion system, which would reduce NOx emissions.

Innovative aspects

The introduced technology has already been tested on buses, but not previously used on marine vessels of this size. The propulsion system was to be the main emphasis, including fuelling capacity and storage of CNG or Biogas. Another innovative aspect was to optimise the hull shape (allowing high speed while minimising waves) together with the use of environmentally approved hydraulic oils and lubricants.

Geographical context

All the original demonstration measures in Göteborg can be seen in the map below and the ferry shuttle route is marked:

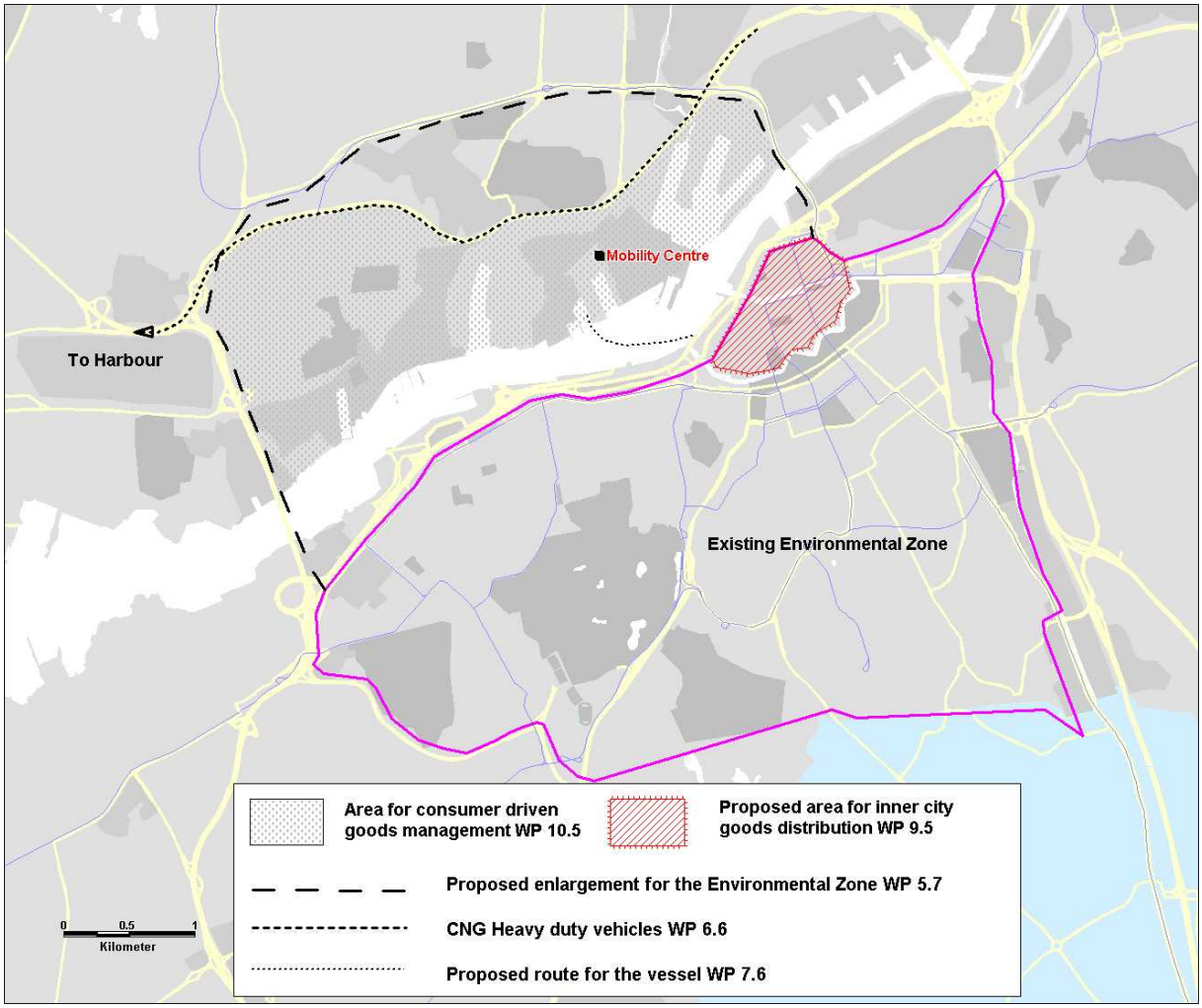


Figure B.4.1. The proposed ferry shuttle is the dotted line "Proposed route for the vessel WP 7.6"

Parties

Main parties in the measure were the Traffic and Public Transport Authority of the City of Göteborg, and the development company for the northern riverbank (Norra Älvstrandens Utveckling AB).

The main actor was the Traffic and Public Transport Authority since it has the overall responsibility for public transport in Göteborg and also was supposed to be the owner of the ferry. The regional public transport company (Västtrafik) was also an obvious cooperation partner since the shuttle was supposed to be an integrated part of public transport system in Göteborg.

2.2 Transport Plan context

The main task for the Traffic and Public Transport Authority is to provide the means for efficient, safe and sustainable mobility in Göteborg. One of the most important goals is to create possibilities for mobility for the inhabitants in the city that are good for the individual as well

as for the society and the environment. In 1995, the first Sustainable Transport Strategy for Göteborg was introduced but is under revision and the new strategy determines the goals for year 2010. Two very important goals in the strategy are that focus should be shifted towards more sustainable means of transportation and new technologies in vehicles should be supported.

Since ferry shuttles are an integrated part of public transport in Göteborg and play an important role in supplying the demand for personal transport to the northern riverbank, it was a logical step to improve also the shuttle technique in a sustainable way.

Ferry traffic is performed today on the proposed ferry shuttle route but with ordinary ferries instead of environmentally optimised ferries.

2.3 Objectives

Immediate objectives

- Plan and build an environmentally optimised river shuttle to be used for public transport in the city centre;
- Introduce tested technologies from buses, but not used on marina vessels this size. The propulsion system would be the main emphasis, including fuelling capacity and storage of CNG.

Intermediate objectives

- Decrease of NOx and CO_2 emissions;
- Decrease of energy use per passenger;
- Decrease of emissions of particles and hydrocarbons.

Ultimate objectives

- Reduction of congestion;
- Reduction of air pollution and noise to levels below national and EC directives;
- Achievement of extensive political and public awareness of TELLUS.

Contribution to TELLUS objectives

- Achieve extensive political and public awareness of TELLUS;
- Reduce air pollution to levels below national and EC directives;
- Reduce congestion.

2.4 Ex-ante evaluation and situation before TELLUS

When planning the exploitation of the northern riverbank it was clear that there would be a great need for passenger transport. The capacity for cars on the two bridges and the tunnel connecting the city centre and the northern riverbank is limited, meaning that an efficient public transport would be necessary in order to provide for the transport needs.

The public transport system in Göteborg is based on trams and buses as well as some ferries as complement. There is no existing tramway to the northern riverbank. Tram was considered a non-viable option in the short run for supplying public transport to the northern riverbank.

When the project started there was no tried concept for high-speed, comfortable efficient buses in a city centre environment, and thus buses were not either considered to be a viable option.

When the exploitation of the northern riverbank took off it was clear that the City Council was interested in a new ferry shuttle. High-class public transport was needed in order to cope with the large amount of personal transport generated.

Therefore it was natural to consider ferry transport as the main public transport supply. As a complement to the already existing ferry traffic, a high-capacity, high-speed ferry shuttle would be introduced.

The ferry shuttle traffic was started in 2002 with ordinary ferries and the initial number of passengers was high.

3 Implementation Process

3.1 Risks

In the beginning of the demonstration, a number of risks were identified as a part of the monitoring and planning of the measure:

- Lack of public acceptance (end-users of the vessel). In order to be financially viable and have a steady flow of passengers the acceptance by the citizens is crucial;
- Technical performance of CNG engines in marine applications. While thoroughly tested for land transport, marine applications are rare;
- Lack of fuelling infrastructure due to logistical and financial difficulties;
- Purchasing costs of marine CNG technology tend to be 20-30 % higher than conventional technologies (i.e. diesel);
- Operating costs are higher for CNG technology compared to conventional diesel technology, since marine diesel fuel is free from taxes;
- Lack of political support for the CNG route, due to higher running costs;

- Lack of suppliers for CNG marine engines.

3.2 Additional problems

During the period of the demonstration several independent developments made the political leadership question the proposed river shuttle.

Transport developments

- The increased numbers of companies, houses and schools on the northern riverbank led to renewed interest in establishing a bridge for pedestrians and bicycles over the river;
- The new high capacity bus line, a regular and frequent CNG bus service (Euro IV), was introduced in January 2003, serving travellers between the city centre and the northern riverbank area. The growth in number of passengers was unexpectedly high, and led to a significant decrease in number of passengers on the existing river shuttles;
- The operating costs for public transport in Göteborg have increased significantly. These costs are supposed to be cut in the already existing transport system and all new investments were thus questioned;
- CNG technology for the shuttle is available, but at a higher investment cost compared to conventional diesel technology, and at a higher yearly running cost. There have been some difficulties, as have been evident in other TELLUS projects, in finding suitable suppliers of CNG engine technology;
- Furthermore, the environmental gain by using CNG technology has decreased since there are much cleaner diesel engines available today than just a couple of years ago.

Ownership

Since the measure was partly funded by the EU, it would be necessary for the Traffic and Public Transport Authority to be the owner of the boat. The ownership was questioned by the politicians in Göteborg, since it could lead to the Authority having the responsibility for the maintenance etc. , which is not a part of the regular tasks. Additionally, owning a ferry shuttle and dictate it to be used by the transport companies performing the traffic is probably not admitted according to competition laws and public purchasing laws.

Operator issues

The company currently operating the ferry shuttle service (Styrsöbolaget) was afraid of running problems when using new, untried technology and were not willing to take the extra risk without compensation from the Traffic and Public Transport Authority.

Fuelling station

The construction of a CNG fuelling station solely for boats would be a very inefficient use of investment. The only reasonable option was to build a combined boat/truck fuelling station. No suitable location was found.

3.3 Consequences

All things considered, the Traffic and Public Transport Authority requested an in-depth analysis over present and future mobility demands across the river. The study concluded that the possibility for a political acceptance for the high costs connected to a CNG ferry was to be very low. This meant that the demonstration could not continue.

4 Results

4.1 Evaluation methods

A plan for the evaluation methodology on measure level was produced and can be found in the annex. No evaluation using the indicators was made since the demonstration was discontinued.

The process evaluation was made by interviews with key persons in the demonstration and by reviewing documents produced during the demonstration. Every six months from the beginning of the measure (Feb 2002) until the end (Jan 2004), Progress reports and Management reports were produced (see planned time schedule below).

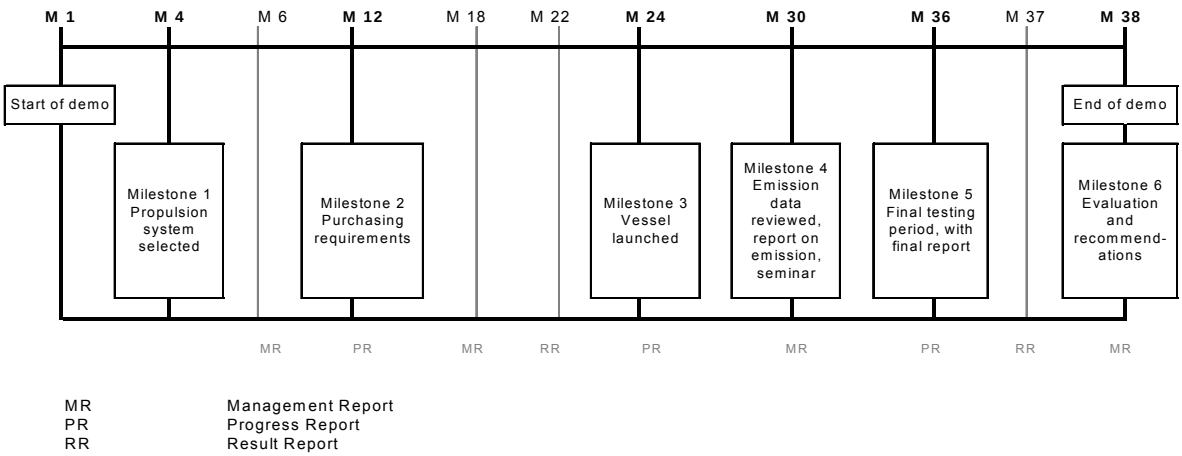


Figure B.4.2. Original time schedule.

4.2 Impacts

Environment

No decrease of emissions was achieved since the demonstration was discontinued. However, the new high capacity bus lines have reduced emissions in total for person transport to the northern riverbank.

Documents

A number of documents were produced in the planning process:

- Draft tender documents;
- Design and specifications of the shuttle;
- Life cycle assessment for the shuttle;
- Review in price elasticity of CNG and price comparison with marine diesel;
- Review of possible alternative propulsion methods, i.e. electric, dual fuel.

Increased level of knowledge

The measure has increased the level of knowledge of environmentally optimised ferries in Göteborg and in Sweden. The measure has also increased the level of knowledge of optimised diesel engines for boats.

Exchange of experiences

Although the measure was cancelled the experiences from this measure could be useful to other cities planning to introduce environmentally optimised ferries.

5 Conclusions

Building an environmentally optimised ferry

The set objective to build an environmentally optimised ferry could not be reached because the measure was discontinued.

Ferry transport as a competitive option for city public transport

Although the competitiveness was not the main objective it turned out to be one of the reasons for discontinuing the measure.

The introduction of new, high-speed, efficient buses has led to a significant decrease in number of passengers on existing river shuttles. This leads to the conclusion that ferries are a viable option for public transport only if they are faster and more convenient than other means of public transport.

Costs

The public transport sector in Sweden is under economic pressure and therefore the possibilities of expensive environmental improvements, such as a CNG ferry, are limited.

6 Scenarios

No scenarios were made since the measure was discontinued.

7 Recommendations

Recommendations for other cities or companies investigating the possibility to construct an environmentally optimised ferry:

- Review the costs at an early stage. Make sure there is sufficient funding for the project;
- Investigate other means of public transport and make sure there are no better options than ferries;
- Investigate if the existing infrastructure is sufficient.

B.5 Demonstration Measure 9.5 – Incentives for improving the load factor in inner-city freight transport

1 Introduction

Environmental Zones, with restrictions on emissions for all vehicles with a total weight above 3,5 tonnes, are implemented in a number of Swedish cities; Göteborg, Stockholm and Malmö since 1996. The city of Lund introduced an Environmental Zone with the same restrictions as in the three other cities in 1999. In Copenhagen there has been an Environmental Zone with demands on load factor, but this project has now ended. An integration of those two ideas; emission restrictions and load factor, is the basis of this measure.

The purpose of the measure is to introduce a pilot project in an inner-city part of the existing Environmental Zone in the city of Göteborg, with demands not only on emissions, but also the load factor of the vehicle. The demonstrator scheme should be on a voluntary basis and thus incentives should be created that gives advantages for suppliers, haulers and retailers to co-ordinate or in some other way consolidate their deliveries to the area. The purpose is also to gain acceptance from the parts of the business world that are influenced by the new demands and that they support this new zone.

The goal is that the number of deliveries to the area should be reduced without introducing severe restrictions on volume of goods, availability or vehicle type. With reduced number of deliveries, positive effects on congestion and total emissions are expected to provide a more attractive city environment for the citizens as well as working environment in the long term.

The experiences from Göteborg are expected to be able to implement in other cities with similar problems.

2 Description of demonstration measure

The design, objectives and problem areas of the demonstration measure are described in this chapter.

2.1 Demonstration design

The measure realised a pilot project (demonstration measure) and is delimited to a specific inner-city area. The pilot project is designed as a voluntary scheme in co-operation with the transport industry. Main design elements are i) definition of the demand on load rate for the vehicles; ii) definition of restrictions for entering the city zone; iii) development of a communication system to measure and report the load rates on the vehicles; iv) implementation of unloading areas for the companies that meet the defined criteria.

Innovative aspects

- New forms of joint environmental development strategies between municipality and market;
- An introduction of positive incentives as a measure for change;
- Increased load factor as a competitive means.

Involved parties

- Hauler parties: Arla Foods AB (delivers dairy products etc.), Carlsberg Sweden AB (delivers brewery products), DHL (GB Framåt AB, delivers parcels and goods), Schenker (TGM AB and Bäckebols Åkeri AB, delivers parcels and goods) and Poståkeriet AB (delivers parcels and goods);
- Technical parties: Hogia Communication AB (development and handling of GPS system for the project), XMS AB (developing the form for registration of load rate with the Anoto digital pen), Catrel AB (drifting of the load rate registration and data base handling), Drivec AB (developing and handling emission measurements of three vehicles in the project).

2.2 Transport Plan context

Heavy duty vehicles contribute to the congestion in the city centre of Göteborg. Despite that those vehicles only represent ten percent of the total number of vehicles; they are often regarded as the main reason for congestion in the narrow streets of the inner-city. In addition to the congestion there is a traffic security issue about heavy duty vehicles. To maintain the goal of possibility for mobility for the inhabitants it is of great interest to reduce the number of heavy duty vehicles in the inner-city.

The measure contributes to the Transport Plan towards more sustainable means of transport by aiming to reduce the number of vehicles as well as the number of vehicle kilometres driven in the city. With a high load rate there is a more efficient use of the vehicles and with some help of innovative technology.

2.3 Objectives

In co-operation with the evaluation team, the measure objectives are set by the city of Göteborg and the project team at TFK. There are different levels of objectives in the TELLUS project addressing short-term outputs and long-term outcomes as well as intermediate steps. Measure objectives are connected directly to this demonstrator and are evaluated in the project.

Measure objectives

The measure objectives are divided into three subgroups; immediate, intermediate and ultimate objectives. The objectives were presented in the “Description of work” for WP 9.5 and have not been changed during the measure period.

Immediate objectives

The immediate objective was mainly to design a voluntary scheme with the transport industry, e.g. defining the demand on load rate for the vehicles necessary for receiving incentives. Restrictions for entering the city zone is also be defined in the scheme.

A communication system was to be developed to measure and report the load rates on the vehicles

Certain unloading areas were to be set aside for the companies that meet the defined criteria. Other incentives may also be realised.

Putting up road-signs, authorising permissions etc.

Intermediate objectives

The intermediate objectives are that this example should be possible to implement in other critical areas of the city if necessary and also in other cities. New forms of joint environmental development strategies between municipality and market are introduced and increased load factor in heavy duty vehicles is received.

Ultimate objectives

Reduce congestion;

Reduce air pollution and noise to levels below national and EC directives;

Reduce NO_x emissions from heavy traffic;

Improve public-private co-operation;

Achieve extensive political and public awareness for TELLUS;

Improved intra-organisational co-operation at the city level.

Contribution to TELLUS objectives

Reduce congestion;

Reduce air pollution and noise to levels below national and EC directives;

Reduce NOx emissions from heavy traffic;

Improve public-private co-operation;

Achieve extensive political and public awareness for TELLUS;

Improved intra-organisational co-operation at the city level.

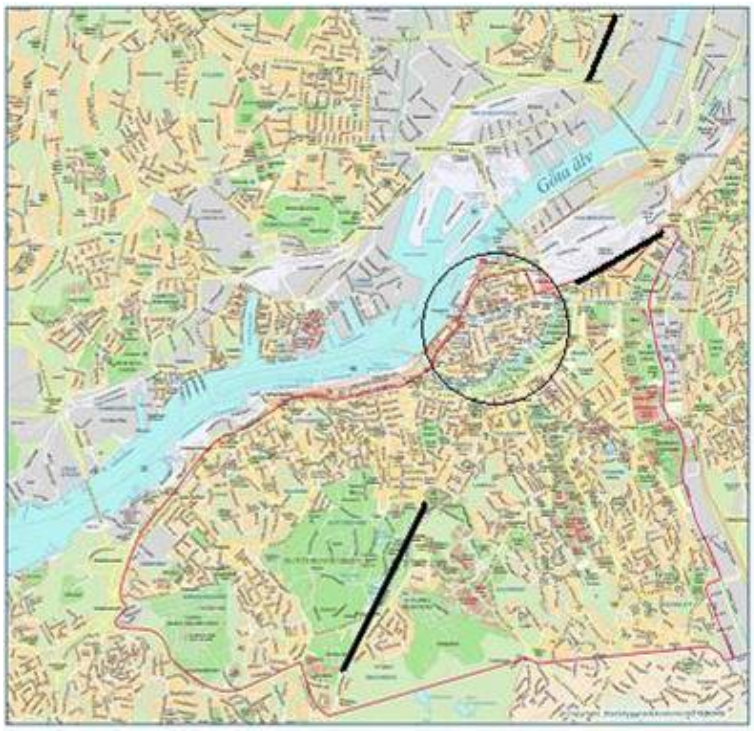
2.4 Ex-ante evaluation and situation before TELLUS

The measure started out as a statement from a house owner company, who told the municipality that there was a big problem with heavy duty vehicles in the inner-city of Göteborg. Heavy duty vehicles cause congestion, insecurity for persons walking in the streets, noise, emissions etc. The company would like to see a change in this. The idea of testing demands on load rate to decrease the number of vehicles was introduced with help of the TELLUS project.

To map the situation before the TELLUS project, a master thesis was initiated at TFK with two students from Chalmers and the University of Göteborg[1]. The aim with this thesis was to find out the possibilities for the project (area, demands etc.) and make a screening analysis of the situation in the city.

Identification of project area

Different areas in the city were studied to find the most well suited area for the measure. The results of the discussions were to delimitate the geographical area to a rather small part of the city. The inner-city of Göteborg (within Vallgraven and Nordstaden) is well delimited by a moat and a national road, see and Map B.5-2. .



Map B.5-1. The area for the pilot project is situated within the circle.

The thicker black lines show approximately the bus lanes available for vehicles in the project.

[1] Leu, E. and Ottosson, M. (2002)

Identification of problems by businesses

A survey was made to localise the biggest problems and a questionnaire was sent to all businesses (approximately 3,000 addresses) in the chosen area with questions about environmental issues, problems and possibilities. The result turned out to be very positive about doing something about the problem with heavy duty vehicles. There was also a willingness to change behaviours in some extent to help improving the area. The biggest problems for the businesses seemed to be congestion at the streets outside shops and not knowing when the goods arrive.

The area has, for Göteborg, obvious problem with congestion. There are few parking places and loading zones, narrow streets, pedestrian streets that do not allow vehicle traffic after 11 a.m. and a lot of small shops and offices. The area is the oldest part of Göteborg.

A count was carried out to map the number of vehicles in the area of different categories, see Figure B.5-1. Measurements were carried out during two days, spring 2002. Private cars and other light duty vehicles stand for 90 % of the total number of vehicles. Buses represent a large part of the heavy duty vehicles.

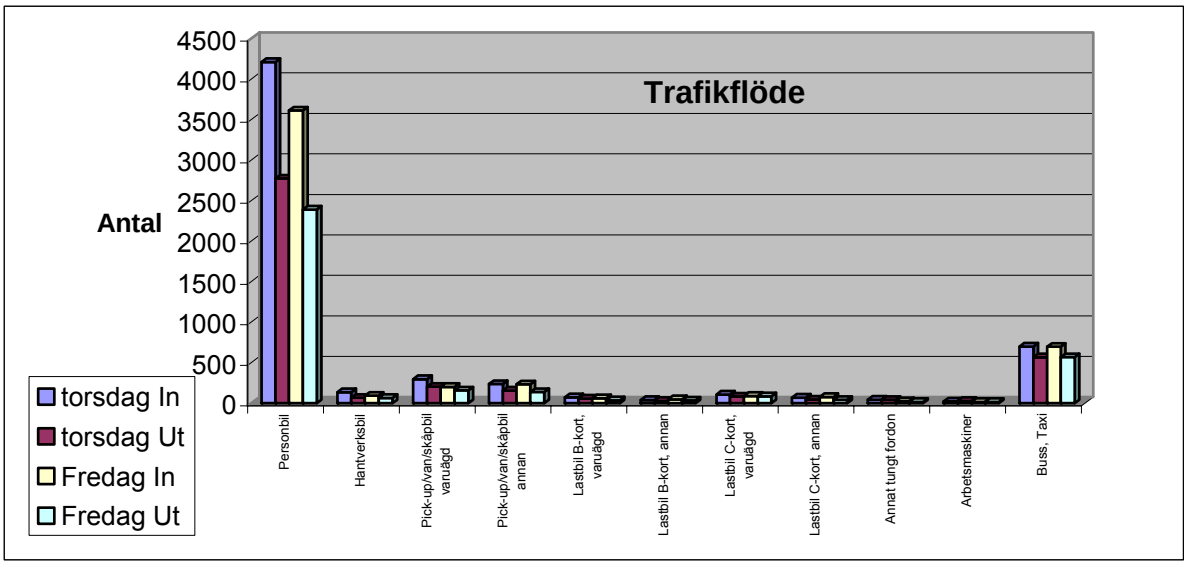


Figure B.5-1. Traffic flow in and out from the chosen area. Translation below.

annan	other	lastbil b-kort	small truck
annat tungt fordon	other heavy vehicle	lastbil c-kort	heavy truck
antal	number	personbil	private car
arbetsmaskiner	construction vehicles	pick-up/van/skåpbil	pick-up truck/van/delivery van
buss, taxi	bus, taxi	torsdag	Thursday
fredag	Friday	trafikflöde	traffic flow
hantverksbil	craftman's car	ut	out
in	in	varuägd	company owned

The survey showed that less than 10 % of the vehicle movements in the area consisted of heavy duty vehicles. Even though that the number of heavy duty vehicles are low they are, according to the survey carried out among businesses, the main problem in congestion issues. They are experienced to be the problem since they are large and claim a big part of the street when they are delivering goods. Smaller vehicles have difficulties to proceed when there is a larger vehicle in the middle of the street. So, even if the number of heavy duty vehicles is low, they need to be reduced since they occur as a problem within this area. They also appear as a traffic safety problem when driving on pedestrian or narrow streets.

A calculation also shows that half of the NO_x emissions in Göteborg originate from heavy-duty traffic.

No emission measurements were carried out in the chosen area, since air quality measurements are hard to delimit to that specific area. City measurements for emissions are possible to take part of and a specific measurement of the vehicles in the pilot project was done in the first phase (base line scenario).

Identification of problems by transport sector

A survey was also sent to all haulers and transport companies in the Göteborg region. The reason for this survey was to find out the problems and possibilities for a project with restrictions in load factor and positive incentives for those who are able to fulfil the restrictions. The questionnaire was sent to 778 receivers. The selection was large with the intention to find all possible vehicles driving on a regular basis in the area of question. Answers were asked for only from those companies who operate in the specific area, and by that the outcome of the questionnaire was quite exhaustive.

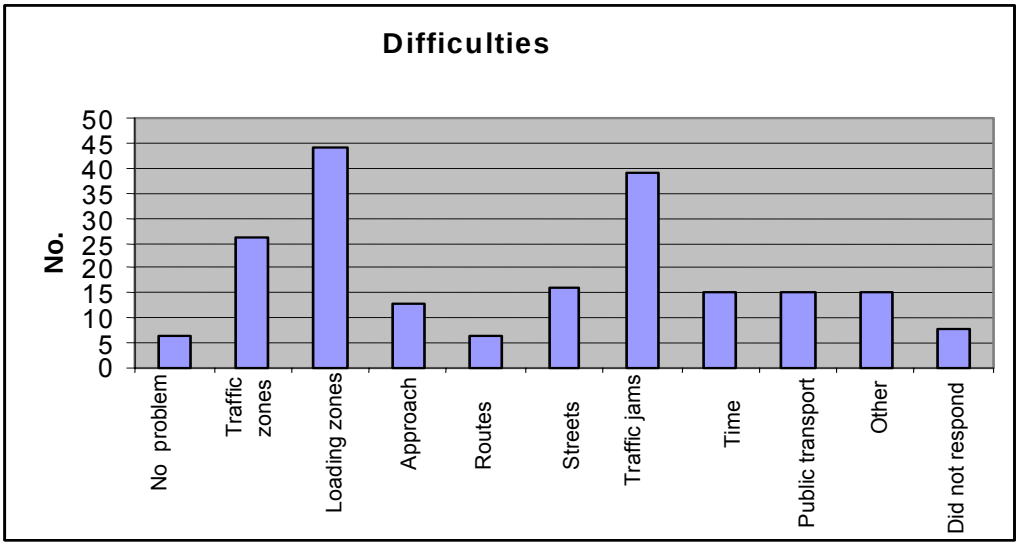


Figure B.5-2. Result of questionnaire sent to 778 haulers in the Göteborg region[2].

[2] Leu, E. and Ottosson, M. (2002)

According to Figure B.5-2, the biggest problems experienced in the area are the lack of goods load and unloading zones together with traffic jams (congestion). Traffic zones, which are number three in the list, are a limitation in the area within Nordstaden and Vallgraven. The area is divided into five separate zones, delimited by tramlines, one-way streets etc. It is not possible to pass between two zones without first going out to the Nya Allén or another ring road around the area. This creates long detours for the distribution vehicles delivering goods into more than one of the zones. The restrictions for driving in public transport lines also cause problems with a lot of unnecessary vehicle kilometres in the city. Those problems were considered during the measure.

3 Implementation Process

The measure has been carried out in a number of steps. The Milestones,

Figure B.5-3, were all followed as planned and the achievement of the Milestones is described during each chapter, except from that Milestone 1 was modified during the first phase of the scheme set in place and adjusted to reality and technology used. Milestone 3 and 5 were a bit delayed, but this did not affect the project outcome in any way. The base line scenario in the first phase formed the criteria for load rate as well as set the possibilities for technology use.

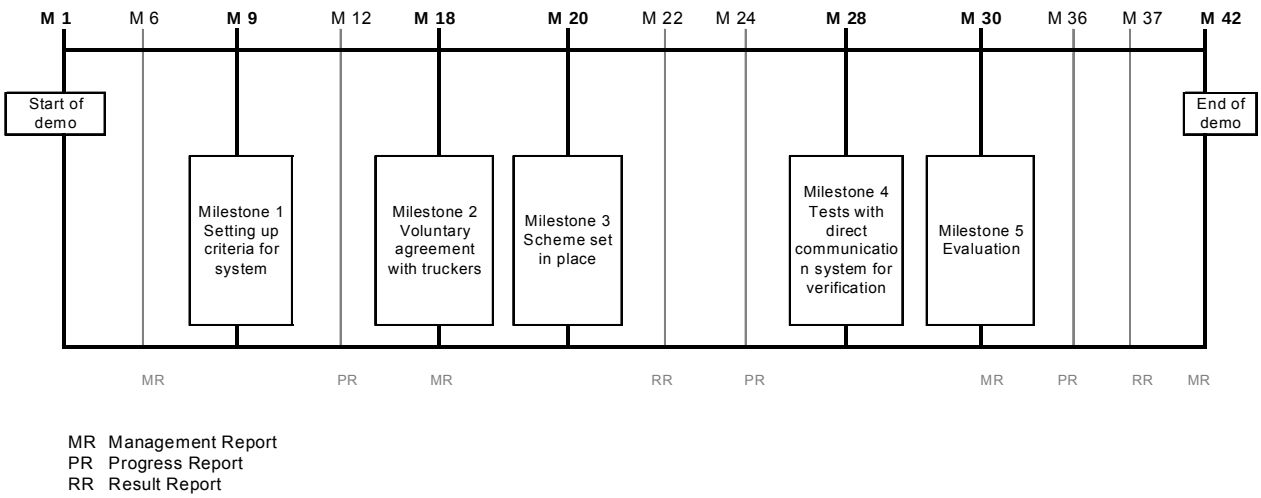


Figure B.5-3 Original time plan

An extensive literature search was made to locate similar projects in Europe. During the first phase of the pilot project it was mostly the Copenhagen project[3] that ideas and inspiration have been collected from.

[3] Leu, E. and Ottosson, M. (2002)

During the complete measure a number of workshops, surveys and meetings have been held with involved and interested actors. Through this the pilot project has been developed and the prerequisites have been discussed.

Finally the pilot project was implemented, carried out and evaluated. Also a proposal for continuation after the TELLUS project ending has been developed.

3.1 Research

During the TELLUS project period, information has continuously been adapted from other similar projects. The two master thesis projects carried out have contributed to the project enormously with extensive literature search in all areas of interest for the measure.

The most similar project to get and compare information and processes with is the Copenhagen project[4]. This project is now (2005) brought to an end, but has been of great inspiration. Copenhagen has an Old Town that, for a period of time, the municipality has set a load rate criterion. A certificate system was carried out to separate the best vehicles from the ones who were not able to fulfil the criteria. The best vehicles did get access to specific load and unloading zones in the area. Meetings have been held with the project group of Copenhagen to discuss advantages, possibilities and problems with this idea versus the Göteborg idea.

Research has also been done to find the best possible technique for measuring the load rate of the vehicles.

3.2 Workshops and surveys

A number of workshops, surveys and meetings have been held during the measure period. The outcome of the workshops has shaped the pilot project, incentives and implementation process. Communication with all involved parties (city representatives, other projects, managers of hauler companies as well as drivers) has been very important during the measure. All plans and suggestions have been discussed and edited to fit as well as possible to all interests.

During the first master thesis work at TFK, performed during the spring of 2002, several interviews were held with persons from the transport industry. A couple of meetings with possible companies for technological solutions were held as well. The master thesis was presented at Chalmers, in the summer of 2002.

In November 2003 there was a start up meeting and workshop about the scheme. Invited to this workshop were responsible persons at haulage contractors that were interested in the scheme. The selection of persons attending were made after surveys undertaken with all transport companies in the region and telephone contact with known large haulers that perform goods transport in the area of interest. During this meeting the suggestion for the pilot

[4] Ibid

project was discussed. All hauler companies in the pilot project participated (Arla, Carlsberg, DHL – GB Framåt, Poståkeriet and Schenker – TGM AB).

In December 2003 a workshop with all drivers that would take part of the scheme was held. The discussions at this meeting were about possible positive incentives in the project, to get the drivers point of view on the issue. The drivers pointed out the problems and possibilities within the chosen area.

During 2004 three workshops took place. The first one was a large discussion meeting with all interested and participating companies, including drivers. This was in March, at the end of the first phase of the pilot project. The results and thoughts about the first phase were discussed and thoughts and ideas about the future second phase were discussed. Some alternative ideas for technology for measuring load rate were presented.

A second master thesis was carried out during the project at TFK during the spring of 2004. It was written by two students from Linköping University of Technology in Sweden, Mats Tjernkvist and Johannes Östlund [5]. The thesis aimed to analyse how to measure the load rate of the vehicles and find a direct communication system for validation. The result was the Anoto digital pen.

The second workshop included a presentation of the master thesis by Tjernkvist and Östlund[6], and was held during April 2004 with all participants of the project (representatives from Traffic and Public Transport Authority, managers of hauler companies, technology companies, drivers etc.). There were also discussions about problems and possibilities for the ongoing pilot project, with the aim to solve problems and upgrade the pilot project for the second phase.

The last workshop was held in September 2004 with haulers and drivers. It mainly focused on results and future plans. The possibility for up scaling of the project was the topic and a future scenario.

Some short meetings and telephone meetings have been held continuously during the project to update information, discuss and solve upcoming problems as well as just talking to drivers about possibilities. The project management group have, on several occasions, been going with a distribution vehicle in the project to get to know the environment and see the problems.

3.3 Setting up criteria for the system (Milestone 1)

The pilot project area was concentrated to the area between Vallgraven and Nordstaden, see Map B.5-2. . This is the city centre of Göteborg and is also a small part of the existing Envi-

[5] Tjernkvist, M and Östlund, J. (2004)

[6] Ibid

ronmental Zone. This area was chosen since it has a clear geographical delimitation by a moat and a national road, because it faces congestion problems and because of the many different businesses in the area[7].

Map B.5-2. The area within Vallgraven and Nordstaden in Göteborg.

Definition of load rate criteria

The load rate criteria have been defined to be (after discussions and result from the base line scenario):[8]

65 % used volume of total volume capacity of the vehicle; or:

65 % used weight of total weight capacity of the vehicle; or:

50 customers visited within the area.

For instance the load rate is not defined as pallets or packages. There has to be a high usage of the total capacity of the vehicle. A combination of both deliveries and collection of goods are measured. This means that a vehicle that delivers a full load of goods in the area and then collects a lot of goods could have a load factor of more than 100 %. The load rate is measured within the area of the pilot project. Deliveries to or goods picked up inside the area are counted into the measure. The vehicles can be used in other areas as well, but the goods delivered to those areas are not counted in the measurement of the load rate. The criteria with at least 50 customers are designed for the parcel vehicles.

[7] Leu, E. and Ottosson, M (2002)
[8] Ibid

Definition of demands and restrictions

There are no restrictions in the pilot project for vehicles that do not fulfil the load rate criteria. This would have been hard to control in the measure and the purpose of the measure was mainly to find out whether or not the positive incentives were useful.

3.4 Voluntary agreement with haulers (Milestone 2)

Five haulers agreed to take part in the demonstrator measure. A total number of eight vehicles took part in the pilot project. There were six heavy duty vehicles, including one gas driven vehicle, and two delivery vans with a total weight of ~3.5 tonnes.

The hauler companies in the project were:

Arla Foods AB (delivers dairy products etc.): Participated with one heavy duty distribution vehicle;

Carlsberg Sweden AB (delivers brewery products): Participated with two heavy duty distribution vehicles. One of the vehicles was a bio gas fuelled vehicle;

DHL (GB Framåt AB, delivers parcels and goods): Participated with one heavy duty distribution vehicle and one light duty vehicle for parcel deliveries;

Schenker (TGM AB and Bäckebols Åkeri AB, delivers parcels and goods): Participated with one heavy duty distribution vehicle and one light duty vehicle for parcel deliveries;

Poståkeriet AB (delivers parcels and goods): Participated with one heavy duty distribution vehicle;

3.5 Implementation of system – Scheme set in place (Milestone 3)

The implementation of the pilot project was divided in two phases. The first phase mainly focused on getting to know the drivers, vehicles, problems and possibilities as well as creating a base line scenario. The second phase was the real implementation of the positive incentives and of the technical system for reporting the load rate.

First phase – Base Line Scenario

The activities carried out during the first phase aimed to understand the mechanisms of commercial transport in the city (demand, load rate, routes, accessibility of the customers etc.). During a period from December 2003 until April 2004, an evaluation of the base line scenario was made. The eight vehicles in the pilot project were during this time evaluated in terms of load rate, number of kilometres driven, number of stops etc. No positive incentives

or demands were put on the vehicle for this period.

The information collected during this period of time came partly from a GPS installed in each vehicle, partly from forms filled in by the drivers and sent to TFK. The load rate was reported in a number of ways: weight, volume, number of pallets etc. The average load rate for the vehicles seemed to be approximately 60 % (with peak values of 95 % and lowest on 5 %) for the heavy duty distribution vehicles. The load rate was around 60 % for the smaller parcel vehicles as well, but for those a high number of customers were also noticed – an average of 50 customers. Those results gave that the basis for the load rate criteria, which was defined as total capacity use or number of stops.

The result of the base line study together with discussion meetings built the foundation for the restrictions and positive incentives in the second phase of the pilot project. The load rate criteria was set as a little bit higher than the average result to see if there was a possibility for increase.

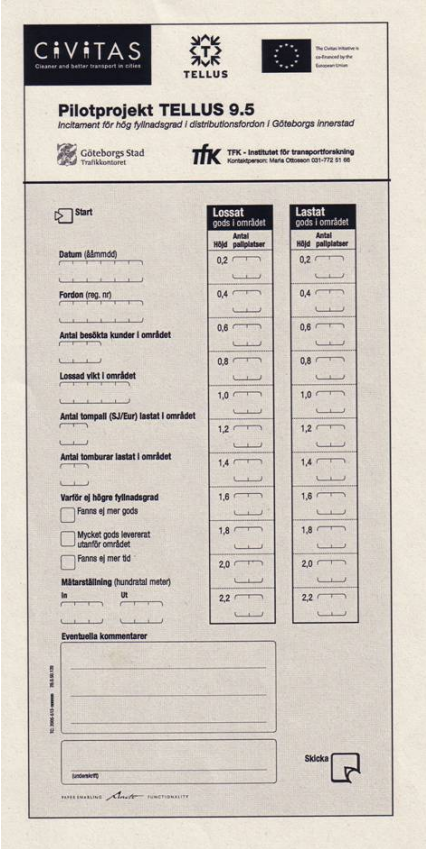
Second Phase – Tests with direct communication system for validation (Milestone 4)

The implementation of the actual system with positive incentives was performed during the second phase of the pilot project. The eight vehicles in the first phase were now equipped with an exemption, a digital pen, a special form (for registration of load rate) and a mobile phone in complement to the GPS[9].

The exemptions enabled the vehicles to use the positive incentives. The exemptions were written by Trafikkontoret, Göteborgs stad, and consisted of a signed paper form attached to the wind screen of the vehicles. The exemptions could only be used by the vehicles in the project. The forms that have been used have a special pattern that is being interpreted by the pen. The background of the form consists of dense grey dots. The pen, see Picture B.5-1, recognizes were on the form that something is written with it, by reading the pattern of the dots. There are standard forms for the pen[10], but in this measure a specially designed form have been used, see Picture B.5-2, to be able to register the things that are interesting in this particular matter.

Picture B.5-1 The digital Anoto pen

[9] Tjernkvist, M and Östlund, J. (2004)
[10] www.anoto.com


CIVITAS
Cleaner and better transport in cities

TELLUS

The Civitas Initiative is co-financed by the European Union

Pilotprojekt TELLUS 9.5

Incitament för hög fyllnadsgrad i distributionsfordon i Göteborgs innerstad

Göteborgs Stad
Trafikkontoret

TFK - Institutet för transportforskning
Kontaktperson: Maria Ottosson 031-772 51 66

Start

Datum (åårrmmdd)

Fordon (reg. nr)

Antal besökta kunder i området

Lossad vikt i området

Antal tompall (SJ/Eur) lastat i området

Antal tomburar lastat i området

Varför ej högre fyllnadsgrad
- Fanns ej mer gods
- Mycket gods levererat utanför området
- Fanns ej mer tid

Mätarställning (hundratal meter)
In Ut

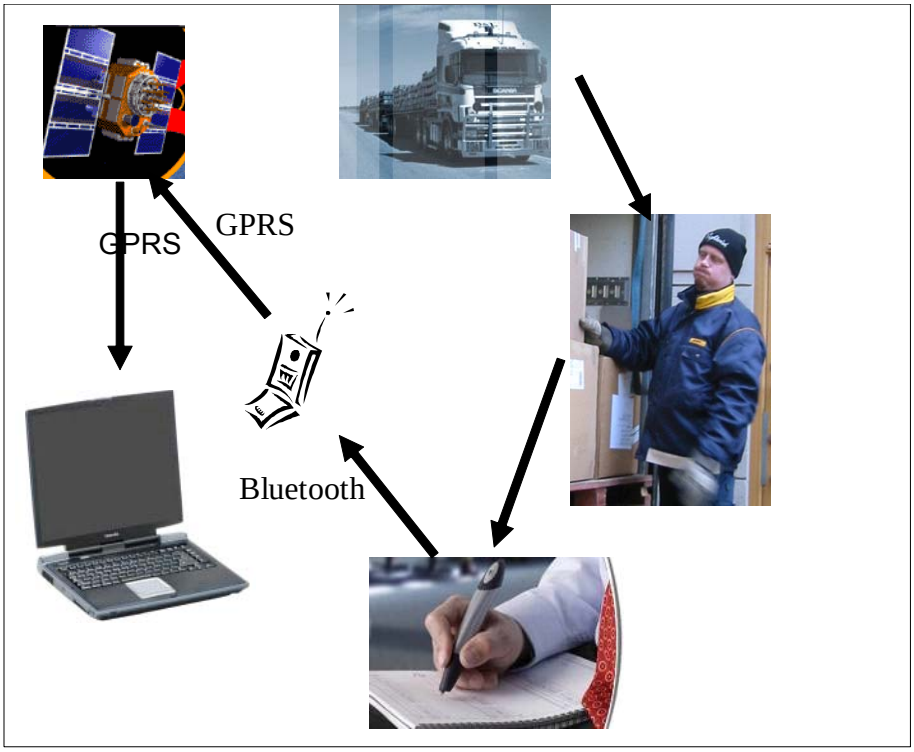
Lossat gods i området		Lastat gods i området	
Höjd	Antal pallplatser	Höjd	Antal pallplatser
0,2		0,2	
0,4		0,4	
0,6		0,6	
0,8		0,8	
1,0		1,0	
1,2		1,2	
1,4		1,4	
1,6		1,6	
1,8		1,8	
2,0		2,0	
2,2		2,2	

Eventuella kommentarer

(underskrift)

Skicka

Picture B.5-2 The form for registration of load rate.



Picture B.5-3 The relations between the different steps in the procedure of sending load rate information.

The GPS was updated more frequently than during the first phase. The drivers now used the digital pen to fill in the load rate of the vehicles in the special designed formed instead of the form in the first phase. The information from the load rate forms was sent via Bluetooth from the digital pen to a mobile phone and from the phone via GPRS to a database where the information was processed, see Picture B.5-3. The database separated the information from the different vehicles and could automatically calculate the load rate of the vehicles for each day. The results were presented on a web site. This site was only available for TFK and for each hauler. They were not allowed to see information from other vehicles than their own.

All information was also presented on a web site for the measure, see Picture B.5-4.

Picture B.5-4 The measure web site on www.webforum.com

The following positive incentives were implemented during this period:

- Seven zones for loading/unloading of goods;
- Access to three bus lanes into the city;
- Contact with parking attendants in the area and extra supervision of the zones for the project;
- Access to Nya Allén.

The zones for loading/unloading in the area were chosen by the drivers. They pointed out nine spots within the area for the measure that was interesting for better prerequisites for deliveries. Seven of those nine spots were accepted by the Traffic and Public Transport Authority. The zones are parking spaces that during the project were marked with stop prohibition between 9 a.m. and 1 p.m. on weekdays and marked with traffic signs, see Picture B.5-5. All other times they were parking spaces as usual. The parking guards in the area were informed about those changes and were asked to check those areas especially during the pilot project period. The drivers did get contact information to the parking guards to be able to call them if there were vehicles unauthorised occupying the zones.

Picture B.5-5 Marking of loading zone

The access to three bus lanes was the most difficult incentive in the project. The wish from the drivers and haulers was that all public transport lanes would be accessible for their vehicles, but this is not possible because of trams in Göteborg. Bus lines into the city were accepted and those three were chosen since they lead traffic into the area of the pilot project. There was no access to bus lanes inside the area.

Nya Allén is a road outside the area for the pilot project, but affects the movements within the area. This road is ordinary prohibited for vehicles above 3.5 tonnes, which causes problems for the drivers with long detours around the city. During the pilot project the involved vehicles were allowed to use this road, which was an extraordinary good incentive.

3.6 Barriers and drivers

Barriers of the measure were:

- Legal issues (procurement for public authorities, equal treatment for equal vehicles);
- The technical solution (reporting technique of load rate).

Drivers of the measure were:

- Communication;
- Enthusiasm from the actors involved.

3.7 Achievement of quantifiable targets

Quantifiable targets for the measure are the indicators (presented in the results) and the objectives from the “Description of work”. The objective fulfilments for the TELLUS WP 9.5 are presented in Table B.5-1 below.

Table B.5-1 Objectives and fulfilment of TELLUS WP 9.5

Objective level	Objective	Fulfilment
Immediate objectives	Design of voluntary scheme with the transport industry, e.g. defining the demand on load rate for the vehicles necessary for receiving incentives. Restrictions for entering the city zone will also be defined in the scheme.	achieved A scheme was designed, defined and implemented as a pilot project.
	A communication system will be developed to measure and report the load rates on the vehicles	achieved GPS and Anoto pen were used for this function.
	Certain unloading areas will be set aside for the companies that meet the defined criteria. Other incentives may also be realised.	achieved Loading zones was set up, bus lines were used, a restricted road was accessible and a direct contact with traffic attendants was initiated.
	Putting up road-signs, authorising permissions etc.	achieved Sign were put up at the loading zones. Permissions were handed out to the eight vehicles involved.
Intermediate objectives	The example may be implemented in other critical areas of the city if necessary and in other cities	achieved Guidelines how to do this in other cities are written.
	New forms of joint environmental development strategies between municipality and market	achieved Good contact between haulers and municipality with workgroups.
	Increased load factor as a competitive means	Not in the pilot project, but in a full scale implementation the load factor should be increased (long term perspective).
Ultimate objectives	Reduce congestion	With full scale implementation.
	Reduce air pollution and noise to levels below national and EC directives	With full scale implementation.
	Reduce NOx emissions from heavy traffic	With full scale implementation.

Objective level	Objective	Fulfilment
	Improve public-private co-operation	achieved With workgroups and close contact with drivers and haulers.
	Achieve extensive political and public awareness for TELLUS	achieved With media exposure and close contact with actors in the project.
	Improved intra-organisational co-operation at the city level	achieved
TELLUS objectives	Reduce congestion	With full scale implementation.
	Reduce air pollution and noise to levels below national and EC directives	With full scale implementation.
	Reduce NOx emissions from heavy traffic	With full scale implementation.
	Improve public-private co-operation	achieved
	Achieve extensive political and public awareness for TELLUS	achieved
	Improved intra-organisational co-operation at the city level	achieved

4 Results

A plan for the evaluation methodology on measure level was produced and can be found in Annex. The evaluation method and evaluation of indicators and objectives are described below. All results are presented in tables and in text; quantitative or qualitative depending on the type of the indicator.

4.1 Evaluation methods

To evaluate the demonstration measure a number of indicators have been used:

- Emissions (NO_x and particulates);
- User acceptance/satisfaction (Customers' attitude);
- Supplier acceptance (Suppliers' attitude);
- Publicity (Media response);

- Freight movements (Number and weight of consignments, Vehicle kilometres for distribution vehicles);
- Congestion level (Number of cars passing in and out of the zone during a certain time, Attitude);
- Costs (Investment costs for haulers, Investment costs for the City of Göteborg).

To carry out the evaluation a various number of methods were used. From the beginning to the end of the measure, different questionnaires, interviews and observations of transports have been carried out in Göteborg. During the pilot project observations of the vehicles in the project were also made by using a certain technology.

The *emissions* have been evaluated for the vehicles involved in the pilot project. The evaluation was carried out in two steps. The first step was to measure the situation before the positive incentives and the second step was to measure the emissions in the second phase of the pilot project when the incentives were implemented. The measurements and calculation of NO_x and particulates were made with reports on the ton kilometres for each vehicle in the area of the project together with specific information about each vehicle engine and fuel type. Data for NO_x and particulates as well as calculation methods were based on NTM[11]. NTM is a non-profit Swedish association working for a common view and consensus on how the environmental issues of the transport sector are to be solved in order to attain a transport system that is sustainable in the long term. The measurements were carried out every day the vehicle entered the specific area and mean values of the periods have been calculated.

User and supplier acceptance and satisfaction have been evaluated with both interviews and questionnaires. Two questionnaires were sent out to find out the attitude towards distribution transports and environmental issues; one to businesses in the specific area and one to hauler companies in the Göteborg region. The questions were of mostly attitude character but there were also questions about behaviour. Both questionnaires were carried out before the beginning of the pilot project.

The publicity through *media response* has not been measured and evaluated especially. All media exposure has been good.

Freight movements have been difficult to measure in this measure since the demonstrator pilot project were set to involve only a few vehicles. The evaluation of freight movements have only been carried out for the vehicles in the pilot project, since there have been no possibility to make those measurements for all vehicles in the area. Number and weight/volume of the consignments as well as the number of vehicle kilometres have been measured continuously during the project for the vehicles involved, i.e. every time the vehicle entered the area. In the first phase of the pilot project the indicators were measured and reported by the drivers of the vehicles on a printed excel sheet. In the second phase of the pilot project the

[11] www.ntm.a.se

measurements were reported by the drivers with a digital pen. The evaluation constituted of a comparison between the before and after situation.

The *congestion level* was measured once in the measure; in the beginning. Cars passing in and out from the specific area were registered at every entrance of the area during two days. The registrations of vehicles were made by persons standing at the entrances to the area, counting different vehicle types. The congestion level for the entire area was then estimated by comparing to other similar areas in the city and to the answers of the questionnaires.

Costs have been evaluated through the project to be able to avoid expensive solutions. During workshops and interviews with haulers, a maximum cost level has been established for the technology investments and other investments for vehicles and to be able to take part of the measure. During the pilot project all costs were covered by the TELLUS project, but for a continuation all investments have to be done by the haulers themselves. Therefore a reasonable cost level was a very important issue during the project. The same discussion is applicable for the City of Göteborg.

4.2 Impacts

The achievement of the impact indicators are presented in Table B.5-2. The results are shortly commented in the table and more elaborated in text below.

Table B.5-2 Evaluation impact indicators and there achievement for TELLUS WP 9.5.

Evaluation Area	Evaluation Category	Impact	Indicator	Achievement
Environment	Pollution/Nuisance	Emissions	NO_x emissions	More during the project, see text
			Particulate emissions	More during the project, see text
Society	Acceptance	User acceptance/ satisfaction	Customers' attitude	Both acceptance and satisfaction among customers.
		Supplier acceptance	Suppliers' attitude	Acceptance among suppliers
	Awareness	Publicity	Media response	Good media response, especially during the second phase of the pilot project.

Table B.5-3 Evaluation impact indicators and there achievement for TELLUS WP 9.5.

Evaluation Area	Evaluation Category	Impact	Indicator	Achievement
Transport	Transport system	Freight Movements	Number of and weight of the consign-ments	Same as before the project.
			v-km for distribu-tion vehicles	More during the project, see text
		Congestion level	Number of cars passing in and out of the zone during a certain time	Cars: ~4,300 = 80% LDV: ~600 = 11% HDV: ~175 = 3% Buses: ~300 = 6%
			attitude	The attitude amongst busi-nesses and people within the city is; the congestion level is high and it is mostly the distribution ve-hicles that cause the congestion.
Economy	Cost-related	Costs	Investment costs for haulers	About 600 € plus engagement from drivers
			Investment costs for the City of Göte-borg	About 5,000 € plus man hours (control and observance)

Environmental achievements

The environmental and sustainability question are one of the main issues in the TELLUS project. The two emission indicators for TELLUS WP 9.5 were NO_x and particulates. The emissions were calculated for both the first and the second phase of the pilot project.

During the measure, measurements of the vehicles were only performed within the specific geographical area. Since the positive incentives with access to bus lanes and to the re-stricted road were localised outside this area, the profits from those two incentives were not taken into account in the measurements. The restrictions in the measurements were made before the project begun and the problem caused by the delimitation were not noticed until the pilot project had ended and the results from the calculations were shown.

The results of this mistake are that the actual achievements of the environmental impact indicators are unknown, see Table B.5-4. The drivers of the vehicles are convinced that both time and vehicle kilometres were saved during the pilot project. The experienced a better working environment because of the reduced vehicle kilometres, by using the bus lanes outside the area, and the reduced time spent trying to get to the area or time finding a good unloading zone. According to those statements the belief is that the vehicle kilometres were reduced if the entire route of the vehicles would have been looked at. But, the results of the pilot project show almost no difference between the first and the second phase. In general (for all vehicles except one) the driven kilometres have increased within the area. But, since the increase is quite small, the difference could be sorted within the margin of error. If the measurements had been increased to involve the surrounding areas and the complete routes of the vehicles in the measure, the results would have showed a decrease in emissions and vehicle kilometres.

Table B.5-4 The emission indicators results of the vehicles in the pilot project.

	NOx [g/route]		PM [g/route]		Km/route		Ton km/route	
	Before	After	Before	After	Before	After	Before	After
Vehicle no. 1	3.8	4.5	0.06	0.08	4	5	4	5
Vehicle no. 2	10.7	17.6	0.18	0.29	4	5	12	20
Vehicle no. 3	27.1	42.1	1.05	1.64	5	7	30	47
Vehicle no. 4	9.0	9.0	0.15	0.15	7	8	10	10
Vehicle no. 5 (parcel vehicle)					8	6		
Vehicle no. 6	4.3	10.3	0.07	0.17	9	9	5	11
Vehicle no. 7	15.5	11.7	0.26	0.20	6	7	17	11
Vehicle no. 8 (parcel vehicle)					6	9		

Since the emissions in this calculation are based on ton km, no emissions are presented for the parcel vehicles – no weight measurements were made for those two vehicles and a mean value of no. of kilometres per route.

The mean value of the NO_x emissions are: **before = 11.7** grams per vehicle and route within the area and **after = 16.6** grams per vehicle and route within the area. The best vehicle had a reduction of 3.8 grams in the second phase compared with the first.

The mean value of the particulates are: **before = 0.29** grams per vehicle and route within the area and **after = 0.42** grams per vehicle and route within the area. The best vehicle had a reduction of 0.06 grams in the second phase compared with the first.

The values are calculated from the number of ton kilometres for each vehicle in the measure. The number of vehicle kilometres did not increase significantly (before = 6.1 km/route, after = 7 km/route) but the weight of the consignments increased and therefore an increase in the ton kilometres were achieved (before = 13 tkm/route, after = 17.3 tkm/route). The increases in emissions are directly connected to the increase in ton kilometres.

The number of customers increased for some of the vehicles during the second phase. If the calculations are based on emissions per customer (see Table B.5-5 for number of customers), the mean results (for all vehicles) are for NO_x: before = 1.61 gram per customer and route, after = 2.1gram per customer and route, which is just a 30 % increase compared to the 40 % increase mentioned per route. The particulates have corresponding values.

Society achievements

As mentioned earlier, surveys have been carried out with questionnaires to find out the acceptance, satisfaction, ideas and thoughts about the measure and other environmental actions within Göteborg. The results of those questionnaires have been quite good and there is a general acceptance among the citizens and businesses about environmental projects – as long as it does not create any difficulties or costs. Since this measure created a better situation for most actors, it turned out positive.

The media response has been good. The measure have been mentioned in articles in logistical magazines, local newspapers, research magazines etc. and a radio program during, before and after the TELLUS project period. The general opinions of the measure in the articles have been positive.

Transport achievements

Transport achievements have been the focus point of this measure. Load rate of the vehicles has been the main issue when planning the pilot project, technology used, evaluation etc. It was not until the end of the first phase that the decision was made about what evaluation method should be used or how to measure the load rate of the vehicles. “Number and weight of the consignments” was the first thought about how to perform this measurement (as mentioned in Table B.5-2), but this was changed according to the results of the first phase evaluation. Suitable for this project and urban distribution in general was to apply measurements of the vehicle total capacity use.

The load rate of the vehicles was almost the same in the first and the second phase of the pilot project. A better result was hoped for on the load rate factor, since this was the main issue. There are several explanations for the result; the vehicles had a good load rate factor from the beginning, the reporting methods were not exactly the same before and after (the

later were more accurate), the both phase periods did not have the same length and the second phase measurements were performed during the summer, when goods flows normally are lower than during winter (first phase) and finally the incentives were not withdrawn if the load rate were not fulfilled. The last reason is probably the most important. To make the pilot project as smooth as possible, the exemptions, that made it possible for the vehicles to use the specially marked non stopping areas as unloading zones, were handled out for the complete pilot project period. This made the administration of the measure easier. The pilot project period also was to short and had too few involved vehicles to be able to withdraw the exemptions for a period when indicators were not fulfilled and then handle them out again when load rate were proved. The point of this was to see all involved vehicles benefits of all incentives during the complete period.

The result of the load rate indicator is presented in Table B.5-5. As discussed earlier, the results of the second phase of the pilot project were not good. Five out of eight vehicles had a better volume result than before, but just two were able to fulfil the demand of at least 65 % volume capacity use. When looking at the weight load rate, the results are almost the same: three out of six are better than the before situation (the parcel vehicles did not measure weight capacity) but none of the vehicles were able to fulfil the demand. The number of customers was in fact just of interest for the parcel vehicles. One of the two parcel vehicles fulfilled the demand of 50 customers (with great margins). When looking at the other vehicles, four out of six managed to increase the number of customers in the area during the second phase.

The criteria for fulfilling the load rate were to reach the demand level for one of the three categories. In total, there were just two vehicles that reached those demands. Some of the others came close and had good results for many days, but with a mean value they did not manage to fulfil the demands.

Table B.5-5 Results of the load rate indicator for the vehicles in the pilot project.

	Volume		Weight		No. of customers	
	Before	After	Before	After	Before	After
Vehicle no. 1	14 %	17 %	15 %	13 %	5	6
Vehicle no. 2	72 %	50 %	41 %	26 %	9	6
Vehicle no. 3	65 %	70 %	39 %	48 %	6	7
Vehicle no. 4	63 %	37 %	21 %	22 %	10	9
Vehicle no. 5 (parcel vehicle)	45 %	44 %			44	44
Vehicle no. 6	29 %	41 %	16 %	31 %	6	7
Vehicle no. 7	53 %	56 %	58 %	56 %	9	23
Vehicle no. 8 (parcel vehicle)	65 %	84 %			61	64

Percentage of the consignment volume or weight of the total volume or weight capacity and no of customers within the area. Weight was not measured for the parcel vehicles.

One of the reasons for that some of the vehicles were not able to fulfil the demands was that their routes are constructed to include customers not just inside this specific area. All vehicles had customers outside the area in some extent, but a couple of vehicles had mostly customers outside the area. This has several reasons, but for, for example, Arla Foods there are almost no grocer's shop within the area and therefore not that many deliveries to this area. Instead, they have some customers with chain stores in adjacent areas. If those areas had been included somehow in the measure, there had been a much better load rate of most of the vehicles.

Economy achievements

The economy achievements mostly concern the cost for the system and for the technical equipment used. The goal was to find technical equipment for the measurements that was as easy as possible to use and as cheap as possible to purchase. Another prerequisite to create a low cost system was that the equipment was easy to integrate with other systems needed for the control of the observance.

The costs for the system in the pilot project were handled by the measure budget and none of the haulers had to contribute or stand for any of the costs for the equipment. But, the digi-

tal pens and the forms for reporting the load rate were sponsored by Schenker AB[12] as well as some of the mobile phones. The subscription fee for the mobile phones and for the cost of transference of information from the digital pens to the data base, were sponsored by TeliaSonera AB[13].

For a continuation of the pilot project the cost to operate the system lands at the City of Göteborg. The total cost for setting up a database of the same type as in the pilot project is about 44,000 SEK or 4,900 EUR[14]. Above this, there is a cost for operating the system for the municipality. This cost depends of the size of the measure, but could probably be handled by existing personnel with not too much extra burden.

For the hauler that wants to be a part of the measure, there is a cost for the digital pen (about 1,500 SEK or 170 EUR) and for the purchase of a licence for the pen (about 4,200 SEK or 470 EUR). Some haulers might have to complement the equipment with a mobile phone that handles Bluetooth, if that is not a part of the regular driver equipment. The transference of information with GPRS creates a small cost but, there is also a possibility to transfer the information with a docking station at a computer (standard equipment with the pen) without a mobile phone[15].

Except from those costs there is also a cost for the form used to report the load rate. A suitable solution for those forms is that the municipality handles the ordering of the forms, which are then purchased by the haulers from the municipality.

The cost seems reasonable for both partners; the hauler and the municipality, since the effect of the measure hopefully create both better possibilities for the hauler and a better environment and/or a better traffic situation in the city as a result for the municipality. I.e. the investments are most probable to be repaid within the project in terms of shorter and more effective routes for the haulers.

Important to mention is that, if the hauler company already has a system that collects the data needed for the measurements of the load rate in the project, there is no need to purchase the digital pen. If the information is available in a XML format or similar, the information can be transferred directly into the data base and used for the reporting.

4.3 Additional impacts

Additional impacts that have not been measured or evaluated by the measure are discussed in this chapter.

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[12] Schenker (Customer Business Solutions), Petter Djerf, www.schenker.com

[13] TeliaSonera AB, Göran Belfrage, www.teliasonera.com

[14] According to a tender from the company Catrel AB, that handled the data base in the pilot project. www.catrel.com

[15] Ibid

Documents

There have been some reports and documents written within this measure:

Leu, E. and Ottosson, M. (2002) Miljözon för distribution av gods i Göteborgs innerstad – ökade miljökrav för distributionsfordon. TFK Rapport 2002:16

This report contains an extensive literature search and descriptions of similar projects performed. The delimitations of geographical project area, surveys and description of the continuation of the measure can also be found in the report. The report is written in Swedish, with a summary in English.

Tjernkvist, M and Östlund, J. (2004) Fyllnadsgrad för distributionsfordon i Göteborgs innerstad – utveckling av definition och tekniskt koncept för mätning och inrapportering. TFK Rapport 2004:5

In this report there is a detailed survey of possible technological solutions for measurement of the load factor in the vehicles. There is also a more detailed description of the definition of "load rate". The report is written in Swedish, with a summary in English.

Ottosson, M. (2005) Fortsättning av TELLUS 9.5 – Vad händer efter pilotprojektet?

This document contains the report of an investigation performed as a commission from the Traffic and Public Transport Authority, Göteborg, during the spring of 2005. The investigation concerns the possible up scaling of the TELLUS 9.5 project after the pilot project period and after the TELLUS period have ended. The report is written in Swedish.

Increased level of knowledge

From this demonstrator measure, the level of knowledge about how to strategise when implementing a pilot project has increased. Strategic implementation has a lot to do with communication. And the most important factor is that communication has to be addressed in different levels in different organisations. The municipality and the research organisations involved in the measure, now have a better knowledge about how to implement pilot project or full-scale projects in a more efficient way.

Another way of increased level of knowledge is the environmental knowledge of the personnel at hauler companies and businesses within the area. Persons that have got in contact with this measure in some way have probably got a wider view of environmental issues and what various number of ways there are to solve such problems, as well as the importance and benefit of all small actions.

There are two important factors in the project, except from the objectives of the measure that have led to further interest of the pilot project from different actors. The first is the definition of the load rate in distribution vehicles. There existed no good definitions of load rate before this measure and hopefully the definition in the measure are possible to use in other contexts. The second is the technology used. The Anoto functionality was not new for the measure,

but the way of using it. Since the technology is very user friendly and comparatively cheap a lot of interest has been showed about this issue.

Exchange of experiences

During the TELLUS project period, exchange of experiences has been made with a lot of different organisations. Mostly project groups for similar projects in other cities have been contacted. Attending in workshops, seminars and personal meetings have increased the level of knowledge in this project and have also led to synergy effects between this and other projects. Experiences about worst practise have been the most helpful, since it is better to learn from someone else's mistake than to make the same again.

Increased national and international co-operation

During this project, co-operation has increased both national and international between different cities. Through workshops, meetings etc. a broad network have been built up. Those contacts have helped create better situations for the projects in the cities with the increased level of knowledge that have followed as well as creating possibilities for co-operation in other projects and getting new ideas for actions. Other European projects like Bestufs, eDrul, Trendsetter etc. have been of great interest in the measure work.

5 Conclusions

One of the main conclusions of the TELLUS WP 9.5 measure is that it has been successful, despite that the results do not show any less emissions etc. The reason for the conclusion of a successful project is that the knowledge about implementing a project of this kind, definition of load rate, technology to report load rate and the possibilities for incentives have been analysed thoroughly and knowledge about how to and what to do in a future full scale project has been increased. The acceptance from drivers, transport companies, the municipality and businesses are most valuable and the communication throughout the project has been very good.

Hence, one of the most important conclusions is that it is possible to talk about goods. It is just a matter of whom you speak to and how you present the information that you want to communicate. It is not always the president of the company, the board or the steering committee that is the best source of information when you want to find out information about problems or possibilities. That is of course the right path when introducing new concepts and involving new companies into projects, but when creating the measure and finding out the best solutions it is often better to talk to the persons "on the floor". The most creative ideas in this project came from the drivers. It was also natural to speak to the drivers of the vehicles when finding the load- and unloading zones for the measure, since it is the drivers who know where those are needed.

From this measure knowledge have increased about that positive incentives are possible to

implement and that they do create possibilities for a better transport situation in the inner city of Göteborg (not according to the measured results, but according to the evaluation from the drivers of the vehicles and from other involved persons in the project). But, it is necessary to withdraw the exemptions when demands are not fulfilled, to create a fair situation with equal incentives for equal vehicles. This would be a better driving force for the involved parties to fulfil the demands. To create an even bigger driving force it is possible to implement restrictions. Restrictions are nevertheless more complicated to implement. The biggest issue about restrictions are that according to national (Swedish) and European legislation; it is not possible to restrict something for one vehicle that another vehicle with the same prerequisites is allowed to. I.e. in this case it is hard to draw the line for the load rate fulfilment, since it could be difficult to demand a report of the load rate of every vehicle in the city. As the system has been designed with just the positive incentives, it is a voluntary agreement where the vehicles that have agreed to show their load rate fulfilment are allowed to use the positive incentives and all others are not allowed to do this. Nothing is taken away for those who do not fulfil the demands, just increased benefits for the ones that can prove a high load rate.

The transferability of the measure is good, since the system and measure idea have an easy design. One of the goals for the project group was to find a solution that does not create too much extra work load for the municipality personnel. The system is easy to implement since it is based on a voluntary agreement and just positive incentives. What incentives that is possible to implement varies between cities and the needs could also vary between cities. Zones for loading and unloading of goods are probable to be a worldly problem, but it is not all cities that have special lanes for busses and trams. Although talking to the drivers of the distribution vehicles in a city most likely gives both problems and solutions to present as ideas for the measure incentives. See further discussion in Chapter 6 about potential up scaling of the measure.

5.1 Objective fulfilment

The objective fulfilment can be found in Table B.5-1. The achievement is commented in each box. Some of the ultimate and TELLUS objectives have not been fulfilled during the demonstrator pilot project, but would most probably do with a full scale implementation of this demonstrator measure.

The reduction of congestion was not possible to fulfil, since there was a limited number of vehicles in the measure. For the same reason it has been difficult trying to reach goals about reducing pollution and noise to levels below national and EC directives. The reduction of NO_x emissions has probably been reached during the pilot project period, but because of the missing data about routes outside the measure area, there is no proof of this. The emissions and vehicle kilometres had probably been reduced if the surrounding areas and the complete routes of the vehicles had been included in the measurements.

5.2 Barriers and drivers

During the measure there have been both barriers and drivers that are worth mentioning. The measure have had to consider legal issues, technical problems as well as figured out good ways of communication for acceptance.

Barriers

Barriers of the measure have mostly been legal issues. One of the most difficult problems was and is the law on public authorities that says that all information at public authorities has to be public. This means that all information that comes into the hands of the City of Göteborg is free for everyone to see. It might not always be easy to find the information, but if you know what you are looking for, the information can be asked for and it is possible to get a copy of specific documents. In this particular measure this is a problem because of the haulers' company secrets – the customers. The haulers do not want their competitors to know what and where they deliver goods and how much. Since the objective of this demonstrator is to find out this particular information, a way around this legal issue had to found out.

It is possible to classify document that are "under progress". But, it is not a guarantee that the information will stay classified for ever. The solution to the problem was to collect data through a database localised at a sub contractor company. Data from the vehicles did not include information about customers in any way and the information sent to the Traffic and Public Transport authority did just include information about if or if not the vehicle had managed to reach the load rate level of acceptance. In this way, no information about each hauler's customers did reach the Traffic and Public Transport Authority.

Another legal framework that has had to be considered discussing the measure is laws about neutral competition and equal treatment. It is not possible to implement restrictions that in some way do not follow the law of equal treatment for equal vehicles. Since this demonstrator have been a pilot project it is possible to experiment outside those restrictions (since the project was delimitated to a certain period of time), but since the measure are planned to be implemented in a full scale version all possible problems had to be considered from the beginning. In the measure it was found out that it is possible to implement positive incentives for vehicles that fulfil certain demands as long as nothing is taken away for others.

To find a suitable technical solution for the load rate reports was another barrier. It was difficult to find a solution that was both users friendly and cheap. Many different technical ideas were evaluated before the Anoto Pen was found.

Factors for success

Communication has been the best factor of success in this demonstrator measure. Through meetings, interviews and workshops, the measure design has been discussed continuously during the complete project period. The communication have not only been between the project management and managers at involved companies – it has also contained of a lot of

discussions with personnel at the municipality, the drivers and other interested parties of the measure. The most valuable information exchange has been with the drivers of the vehicles.

Drivers to keep the measure going have been the enthusiasm of some of the drivers of the vehicles in the project. After the ending of the pilot project those persons have created a wish for a continuation of the project.

5.3 Synergies

One synergy to be mentioned was the co-operation between this measure and the Environmental Zone. The measures were different and had different objectives, but, the same type of target group. The same type of problems were discovered in both measures and the joint effort to solve the problems and to create a possibility for the actors in the measure to make their voice heard seem to have been a success. To create a situation were the hauler companies on all different levels are interested in the measures and willing to make a big change or just contribute in some way, communication are essential. Workshops and meetings in both measures handled the same issues and the results from one measure could often be used in the other.

Another synergy effect related to the communication success is the increased awareness of environmental issues among haulers. Especially the drivers in the measure have learned more about city distribution problems from “the other side” – the municipality, and the word has been spread.

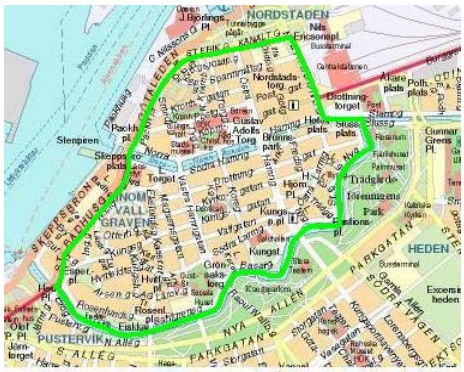
6 Scenarios

Future scenarios for the measure have been discussed during the entire pilot project. The goal was to create a pilot project that could be possible to implement as a full scale measure after the pilot project period and/or for up scaling. Since the pilot project ended, the evaluation of the project has been combined with strategies for up scaling and a suggestion for up scaling has been presented for the municipality, Trafikkontoret Göteborgs Stad[16].

6.1 Potential up-scaling

The potentials for up scaling of the pilot project are big. With just positive incentives and no restrictions it is rather easy to implement such a measure in a bigger scale, since there are no legislations that have to be changed. If, though, restrictions are wanted to complement the project and to get a more extensive effect, it is probable that national traffic legislations have to be adjusted.

[16] The suggestion was presented in a written report (*“Fortsättning av TELLUS 9.5 – Vad händer efter pilotprojektet?”*) as well as during a steering group meeting at the Traffic and Public Transport Authority in June 2005, by Maria Ottosson, TFK. This investigation was performed as a commission from the Traffic and Public Transport Authority.



Map B.5-3. Area: Pilot Project

In Göteborg the measure will probably be implemented in an up scale version in the beginning of the year 2006. The measure will be designed as a voluntary agreement, just as during the pilot project, and will be open for each hauler that wants to join. I.e. the project will not be restricted to a certain number of participants.

The demands of the load rate will be the same as in the pilot project; 65 % of total volume or weight vehicle capacity or at least 50 customers within the area. The area will be expanded and consist of three different areas; the same area as in the pilot project, an area around Avenyn/Vasastaden and an area around Haga/Linnégatan, see Map B.5–3, Map B.5–4 and Map B.5–5. Those areas are adjacent to each other. This extension of the area is a result of the pilot project and the areas are discussed with both municipality and haulers. The load rate criteria have to be fulfilled in one separate area or in a combination of two adjacent areas. The load rate criterion is complemented with a possibility for environmentally friendly vehicles to take part of the measure. Gas fuelled vehicles etc. are allowed to take part of the measure without fulfilling the load rate criteria. This gives an extra spur to the haulers that invest in better vehicles.

Map B.5-4. New area: Avenyn/Vasa

Further on, there will be an additional demand for the vehicles; the load of the vehicles has to be sent to or sent from at least two different customers. I.e. if a vehicle from one company/storage delivers to shops or other businesses in the same company the demands are not fulfilled. This criterion is implemented to increase the incentive of cooperation and consolidation of good between different companies.

The incentives will be the same as in the pilot project with some changes. During the autumn of 2005, the number of loading and unloading zones will be discussed with possibilities to implement some in the extended areas as well. The bus lanes have to be discussed with the operating company before they can be implemented again. Hopefully the incentives will be even better than in the first pilot project.

Map B.5-5. New area: Haga/Linné

This up scaled version of the measure will also be a pilot project, but for an extended period of two years instead of the six months in the earlier measure. During this time the results can hopefully be showed better than before the measure and better than in the first pilot project. Another reason to implement the measure as a pilot project instead of a full-scale implementation is that there is a wish to investigate the possibilities to implement restrictions and what type of restrictions that is possible.

6.2 “Do nothing” scenario

If nothing will be done after the TELLUS period, the situation will be just the same as before. The drivers of the vehicles that have a good load rate will be frustrated over the fact that no one ever benefits the ones who make an effort, the people walking down the streets in the inner city will feel insecure because of the many heavy distribution vehicles and the working situation for the drivers will continue to be stressful. But, the situation will not be worse than before. Some of the loading and unloading zones of the pilot project might be implemented as regular loading zones for all vehicles which will create a general better situation for all distribution vehicles in the city.

6.3 “2010” scenario

A probable scenario for 2010 is that the national Swedish legislation for traffic is changed. This will give us the possibility to implement restrictions on heavy-duty vehicles for distribution within Göteborg as well as light duty distribution vehicles. The load rate criteria might also be possible to implement in the Environmental Zone criteria.

For instance in 2010, the second pilot project have ended and turned out positive. The results now show that the routes are shortened and that there are significant time savings for the haulers involved. A city distribution terminal is implemented at the border to the inner city of Göteborg and almost all deliveries into the area with vehicles that are not fully loaded are reloaded at this terminal. This has resulted in fewer vehicles at the pedestrian streets and a lot safer and better environment within the city among with a better working environment for the drivers. The measure with incentives for vehicles with a good load rate factor is no longer needed since there are area restrictions that hinder all other vehicles to enter the area. The measure is delimited to a small part of the inner city of Göteborg, since it is not needed in the entire city. A synergy effect of the project is that there is a general better load rate of distribution vehicles.

The awareness of environmental issues in the city has increased. Since the municipality has started to make demands of their purchases among with purchase transports separately from

the merchandise, the marketing of this kind of environmental actions have been better. Several other businesses have followed the municipality good example.

With legal possibilities to implement restrictions of different types, it is also possible that the project scenario includes time frames. Perhaps it is possible to restrict distribution vehicles to enter the area during certain time frames, and vice versa with private cars. A restriction with time frames for distribution vehicles are likely to be easier accepted if private cars are restricted during the time frames that distribution vehicles are allowed inside certain delimited areas or streets.

7 Recommendations

This measure is possible to implement in other cities and the recommendation is that this is done. One of the reasons to do this is the possibility to create a good relationship between the municipality and the haulers. With good communication about the scheme: the problems and the possibilities, this gives the haulers some positive attention. A common situation is that restrictions are implemented for heavy duty vehicles, like Environmental Zones, and no restrictions are implemented for private cars. This upsets the haulers since their reason for driving distribution vehicles inside city centres are the customer demand – they are just performing their job. If the haulers that make an effort to reach high load rates, choosing environmentally better fuels etc. are being noticed and given something in return, the relationship will be better between the parties and there will be better opportunities to create other demonstration measures further on. One surprising effect of the TELLUS 9.5 project in Göteborg was that, when discussing the future potential of the measure, the haulers suggested restrictions. Their solution to a better urban environment was to close some of the streets within the city and just allow certain, high performance vehicles, to enter those streets - a radical but effective solution.

But, when implementing this kind of measure there are some important issues that need to be considered. See chapters below were the need for supplementary measures (for the TELLUS 9.5 project) and how to implement this measure are discussed.

7.1 Need for supplementary measures

Supplementary measures are needed as described in Chapter 6.1 about the potential upscaling of the measure. I.e. the measure needs to be implemented as a longer pilot project to be able to prove the benefits and also to be able to investigate the possibilities to implement restrictions to reach a better effect. In the extended pilot project it is important to involve the complete routes of the vehicles, to be able to include incentives that are situated outside specific demonstrating areas and to map the complete effect of the measure. It is also important to withdraw the exemptions for those who do not fulfil the demands.

7.2 How to implement

This measure and/or the technique used in the measure could be implemented in other cities than Göteborg. All solutions in the measure could be adapted and adjusted to the specific situation in another city. Some thing to consider when implementing a measure of this kind (those advises are constructed by experiences from the pilot project in TELLUS 9.5):

Let the project take time Make sure that there is enough time to plan the implementation of a pilot project, before the actual implementation. There are several partners that have opinions that have to be considered and there are a lot of different authorities that need to make their point. It is also important to have a demonstration measure period that is long enough. One or two years can make a good project period, since it is possible to see variations over the seasons etc.

Legal barriers When a project idea is designed it is necessary to check the legal possibilities. A voluntary agreement with no restrictions for those who do not join the project is often easier to implement than a project with restrictions, which might require changes in traffic legislations.

Communication Communication and to keep an open dialogue are essential. The project suggestion has to be presented to the managers of hauler companies, the municipality and other partners that might be involved some how during the project period. The first presentation is recommended to be presented in some kind of business magazine that reaches most haulers and other interested parties. It is then easy to refer to an article when meeting persons at the transport companies.

Workshops that involve not only managers, but also drivers and other personnel at the transport companies are appreciated. But, it is important to let the drivers speak their opinion. It is also good to have meetings with just drivers – maybe as a walk through the possible project area to see the problems and possibilities. To go with a driver in a distribution vehicle for a day or two are very instructive and gives a lot of good experience into the project.

Communication with personnel at the terminals is as important as with the drivers. The persons that are planning the routes and consignments for each vehicle need to know that it is preferable for the company to consolidate all goods to one specific area in the same vehicle and that some routes need to be redirected in order to make it more efficient.

Step by step-implementation Start by designing a preliminary project plan, and make sure that every partner realise that it is preliminary, and then evolve the plan continuously depending on comments, discussions during the start up period. Make the implementation of the demonstration measure in two steps. Start with an evaluation of the base line and perform measurements of vehicles involved, then continue with the actual implementation of the demonstration measure.

Delimitations To create delimitations makes it possible to see the benefits of implemented measures within certain areas. To have a measure area that is too big can create sub optimisations that are not wanted.

It is important to consider the measurements and see to that the results are based on the information needed.

Create an interest To engage the drivers and small businesses that receive goods from the distribution vehicles in discussions and interviews, it is possible to create and spread an interest for the project. Try to persuade reporters at the local newspaper to write an article about one of the vehicles in the measure or similar.

User friendly technique It is important that the system, for reporting load rates etc. and for the municipality, is not too complicated. With an easy to use system, it is much easier to get the information needed, when you need it and it does not create extra work load for the involved parties. Systems that could be integrated to existing systems are preferable. The system used in the TELLUS project has been very good and information about this system can be sent by Maria Ottosson, maria.ottosson@transek.se or by the Traffic and Public Authority in Göteborg.

*Information exchange*To create a good possibility for an open dialogue and information exchange, it is a good idea to introduce a web page for the project. On this web page it is possible for the project management to present updated information throughout the project period. A log in system, where the haulers in the project can see and follow the results and information about their vehicle/vehicles is probable to be appreciated.

Do not forget information to the public. Signs or stickers on the vehicles that are involved in the project together with signs in the areas where the project are carried out are recommended.

Cost effective Depending on the budget, the cost for the system are not to be too high. If haulers are to purchase their equipment needed themselves, the cost need to be kept low. Calculations that show the benefits of the measure, like saving in vehicle kilometres are good to show as an example of the investment pay back.

Follow up The information of the measure and the results are important to follow up. A written report is good, but most important is to talk to the persons involved. A final workshop that concludes the measure and that open up for a continuation or an ending depending on results and interest is good.

8 References

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www.anoto.com

www.webforum.com

www.ntm.a.se

B.6 Demonstration Measure 10.5 - Consumer driven goods management from a Mobility Centre base

1 Introduction

1.1 The Lundby district

The Lundby district is one of the largest of the 21 districts within the City of Göteborg. The population in Lundby area was 34,380 inhabitants in 2004 and the area is 16 square kilometres. There are 21,000 work places in approximately 4,500 companies, giving a high number of commuters relative to an area of this size. Most residents of Lundby work in manufacturing, trade or transport.

1.2 The northern riverbank

One of the biggest industrial and commercial development projects in the history of the city is the development of the northern riverbank of the Göta Älv, in the Lundy district. The area used to be part of the docklands of Göteborg, an engine for the financial foundation of the city. Over the past decades, however, industrial structures have changed, leaving this central area open for redevelopment.

The company Norra Älvstranden Utveckling AB has a key role as developer of the former docklands between the Älvsborg Bridge and the Göta Älv Bridge. On the northern riverbank a new IT cluster, Lindholmen Science Park, has been established, involving many of the leading IT companies in Sweden. There are also other important establishments, including two universities and five secondary schools. Norra Älvstranden Utveckling AB also creates new housing areas, and one of the prime objectives is to create a fruitful blend of workplaces, housing, services, education, commerce, research, cultural activities combined with green areas and other opportunities for recreation. Norra Älvstranden Utveckling AB coordinates measure 10.5 in the name of the Lundby Mobility Centres (see 2.1 Demonstration design and involved partners).

1.3 Goods transport to the Lundby area

New companies and housing areas together with a more frequent delivery trend for companies create larger goods flows leading to problems with air quality and safety.

By co-ordinating deliveries from suppliers to companies in Lundby, the demonstration aims to show the potential of improving the efficiency of goods transportation in the area. The demonstration measure focuses on consumer companies of office materials and makes them aware of their role in the logistic chain.

2 Description of demonstration measure

2.1 Demonstration design

The main question to design the measure was; How can a Municipality influence the private sector when it comes to transport of goods without regulations?

The measure tests communication as a tool to reach an answer to this question. In the measure companies are provided with free consultation on how to change purchase- and delivery routines/behaviour. This scheme is on a voluntary basis, helping the costumer to renegotiate delivery frequencies for office materials. It is envisaged to decrease the number of transports by having orders for office supplies stacked for deliveries less frequently.

Lundby Mobility Centre

In year 2002 the municipality opened the Lundby Mobility Centre, the first mobility centre in Göteborg. The Lundby Mobility Centre is a service centre for those companies and individuals in Lundby who require support and advice with regard to developing efficient and sustainable transportation of people and goods. The work with companies is divided into personal travels and goods management, a choice made to provide the companies in the Lundby district with a broad service opportunity. Working from a local Mobility Centre has several advantages. One of them is the geographical closeness to companies; another is the opportunity to develop a personal relationship with a selected contact person within the company.

A vital part of the work of the Lundby Mobility Centre is to encourage companies to learn about and then test available transport alternatives, in order to generate improved transport patterns for both goods and personnel.

Map B.6-1. Location of Lundby Mobility Centre

Innovative aspects

- The establishment of a market driven goods optimisation programme
- The establishment of a mobility centre
- Targeted activities directed at companies and households in the area

Involved parties

This demonstration measure was initiated through cooperation between AB Volvo and the Traffic and Public Transport Authority of the City of Göteborg. The main partner in the measure is Norra Älvstranden Utveckling AB (see chapter 1) in close cooperation with the Traffic and Public Transport Authority of the City of Göteborg in the Lundby Mobility Centre.

The participating suppliers of office material were; Corporate Express, Lyreco, Svanströms, TG Skrivab and Wettergrens

2.2 Transport Plan context

In 1996 the city of Göteborg established the Environmental Zone for transport in the city centre. Its purpose is to decrease emissions from heavy vehicles. Studies show that most of the distribution vehicles have a low load factor and that there is a potential for a higher amount of collaboration. With more cooperation within the Environmental Zone, the city can achieve a decrease in the number of delivery vehicles. One way is to demand a specific load factor for distribution vehicles for deliveries in the Zone. The first step would be to try with incentives so that the market itself strives towards a better load factor on the vehicles. An example of incentive would be to give distribution vehicles admission to public transport lines and better loading zones. This will give the City knowledge and experience about this subject and also increase the knowledge how to communicate and collaborate with companies and inhabitants. This will also increase the cooperation between public and private interests, and is realised in measure 9.5 within TELLUS Göteborg.

The city also investigates the opportunity to introduce road pricing and congestion charges.

The measure 10.5 contributes to the transport plan in a sustainable direction by aiming at reducing the number of transport vehicles in a specific area. This is done by making the corporate consumers aware of their part in the logistic chain and by making them change their purchase- and delivery routines.

2.3 Objectives

The aim of the demonstration measure was to establish contacts between wholesalers of office material and companies on the northern bank of the river, and through a voluntary agreement between both entities decrease the number of transports of office material by 30%.

This measure should, with the contribution of TELLUS, change a trend towards more frequent deliveries and make the consumers and suppliers more aware of the benefit of more organised distributions and contribute to building “the good city”.

Measure objectives

There are several levels of objectives in the TELLUS project addressing short-term and long-term outcomes as well as intermediate steps. The measure objectives are therefore divided into three subgroups; immediate, intermediate and ultimate objectives.

Immediate objectives

- Influence the buyer companies to change behaviour, to plan their purchases more efficiently
- Help the buyer to create better purchasing routines that will lead to less transportation
- Create an Internet portal to help the buyers in their purchase routines

Intermediate objectives

- Establish a showcase showing the new possibilities. The example may be implemented in other critical areas of the city
- Investigate incentives and means of control for long-term freight co-operation systems in urban areas

Ultimate objectives

- Reduce air pollution and noise to levels below national and EC directives
- Reduce NO_x emissions from heavy traffic
- Improve public-private co-operation
- Achieve extensive political and public awareness for TELLUS

Contribution to TELLUS objectives

- Reduce air pollution and to levels below national and EC directives
- Achieve extensive political and public awareness for TELLUS.

2.4 Ex-ante evaluation and situation before TELLUS

A study at the beginning of the project indicated office material as one of the largest product groups for offices in the Lundby area.[17] The measure thus selected office material as the product group to work with. The study indicated that the companies in question received in

[17] Sörheim, E. (2003)

average 1.3 deliveries of office material per week. Some of the conclusions from this study were that the transport of office material is quite difficult to handle, that the time frame for delivery is narrow and that the amount of stops together with the time it takes to unload are more important limiting factors than the actual load factor. Most orders of office material were processed over night, with automatic delivery 1-2 days after purchase.[18] The wholesalers often include costs for transports in the price for the goods, thus making transportations costs less transparent for the costumer. With a hidden price for transport, there are no apparent incentives to have goods delivered less frequently.

There were several different transport companies active in the area, working from terminals some 10 kilometres from the Norra Älvstranden area.

Since year 2002 a yearly evaluation questionnaire has been sent out to both households and companies in the Lundby area. The aim for this questionnaire was to investigate annual improvements in sustainable transportation behaviour. In this way it gives the opportunity to see changes over time in interest and behaviour.

At the beginning of the TELLUS project a small information brochure was produced, giving an outline of the demonstration measure.

3 Implementation Process

The measure has been carried out in number of steps. The milestones are listed in Figure B.6-1. All milestones except number 5 (delayed) were adhered to. The delay of milestone 5 does not affect the measure outcome in any way.

The achievement of the milestones is described in this chapter.

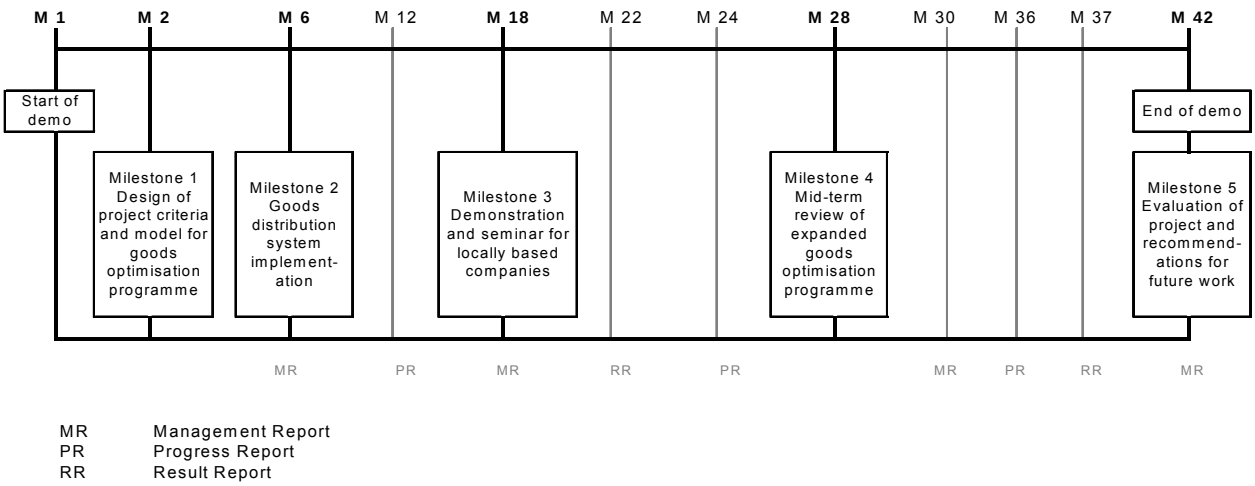


Figure B.6-1. Original time plan

[18] Ibid.

Design of project criteria and model for goods optimisation programme, milestone 1

One baseline report was written for the measure. The report investigated the transport situation on Norra Älvstranden, how the companies order office material, and the type and mode of delivery of distribution vehicles.[19] At the beginning of the demonstration measure a consultant was in charge of the measure.

Four of the largest wholesalers of office material were contacted in order to verify their interest to work more with goods management and cooperate with their own costumers in the demonstration measure. Over the implementation the number of wholesalers had increased to five participants. In year 2002 the municipality opened the Lundby Mobility Centre and this measure was included in the group of measures based at the Centre. In this way the measure experienced synergies with other projects with a similar target group.

Goods distribution system implementation, milestone 2

Having secured the interest of the wholesale companies, purchasing companies in Lundby were contacted. The new goods distribution system was launched, but initially there were some problems.

The Internet portal intended to help the purchasing companies in the Lundby area became more of a marketing base than a help in the purchase routine. The reason for this was the lack of interest from the purchasing companies and the wholesalers' unwillingness to cooperate with their competitors.

Since 2002 a yearly evaluation questionnaire from the Lundby Mobility Centre has been sent out to both households and companies in Lundby area. The aim of the questionnaire was to investigate annual improvements in sustainable transportation behaviour.

At an early stage the personnel from the Lundby Mobility Centre realised that it was very important to use different communications tools to be able to reach out to the companies in Lundby area. The choice of tool depends on who the receiver of the information in the company is; the company management, director of environmental affairs or the receptionist.

The following communication activities/tools have been used and some of them are still in use:

- Information through website
- Mass distribution of information brochure by ordinary mail
- Phone calls
- Personal meetings
- Personal letters

[19] Sörheim, E (2003)

- Information through different networks
- Seminars and workshops
- Media; newspaper
- Marketing Lundby Mobility Centre by showing good examples

Website

Lundby Mobility Centre has its own website www.visionlundby.goteborg.se that provides detailed information about the measure and also information about the TELLUS project. The measure has also been on display on the Norra Älvstranden Utveckling AB website; www.alvstranden.com (see also the Internet portal). This two websites still provides information.

Mass distribution

At an early stage The Lundby Mobility Centre sent an information brochure to introduce Lundby Mobility Centre and its measures to all companies with more than 10 employees in the Lundby area. This brochure did not get any response at all. Mass distribution was also used for invitation to the seminar at the 16th of September 2003. This tool is still in use (see Good examples).

Phone calls and Personal meetings

These two communication tools are the most used. Phone calls have been used for day to day activities and to book personal meetings. It is in the personal meeting with the company management the agreement of joining the demonstration has been made.

Personal letters

Letters addressed to MD at the company have worked out very well. The letter outlines the aims of the measure, and informs that he/she will be contacted for booking a personal meeting. The personal letter gives a good platform for continuing activity, such in this example, personal phone calls and meetings.

Networks

The Lundby Mobility Centre has used an existing network, the local business association on Norra Älvstranden, to try to reach out to the 60 member companies in the Lundby area. Lundby Mobility Centre has arranged two workshops together with this association. The membership has also been a good base to spread information. The Lundby Mobility Centre is still a member in this network. Website: http://www.alvstrandenforetag.com/

Lundby Mobility Centre has also worked through the network of Lindholmen Science Park that reaches out to over 100 companies. Website: www.lindholmen.se

Seminars and workshops

The measure has arranged mobility seminars for locally based companies, see milestone 3, and also 3 workshops together with Lundby Mobility Centre.

Media

The media response has been good. The demonstration measure has been covered in articles in local newspaper, logistical magazine, business to business magazines, etc, during all the different periods in the TELLUS project

Good examples/ Champions

Since 2004, the Lundby Mobility Centre distributes twice a year a newsletter to companies in Lundby area. This newsletter shows local companies as good mobility example. The newsletter is distributed to 2,500 companies in the Lundby area.

The Internet Portal

The Internet portal that was planned did not get as much interest from the companies in the area as expected so it developed into a web marketing solution instead. The idea of this portal was that everyone in the measure should use it when ordering office material and eventually other products. If all companies used the same Internet portal it would be easier to cooperate with the delivery services. But the wholesalers of office material were not interested in sharing information with their competitors. Another problem was that everybody had different skeleton agreement with different forwarding agents.

Demonstration and seminar for locally based companies, milestone 3

The measure arranged a big seminar at the 16th of September 2003 that gathered almost 60 persons. The aim of the seminar was to illustrate the measure from different perspectives of stakeholders such as Traffic and Public Transport Authority, AB Volvo, an office supplier and a forwarding agency. The outcome of this seminar was that two new companies joined the measure.

Studies

During 2003 a student named Magnus Larsson, from Chalmers University of Technology, conducted a master thesis with the title “Incentives and means of control for long-term freight cooperation system in urban areas”. The main purpose of this study was to identify and analyse incentives and means of control for sustainable freight cooperation in the long term at Norra Älvstranden. The conclusion was that Norra Älvstranden needs a reloading terminal at the entrance to the district. It is not possible to separate and optimise one product group from another to get the desired results; the problem has to be handled in its entirety.

In 2004 two students from Chalmers University of Technology made their thesis, “Analysis of the person- and goods flow to and from Campus Lindholmen”. The authors have among

other things made a survey of goods distribution entering and exiting the cluster with the Universities together with five Upper Secondary Schools who are located in the same area.

The survey showed that almost 65 freight transports were taken place in this quite narrow area every day. The authors say that the goods flow could be improved through coordination.

4 Results

4.1 Evaluation methods

The evaluation is based on interviews with key persons in the involved companies, and an annual questionnaire that was sent out to 600 companies in the Lundby area. Before this evaluation a web-based questionnaire was sent out to most of the contacts that the Lundby Mobility Centre have been in contact with during the last four years. An external consultant has also conducted in-depth interviews with key shareholders.

4.2 Impact indicators

Table B.6-1. Evaluation impact indicators and their achievement for TELLUS measure 10.5

Evaluation Area	Evaluation Category	Impact	Indicator	Achievement
Environment	Pollution/Nuisance	Emissions	NOx emissions	5,2 kg
Society	Acceptance	User acceptance/ satisfaction	buyer and supplier	5 wholesalers and 17 buyer companies in Lundby area
	Awareness	Publicity	Media Response	1 seminar, 3 workshops, 7 articles, 2 thesis

Table B.6-1ctd. Evaluation impact indicators and their achievement for TELLUS measure 10.5

Evaluation Area	Evaluation Category	Impact	Indicator	Achievement
Transport	Transport system	Freight Movements	Lorry traffic in specific area	Transports reduced by almost 500 trips per year.

Environmental achievement

The environmental indicator for this demonstration measure is the NO_x emissions. There were 17 companies in Lundby that joined the measure and the majority of them showed a decrease of transport frequency of office material by 30 to 80 percent with a mean of 41% (see table B.6-3). This means that out of 101.5 transports per month to the target companies, 42 have disappeared as a result of the measure.

In reality the distribution trips may not have disappeared at this stage, but the need for stopping as often as before at the selected companies has decreased. Since the limiting factor to distribution is the number of stops for the distribution vehicle, it can be argued that this behaviour opens up to a more rational distribution. With more companies entering into a similar scheme, the potential is large.

To show the potential in environmental savings for the measure emissions from a normal delivery vehicle have been used to extrapolate the decrease of emissions from the 17 companies currently involved in the measure. For clarity we have included an estimation of results if three times as many companies would join.

The calculation that has been using the decreased frequency is listed in table B.6-3, and template figures on emissions[20].

Table B.6-2. Estimated decreases in emissions.

	Emissions. Per delivery (10kms, Euro 3 engine, Mk1 diesel)	Emissions saved on a yearly basis (kg) from the participating (n=17) See table B.6-3.	Emissions saved on a yearly basis (kg) with extrapolated larger group of participating companies (n=50)
Carbon dioxide (CO_2) (kg)	0.57	260	800
Nitrogen oxides (NOx) (g)	3.8	1.8	5.2
Particulate Matter (PM) (g)	0.,066	0.03	0.090
Hydrocarbons (HC) (g)	0.96	0.45	1.3
Sulphur Oxides (SO_2) (g)	0.15	0.07	0.2

Table B.6-2 is based on a distribution vehicle, 8.5 metric tons, Euro 3 engine, mk1 diesel. No after-treatment. Figures from Scania (certification data). Figures in italic strongly reduced if distribution vehicle equipped with Catalytic Particulate Filter (CPF).

The amount of distribution vehicles has decreased with 60 percent from today.

[20] www.ntm.a.se

Society achievement

To indicate how the users of the measure, the buyer and wholesaler of office material, really think and feel about this measure there have been in-dept interviews with them with the help of an external consultant. A web-based questionnaire has also been sent out to all the persons that Lundby Mobility Centre have contacted.

The in-depth interviews show that there is a clear positive reception of the initiative from the municipality through Lundby Mobility Centre. The companies appreciate the initiative, and are favourable to continued contact. On average, they rate the interaction with the municipality as good or very good, i.e. high grades.

In a web survey carried out to measure the acceptance of companies to the work of the Lundby Mobility Centre, more than half of the companies asked stated that the LMC had helped them to start a measure for the environment, or helped them in their environmental work. 75% of the companies asked stated also that they have a more positive view on the environmental competence in the City of Göteborg due to the work of the Lundby Mobility Centre.

The media response has been good. The demonstration measure has been illustrated in articles in local newspaper, logistical magazine, business-to-business magazines, etc, during all the different periods in the TELLUS project.

Road safety achievement

A decrease in number of distribution vehicles indicates a safer road environment. This has not been measured in the demonstration, but has been the reason for some companies to join the demonstration.

Transport achievement

How can a municipality influence the buyer companies to become aware of their part in the logistic chain? If the municipality can help companies to take command over their transport situation and work towards coordinated ordering- and purchase routines, a decrease of transport frequency will occur. This can be seen in table B.6-3 where the 17 companies in Lundby show the changed frequency of deliveries of office material.

Table B.6-3. How the companies have changed their transport frequency of office material

Company	Before the measure Frequency per month	At the end of measure Frequency per month	Change in percent (approx.)
Company 1	4	1.5	-60 %
Company 2	3	2	-30 %
Company 3	7	Max 4	- 40 %
Company 4	2	0.5	- 75 %
Company 5	5	2	- 60 %
Company 6	4	2	- 50 %
Company 7	20	4	- 80 %
Company 8	1	1	+/- 0
Company 9	4	2	- 50 %
Company 10	4	2	- 50 %
Company 11	4	2	-50%
Company 12	2	1	- 50 %
Company 13	20	20	+/- 0
Company 14	6	4	-30%
Company 15	4	2	-50%
Company 16	10	9	-10%
Company 17	1.5	1	-33%
Sum	101.5	59.5	41%
Number of trips eliminated through project:		42	Average number of trips eliminated per company and year =27
Estimation on a yearly basis (11 months)		462	

4.3 Objective fulfilment

Table B.6-4. Objectives and fulfilment of TELLUS WP 10.5

Objective level	Objective	Fulfilment
Immediate objectives	Influence the buyer to change behaviour, to plan their purchases more efficiently by for examples personal visits, seminars and workshops.	achieved 17 buyer companies joined the measure. Many other companies chose to wait or felt that they had no transport to talk about.
	Help the buyer to create better purchasing routines that will lead to less transportation	achieved During personal meetings and e-mail showing what other companies with good routines have done.
	Create an Internet portal that will help the buyers in their purchase routines	achieved The Internet portal became more of a marketing portal than help in the purchase routine. The reason for this was the lack of interest and the wholesalers unwillingness to cooperate with their competitors.
Intermediate objectives	Test bed for showing the new possibilities. The example may be implemented in other critical areas of the city	achieved Using companies in the measure as good examples via the website www.visionlundby.goteborg.se and Lundby Mobility Centre's newsletter for companies (twice a year). Continually having meetings with key persons in the municipality.
	Investigation of incentives and means of control for long-term freight co-operation systems in urban areas	achieved A thesis work by Mr Magnus Larsson, Chalmers University of Technology (see chapter 4.4 Documents).

Table B.6-4 ctd. Objectives and fulfilment of TELLUS WP 10.5

Objective level	Objective	Fulfilment
Ultimate objectives	Reduce air pollution and noise to levels below national and EC directives	The number of delivery trips in the area has decreased with 462 deliveries, or 41%.
	Reduce NOx emissions from heavy traffic	Already with only 17 companies taking part in the measure, there is a small decrease in NOx emissions, some 5kg.
	Improve public-private co-operation	achieved Lots of marketing activities and personal visits to companies management.
	Achieve extensive political and public awareness for TELLUS	achieved With media exposure and close contact with actors in the project.
	Improved Intra-organisational co-operation at the city level	achieved
TELLUS objectives	Reduce air pollution and noise to levels below national and EC directives	The number of delivery trips in the area has decreased with 462 deliveries, or 41%.
	Achieve extensive political and public awareness for TELLUS	achieved
	Reduce NOx emissions from heavy traffic	Already with only 17 companies taking part in the measure, there is a small decrease in NOx emissions, some 5kg.
	Improve public-private co-operation	achieved
	Improved intra-organisational co-operation at the city level	achieved

4.4 Additional Impacts

Documents

There have been some reports written in this measure:

Sörheim, E., (2002) Samlastningsprojekt på Norra Älvstranden – Nulägesbeskrivning. TFK Rapport 2002:17, Göteborg

This report contains a base line study for this measure. It gives a description and a survey of the transportation situation in the area and also describes how the transportation chain works in Norra Älvstranden. The report is written In Swedish.

Larsson, M., (2003) *Incentives and means of control for long-term freight cooperation systems in urban areas.* Thesis work, Chalmers University of Technology, School of Architecture Dep. of City and Mobility, Göteborg

This study identifies and analyses which incentives and means of control that needs to be used in order to get sustainable freight cooperation in the long-term at Norra Älvstranden and gives recommendations to the city of Göteborg on how to go ahead with this measure. The thesis is written in English.

Arévalo, S and Göransson, D, (2005) *Utredning av person- och godsflöde till och från Campus Lindholmen,* Chalmers University of Technology, Dep. Of Civil Engineering, Göteborg

The study gives a picture of the person- and goods flow at the Campus Lindholmen, containing Chalmers Lindholmen, IT-university, Lernia - adult education, and five different senior high schools. The thesis is written in Swedish.

4.5 Exchange of experiences

During the TELLUS period, exchange of experiences has been made with a lot of different organisations and actors. There has been a network with measure 5.7; the Environmental Zone for heavy-duty vehicles, and measure 9.5; Incentives for improving the load factor in inner-city freight transport. Attending in seminars and workshops, and personal visits to other Mobility Centres in Sweden and attending to different conferences in both Sweden and Europe have increased the knowledge in the measure. Also to follow other projects in the CIVITAS initiative like TRENDSETTER- and VIVALDI has been important.

5 Conclusions

One important conclusion is that the measure has been successful in establishing a way to decrease transport by strengthening communication between suppliers and customers. They majority of the 17 companies have decreased their frequency of deliveries between 30 and 80 percent. The objective of this demonstration measure was to decrease the number of

transports of office material by 30%.

It is possible to talk about the complexity of goods transport to the company management, but the priority in this area is very low. That is why it is important to present all the benefits and give the companies the reason why they should work more actively with this issue. It is important to use the right communication tools for opening up a dialogue with companies.

Because few companies have joined the measure it is hard to demonstrate any measurable effect on emissions in the City, but the measure is very successful in establishing a working model with concrete and quite impressive results. By enlarging the model, and having more companies join, emissions would decrease.

To make this measure more attractive and faster implemented for the companies, stronger incentives are needed. The Lundby Mobility Centre has tried to make the wholesalers/suppliers to give some discount on the price when companies are asking for less frequent deliveries, something that was not successful at this stage.

A master thesis[21] discussed how to make a long-term freight cooperation system in an urban area to work and the conclusion was to arrange a reloading terminal at the entrance to the district. This terminal is estimated to rapidly decrease the number of distribution vehicles to the area. But is this a way the municipality wants to go? European examples from City logistic Centres shows problems with profitability and that the municipality more or less has to pay the extra cost. It can be argued that the current measure is more cost efficient.

The transferability of this measure is good. The measure has a simple design with small initial costs. Small changes in the purchase- and distributions routines of the companies have a direct effect on the transport frequency. It is also a measure that improves the public and private cooperation. The measure is based on voluntary agreement and has no restriction to consider so it is quite easy to implement.

5.1 Barriers

To change behaviour takes time and four years is a short period of time. While it was a quick process in getting each of the companies to implement changed behaviour, it took a long time to find interested companies for the measure. The project manager thought that the process to convince the company managements would go faster and smoother than what it did. The logistic question does not have high priority at the buyer companies. For that reason is it important to raise attention and information before you can change their behaviour.

The wholesalers of office material have not marketed the measure to the extent that was expected from the beginning. Some of the wholesalers say that the competition is hard and as all the other wholesalers of office material are involved in the measure there is little

[21] Larsson, M., (2003)

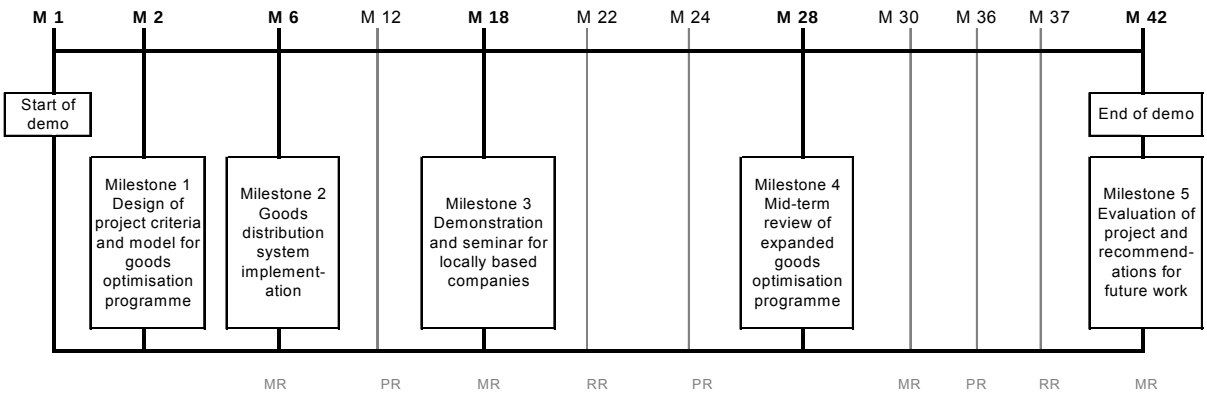
uniqueness. The project manager has continuously tried to communicate the importance to work towards better delivery behaviour.

5.2 Drivers

The project manager is convinced that there should be an economical benefit for the buyer companies when they change their purchase routines towards less frequent delivery behaviour. The wholesaler who is the part that gains most in an economic point of view of the new behaviour should compensate the buyer companies and give some discount on what they order. This is something to bear in mind if there is a second step of this scheme.

5.3 Achievement of milestones

There was a time plan for evaluation events during the project period. Five milestones should be followed, see figure 1. These constitute the evaluation.



MR Management Report
PR Progress Report
RR Result Report

Figure B.6-2. Original time plan

Every milestone has been fulfilled and in time.

5.4 Synergies

To work from a mobility centre base has given the measure some synergies. The Lundby Mobility Centre markets different measures that target the same target group, and can now offer them the whole range of activities for the companies in the Lundby area when it comes to mobility solutions.

A good strategy was also to identify companies with environmental certification and help them in their process to work with their transport situation.

6 Scenario

6.1 “Do nothing” scenario

If nothing will be done after the demonstration period, the purchasing companies will probably stay with their new routines. They would, however, not go deeper into finding other innovative transport measures. No party (wholesalers or buyer companies) is going to work actively towards a less frequent delivery behaviour. But, overall the situation will probably remain the same after the measure.

6.2 “2010” scenario

A possible scenario for 2010 is that the different measures in the TELLUS-project in Göteborg are now more integrated and are a part in the transport policy for Göteborg. The Environmental Zone now covers light transport vehicles, almost all of Göteborg is covered and the Zone will most probably include restrictions on the load factor.

The communication towards the buyer companies has resulted in that they work more actively with their transport situation. The companies have formed clusters in their neighbourhood, exchanging experiences. The municipality is supporting these clusters with ideas and knowledge, etc. This has lead to one delivery free day per week. The other days a chosen haulier delivers all goods to the neighbourhood with a high load factor. The load factor has really improved and the haulers that do not have an acceptable rate have to unload their cargo to the new city distribution terminal that is located at the border of the city. From these terminals, clean vehicles deliver once per day.

7 Recommendations

This measure is possible and easy to implement in other cities since it is based on voluntary agreements. There is no regulation to consider and the initial cost is low. But the recommendation for implementation is to have a stronger incentive than this measure had, for example a discount on the price when ordering more seldom than before. It is easier for the company management to accept the change in their routines when it gives direct economical benefits.

7.1 Good lessons learned

Working from a Mobility Centre provides a lot of synergy effects. One of them is the opportunity to use the same contacts at the companies for different measures. The information spreads faster than without this collaboration. Together with this measure the Centre could offer the companies in the Lundby area solutions for both personal travels and goods transports.

The companies that join the measure show very good results in decreasing transport frequency. This was achieved by fairly small changes in purchase- and delivery routines.

The companies are positive about the municipality contacting them, something they are not used to.

It is preferable to work with companies that have some kind of environmental certification. Goods deliveries are often not included in the environmental work and the municipality can be a catalyst and provide the management with good advice and support to deal with their transport situation.

Use other companies in the area as good examples in external communication. Company management listens more to practical examples than theoretical.

The Lundby Mobility Centre found a business association in the area and used its network to reach its members. The Centre arranged two different workshops for this association to increase the knowledge and interest about transport questions.

7.2 Bad lesson learned

Freight transport has a low priority for the company management and they have no direct know-how about the transport situation in the company. Frequently it is felt that it is a question for the suppliers and wholesaler.

The wholesalers were not active in the marketing activity of this measure at all. Since the cost of transport is often included in the price of the goods, customers fail to see the benefit of efficient transports. The measure failed to make transport cost visible on the invoice.

The incentives to the purchasing companies in this measure were not enough to attract the majority of the companies. Just pointing on costs is not enough. Why not give some discount or let the wholesaler and the buyer company split the profit that occurs when the frequency of delivery is decreasing?

7.3 How to implement

This measure could be implemented in other cities than Göteborg. All solutions and activities are possible to adapt with small changes.

Plan the project carefully Do a careful base line study that covers what kind of goods, the type of companies, amount of distribution vehicles, etc. Let this level take time, it is very important to know what you are going to change and deal with. Knowledge is the key to success. Then plan the implementation carefully. Find several partners, wholesalers/suppliers that find the measure interesting and that see the possibilities of collaboration and are willing to give some incentives to the companies, for examples some discount on the price.

Communication This is a communication measure that works with behaviour changing aspects, it is very important to keep an open dialogue with the different stakeholder in the

measure. Look for other partners that can give synergies for example similar measures that target the same target group. Maybe there is already an existing network that can be used in marketing of the measure? Use different communication tools. There is no universal tool for communication; use a combination of them, personal letters, phone calls, personal visits, seminars, workshops, etc.

Create interest Have a clear message when addressing the company management, look for existing network, arrange workshops and seminars to create interest. The most effective way is to arrange personal meetings with the companies. It is easier to create interest here. A good example how to create a personal contact with the companies is first to write a personal letter to the MD that informs about the measure and contact the person a few day later to arrange a meeting. Use solutions from other companies as good examples in marketing. Companies are more interested in practical examples then theoretical examples.

Information exchangeGive feedback to the companies that have been contacted, give examples of solutions that will help the companies, ask if they want assistance. Exchange continuously information to all the stakeholders in the measure.

Don't forget to measure the demonstration measure continuously, for example use an annual questionnaire to see if you reach out to the target group with your message. This will be used in the evaluation process later on.

Let an external consultant do the whole or part of the evaluation because there is easy to become "blind" for crucial information that are obvious for them how work with the project that can be lost in the evaluation.

Follow up The result and information from the measure is important to follow up to the stakeholders. Use a workshop to conclude the measure and let it also include thoughts about the future.

8 References

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www.ntm.a.se

B.7 Demonstration Measure 12.7 – Introduction of clean vehicles in public and private fleet

1 Introduction

Since the beginning of the 1990's a small number of environmentally adapted car models ("clean vehicles") have been available on the Swedish market. At that time, the city of Göteborg decided to encourage the use of clean vehicles in order to help the market grow bigger. At first, there was great focus on electric powered vehicles. But the available models were fewer and other clean technologies took over. Now however, there are a number of different models available with less emission of hazardous compounds and global warming potential.

In later years, similar initiatives have been introduced in other Swedish cities, and by the Swedish government. In Sweden, there are commercially available vehicles running on ethanol (E85), natural gas, biogas, electricity, FAME (Fatty Acid Methyl Esters) such as RME (Rapeseed oil Methyl Ester) and electric hybrids.

Local definition of Clean Vehicles

The city of Göteborg has its own definition of clean vehicles. The definition has gradually been made more stringent as new types of vehicles and emission standards were introduced into the market. The current Göteborg definition of clean vehicles is as follows:

Light vehicles

- Vehicles that can run on alternative fuels, except LPG, for more than 50 %;
- Electricity / fuel cell technology;
- Hybrid technology, min. 25 % energy from electric engine;
- Diesel cars max. 90 g CO_2/km;
- Petrol cars max. 120 g CO_2/km.

Passenger cars may emit 190 g fossil CO_2/km when running on alternative fuel. All engines must meet Euro IV emission levels.

Buses and heavy duty vehicles

- Euro IV-level;
- Alternative fuels, except LPG;
- Electricity / fuel cell technology;
- Hybrid technology, min. 25% energy from electric engine.

Parking incentives

In order to encourage customers to buy clean vehicles, Göteborg has introduced a certain parking certificate for clean vehicles. The certificate is valid for three years and offers free parking between 2 and 24 hours in city streets.

Political target in Göteborg

In Göteborg, the political target is that the number of clean vehicles in the municipality fleet shall amount to 90 % in 2008. Another goal is that 5 % of total new light vehicles sale shall be clean vehicles.

Situation before demonstration measure

The demonstration measure TELLUS WP 12.7 started in TELLUS M25, February 2004. Before the TELLUS demonstration measure, in the beginning of 2004, there were approximately 2,900 clean vehicles running in Göteborg. Their share of new car sale in Göteborg was 2-3%. Within the municipal fleet of cars and light commercial vehicles there were 800 clean vehicles. They represented 50% of the fleet.

2 Description of demonstration measure

2.1 Measure design

Measure description

The idea was to emphasize clean vehicles and alternative fuels, which are commercially available in Göteborg today. These were not actively marketed by local vendors before the project was initiated, or were hampered by other market obstacles such as the car buyers' lack of knowledge on filling stations or economy.

Design of the measure

In order to reach the local political goals, Göteborg has launched a number of different activities. The purpose of the measure is to stimulate the local market for clean vehicles. The program includes among others the following activities:

- Information to private, public and company car users;
- Activities together with car dealers and fuel suppliers;
- Information to the Swedish government and national authorities.

It should include the following activities

- mail shots, telephone marketing, newsletters;
- seminars, personal visits;

- press activities;
- a new national clean vehicle website in collaboration with Stockholm and Malmö;
- especially targeted activities towards heavy vehicles;
- exploitation of the already existing incentives (for example free parking).

Involved parties

The measure is coordinated by the city of Göteborg, Traffic & Public Transport Authority (Trafikkontoret Göteborgs Stad), and supported by the Environment Administration (Miljöförvaltningen), Gatubolaget (a publicly owned car supplier company) and Göteborg Energi (a publicly owned energy supplier company). Decisions on direction and financing are made by the Traffic & Public Transport Committee (Trafiknämnden) and Göteborg City Council.

Innovative aspects

The measure should show the efficiency with targeted communication towards special target groups, well-directed incentives and demands on procurement.

2.2 Transport Plan context

The main task for the Traffic and Public Transport Authority is to provide the means for efficient, safe and sustainable mobility in Göteborg. One of the most important goals in the Sustainable Transport Strategy is to create a higher level of mobility for the people living in the city that is good for the individual as well as for the society and the environment. Focus should be shifted towards more sustainable means of transportation and new technologies in vehicles should be supported.

A natural consequence of this strategy is to introduce more clean vehicles. The demonstration measure is aimed at increasing the use of clean vehicles. If clean vehicles are to reach a higher market share, the consumers must be made aware of their existence and find them economically attractive.

Cooperation with car dealers and fuel suppliers is essential if the local market is to increase. An important part of the strategy has also been to inform and influence vehicle procurement at large car fleet owners.

2.3 Objectives

Immediate objectives

- Affect suppliers' methods of purchasing clean vehicles;
- Influence legislation for clean vehicles sales.

Intermediate objectives

- Test bed for showing the new possibilities. Better awareness for both retailer and end user;
- Influence the market for clean vehicles in a positive way;
- 1,500 new private clean vehicles and 250 clean vehicles in the municipal fleet at the end of 2005.

Ultimate objectives

- Reduce air pollution and noise to levels below national and EC directives;
- Improve public-private cooperation;
- Achieve extensive political and public awareness.

2.4 Ex-ante evaluation and situation before TELLUS

Clean vehicle models have been sold since the beginning of the 1990's in Sweden. But in the first years of the 21st century, only a few clean vehicles models were available. The battery electric technology halted and the car manufacturer one after another stopped offering such vehicles in the Swedish market. From 2000-2002, almost no manufacturers offered any new gas-petrol CNG cars. The introduction of an announced new ethanol-petrol car was delayed, but started slowly in 2002. As a consequence, neither the car dealers nor the consumers paid much attention to clean vehicles. In short: there were few models and not many filling stations.

The demonstration measure started in February 2004 (TELLUS month M25). The number of clean vehicles in Göteborg was by then approximately 3,300. Out of these, 800 were owned or rented by the municipality.

A survey has shown that the consumers and end users have an interest in clean vehicles. The main outcome of the study was that those groups that had been informed of clean vehicles had a better knowledge and a more positive attitude towards environmentally friendly vehicles compared to those that had not been informed. The study also showed that the information provided by the Clean Vehicle project in Göteborg was both effective and able to influence individuals' attitudes to become more positive towards clean vehicles.

The already existing website www.miljofordon.org which gives information about the latest progress in the clean vehicle field had before the measure started approximately 120 visitors per day.

3 Implementation Process

Actual implementation

The information campaigns consisted of direct targeting of companies, local city administration and businesses as well as other organisations, to some extent also the public. They have been offered a summary of the vehicles available, cost calculations, information about petrol stations, etc. Printed material and press releases have been produced and seminars have been held for selected target groups. They have also been offered free visit from a consultant. This part of the measure has mainly been managed by Göteborg Traffic & Public Transport Authority.

The information was focused towards the following groups:

- Companies with active environmental programmes, e.g. certified;
- Companies with many light vehicles;
- Car sales staff, dealers and leasing companies;
- Fuel suppliers;
- Environmental consultants;
- Taxi and courier companies;
- Municipal suppliers;
- Media;
- Local authorities, car users and car buyers in the municipality.

External consultants have been engaged to run the information part of the measure. The consultants are experts on environmental management, vehicle emissions, public relations, market communication and vehicle economy. All these consultants were used to inform targeted groups by way of personal meetings, seminars and telephone marketing.

The consultant project group reports monthly to the project leaders at Göteborg Traffic & Public Transport Authority. Together, they have designed the events.

In order to reach broader target groups, the measure has expanded the Internet information service (www.miljofordon.se) in collaboration with the cities Stockholm, Göteborg and Malmö.

Two important target groups are the car dealers and fuel suppliers. The ultimate purpose of the measure is to establish a self-running market for clean vehicles. Therefore, there is ongoing exchange of information and support to the car dealers. The primary purpose has been to stimulate the dealers to become more active and promote cleaner vehicle alternatives by themselves in their own market activities.

The car market is mainly national. Fuel and vehicle costs, taxes and direct marketing are the

same all over the country. In order to increase the use of clean vehicles, Göteborg has proposed a number of national incentives for clean vehicles.

Activities from Demo start (M25) up to present (M44)

- A certain campaign has been addressed towards companies in Göteborg with many passenger cars. Personal advisory services have been offered economic and technical information about clean vehicles and fuel infrastructure. Approximately 30 companies have been contacted.
- One big local event, a Clean Vehicle Fair, was arranged in April 2004 (TELLUS M27) and April 2005 (TELLUS M39) together with car dealers and fuel suppliers. Local companies were invited to seminars, clean vehicles and fuels exhibition.
- An internal seminar was arranged in June 2004 (TELLUS M29) to inform local car dealers and fuel suppliers about the clean vehicle market and environmental demands in business management.
- A local outdoor exhibition for the public was held during European Mobility week (TELLUS M32). It was held in the centre of Göteborg with information about bicycling, walking, public transport, car sharing, clean vehicles etc. Thousands of Saturday shopping citizens visited the event. The event was co-financed by the Clean Vehicle project in Göteborg.
- Two seminars were held in October 2004 (TELLUS M33) as a part of the Ecology 04, the biggest environmental conference and fair in Sweden. The seminars focused on the market for light clean vehicles and mobility management, and heavy clean vehicles and exhaust emission technology, respectively.
- An internal seminar towards Göteborg municipal decision makers, purchasing leaders and environmental executives was held in March 2005 (TELLUS M38). The seminar focused on the local municipal targets for clean vehicles, mobility management and how to reach the internal goals.
- A seminar towards companies with many passenger cars, car dealers and fuel suppliers was held in March 2005 (TELLUS M38). The seminar focused on economy, coming new models, new scientific support on global warming and hybrid / fuel cell technology.
- Lobbying activities and contact with national authorities and the Swedish government during 2004 have focused on the following issues: Make a national definition standard of clean vehicles; make it legally easier for cities to offer free parking for clean vehicles; introduce incentives for biogas in a proposed national biofuel certificate system; give better information about clean vehicles at national authorities' websites. Representatives from Göteborg participated in a national reference committee and two na-

tional meetings in May 2005 (TELLUS M40) to formulate a common definition of clean vehicles in Sweden.

- A seminar towards environmental consultants regarding clean vehicles, mobility management and business cooperation was held in May 2005 (TELLUS M40).
- The website www.miljofordon.se has during 2004 been co-financed by the three largest cities in Sweden – Stockholm, Göteborg and Malmö. In Feb-May 2004 (TELLUS M25-M28), the website was rebuilt to create better functions and a fresher layout. The updates included detailed maps of all filling stations with alternative fuel in Sweden, news calendar, interactive calculations for vehicles and information about electric two-wheelers.
- Data about models and prices on the website have been continuously updated during the period. Fuel prices are updated weekly.
- Information to car buyers, local car dealers and companies by telephone, email and personal visits.

Deviations from the plan

In previous reports the number of clean vehicles in the municipality was overestimated. The number was then estimated between 850 and 870. But a more thorough calculation that was recently made, showed that the correct number in January 2004 was approximately 800.

No other deviations from the original plan have occurred during the demonstration period.

Barriers and driving forces of the measure implementation

The demonstration is to a large extent about changing the behaviour of consumers when it comes to buying cars. Ordinarily what would affect the decision of a costumer the most are engine output, equipment and price. This is obvious to the car industry and therefore marketing and sales are emphasizing those properties. The demonstration is trying to make car buyers add environmental aspects to a larger extent when considering a purchase.

The normal behaviour of costumers is thus a barrier. The same is true for the vendor, who often has insufficient knowledge of the environmental performance of the car models.

Another barrier has been that some clean vehicles encompass new technology. Customers do not choose new technology or alternative fuels if they do not feel comfortable with the new technology. If the vehicles are powered by alternative fuels the customers must know where the filling stations are located.

The greatest barrier however has shown to be the lack of knowledge on running costs. Customers who are on the whole positive to new technology and say they prefer a vehicle with less impact on environment often have poor knowledge of the running costs of these vehicles. If they are to choose clean vehicles they have to know as much about the running costs of these vehicles as they know about ordinary cars. Also the car dealers have shown they

could need more knowledge on what kind of economical comparisons could be made to make their customers choose clean vehicles.

To overcome these barriers the demonstration has focused on supplying economical information to selected groups. For example, a company that can save money on the fact that biogas and natural gas are both cheaper than petrol are more likely to choose CNG vehicles. Companies that can increase credibility in their environmental agenda through purchasing a more environmentally friendly fleet of vehicles are also easier to influence so that they will overcome these barriers. Private persons who can save money through cheaper parking if they choose clean vehicles also make up an interesting target group that has become a driver.

As a consequence of the increase in demand on clean vehicles from these customers, the car industry has been more inclined towards educating their sales personnel and marketing their clean vehicles. And so the local dealers have changed from being barriers to becoming drivers.

Mass media has also become an important driver. Since the knowledge on clean vehicles and filling stations was initially poor the national website had a very important function to fill. It has been the place for car buyers to find factual information. The daily press and trade journals have used the website for research and background information and have also been in contact with the experts of the project. By supplying the media with information the demonstration has influenced the media to become a driver through their local, regional and national papers and trade journals on vehicles and the environment.

Achievement of quantifiable targets

The only quantifiable target of the demonstration measure was to increase the number of clean vehicles according to the definition in Göteborg with approximately 1,500 private vehicles in the city and 250 in the municipal fleet from February 2004 to January 2006. The target of 1,500 private vehicles has already been achieved. But it is not yet (in November 2005) possible to tell if the target of 250 municipal vehicles will be reached

Achievement of evaluation-related milestones

Below is specified what milestones were decided upon when the demonstration measure was initiated and, whether they were reached or not.

Milestone 12.7.1: New website for clean vehicles developed.

Planned: May 2004 (month 28).

Implemented: June 2004 (month 29).

The new website was developed in cooperation with Stockholm and Malmö. The website was created through restructuring and updating a previous version launched website by Göteborg during 1998. The updating of the website began during month 24 and it was

launched with a face-lift during month 29. The fact that it was launched a month later than planned was due to the purchase of a new map function that dragged on. Rather than publishing the website without the map it was chosen to wait another month to be able to launch a complete website.

- Milestone 12.7.2: Start of active collaboration with car dealers.

Planned: July 2004 (month 30).

Implemented: February 2004 (month 25).

During month 25 collaborations with the car industry started. This is when preparations for a local clean vehicle exhibition began that was carried out in month 27. After this event, collaboration has continued with a number of seminars and conferences, the educating of car dealers and another clean vehicle exhibition in month 41.

- Milestone 12.7.3: 20 companies with lots of company cars reached by information campaign.

Planned: December 2004 (month 35).

Implemented: December 2004 (month 35).

During 2004 more than 20 companies were contacted. The companies were visited and informed about, among other things, clean vehicles. An additional number of companies were contacted via phone calls, mails and through the newsletter etc. More seminars on clean vehicles, where companies have participated, have been arranged since the demonstration measure was initiated. By month 35 far more than 20 companies had been reached by the information campaign.

- Milestone 12.7.4: Measurements and calculations of alternatively fuelled vehicles and alternative fuel in the city.

Planned: January 2005 (month 36).

Implemented: March 2005 (month 38).

The number of clean vehicles in the city and in the municipal fleet has been calculated for the year 2004. A calculation of the environment benefits through vehicles powered by alternative fuels or vehicles that are fuel efficient has been done for the year 2005. The calculations comprise the period 2005 and were presented during month 38. The reason why the calculations could not be presented earlier was the fact that official statistics for car retail sales 2004 provided by Statistics Sweden was not available until March 2005.

4 Results

4.1 Evaluation methods

During the demonstration measure the number of consultant hours used to inform selected target groups was measured. This is the measurement for the amount of information delivered to the selected target groups. The numbers are presented monthly by the consultants in their respective time sheets and then compiled annually.

Table B.7-1 Main marketing activities during the period

Activity	Hours spent per month	**Number of activities in total**
Contacts with different target groups	50-60	several hundreds
Events (clean vehicle fair, seminars etc)	50-60	app. 10
Contact with municipalities and national authorities	10-20	hundreds
Personal visits (car dealers, companies)	app. 5	app. 20
Media contacts	app. 2	50-100

The following table gives an account of the number of seminars, exhibitions and other public events and how many participate in these events.

Table B.7-2 Seminars and events

Seminar/event	Date	**Attendants (approximately)**
Local Clean Vehicle Fair	2004-04-20 2005-06-02	120 116
Seminar for vehicle retailers and fuel suppliers	2004-06-17	15
Outdoor exhibition and information desk during European mobility week	2004-09-17 2005-09-22	50-100 30-60
Seminars during the fair Ecology 04.	2004-10-07	70
Seminars towards Göteborg municipal decision makers, purchasing leaders and environmental executives	2005-03-03	100
Seminar towards companies with many passenger cars, car dealers and fuel suppliers	2005-03-16	60
Seminar towards environmental consultants	2005-05-24	40

The outcome of the information efforts has been measured through interviews with selected target groups during the period February 2004 to August 2005. To ensure impartiality the interviews were carried out by a person who had not previously met with the people interviewed. During the interviews questions have been asked on how information or a specific event was perceived, how valuable the information was considered to be, if the information will be able to influence the purchasing policies of the companies or if it would directly influ-

ence the companies to increase purchase of clean vehicles. Approximately four such phone inquiries were made during the period.

An extensive attitude survey was also carried out during November to December 2004. It was addressed to approximately 40 companies belonging to any of the target groups but who had never been in contact with us directly or participated in the seminars. The companies interviewed had only received written information from us. Through the interviews the goal was to judge the attitude towards clean vehicles of companies who are target groups but who there has not been time to influence personally. Another wish was also to try and measure if written information only had any influence on the companies and if they would have been even more influenced if they had been reached by information from car dealers and media.

After the 2004 Clean Vehicle Fair, representatives from all participating companies and exhibitors were interviewed during May 2004.

After a seminar on environmental standards for company cars, a web based inquiry was carried out in March 2005. The questions were emailed this time instead of using a phone inquiry and the answers were compiled automatically. It is a less expensive way of conducting surveys but will obviously return a lower number of replies. Web based inquiries were carried out after events that had many participants as it would be too costly to interview large numbers in person. These inquiries are not replacing the interviews but the web technology is making it possible to carry out more inquiries than would otherwise be possible.

After the 2005 Clean Vehicle Fair a web based inquiry to both participants and exhibitors was carried out.

The number of visitors to the national website of clean vehicles is measured every month. This shows the collected interest with car buyers, authorities and the car industry in Sweden. The number of readers of the Swedish newsletter is also measured at the same time.

The number of clean vehicles in the city of Göteborg and in the municipal fleet is measured yearly and compiled into numbers of vehicles in the Göteborg region during the end of December every year. The numbers are based on statistics bought from Statistiska Centralbyrån SCB (Statistics Sweden), which is supplementing the inquiries with all car dealers in Göteborg.

Once a year an estimated calculation of the environmental benefits obtained through a growing number of ordinary vehicles being replaced by clean vehicles was also made. The numbers are calculated by using standard values for emissions from various types of vehicles and then multiplying these with the number of vehicles and the average mileage for different types of vehicles.

4.2 Impacts

Through the demonstration measure, influencing the car buyers' choice of model was de-

sired. Surveys have continuously been carried out with the target groups to be able to find out the success rate.

During the demonstration measure period, approximately six inquiries, interviews as well as web based inquiries, have been carried out after visiting companies, seminars and fairs. All inquiries show that the greater part of the companies has answered that the activities have contributed to a restating of car policies towards an increase of clean vehicles purchases, or have contributed towards buying these vehicles.

Inquiries made after both clean vehicle fairs in 2004 and 2005 show that on the whole most participating car dealers and fuel suppliers were “satisfied” or “very satisfied” with the events. They also said that the event will have positive effect on their ability to persuade their customers to choose clean vehicles instead of conventional cars.

Almost all participants in the fairs said they were ”satisfied” or “very satisfied” with the event. The greater part of them thought they would have use of the seminar in their future work and many also said the event would be influential on future choice of cars in the company.

An inquiry was carried out during the period November to December 2004 and it was directed to companies who had only been contacted via mail previously. The inquiry showed that such information had little effect. It was not possible to show with any certainty that any of the companies contacted had been influenced to actually buy clean vehicles on the information sent by mail. The most interesting conclusion from this inquiry was however that those who had been reached by the written information and who had also received information about clean vehicles through for example media or car dealers, were more positive than those who had only had written information from us. This implies that the mailing of information is boosting the message from other senders, and thus was influential. Furthermore previous experience of this type of distribution of information can be effective if followed up by a phone call or an invitation to a seminar. Mailing is a cheap way of reaching many and therefore the result of the inquiry should not be interpreted as if it was wrong to mail written information. This method of reaching people is a complement to other methods, but has no obvious effect on its own.

During the demonstration measure period several car dealers have said that customers who have chosen clean vehicles state that the demonstration project was an important contributing factor to their choice of car.

The number of visitors at the national website has risen constantly during the period. The increase is mostly due to a general increase in interest in Sweden for clean vehicles. It has not been measured how much the demonstration measure has contributed towards this increase in interest and it was not considered important to know. The interviews show that target groups foremost use the website to gather updated information. The website is filling its purpose through supplying the target groups with information that will ease the decision process concerning clean vehicles. Furthermore the website is used by more car buyers than has been contacted, and this is contributing towards an improvement of the national market.

The increase in the number of visitors shows that the need for such information is great and fills an important function.

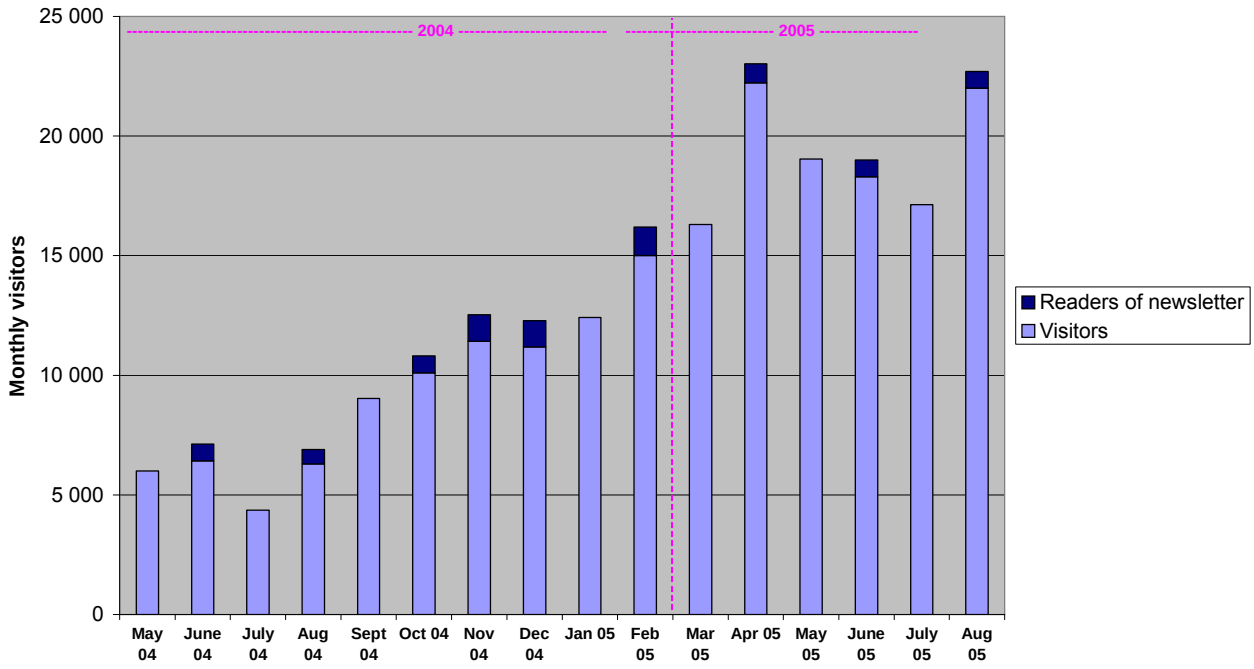

Figure B.7-1 Visitors at www.miljofordon.se since the new website started

Another important measure of how the demonstration measure is successful is obviously sales of clean vehicles in Göteborg and the number of clean vehicles in the municipality fleet. However it is important to emphasize that car sales is affected by many factors that the measure could not influence. Price, supply of models, number of filling stations and governmental taxation are among the more important factors. The yearly summary of the number of clean vehicles shows a strong increase in Göteborg. Clean vehicles make up approximately five per cent of new passenger cars and light commercial vehicles in Göteborg. The target to introduce 1,500 new clean vehicles in Göteborg has already been met. Judging by the evaluations described above the demonstration has without a doubt contributed towards that target.

Considering the number of vehicles in the municipality, the target will not be met. During the period there has been a lack of clean vehicles in the small passenger car segment. It has also proven difficult to purchase light commercial vehicles that fulfil the definition decided by the municipality. This is why the number of clean vehicles has not increased at the pace anticipated when initiating the demonstration measure.

Table B.7-3 Increase of the number of clean vehicles

Target from demonstration start Feb-04 to end Jan-06	Target	**Actual number Jan 2006 (prognosis)**
Total number of new clean vehicles in the city	1,500	app. 3,000
Number of new clean vehicles in the municipality	250	app. 200

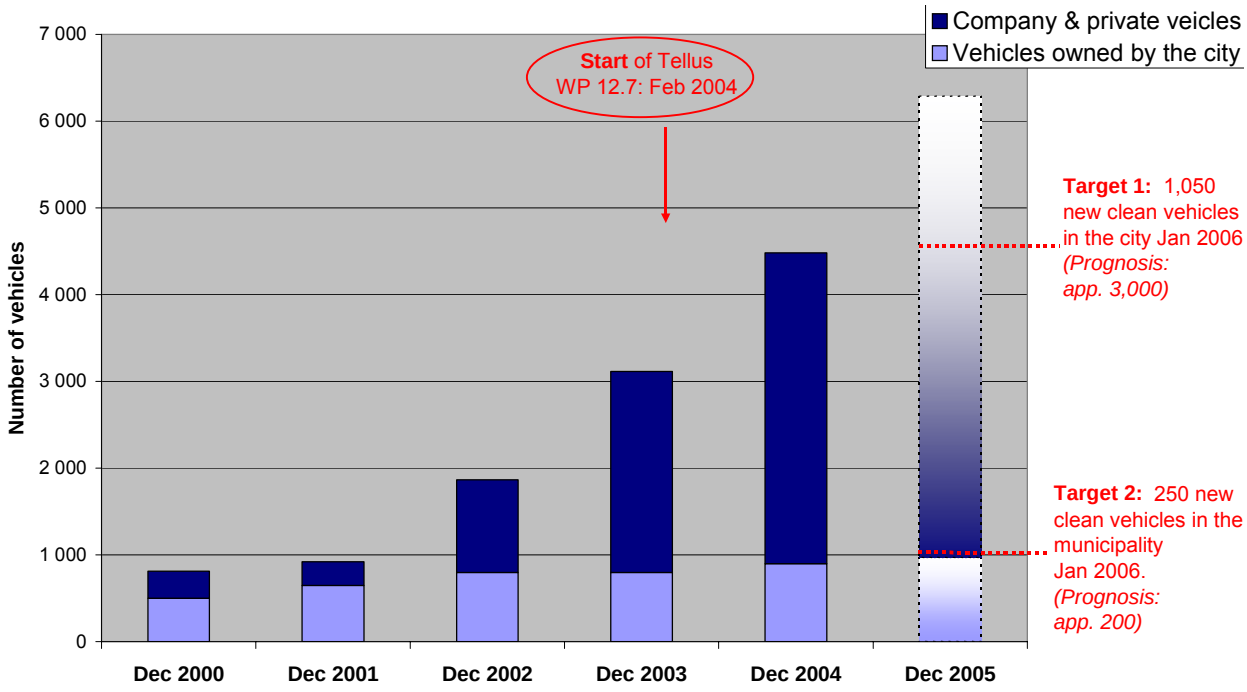

Figure B.7-2 Number of clean vehicles (cars + light commercial) in Göteborg (forecast 2005)

The use of clean vehicles has meant a decrease in local emissions compared to what would have been the case if these vehicles would have been conventional vehicles. The decrease is small compared to the whole road sector emissions due to the fact that the number of clean vehicles is proportionally low. This means that projects similar to this one need a long-term strategy to break trends and introduce new technology, and are not just a way of rapidly reducing emissions.

Table B.7-4 Emission reductions due to clean vehicles

Reduced emissions 2004 due to the use of light and heavy clean vehicles in Göteborg (approximation)

CO_2, tonnes/yr	Particles, tonnes/yr	NOx, tonnes/yr	HC, tonnes/yr
13,000	0.1	20	0.7

Comparison, total emissions from road traffic in Göteborg 2004

CO2, tonnes/yr	Particles, kg/yr	NOx, tonnes/yr	HC, tonnes/yr
66, 000	82	2,700	3,100

Reduction in per cent

CO_2	Particles	NOx	HC
2%	0.1%	0.7%	0.0%

5 Conclusions

Almost all targets have been reached. With minor deviations all milestones were reached as intended. The website was launched a month later than expected but on the other hand the collaboration with the car dealers was initiated four months earlier than promised. This shows that there was a realistic view on what measures were planned and what kind of a project organisation was necessary.

The target of 1,500 new clean vehicles during the period was rather optimistic but not unrealistic. The reason why the target was reached after only half the time, after one year instead of two, is due to the change of governmental taxation rules that make it easier for companies to purchase clean vehicles. If these rules would have been implemented before the demonstration measure began, the target number might have been set even higher. On the other hand you can not with any certainty set an ambitious target for the number of vehicles in a region where the municipality can not directly control what vehicles companies and private persons decide to purchase.

The target of 250 new clean vehicles in the municipality fleet will not be reached. Though, there is still some uncertainty depending on how many small passenger cars and light commercial vehicles can be changed during the autumn of 2005. The lack of these types of vehicles during the last year has postponed the introduction. This shows that it is hard to set a target for the changing of vehicles when it comes to new technology with limited supply.

All target groups that were selected in the beginning of the measure have been canvassed. It shows that there was a realistic view on what groups would be reachable via local resources and the contributions from TELLUS. The selected groups were the relevant groups to inform

and receptive to the information. Some groups have been easier to influence than others. The target groups that were found to be the most important to work with to reach the targets were companies with active environmental programmes, car sales staff, dealers and leasing companies, fuel suppliers, media and car users and car buyers in the municipality.

The first immediate objective was to influence the suppliers' methods of purchasing clean vehicles. The demonstration measure has managed well in that respect. The suppliers have actively participated in the common events and have considered them to be successful.

During the period of the demonstration measure a legislation issue surfaced that was important to work with nationally. It was about the national definition of clean vehicles that initially in its first draft during the autumn of 2004 treated some CNG-vehicles unfairly. After Clean Vehicles in Göteborg called on the government, the proposal was changed into something more similar to what Göteborg had suggested. During the spring of 2005 Göteborg continued to participate in national councils regarding the future national definitions. The national definition will affect the clean vehicles sales and that is why Göteborg was committed to this. This shows that the immediate objectives were fulfilled.

The intermediate objectives aimed at influencing the market in a positive way, both retailers and end users, and to achieve the goal of 250 new municipal and 1,500 new sold clean vehicles in Göteborg by the end of 2005. There has been a dramatic change in the awareness of clean vehicles among car dealers, local companies and the public during this period. The total amount of clean vehicles in Göteborg will increase by roughly 3,000, twice as many as predicted. And, as already mentioned above, the surveys show that the measures of the demonstration have had a significant influence on that development. The car dealers and fuel suppliers also consider the clean vehicle measures to have been of considerable importance for increasing the interest by the costumers so quickly.

But the intermediate objective of 250 new municipal clean vehicles will probably not be achieved. The number will be approximately 200. This depends mostly on a lack of vehicles in the right size and price-interval according to the actual need in the city fleet during the demonstration period. The possibility that this objective will not be fulfilled is depending on factors beyond the direct control of the municipality.

The ultimate objectives were to improve public-private cooperation and achieve extensive awareness with the public and politicians. The objectives were achieved by focusing on certain target groups among companies and car-fuel retailers, as well as the media and politicians. The relative success of the measure has in part been achieved as the information mainly focused on vehicle running costs, technology and the car fuel market. It also contained facts about the environment and emissions, but to a lesser extent, as environmental aspects are less important to the average car buyer than other aspects. But it was also found that lower emissions from cars can be an important "second-value" to certain user groups. That is why the activities and information focused mostly on the factors that were of the most interest to the target group.

Another ultimate objective was to reduce air pollution. By stimulating target groups to buy clean vehicles, that goal was achieved. Still, there are less than one per cent clean vehicles in total and thus the reduction is not so big. But the fact that car dealers and end users can be influenced to use cleaner vehicles shows that this kind of demonstration can be of great importance in the long run.

6 Scenarios

In this chapter a simple scenario is presented. It shows the effect of a demonstration measure at the present level, continued until 2010.

Another five years of information and collaboration with local car dealers and end users among companies the municipality would establish a network of cleaner vehicles users. It would probably be possible to have continuous contact with practically all of the local fuel suppliers, car retailers and environmental consultants in the region; and also with many big or important companies and environmentally certificated institutions. This kind of network could for instance provide adequate information about cleaner vehicles, travel policies, car sharing and public transport in order to stimulate the use of cleaner vehicles and a more sustainable mobility policy. Companies that are already in contact with the municipality would be provided with broader information about sustainable transports, while new contacts initially will be informed mostly about clean vehicles. With such a strategy, it is easier to get in contact with new companies, while the established contacts must be supported with new and added values if the city shall be able to maintain its contacts and keep its high credibility.

It is, though, very difficult to forecast how many “extra” clean vehicles that would come into use in Göteborg as a result of a prolonged information campaign. Many important external factors such as national taxes, available models and fuel economy are not possible to foresee five years from now. So this short scenario basically emanates in a prognosis that a potential up-scaling over the next five years could possibly lead to the establishment of an important network of professional car users, retailers, fuel suppliers and public authorities to promote a more sustainable vehicle use in Göteborg.

The relationship between this scenario and the ones of the other demonstration measures in Göteborg is not very strong. This scenario includes mainly activities towards users of light vehicles, while the other mainly focus on heavy vehicles and freight transport.

Table B.7-5 Relations between this scenario and others

TELLUS measure in Göteborg	Interrelationship
5.7 Environmental Zone for heavy duty vehicles	LOW.
6.6 Incentives for purchasing of CNG heavy duty vehicles	HIGH: It is important to increase the number of light duty CNG vehicle users so that the fuel suppliers will find it economically feasible to extend the number of filling stations. By promoting the use of clean vehicles and thereby the expansion of filling stations, also heavy duty vehicles that run on CNG can be promoted.
7.6 Environmental optimised ferry shuttle	LOW.
9.5 Incentives for improving the load factor in inner-city freight transport	LOW.
10.5 Consumer driven goods management from a Mobility Centre base	LOW.
12.8 Introduction of clean waste collection vehicles	HIGH: se above.

7 Recommendations

If a medium size city shall be able to influence the local car market, it is necessary to cooperate with car dealers and fuel suppliers. Virtually all decisions that the costumers make about vehicle purchase are made up in contact with a retailer. The retailers must be able to give accurate information about running costs and environmental aspects if their costumers are to feel confident with a new and cleaner car technology. Both retailers and costumers need help to analyse the near future, for example if there are any future taxes on high emitting technology or incentives towards cleaner vehicles.

It is also necessary to analyse the actual market of clean vehicles in the region. Who can possibly buy such vehicles, and why? If there are to many barriers, goals will not be met. If the barriers consist of for example lack of models, few filling stations, contradicting national tax rules or lack of international emission standards, it is wise to focus on these barriers in

order to influence them in a positive direction. Therefore, a local campaign to promote the use of clean vehicle will probably be more successful if it includes a strategy to reduce barriers even if these are national or even at EU level.

But the most important factor is to have the right approach to the selected target groups. If representatives of a municipality are to be able to promote their vehicle preferences, the people giving the information must be considered trustworthy. The given information must be accurate to the selected target group, and include information that is valuable for the end user. This means, it is seldom enough to inform about environmental aspects of a vehicle. The information must include all the parameters that are considered important when a buyer makes his choice.

The bad lesson learned within the demonstration measure is that environmental aspects of a vehicle are poor arguments for the average costumer when choosing between different models. Only providing information about emissions from clean vehicles is not going to influence more than a handful of vehicle buyers. The good lesson learned is that if you combine information on the ecology, economy and infrastructure, and address it towards selected target groups, you can influence buyers to choose vehicles with lower emissions if the overall running costs and function is similar to the standard vehicle. If so, sooner or later the local car dealers will notice an increase in interest in cleaner vehicles, which in turn encourages them to be more active in their marketing activities.

It would be possible to start similar demonstration measures in other European cities. There are probably many regions throughout Europe where cleaner vehicles and technologies are waiting for a break-through on the market. Certainly, it would be possible to find available target groups also in other cities that could lead to a more environmentally adapted choice of vehicles, if the right information support was given to them from the local authorities.

8 ANNEX

Hedén A. (2001): Attityder till miljöfordon bland olika intressenter i samhället. Examensarbete i Miljövetenskap: 20 poäng för Filosofie Magister examen. Miljö- och Naturresursprogrammet 140 p/160 p.

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Monthly time reports from Miljöinfo AB. Enclosed in invoices to Trafikkontoret Jan 2004 – Aug 2005.

Monthly time reports from Ordsmedjan HB. Enclosed in invoices to Trafikkontoret Jan 2004 – Aug 2005.

Telephone surveys to target groups after contacts and attendants after seminars. Made by Helene Larsson 1-4 months after the events.

Webbsurveys surveys to target groups after contacts and attendants after seminars. Made with a webbtool by Questbac 1-3 weeks after the events.

Data from Statistics Sweden concerning the amount of different vehicle types in Göteborg.

Data from car retailers concerning the amount of clean vehicles sold in Göteborg.

Data from fuel suppliers concerning the amount of ethanol and methane sold in Göteborg.

Emission factors used in calculations

Electric vehicles	No tailpipe emissions
Hybrid cars	CO_2-eqv -40% compared to conv. petrol car
Ethanol vehicles	CO_2-eqv -70% compared to conv. petrol car
CNG vehicles	
CO_2-eqv:	- 80% if biogas compared to diesel (heavy veh.)
	no difference if natural gas (heavy veh.)
	- 20% compared to petrol (natural gas, light veh.).
Particulates:	- 0.1 g/km (heavy veh.)
	- 0.01 g/km (light veh.)
NOx:	- 4 g/km (heavy veh.)
	no differences (light veh.)
HC:	no differences (heavy veh.)
	- 0.2 g/km (light veh.)

B.8 Demonstration Measure 12.8 – Introduction of clean waste collection vehicles

List of keywords and abbreviations:

Back-loader: A waste collection vehicle, which lifts the waste into the vehicle at the back.

BAT: Best Available Technique.

Electric hybrid vehicle: CNG engine combined with electric powered bodywork. **Clean waste collection vehicle**: refers to the introduced new vehicles with the features CNG engine combined with electric powered bodywork and water hydraulics.

CBG: Compressed Biogas.

CNG: Compressed Natural Gas.

CNG vehicle: Vehicle fuelled by Compressed Natural Gas.

Conventional waste collection vehicle: A waste collection vehicle using the main engine of the vehicle for the actual waste collection procedure, i.e. lifting and compaction of waste.

Diesel vehicle: A conventional waste vehicle using diesel as fuel.

MSW: Municipal Solid Waste

Rear-loader: see Back-loader above.

State-of-the art vehicle: A diesel-fuelled vehicle in compliance with the latest environmental and technical standards.

1 Introduction

Waste transportation with back-loaders is a flexible and efficient technique for collection of municipal solid waste (MSW). That is why this type of vehicle is the most widely used for waste collection throughout the world.

Picture B.8-1. The design of a back loader.

In recent years the demands on waste management have changed. Citizens ask for recycling systems, safety, satisfactory air quality and comfortable environment. One of the more important qualities in a comfortable city environment is low levels of noise. The city of Göteborg has for example introduced an Environmental Zone for heavy-duty vehicles in the central parts.

Renova, a waste and recycling company in western Sweden, with a long history in waste management has all the knowledge, skills and resources necessary to implement new ways to handle MSW. Besides the knowledge of the needs of the citizens, Renova has the power of an influential purchase organisation. The manufacturers of waste collection equipment are keen on satisfying presented requirements. Göteborg is also an inspiring arena in the respect that one of the world's largest truck manufacturers has its headquarters in Göteborg.

Renova has early been sensitive to the question of saving resources. Recycling of energy and materials has been in focus for thirty years. In the last ten years the scoop has widened to comprise the transportation part of the business. First of all alternatives to fossil fuels had to be developed. CNG was early recognised to be an interesting alternative in the sense that Göteborg was connected to the North Sea gas grid. Locally it was important because of the reduction in indicators such as NOx, PM and noise. Another important reason was the possibility to use locally produced biogas from waste-to-gas-plants.

Studies of waste collection in densely populated areas have shown that only about 40% of the time during a work shift, the waste collection vehicles main engine is used for transportation. During 60% of the time, the vehicle is standing still at the pick-up sites. Only half of the stop-time, the main engine of the vehicle is used for the actual waste collecting procedure, i.e. lifting and compaction of waste. The rest of the time, the main engine is running on idle. It implies that the use of the main engine of the vehicle for the waste collection process performed at the pick-up sites is inefficient and is causing excessive noise and emissions.

To reduce the use of scarce resources, improve the air quality and increase the comfort of citizens and staff, an electric hybrid waste collection vehicle was developed in close relation to leading suppliers. The principal innovation is the application of electric hybrid technique during the waste collection procedure. The hydraulic pump performing the waste collection procedure is powered by an electrical engine, which is supplied by two standard lead block battery packages. The batteries are charged in the garage after operation and are fully re-charged until the following morning. There is also a possibility to charge the batteries during operation through generators if needed. Furthermore the hybrid technique is complemented with an advantageous engine steering, an automatic turn-off function of the main engine at each pick-up site.

In the end of 2003, ten unique two-axle CNG powered back-loaders complemented with electric hybrid technique were received. In the end of 2003 Renova was invited to substitute the planned CNG-powered ferry in Göteborg. This request ended up in the clean waste vehicle demonstration measure, which is stretching beyond the electric hybrid technique. The demonstration measure has been carried out during a 2-year period starting in February 2004, where 4 vehicles were purchased. The clean waste vehicle is a three-axle truck with the same characteristics as the earlier ten but added with water hydraulics. The aim was to significantly improve the environmental output in purpose to offer a unique waste management product.

2 Description of demonstration measure

2.1 Demonstration design

Measure description

The demonstration measure was to introduce and evaluate four innovative clean waste collection vehicles running in Göteborg.

Design of the measure

Main activities that have been carried out:

- Purchase of 4 clean heavy waste collection vehicles;
- Noise measurement of the vehicles in comparison to state of the art vehicles;
- Emission measurement of the vehicles in comparison to state of the art vehicles (CNG vehicles only);
- Evaluation of the environmental output;
- Dissemination of experiences and results.

Innovative aspects

Innovative aspects of the clean vehicles are:

- CNG (Compressed Natural Gas)-fuelled vehicle;
- Electric powered bodywork;
- Water hydraulics instead of traditional oils.

Furthermore the vehicles are complemented with an advantageous engine steering, an automatic turn-off function of the main engine.

Additional processes, like effective route maps, adjusted management of the waste collection vehicle called Eco-driving and re-charging of the electrical equipment supports the vehicle and is an integrated part of the system.

Involved parties

Involved parties besides Renova are Mercedes, supplier of the chassis, Norba, supplier of the bodywork, ETP, supplier of the electrical equipment and Danfoss, supplier of the water hydraulics.

2.2 Transport Plan context

The main factor why the vehicles have been introduced, are the customer's requirements of more environmentally friendly waste collection systems. CNG fuelled waste collection vehicles is one example of requirements specified by the City of Göteborg which is Renovas largest customer. This in order to decrease the emissions of particulate matter and NO_x and to decrease the resource depletion (oil) caused by transport and collection of waste.

Another main factor is the local Environmental Zone, which restricts the emissions and thus controls the standards of the vehicles.

The introduction of the new more environmentally friendly vehicles is moreover a result of the increased awareness within Renova of the company's own environmental performance, partly due to the implementation of the Environmental Management System, ISO 14 000. Renova is today totally aware of the significant environmental impact caused by the collection and the transportation of waste.

2.3 Objectives

The main objective of the measure was to perform a full-scale demonstration of the innovative clean waste collection vehicles. The aim was to reduce environmental problems in terms of noise, water and air pollution, aligned with conventional waste collection in urban areas. The vehicles introduces an environmental and cost-effective approach to waste collection, which efficiently reduces noise, risks of hydraulic oil leakage, fuel consumption and emissions of NO_x, PM (Particulate Matter), HC, CO and CO_2.

Immediate objectives

- Plan and order an environmentally optimised rear loader to be used for waste transport in the city centre of Göteborg;
- Plan for a fast full-scale implementation of quality controlled vehicles. The main emphasis will be directed to optimisation of collection routes, infrastructure as recharge equipment and training of staff.

Intermediate objectives

- Decrease of emissions of particles, hydrocarbons and NOx;
- Decrease of energy use and CO_2 emissions;
- Decrease of noise;
- Decrease of risks for oil leakage.

Ultimate objectives

- Reduction of air pollution and noise to levels below local, national and EC directives;
- Decrease of energy use and CO_2 emissions;
- Illustrate a possible BAT for waste collection in densely populated areas within EU;
- Reduce the negative impact on drain water and ground water.

2.4 Ex-ante evaluation and situation before TELLUS

In Sweden a back loader is the most common means of transportation of waste and this is also true for Göteborg. Municipalities and contractors have historically emphasised transport efficiency. As a conventional diesel truck is effective, reliable and represents comparatively low investments it is by far the mostly used vehicle within the transport sector. In Göteborg, the environmental output was put on the agenda when Göteborg became a part of the new natural gas grid. Renova has since the middle of the nineties invested heavily in CNG-trucks. At Renova, about 60% of the total fleet of back loaders are powered by CNG engines. The mileage is about 20,000 km for each vehicle annually.

As a major waste and recycling business in Göteborg, Renova is not only concerned in the building of an efficient recycling system but also in the environmental aspects of transportation of the large streams of waste and recoverable materials of the city. This newborn interest was reinforced by the fact that Renova was certified to ISO 14001 in 1999.

Renova soon noticed the environmental output improved moderately due to the fact that only a small part of the trucks were purchased each year. After studying the collection in detail Renova could state that the trucks were idling about 60 % of the total work time. As mentioned earlier, this implies that the use of the vehicles main engine for the waste collection

process performed at the pick-up sites, is inefficient and is causing excessive noise and emissions.

3 Implementation Process

3.1 Actual implementation

A Public procurement process was first carried out. The first waste collection vehicle was delivered in April 2004 (M27) and vehicles 2-4 were delivered in August (M31).

A quality control was made at the delivery of the 1st vehicle and three minor problems were discovered: The electrical winch for the lifting of the containers was too weak and the transmission had to be changed. Moreover the container locks needed to be strengthened. The vehicle was sent back to the manufacturer, Norba, for modifications. Due to the problems, the vehicle was out of production for three weeks. It was also discovered that the hydraulic system had a reduced capacity and problems with locking the emptying-hatch. The problem was solved together with the supplier, Danfoss, in September 2004. In August the main engine in the first delivered chassis broke down. The engine was replaced by a new. The broken engine was sent to the manufacturer, Mercedes, as a work of guarantee.

Noise measurements were carried out in April 2004 followed by emission measurements in June 2004. A pre-investigation of what real waste collection routes look like was performed. The aim was to get a ”real-life” situation to use for the emission measurements.

Drivers and maintenance staff were educated in handling the vehicles in August 2004.

Participation at a National CNG fuel seminar, 24th of May 2004, at Svenska Mässan Congress Centre, Göteborg with the first waste collection vehicle placed outside the fair. Also an exhibition of one vehicle at the Elmia Waste Management Fair in Stockholm, 14-18 of September was carried out.

A market survey was carried out from June to August 2004 focusing on the attitudes towards electric hybrid trucks. Lars Thulin, manager of maintenance and repairs participated in a Seminar on Waste Collection in Blomstermåla, Sweden, 8-9 of December.

3.2 Deviations from the plan

Evaluation of noise and emissions has not been carried out according to the original plan in which it was stated that the measurements should be in accordance to standardised measurements.

The reason why the emission measurements were not carried out on a laboratory scale was due to the very high costs involved. Furthermore it was more difficult to simulate real life operation in the laboratory compared to on board measurements, which were carried out instead.

The noise measurements were not carried out absolutely according to standardised measurements (Directive (2002/49/EG), due to the fact that the directive does not simulate real life operation to any greater extent. For example does not the directive consider the ability of the clean vehicle to turn-off the engine and thereby not running on idle while loading. Therefore, supplementary measurements were carried out, which simulated real life operation to a greater extent.

In conclusion the demonstration measure from an evaluation point of view, has developed according to the original plan.

3.3 Barriers and drivers of the measure implementation

A barrier identified when introducing the clean vehicles was the high investment costs involved compared to conventional vehicles. Only considering a CNG and a diesel engine, the CNG engine is about 350,000 SEK more expensive. Furthermore, in order to apply electric hybrid technique and extra investment cost of about 270,000 SEK is added. Moreover the water hydraulics is about 270,000 SEK more expensive compared to traditional oil hydraulics. But it should however be observed that the vehicles should be considered as prototypes. If they were to be introduced on a large scale, the investment cost would be significantly lower.

Another barrier identified involved the new technique implemented in the waste collection vehicles. Both water hydraulics and the electric hybrid technique are technologies that have been applied for the very first time on waste collection vehicles. As with all new technologies this has caused some unforeseen problems such as a reduced capacity of the water hydraulic systems, which was stated in the actual implementation process. The problems occurred have however been taken care of as a work of guarantee.

A major driver identified was the willingness of the municipality of Göteborg to consider the environmental performance of waste collection and to implement products and services, which are better from an environmental point of view although the initial investment costs are higher. Since the municipalities in Sweden have the responsibility for MSW collection and treatment, they set the regulations on how it should be performed and can thereby demand that BAT should be used.

3.4 Achievement of evaluation-related milestones

Table B.8-1 shows a comparison of the actual achieved results with the originally envisaged results/milestones.

Table B.8-1. Achievement of quantifiable targets.

Milestone	Planned	Actual
Introduction of 1:st waste collection vehicle.	M26	M27
Introduction of 2nd, 3rd and 4rt waste collection vehicles	M29	M31

The 1st waste collection vehicle was delivered in April 2004 (M27), a delay of about one month compared to the original plan and vehicles 2-4 were delivered in August (M31), a delay of about two months compared to the original plan.

4 Results

4.1 Evaluation methods

Emissions

The demonstration measure management chose to carry out measurements of the emissions by using mobile equipment.[22] The measurements were carried out on a landfill owned by Renova. This was done in order to carry out the measurements in a more controlled manner and thus obtaining more reliable data. In order to compare the performance of the electric hybrid vehicle with a state-of-the-art waste-collecting vehicle, measurements of emissions were performed for the electric hybrid during two different modes of operation. One mode was carried out during which the electric hybrid technique was in use and one mode during which the very same vehicle was functioning as a conventional vehicle with its engine running on idle. This way, the sole effect of the electric hybrid technique could be isolated.

The parameters being analysed were CO, CO_2, HC, NO_x, particulate matter (PM) and fuel consumption. The measurement of emissions was carried out at different engine modes in order to simulate real life conditions to the greatest extent and to quantify to what extent the clean waste collection vehicle improves the environmental performance.

To simulate real life condition a waste collection vehicle was monitored during one spell of duty where its different engine modes were being registered. From the data obtained, a course on the landfill was set in order to simulate the actual waste collection procedure, that is lifting and compaction of waste and driving in between the pick-up sites. Furthermore, in order to simulate driving to and from the incineration plant and the garage, the emissions from the vehicle was measured at a constant speed of 50 km/h.

[22] Ahlvik, P. (2004).

To facilitate the measurements and making comparisons more precise, the vehicle was loaded with used tires instead of household waste. This was done due to the fact that household waste is not considered to be homogeneous.

Noise

Noise measurements were carried out during four modes of operations, engine running on idle, lifting device running, filling of waste and compaction system running.[23] The clean waste collection vehicle was being compared with a conventional CNG- and diesel vehicle.

Electricity consumption

Measurements of the electrical energy consumption were carried out during one month. The meters were read each morning in the garage before the vehicles took off to find out the consumption from the spell of work the day before. As the energy use (kWh) is directly proportional to the amount of waste collected (tonnes), a ratio (average value) has been obtained. This ratio obtained has been applied when calculating the electricity consumption on an annual basis.

Publicity

During the demonstration measure, brochures and articles giving information about the vehicles have been published. Also during the demonstration measure Renova representatives have been attending fairs and conferences.

User satisfaction acceptance

Interviews with the drivers have been carried out focusing on the experienced benefits and drawbacks of the clean vehicles.[24] This in comparison to conventional vehicles.

In Table B.8-2 is shown an overview of the evaluation indicators used in the measurement.

[23] Wangson-Nyqvist, I. (2004).
[24] Renova, (2005).

Table B.8-2. Overview of the evaluation indicators used.

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement
Environment	Pollution/ Nuisance	Emissions	NO_x	kg/year	Emission measurement on vehicle in real traffic situation
			PM	kg/year	Emission measurement on vehicle in real traffic situation
			CO	kg/year	Emission measurement on vehicle in real traffic situation
			HC	kg/year	Emission measurement on vehicle in real traffic situation
			CO_2	kg/year	Emission measurement on vehicle in real traffic situation
Energy	Resource consump-tion	Consump-tion/ use of CNG	Average fuel con-sumption	Nm³ gas per year	Measured consumption
		Consump-tion/ use of electricity	Average electricity consump-tion	kWh per year	Measured consumption

Table B.8-2 ctd. Overview of the evaluation indicators used.

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement
Noise	Noise- environment/ health	Noise emissions	dBA	Operational mode LAeq/La1s dBA	Measured levels
Society	Acceptance	User acceptance/ satisfaction	Attitudes drivers	Level of satisfaction	Interviews
	Awareness	Publicity	Media Response	No of articles, reports, seminars	Collected data

4.2 Impacts

Emissions

Table B.8-3 shows the emissions from a clean waste collection vehicle in comparison to a conventional CNG fuelled waste collection vehicle. This based on one-year operation.[25]

Table B.8-3. Results from emission measurements.

	Fuel consumption (kg)	CO_2 (kg)	NOx (kg)	HC (kg)	CO (kg)	Particles (g)
Clean waste collection vehicle	6,940	21,521	77	60	51	51
Conventional waste collection vehicle	13,550	42,099	159	64	85	85
Reduction	6,610	20,578	83	4	34	34
Reduction (%)	49	49	52	7	40	40

[25] The calculations are based on 250 days of operation each year.

As can be seen from the table above, a major reduction in emissions of about 40-52% is obtained for five of the six parameters being analysed. Regarding hydrocarbons, a reduction was also obtained of 7%.

In absolute numbers the improved performance is significant, where the reduction of fuel and carbon dioxide is more than 6 tonnes and 20 tonnes respectively.

As stated earlier only the clean vehicle was being measured at two different modes, one in which the electric hybrid technique was in use and one mode during which the very same vehicle was running on idle. This in order to isolate the sole effect of the electric hybrid technique. However this method underestimates somewhat the effect of the hybrid technique as the power necessary for the waste collection procedure (lifting and compaction of waste) cannot be powered by the main engine for the clean vehicles as it does for conventional vehicles. That is, fuel consumption and thus emissions are higher when the main engine is performing the actual waste collection procedure compared to when the very same engine is only running on idle.

Furthermore the increase in emissions during transport due to the extra load of two the lead block batteries for the clean vehicles has not been accounted for. Earlier studies (theoretical) have shown that this increase in weight will cause an increase in fuel consumption of about 4% and is therefore considered to be of small importance.

Moreover, due to the extra weight of the batteries, the clean vehicles cannot load the same amount of waste compared to conventional waste collection vehicles. Studies within Renova have shown that conventional vehicles load about 3.2% more waste. This in turn leads to that the clean vehicles have to be emptied somewhat more often. This has not been accounted for in the tables above but is considered to be of small importance to the environmental performance.

Noise

In Table B.8-4 the results from the noise measurements are shown at different modes of operation and positions relative to the vehicle during which the clean waste collection vehicle was being compared to a conventional CNG vehicle and a diesel vehicle.

Table B.8-4. Results from noise measurements.

	Position relative to vehicle			
Mode of operation	**In front (Laeq(dBA))**	**Left to (Laeq (dBA))**	**Right to (Laeq(dBA))**	**Behind (Laeq(dBA))**
Engine running on idle				
CNG vehicle	64	60	60	55
Diesel vehicle	69	66	65	57
Clean waste collection vehicle	0	0	0	0
Lifting device running				
CNG vehicle	65	65	68	71
Diesel vehicle	75	75	74	72
Clean waste collection vehicle	55	63	62	76
Filling of waste				
CNG vehicle	81	65	66	96
Diesel vehicle	87	74	74	101
Clean waste collection vehicle	81	62	61	102
Compaction system running				
CNG vehicle	70	91	92	60
Diesel vehicle	76	94	94	69
Clean waste collection vehicle	56	96	94	66

As can be seen from the table, the major benefit from the clean waste collection vehicle innovative technique is obtained when the vehicle stops at the collection site. After its engine is

turned off (after 30 seconds), there is no noise generated from the vehicle compared to conventional vehicles running on idle. This sequence corresponds to the actual collection of bins in real life operation and is furthermore the most dominant of the four sequences occurring at the collection site with respect to the length of time. From studies made on waste collection vehicles during operation, the sequence when the engine is running on idle, i.e. when the compaction system or the lifting device is not running, is on average 54%. The relative time during which the lifting device is running and the compaction system is running is around 23% on average for both sequences. The relative time when the waste is emptied is negligible accounting for about 1-2 seconds. Another conclusion obtained from the measurements was that water hydraulics is causing slightly more noise compared to oil hydraulics. This increase is considered as negligible.

When comparing the different measuring positions it is observed that the innovative vehicle is mostly favoured at the measuring position in front of the vehicles. This was expected as the noise from the main engine for the conventional vehicles is located in the very front of the vehicle, whereas the electrical engine found on the innovative waste collection vehicle is found on the side of the vehicle.

When comparing the noise levels when standardised waste is being emptied into the truck, the noise level generated, when the waste is hitting the steel container in the truck diminishes the benefits of the clean waste collection vehicle. It can however be concluded that the higher noise level from this sequence is not because of the hybrid technique itself. Possible explanations of the differences in noise levels are differences in the design of the steel container receiving the waste and differences in the distance the waste falls down. The latter results in a higher velocity of the waste generating a higher noise level. It should also be noted that the high noise levels observed for the three vehicles are presumably higher compared to household waste. The reason why the standardised waste was used was to make comparison between the vehicles more easily. This as household waste is not to be considered as homogeneous.

Moreover it should be noted that the noise for the modes of operations at the pick-up sites only has been evaluated. Driving the vehicles also cause noise, in which the clean vehicles work as conventional vehicles. Therefore the clean vehicles are estimated to generate the equal amount of noise as a conventional CNG vehicle.

Energy consumption

Based on an electricity consumption of 2.1 kWh per collected ton of waste and the total amount of waste collected during a month, the annual consumption of electricity is about 5 MWh for each vehicle. This corresponds to the annual electricity consumption of about 10 light bulbs (60 W) being turned on 24 hours per day.

It is important to notice that the electricity consumption also give rise to emissions depending on from what energy sources the electricity has been produced. This has not been ac-

counted for, when evaluating the emissions during use, see above.

Publicity

Number of articles:

During the measure period, 7 articles have been produced, both on a national and a European level.

Number of brochures:

One brochure has been produced on a European level. Information about the vehicles was presented including a description of the environmental benefits of the vehicles compared to conventional vehicles.

Number of conferences fairs:

Renova has sent representatives to 5 conferences and fairs throughout the measurement reaching a national as well as a European audience.

User satisfaction acceptance:

The drivers are satisfied with the lower level of noise from the clean vehicles, which is seen as an improvement of the work environment. Less exhaust fumes is another improvement of work environment, although not as striking.

A problem with the first ten electrical hybrid vehicles was that the engines were considered not to be powerful enough. This led to some extent to an aversion to the vehicles. The four vehicles in the TELLUS measure do not have this problem since these are equipped with stronger engines, the acceptance is much more extensive.

A general opinion is that vehicles fuelled with diesel are to prefer to CNG fuelled vehicles, at least regarding the power of the engine. Diesel is also available to a greater extent than CNG. One advantage with gas-fuelled vehicles is however that they are less noisy than diesel fuelled ones.

One problem identified is that the vehicles are somewhat low, which leads to a risk to bump the front into e.g. edges and slopes. Some of the drivers also think that the compaction may be too slow. Whether this is due to the electric hybrid technique or not is not yet proved.

Over all, the drivers are satisfied with the new technique. There are some potential for improvements, but the vehicles are considered to offer a better work environment. The drivers recommend that more clean vehicles are put into operation, and the technique is to prefer over conventional ones.

Objective fulfilment

Immediate objectives

- Plan and order an environmentally optimised rear loader to be used for waste transport in the city centre of Göteborg.

Fulfilled. All four vehicles have been in full scale operation since the fall of 2004.

- Plan for a fast full-scale implementation of quality controlled vehicles. The main emphasis will be directed to optimisation of collection routes, infrastructure as recharge equipment and training of staff.

Fulfilled. All four vehicles have been in full-scale operation since the fall of 2004.

Intermediate objectives

- Decrease of emissions of particles, hydrocarbons and NOx.

Fulfilled. During one year operation for one clean vehicle, the reductions of particles, hydrocarbons and NOx are 34 g (40%), 4 kg (7%) and 83 kg (52%) respectively. This in comparison to a conventional CNG vehicle.

- Decrease of energy use and CO_2 emissions

Fulfilled. During one year operation for one clean vehicle, the reduction of CO_2 is about 20-21 ton or 49%. This in comparison to a conventional CNG vehicle. The corresponding reduction of energy use is 6.6 ton (49%). Taking into account the electricity consumption of the clean vehicles the reduction in energy use is 46%.

- Decrease of noise

Fulfilled, for all modes of operations at the pick up site involving the electric hybrid technique.

- Decrease of risks for oil leakage

Fulfilled. The risk of oil leakage in the hydraulics has been eliminated due to the replacement of water in the hydraulics.

Ultimate objectives

- Reduction of air pollution and noise to levels below local, national and EU directives.

  Most certainly regarding both air pollution and noise.

  Regarding air pollution it has not been proved that the clean vehicles discharge less than existing directives, but it is reasonable to assume that there has been a noticeable contribution. This as the air pollution in the directives is given in g pollutant/kWh, whereas the air emissions from the measurements were given in g/km and g/h. Furthermore, there are no existing standardised driving patterns (used for certifying of the engines) for waste collection today. Moreover the existing EURO classes (air pollution restrictions) only apply

for diesel vehicles whereas corresponding classes for gas-fuelled vehicles do not exist.

The vehicles fulfil the demands given by the city of Göteborg to operate in the very central parts of the city within the Environmental Zone, a locally air pollution restriction given by the municipality.

The measurements of noise were not totally carried out according to an EU directive (2002/49/EG). This as the EU directive does not consider the Eco-vehicle's ability to turn-off the engine and thereby not running on idle while loading. Instead the measurement of noise was carried out, which simulated real life operation to a greater extent. As seen, the clean vehicles do however decrease the noise to a great extent compared to conventional waste collection vehicles, why it is reasonable to assume that the reduction obtained is lower than existing noise directives.

- Illustrate a possible BAT for waste collection in densely populated areas within EU.

Fulfilled. The measurements have shown that the clean vehicles do reduce both noise and emissions during operation. Regarding emissions it is however important to consider that the vehicles do deteriorate the environmental performance compared to conventional vehicles during the production phase. This due to the extra equipment applied such as batteries (about 1 ton), electrical engine and three generators, which also cause an environmental load.

Furthermore one must take into account the relative high extra costs involved due to CNG technology, batteries and water hydraulics, when evaluating whether or not it should be considered to be BAT. As mentioned earlier however, if the vehicles were to be introduced on a large scale the investment costs would be significantly lower than today.

- Reduce the negative impact on drain water and ground water

Fulfilled. The risk of oil leakage in the hydraulics has been eliminated due to the replacement of a water solution consisting of water, propylene glycol and anticorrosive agent in the hydraulics.

5 Conclusions

From the evaluation measurements carried out it can be concluded that the clean vehicle:

- do improve the environmental performance with respect to emissions and fuel consumption during use and eliminate the risk of pollution due to hydraulic oil leakage;
- do decrease the noise during the actual waste collection procedure.

The clean waste collection vehicles have so far proved to accomplish waste collection with satisfactory productivity. This means that the implemented technique has been as reliable as conventional techniques. It can thus be concluded that the overall environmental performance is clearly superior to the conventional vehicles.

Another conclusion made is that the vehicles are best suited to operate in highly densely populated areas, characterised by long stops with respect to time at the different collection stops. That is waste collection where the collection stops are a significant part of the total operation.

The noise in densely populated areas has received increased attention in recent years. Studies have shown that high constant noise levels can cause health problems such as fatal heart diseases.[26] One of the main advantages with the clean vehicles is the significantly lower noise level, why this technique can contribute to a better situation in cities.

Another important issue relates to the increased focus on work environment. The clean vehicles do offer a better working environment for the drivers, not only by the lower noise- and emission levels but also by the design of the cabin itself. The cabin is situated lower than in conventional vehicles, which makes the exit of the vehicle at each collection site less harmful for the drivers.

A barrier identified of introducing the clean vehicles is the high investment costs involved compared to conventional vehicles, where an extra investment cost of about 100,000 EUR compared to conventional diesel vehicles was needed. As stated earlier it is however very important to consider that the vehicles should be considered as prototypes. If introduced on a large scale, the investment is expected to be significantly lower. The clean vehicles do however accomplish a lower fuel consumption. As the fuel cost is a significant part of the total operating costs, the technique does have a positive impact on the total life cycle cost. From the measurements carried out it could be concluded that the clean vehicles do reduce the fuel consumption with up to 50 %. Statistics within Renova of the four clean vehicles in operation have shown that the annual average fuel consumption for one vehicle is about 9,800 nm3. Based on a CNG fuel cost of 6.9 SEK/nm3 (VAT of 20 % included) an annual reduction of fuel of about 68,000 SEK is expected. This compensates to some extent the higher investment costs. The benefits of a better fuel economy increase as the fuel costs currently rise at a high rate. It is however important to consider that the 50 % reduction was being measured during simulated waste collection procedures and not during real waste collection.

6 Scenarios

In Göteborg there are about 58[27] rear loaders collecting MSW, both running on CNG and diesel. In Table B.8-5 is shown the emissions if all 58 vehicles would be replaced by the clean vehicles. This based on one-year operation.[28]

Table B.8-5. Results from scenario.

[26] Uppsala University, (2001).

[27] This based on information from Renova. There are also some pickups within who collect bio waste (MSW) but that amount is negligible. The number also includes waste collection vehicles outside Renova.

[28] The calculations are based on 250 days of operation each year.

	Fuel consumption (kg)	CO_2 (kg)	NO_x (kg)	HC (kg)	CO (kg)	Particles (kg)
Clean waste collection vehicle	402,525	1 248,194	4,463	3,477	2,940	3
Conventional waste collection vehicle	785,881	2 441,713	9,250	3,722	4,910	5
Reduction	383,356	1 193,519	4,787	245	1,969	2
Reduction (%)	49	49	52	7	40	40

As can be seen from the table above, the reduction of emissions is significant if the clean vehicles would be introduced on a large scale, i.e. if all 58 back loaders collecting MSW in Göteborg would be replaced by the clean vehicles.

The annual reduction of fuel consumption and CO2 emissions is about 400 ton and 1 200 ton respectively. Also for the other parameters such as NOx, HC, CO and particles, the reduction is significant.

It should however be observed that the conventional vehicle being compared to the clean vehicle is CNG fuelled. In reality many diesel-fuelled vehicles are also in operation in Göteborg, i.e. in this measurement no comparison of the clean vehicle with a conventional diesel vehicle has been carried out.

The clean vehicle measure is interrelated with the measure “Incentives for purchasing of CNG/CBG heavy duty and distribution vehicles” within TELLUS. The interrelationship is considered to be high since a high availability of CNG stations is important if CNG vehicles are to be introduced on a large scale.

If biogas would be introduced on a large scale in Göteborg, the environmental performance of the vehicle would be further improved. This as biogas is considered to be CO2 neutral, i.e. does not contribute to any CO2 emissions and thus the green house effect.

If the clean vehicles were to be introduced in a large scale, a considerable reduction in noise would be obtained for a large number of people. This as waste collection vehicles do operate in close proximity to where people live during times when people are most sensitive to noise, i.e. early mornings. Studies within Renova have shown that noise by people is by far the most recognised aspect when it comes to waste collection.

7 Recommendations

7.1 Replication of the measures

If the clean vehicles were to be introduced in other cities throughout Europe there are some important aspects to consider, which are listed below.

First of all the clean vehicles should operate in highly densely populated areas, characterised by long stops with respect to time at the different collection stops. That is waste collection where the collection stops are a significant part of the total operation. That is, this kind of vehicle is not suited to operate on the countryside considering only the emissions.

Furthermore it should be noted that the electric hybrid technique might as well be applied on a diesel vehicle. Even though no measurements have been carried out on such a vehicle, the same relative increase in environmental performance is expected as for the electric hybrid technique applied on a CNG vehicle. This is important to consider as the infrastructure for distribution of CNG fuel in general is rather poor, both in Sweden and in Europe.

7.2 Areas of improvement of the clean vehicles

Even though it has been shown that the clean vehicles do improve the environmental performance with respect to emissions, noise and fuel consumptions there are some potential to improve the performance even further.

At the emission measurements rather high peaks of hydrocarbons, nitrogen oxides and carbon monoxide were detected at the start of the engine. In order to improve the environmental performance even further the engine should be optimised for usage with hybrid technique.

Another area of improvement concerns the batteries. In the clean vehicles ordinary lead batteries were used, which have a total weight of about 1,100 kg. Further improvements of the vehicles should focus on better batteries, i.e. batteries with more power per unit of weight. This would improve the environmental performance as the extra load of batteries itself causes an increase in fuel consumption and thus emission during the actual transport of the waste due to its weight. Another aspect of improvement of the batteries is to replace the lead content with a more environmentally friendly material.

Problems with the start engines have occurred for ten other electric hybrids (not included in the TELLUS measurement) running in the very central parts of Göteborg. It is today however not clear if this problem has occurred due to the many more starts the engine has to perform compared to a conventional vehicle. For the ten vehicles, the start engines have been repaired as a work of guarantee and are now working properly. To assure problems with the start engine, it should be more adapted to the many starts in a future generation of electric hybrid waste collection vehicles.

Another area of environmental improvement for future generations is to completely replace

the fuel used in waste collection vehicles by electricity. The clean vehicles do use electricity but only during the actual waste collection procedure, i.e. lifting and compaction of waste. At the actual transport of the waste they are using CNG. This area of improvement depends on the progress made within battery research and how to development batteries with more power per unit of weight.

Another possible improvement is to make use of the kinetic energy of the vehicle during the transport of waste and convert that energy into electrical energy. That is when the vehicles today slow down by applying the brakes, the kinetic energy is lost as heat. Instead that energy could possibly be recovered and stored in a battery as electrical energy. As waste collection in densely populated areas is characterised by many stops, this is considered as a major area for improvement.

8 References

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C EVALUATION ON CITY-LEVEL

C.1 General approach

In the evaluation on city-level a summary analysis of how the city has achieved its quantified objectives is made. The small scale of the demonstration measures seen from a citywide level has put the emphasis of the city-level evaluation on up-scaling scenarios and on what synergies can be found between the different measures in terms of spin off or side effects.

In this general approach the quantified objectives and the methodology used is described in short. In the second part an evaluation of the objectives and a summary evaluation is presented. In the final section the up-scaling and scenarios are presented.

1 TELLUS quantified objectives

The assessment of the results that the demonstration measures achieved on city level is done on the basis of the TELLUS objectives identified for Göteborg. Göteborg has six objectives within three evaluation areas:

- **Transport** Reduce congestion
- **Environment** Reduce NOx emissions from heavy traffic
  Reduce air pollution and noise to levels below national and EC directives
- **Social** Improve intra-organisational co-operation
  Achieve extensive political and public awareness for TELLUS
  Improve public-private cooperation

1.1 Methodology

The evaluation of the objectives has been done from two different perspectives; how the city has achieved its specific objectives and in what way the demonstration measures have contributed to the different objectives.

Contribution of TELLUS measures to TELLUS objectives

At the beginning of TELLUS, a specific set of quantified objectives were set up for each demonstration measure. In these individual planned contributions are displayed.

Please note that the objective “Improve intra-organisational co-operation at the city level” has been assessed only on city level and is therefore not addressed by the demonstration measures. Furthermore, no contribution was made from measure 7.6, since it was discontinued.

Table C.1-1: Contribution to the TELLUS objectives by the demonstration measures in Göteborg.

TELLUS QUANTIFIED OBJECTIVES 2006/2010	Demonstration Measures Göteborg					
	5.7	6.6	9.5	10.5	12.7	12.8
Reduce congestion by 5%/10%						
Reduce NOx emissions from heavy traffic by 5%/10%						
Reduce air pollution and noise to levels below national and EC directives						
Achieve extensive political and public awareness for TELLUS						
Improved public-private co-operation						

Legend:

2002-2006	measured
2006-2010	estimated
Measured from 2002 until 2006 and estimated from 2006 until 2010	
No contribution	

The evaluation of the effects of the set of demonstration measures until 2006 is based on data monitored within the TELLUS lifecycle whereas the data for 2010 have been estimated. The evaluation for 2010 is based on the scenarios made in each measure evaluations in chapter B.

Since the quantifications of the TELLUS objectives distinguish between two different time frames (2002-2006 and 2006-2010), the objectives relevant for the demos have been stated according to this division. However, since 2004 is the last full year of the project where it is possible to perform measurements etc, the evaluation for 2006 is based on figures from 2004 for most objectives.

Evaluation of the quantified objectives

The first level, the evaluation of the quantified objectives, is based on the development of key indicators carefully chosen in order to reflect the level of achievement of the TELLUS objectives. In the table below the objectives, key indicators and methods used are listed.

Table C.1-2: TELLUS quantified objectives 2006/2010 for Göteborg.

TELLUS Objective	Key Indicator	Method
Reduce congestion	Average vehicle speed	Measurement of vehicle speed at three critical locations in the Göteborg road network.
Reduce NOx emissions from heavy traffic	NOx emissions	Calculations based on estimations of traffic figures and average emissions from individual vehicles.
Reduce air pollution and noise to levels below national and EC directives	CO levels, NO2 levels, PM levels, Benzene levels, Number of inhabitants exposed to noise	Continuous measurements of emissions at representative locations in Göteborg. Calculations and estimations on noise exposure in Göteborg based on modelling and measurements made by the Environmental Office.
Improve intra-organisational co-operation	Quality of Intra-organisational co-operation	Interviews with identified key persons within the TELLUS project in Göteborg.
Achieve extensive political and public awareness for TELLUS	Media exposure Events organised Presentations given	Analysis of media exposure, meetings and presentations held targeted at politicians or the public.
Improve public-private co-operation	Quality of public-private co-operation	Interviews and surveys with identified key persons.

Three of the objectives are quantified and relate to two periods of time. The first period is from 2002 until 2006, the second from 2006 until 2010.

Regarding the objectives “Improve intra-organisational co-operation” and “Improve public-private co-operation” it should be noted that the interpretation of these objectives in Göteborg is slightly different from the other TELLUS cities. The reason is that it is more valuable to evaluate the co-operation between all the partners involved in TELLUS Göteborg than only within the city administration, which would be a too small number of people. Hence, intra-

organisational co-operation is interpreted as the co-operation between the TELLUS partners in Göteborg and private-public co-operation is interpreted as the co-operation between the partners within the measures and their respective target groups.

To describe the TELLUS Key Indicators special fact sheets were created – the Indicator Fact Sheets. These fact sheets contain all the important information concerning the key indicators. Elements of the fact sheets are the name and the description of the indicator including context and impacts, the unit of the indicator, indicator-related objectives, methods of measurement, sources of data, a timetable for the measurement of the data, the legal basis, the development of the indicator, the relation to other indicator systems and references.

The Indicator Fact Sheets provide the basis for the continuous monitoring and further evaluation reports. Their structure enables transparency and comprehensibility, as well as the documentation of the development of the indicators.

TELLUS Key Indicators together with Indicator Fact Sheets can provide an important mean to develop and establish an urban transport monitoring system The TELLUS Key Indicators and Indicator Fact Sheets are documented in the annex.

C.2 Ex post evaluation for 2006

The following section discusses and analyses the results of TELLUS objectives on a citywide level, based on the Key Indicators. Description of the methodology, quantification and the results of the Key Indicators are specified in the annex

The measures have contributed to the TELLUS objectives in various ways. Measure 7.6 gave no contribution since the measure was discontinued. However, since the measures involve a very small number of vehicles or are carried out in a limited scale, the effects of the measures are too small to show any real effects on a citywide level. On a smaller scale, and locally, the TELLUS measures do have a greater impact.

Overall, the TELLUS measures have been an important element as a first step and by contributing with innovative aspects in the work of the city towards improving the air quality..

1.1 Reduce congestion

The TELLUS objective is to reduce congestion by 5% in 2006 and by 10% in 2010. The objective has not been met for 2006.

The main indicator for congestion is vehicle speed, where a lower vehicle speed indicates more congestion. To determine the magnitude of the congestion, vehicle flow is used as a base to determine the amount of vehicles that are affected by the congestion, i.e. congestion is defined as (current speed-free flow speed)*number of vehicles).

Vehicle speed and traffic flow have been measured at three representative and critical locations in the Göteborg road network: Göta Älvbron, Oscarsleden and Parkgatan. No significant change has been detected in vehicle speed during the period and thus it is not possible to assess an increase or decrease in congestion. A slight reduction of traffic flow can be observed at two of the measuring points (Göta Älvbron and Oscarsleden). It is however not yet possible to assess whether this is a real trend since both points are affected by the construction of a new city-centre tunnel, Götatunneln. At the third measuring point, Parkgatan, an increase in traffic flow can be noticed, but since the vehicle speed has not changed significantly, it is not possible to assess any change in congestion.

To further analyse the trend in congestion, comparisons were made with historical data from 1998-2001. It is, however, still difficult to see a trend in vehicle speed or traffic flow. One significant change, though, is the heavy traffic share, which at the three measurement points has decreased significantly, by 5-20%.

Since no significant change in vehicle speed and thus neither in congestion has been noticed, the TELLUS objective, to reduce congestion by 5% in 2006 has not been met. It is also not likely that the TELLUS objective for 2010, to reduce congestion by 10%, will be met.

1.2 Reduce NOx emissions from heavy traffic

The TELLUS objective is to reduce NOx emissions by 5% until 2006 and by 10% until 2010. For the sake of completeness and comparability, NOx emissions from all road traffic and not only heavy traffic have been assessed. The objective for 2006 has been met.

NOx emissions have been estimated by calculating the NOx emissions from all sources in Göteborg, traffic and non-traffic. The estimations are based on emission calculations made annually by the Environmental Office of the City of Göteborg.

The total NOx emissions in Göteborg are decreasing rapidly (-20% 1998-2003 and -8% 2001-2003). Traffic related NOx emissions are also decreasing, but at a slightly slower rate (-13% 1998-2003 and -10% 2001-2003).

Since emissions from the average vehicle have decreased significantly over the period, the decrease in traffic related NOx emissions would be expected to be even bigger, but since the total traffic volume is increasing, the lower emissions from the average vehicle are balanced by a higher total number of vehicles.

The TELLUS objective, to reduce traffic related NOx emissions by 5% in 2006, has been met and considerably surpassed. The prediction is therefore that also the TELLUS objective for 2010, to reduce traffic related NOx emissions by 10%, will be met.

All measures have contributed to decreasing NOx emissions. Measures 6.6, 12.7 and 12.8 by introducing/promoting clean vehicles producing fewer emissions. Measures 9.5 and 10.5 contribute to the reduction of NOx by reducing the total amount of kilometres driven by each vehicle. Measure 5.7 has not yet contributed since there has been a delay in the project. It is however expected to contribute to the objectives for 2010.

1.3 Reduce air pollution and noise to levels below national and EC directive

Air pollution

The TELLUS objective is to reduce air pollution to levels below national and EC directives until 2006 The objective for 2006 has been met.

Continuous measurements of the air quality have been made of CO, NO_2, PM and Benzene at one representative location in the city centre, Femman, which is the oldest and most reliable air measuring station in Göteborg.

The air quality in Göteborg has improved dramatically over the last decades and all national and EC directives for 2006 and 2010 have already been met.

CO levels in Göteborg are at very low levels and decreasing, probably due to the fact that the number of older vehicles without catalytic converters is decreasing.

NO_2 levels in Göteborg are below the EU and national limit values. Levels are however not decreasing. This is probably due to the fact that lower emissions from the average vehicle

are balanced by a higher total number of vehicles. The levels measured at Femman are probably mostly traffic related and since traffic is increasing no real decrease in NO_2 levels can be expected.

Levels of PM are not decreasing, rather increasing at Femman. Most of the Particulate Matter probably originates from studded tyres, and the increase in traffic consequently results in higher PM levels.

Benzene levels have not been measured long enough to draw any definite conclusions on the trend of the development. Measured levels are still uncertain and there might be errors in the results, especially for 2002.

Noise

The TELLUS objective is to reduce noise to levels below national and EC recommended limit values until 2006.

To assess noise exposure, the Environmental Office of the City of Göteborg performs calculations and measurements. Model calculation is carried out for 1600 places around Göteborg. 300 measurements complement the results. The figure chosen for TELLUS assessments is the number of inhabitants exposed to traffic noise levels above 65 dBA outside the building. The objective is that no inhabitants should be exposed to this noise level.

The TELLUS objective has not been met since the number of people exposed to noise levels (from traffic) above 65 dBA during the day is about 10,500 inhabitants. This is equivalent to 2% of the inhabitants in Göteborg.

A small reduction in traffic flow will normally not generate any measurable changes in noise. For this to happen a major reduction is required. Alternatively, a decrease in speed can also decrease noise.

Reducing traffic flow is not an efficient and often not even possible method to significantly reduce noise. Measures in Göteborg for reducing noise are instead focusing on construction noise shields, changing windows on buildings etc.

1.4 Improved intra-organisational co-operation at the city level

Improved intra-organisational co-operation at the city level is interpreted as the co-operation between the different involved partners within the TELLUS project in Göteborg. Intra-organisational cooperation was evaluated using a questionnaire and interviews with key persons within the measures.

The co-operation between the different partners has increased and improved as a result of TELLUS. It is, however, not yet possible to quantify or to show concrete results of the increased co-operation. The co-operation has up to now primarily been within the TELLUS project, but already some external projects have been started and all repliers to the ques-

tionnaire believe that TELLUS will have a lasting and positive effect on co-operation even after TELLUS has been ended.

Several meetings and seminars have been held involving different partners, thus improving both the formal and informal co-operation, which will greatly benefit further co-operation. A non-negligible part of the achievements within the measures can be related to the improved co-operation, since this has helped the measures promoting each other.

There have been continuous meetings during the TELLUS project where all partners have informed each other of the progress. After two years into TELLUS, in relation to the TELLUS amendment, four new partners were added to TELLUS in Göteborg. An informal mingle party, with representation by the deputy mayor, was arranged. This contributed to better knowledge and better cooperation on the local level and within the internal target group.

1.5 Improved public-private co-operation

Public-private co-operation is, within TELLUS Göteborg, interpreted as the co-operation between the partners and the external target groups.

To succeed with the implementation of TELLUS Göteborg, the co-operation between the partners and their respective target groups was identified as a critical success factor. Within the demonstration measures, workshops have been held and seminars and smaller information meetings have been arranged continuously with target groups and much of the work within the demonstration measures have been done together with external target groups in various areas.

To summarise, the public-private co-operation has greatly improved, mainly due to the fact that this has been a major focus in many of the measures, since the belief is that it will not be possible to achieve good results unless the target groups are closely involved in the measures.

The objective “Improved public-private co-operation” is closely related to the objective “Achieve extensive political and public awareness for TELLUS”, and thus further elaboration is made in chapter 1.6 below.

1.6 Achieve extensive political and public awareness for TELLUS

Through the work made in the different demonstration measures, TELLUS has achieved awareness for the TELLUS measures in Göteborg as well as the TELLUS project as whole. Many of the measures are widely known in Göteborg and in all official documentation and publicity of the measures, the TELLUS project and logotype has been used, thus improving the awareness for TELLUS project. Concerning other publications and publicity not under control by the TELLUS project, TELLUS has not always been mentioned, since focus often is on the measures and the results of the measures. Thus it should be noted, that more aware-

ness has been achieved on the measures themselves, i.e. the awareness of the different measures is higher than the awareness of TELLUS.

Politicians

Each year, there have been presentations in the Traffic and Public Transport Committee about the TELLUS project and its progress. By the active involvement of deputy mayor Anneli Hulthén in the CIVITAS Policy Advisory Committee, the project has become very well known to the politicians in Göteborg.

Research and Development Centres

In Göteborg there are already developed channels for knowledge transfer with the University of Göteborg and Chalmers University of Technology. Through the involvement of TFK – Institutet för Transportforskning based at Chalmers, the knowledge about TELLUS and its local initiatives have become known at the university. A number of student theses by students at Chalmers University have been written within WP 9.5 and WP 10.5.

Business Community

The co-operation with the business community in Göteborg is important, not only for the dissemination of TELLUS but also for the exploitation of new transport solutions. The City of Göteborg has a long tradition of working close to companies within the environmental sector. To succeed with the implementation of the TELLUS Göteborg measures, a close co-operation with private companies and industry is necessary. After the amendment, three haulage companies entered TELLUS as partners, which deepened the collaboration further. Within all measures, the focus has been put on developing networks with the business sector. Workshops have been held and seminars and smaller information meetings have been arranged continuously during the project.

Media

TELLUS Göteborg has gained a lot of attention in the media, both on local and on national level. Press releases have been sent out in relation to major events, such as the CIVITAS City of the Year Award in November 2004 and the Goods and Logistics workshop held in Göteborg in June 2005. The City of the Year Award, that Göteborg won, gained a lot of much attention in all kinds of media. All the individual TELLUS measures have also been presented in the local media. Experiences show, however, that it is much easier to get attention for the local measures as such than for the concept of the EU-project TELLUS.

Residents of Göteborg

One of the measures in Göteborg was intended to have more advertising and activities directed to the inhabitants than the other measures; the Environmentally Optimised ferry shuttle (WP 7.6). The other measures should also be marketed but not directly for the residents.

Since WP 7.6 unfortunately was not fulfilled, the direct information campaigns towards the public did not take place. However, the attention gained for the other measures, in the media for example, has made them more visible for the public than was expected.

2 Baseline and trend scenario

Since the TELLUS measures are limited in size and scale, it is difficult to state that the results of the measurements up to 2006 are directly a result of the TELLUS measures. On the other hand, this makes it very interesting to perform a trend scenario to see what the results would be if the measures were to be up-scaled.

At the start of the project, ITEMS was planned to be used for up-scaling on a European level. This has not been possible to do in Göteborg, mainly due to the fact that the small scale of the measures would not give any measurable impact. For this reason, all measures, except 7.6, have been up-scaled and put into a discussion over a citywide scenario for 2010. The scenario has been based on realistic assumptions, meaning that the scenario presented is economically, technologically and legally feasible. Assumptions made for the scenarios for up-scaling every measure individually are found under chapter 5 of each measure evaluation. In this part of the evaluation the possible synergies are discussed.

Synergies

Goods distribution

There are possible synergies between the different measures in Göteborg, some stronger and some weaker. The most obvious synergy is between measures 5.7, 9.5 and 10.5, as they all relate to goods distribution and focus on city areas with a large number of inhabitants and involve a large number of companies. If all three measures were to be implemented on a larger scale, this would most probably have a significant impact on the air quality in the central parts of Göteborg. One other major synergy would also be the awareness that this kind of overall view on efficient and low-polluting distribution traffic would have.

One interesting possible synergy in particular would be using incentives in combination with restrictions and targeting both hauliers and buyers of goods.

CNG/CBG fuel

This synergy relates to the measures involving vehicles using CNG/CBG: measures 6.6, 12.7 and 12.8. Measure 12.8 does not focus primarily on CNG/CBG but the vehicles in this measure use this fuel. All measures could to some extent be said to have possible synergies relating to alternative fuels, since even the measures not focusing on alternative fuel would have lower emissions if alternative fuel was to be implemented as a complementary move within the measures.

If the above mentioned measures were up-scaled to include the major part of distribution vehicles running in the central parts of the city, it would signify from the present 10-20 vehicles involved in the measures to over a 1,000 vehicles. The environmental effects would be significantly improved for NOx and particulates. If CBG would be introduced on a large scale in Göteborg, the environmental performance of the vehicle would be further improved. This as CBG is considered to be CO2 neutral, i.e. does not contribute to any CO2 emissions.

The interrelationship between the clean vehicle measures and the measure “Incentives for purchasing of CNG/CBG heavy duty and distribution vehicles” is considered to be high since a high availability of CNG stations is important if CNG vehicles are to be introduced on a large scale.

C.3 Ex ante evaluation for 2010

1 Environmental plan

The Traffic and Public Transport Authority is currently working on a revision of the existing environmental plan, which will include the objectives up to 2010. The focus in the environmental plan will be on counteracting the increase in traffic through various means, including economy, planning and policies, improved public transport and bicycle traffic, information campaigns and introduction of new technology. The major goals of the environmental plan will probably be the following:

- Decrease the transport demand;
- Using the right means of transport;
- Increase transport efficiency;
- Support of new environmental technology in vehicles;
- Protection against the negative effects of traffic and reduction of land and resource usage.

Many of the TELLUS measures in Göteborg correspond very well with these goals and it is expected that much of the knowledge and awareness achieved in the TELLUS project will serve as a part of the continuing work of the city towards a better environment. The TELLUS project itself, including up-scaling, will not be sufficient if the ambitious TELLUS objectives are to be met. To reach the objectives, an overall view must be taken and massive actions undertaken in several areas, not only including areas covered by TELLUS.

2 Contribution of TELLUS

General

A probable situation in 2010 is that the different measures within the TELLUS project in Göteborg are more integrated and a part of the transport policy for Göteborg. It is furthermore reasonable to assume that the national Swedish legislation for traffic has changed, giving the possibility for the City to implement restrictions on heavy-duty vehicles for distribution within Göteborg as well as light duty distribution vehicles.

Environmental Zone

The Environmental Zone in 2010 probably covers restrictions for light transport vehicles, and has been extended to cover almost all of Göteborg and also includes restrictions on the load factor.

To reach the air quality norm for NO2 it is also important to reduce the number of old private cars especially those without a catalytic converter. The development of the Environmental

Zone could also include a restriction of the oldest private cars, which could be implemented in 2009-2010. A prerequisite for this is changes in the national traffic legislation.

With legal possibilities to implement restrictions for different types of vehicles, it is also possible that the project scenario includes restrictions with different time frames. Perhaps it is possible to restrict distribution vehicles to enter the area during certain time frames, and vice versa with private cars. A restriction with time frames for distribution vehicles is likely to be easier accepted if private cars are restricted during the time frames that distribution vehicles are allowed inside certain delimited areas or streets.

Efficient goods transport

Regarding efficient goods transport the routes are probably shortened in 2010 and there are significant time savings for the hauliers involved. A city distribution terminal is implemented at the border to the inner city of Göteborg and almost all deliveries into the area with vehicles that are not fully loaded are reloaded at this terminal. This will probably result in fewer vehicles at the pedestrian streets and a safer and better environment within the city as well as a better working environment for the drivers. The incentives for vehicles with a high load rate factor have been included in the regulations for the Environmental Zone, which thus has been extended to include load rates. The measure is delimited to a small part of the inner city of Göteborg, since it is not needed in the entire city. A synergy effect of the project is that there is a general better load rate of distribution vehicles.

Separating goods purchase from transport purchase is one further step, which the City probably has started to use: making demands of their purchases among with purchase transports separately from the merchandise. Acting as a leading example, several other businesses hopefully will have followed the City's good example.

The communication toward the buyer companies have resulted in that they work more actively with their transport situation. The companies have formed clusters in their neighbourhood, exchanging experiences. The municipality is supporting these clusters with ideas and knowledge, etc. This has lead to one delivery free day per week. The other days a chosen haulier delivers all goods to the neighbourhood with high load factor. The load factor has really improved and the haulers that do not have an acceptable rate have to unload their cargo to the new city distribution terminal that is located at the border of the city. From these terminals, clean vehicles deliver once per day.

Awareness

The TELLUS project and the spin-off effects of it will probably have had the effect that the awareness of environmental issues in the city has increased significantly, thus enabling the citizens and the companies in Göteborg to make better, and environmentally conscious, decisions about goods and personal transport.

D Final Conclusions

General

The TELLUS project in Göteborg has in general been very successful, the one exception being measure 7.6 “Environmentally optimised ferry shuttle”, which had to be cancelled.

The measures themselves have been successful, but due to the nature of the measures (small demonstration measures), no measurable impact has been noticed on a citywide level. However, the continuing work and up-scaling of the measures which will commence after the TELLUS project has ended will probably lead to noticeable effects in the long run.

The results achieved from TELLUS and the awareness that TELLUS has raised in the City, private companies and private persons will greatly facilitate present and future environmental work in Göteborg.

Some of the major findings of the different measures are commented below:

Measure 5.7 – Environmental zone for heavy-duty vehicles

Increased co-operation between the Swedish cities of Lund, Malmö, Stockholm and Göteborg and the Industry Ministry has been established. This has resulted in a final proposal for the new regulations for the Environmental Zones, which has been developed together with the Industry Ministry.

Changes to national legislation take time, and this has meant that the new regulations could not be implemented by 01-01-2005, which was the planned date. The delay will probably be 18 months (01-07-2006). Information meetings for politicians have been held in September 2004 and February 2005.

The existing regulations have two problems that need to be solved, and this is also why it is so important for the cities to implement the proposed regulations as soon as possible. One problem is the legality of the existing regulations because of some questions from the European Commission in 2002, and the other is the lack of technical scope.

There has been a remark from the European Commission concerning the legality of the exemptions from the regulations in the Environmental Zone. The regulations for the Environmental Zones in Swedish cities are not allowed to contain any details that could infringe on free trade between members of the EU. The European Commission is investigating the regulations of the Environmental Zone and if the regulations can be seen as a hindrance to the solidarity rules, the legality of the Zone may be questioned. This also made it very important to co-operate with the Industry Ministry.

6.6 – Incentives for purchasing of CNG/CBG heavy duty and distribution vehicles

Projects with a customer driven demand will have the most probable possibility to succeed. The success factors are co-operation and collaboration. The effort of all stakeholders is

needed in order to create a breakthrough in clean vehicles and fuels. Stakeholders are authorities, official bodies, ministries, energy enterprises, fuel distributors, vehicle industry, private sectors with small and large companies, suppliers and customer's customers, non-profit organizations etc. Non-existing co-operation and a traditional viewpoint with regard to fuels are risk factors for the project.

To summarize, it can be stated that the methods and success factors for a project of this type are: excellent preparation, the development of communication strategies, spending time on initial research, having ad-hoc contingencies, investing in media canvassing and personal contacts, distributing outline facts and arranging meetings such as direct meetings and seminars, lobbying to stakeholders in a long-term perspective and having economically beneficial incentives. These factors combined with a strong driving and willpower will result in a breakthrough in the vehicle and fuel industry.

9.5– Incentives for improving the load factor in inner-city freight transport

Despite that the results do not show any decrease in emissions the outcome of this measure can still be interpreted as good. The project did not have the prerequisites to decrease the emissions as the number of vehicles involved in the project was to few. However, the knowledge about implementing a project of this kind, definition of load rate, technology to report load rate and the possibilities for implementing incentives have been analysed thoroughly and knowledge about how to and what to do in a future full scale project has been increased. The acceptance from drivers, transport companies, the municipality and businesses are most valuable and the communication throughout the project has been very good.

Hence, one of the most important conclusions is that it is possible to talk about goods. It is just a matter of whom you speak to and how you present the information that you want to communicate. It is not always the president of the company, the board or the steering committee that is the best source of information when you want to find out information about problems or possibilities. That is of course the right path when introducing new concepts and involving new companies into projects, but when creating the measure and finding out the best solutions it is often better to talk to the persons "on the floor". The most creative ideas in this measure came from the drivers. It was also natural to speak to the drivers of the vehicles when finding the load- and unloading zones for the measure, since it is the drivers who know where those are needed.

10.5 – Consumer driven goods management from a Mobility Centre base

One important conclusion is that the measure has been successful in establishing a way to decrease transport by strengthening communication between suppliers and customers. They majority of the 17 companies have decreased their frequency of deliveries between 30 and 80 percent compared to the objective of this demonstration measure to decrease the number of transports of office material by 30%.

It is possible to talk about the complexity of goods transport to the company management, but the priority in this area is very low. That is why it is important to present all the benefits and give the companies the reason why they should work more actively with this issue. It is important to use the right communication tools for opening up a dialogue with companies.

Because few companies have joined the measure it is hard to demonstrate any measurable effect on emissions in the City, but the measure has been very successful in establishing a working model with concrete and quite impressive results. By enlarging the model, and having more companies join, emissions would most probably decrease.

12.7 – Introduction of clean vehicles in public and private fleet

The target of 1,500 new clean vehicles during the period was rather optimistic but not unrealistic. The reason why the target was reached after only half the time, after one year instead of two, is due to the change of governmental taxation rules to make it easier for companies to purchase clean vehicles. If these rules would have been implemented before the demonstration measure began, the target number might have been set even higher.

The target of 250 new clean vehicles in the municipality fleet has not been reached. Though, there is still some uncertainty depending on how many small passenger cars and light commercial vehicles will be changed during the autumn of 2005. The shortage of these types of vehicles during the last year has postponed the introduction. This shows that it is hard to set a target for changing vehicles when it comes to new technology with limited supply.

All target groups that were selected in the beginning of the project have been canvassed. It shows that there was a realistic view on what groups would be reachable via local resources and the contributions from TELLUS. The selected groups were the relevant groups to inform and receptive to the information. Some groups have been easier to influence than others. The target groups that were found to be the most important to work with to be able to reach the targets were companies with active environmental programmes, car sales staff, dealers and leasing companies, fuel suppliers, media and car users and car buyers in the municipality.

The first immediate objective was to influence the suppliers' methods of purchasing clean vehicles. The demonstration measure has managed well in that respect. The suppliers have actively participated in the common events and have considered them to be successful.

During the period of the demonstration project a legislation issue surfaced that was important to work with nationally. It was about the national definition of clean vehicles that initially in its first draft during the autumn of 2004 treated some CNG vehicles unfairly. After contacts with the government, the proposal for legislation was changed into something more similar to what Göteborg had suggested. During the spring of 2005 Göteborg continued to participate in national councils regarding the future national definitions. The national definition will affect the clean vehicles sales and that is why Göteborg was committed to this.

12.8 – Introduction of clean waste collection vehicles

From the evaluation measurements carried out it can be concluded that the clean waste collection vehicles:

- do improve the environmental performance with respect to emissions and fuel consumption during use and eliminate the risk of pollution due to hydraulic oil leakage;
- do decrease the noise during the actual waste collection procedure.

The clean waste collection vehicles have so far proved to accomplish waste collection with satisfactory productivity. That means that the implemented technology has been as reliable as conventional technology. It can thus be concluded that the overall environmental performance is clearly superior to the conventional vehicles.

Another conclusion made is that the vehicles are best suited to operate in highly densely populated areas, characterised by long stops with respect to time at the different collection stops. That is waste collection where the collection stops are a significant part of the total operation.

The noise in densely populated areas has received increased attention in recent years. One of the main advantages with the clean vehicles is the significantly lower noise level, why this technique can contribute to a better situation in cities.

Another important issue relates to the increased focus on work environment. The clean vehicles do offer a better working environment for the drivers, not only by the lower noise- and emission levels but also by the design of the cabin itself. The cabin is situated lower than in conventional vehicles, which makes the exit of the vehicle at each collection site less harmful for the drivers.

A barrier identified of introducing the clean vehicles is the high investment costs involved compared to conventional vehicles, where an extra investment cost of about 900,000 SEK (100,000 EUR) compared to conventional diesel vehicles was needed. As stated earlier it is however very important to consider that the vehicles should be considered as prototypes. If introduced on a large scale, the investment is expected to be significantly lower. The clean vehicles do however accomplish a lower fuel consumption. As the fuel cost is a significant part of the total operating costs, the technique does have a positive impact on the total life cycle cost. From the measurements carried out it could be concluded that the clean vehicles can reduce the fuel consumption with up to 50 %.

A success factor is when the public sector decides to set demands in public procurements. This has increased the general interest in clean vehicles (all sizes and models). The Swedish government has decided that 25 % of all purchases of vehicles must be clean vehicles starting in 2005. The City of Göteborg has also set the target that 90 % of all vehicles in the municipal fleet should be clean vehicles by the year of 2008.

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ANNEX:

TELLUS Key Indicators

List of Indicators

Transfer Guide to METEOR

TELLUS Key Indicators

TELLUS objective	TELLUS Key indicator	METEOR core indicator	Unit	Source of data	Method of data collection
TRANSPORT					
Reduce congestion	Average vehicle speed	23/24	Km/h	Car detectors in 22 stable counting points that measure flow and speed, 200 mobile measurement points.	Fixed points: Measurements about 12 times/year to establish the trend Mobile points: Recurring measurements to get an overall view over the road network
ENVIRONMENT					
Reduce air pollution to levels below national and EC directives	PM10 levels	7	µg/m³	Environmental office: 5 fixed measurement stations and 3 mobile.	Fixed points: Measurements about 12 times/year to establish the trend Mobile points: Recurring measurements to get an overall view.
	NO_2 levels	6	µg/m³	Environmental office: 5 stable measurement stations and 3 mobile	Fixed points: Measurements about 12 times/year to establish the trend Mobile points: Recurring measurements to get an overall view.
Reduce NOx emissions from heavy traffic	NOx emissions	10	kg/year	Environmental office: 5 stable measurement stations and 3 mobile	On-board measurements, Calculations based on traffic flow data and average emissions from vehicles.
Reduce noise to levels below national and EC directives	Noise calculations	12	Equivalent noise level Laeq in dB(A)	Environmental office: Calculations and measurements	Secondary data analysis, calculations based on the traffic counts made by the Traffic and Public Transport Authority
SOCIETY					
Improved intra-organisational co-operation at the city level	Co-operation strategies	none	Descriptive	Own survey	Interviews with staff of relevant departments
Achieve extensive political and public awareness for TELLUS	Media response	13	Descriptive	Media analysis	Analysis of number, quality and coverage of media response and events organised within TELLUS
Improved public-private co-operation	Quality of co-operation	none	Descriptive	Own survey	Interviews with relevant public and private partners and stakeholders about their co-operation within the TELLUS project

List of Indicators

5.7 Environmental Zone for Heavy Duty Vehicles

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/ Nuisance	Emissions	NOx emissions	kg/year	Measured and calculated values	1) Measurements by the National Authorities and 2) Local vehicle measurements (on-board measurements, see ch 5)	1) M 12, M 24, M 36, M 48 2) M 22
		Air quality	NO_2	µg/m³	Calculated value	Local Environmental Authority and local stations of measurement	M 12, M 24 , M 36, M 48
	Resource consumption	Change in areas	Enlargement of Zone area	km^2	Measurement of the zone enlargement, calculations	Local WP Leader	M 42
Society	Awareness	Political and public awareness for TELLUS	Media response	Number of newspaper articles about the Environmental Zone	Quantitative, collected	Local WP Leader will collect material and analyse at the end of the project	Continuously with analysis M 42
	Acceptance	User acceptance	Attitude	Acceptance rating	Surveys and interviews	Local WP Leader	M 14, M 42

6.6 Incentives for purchasing of CNG Heavy Duty Vehicles

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/ Nuisance	Emissions	NOx emissions	kg/year	calculated values	Calculations made from the volume of sold gas from the fuel station	M 36
	Pollution/Nuisance	Emissions	NOx emissions	kg/year	Calculations gas compared to diesel vehicle	Local WP leader + partners	M 36
			CO2	kg/year	Calculations gas compared to diesel vehicle	Local WP leader + partners	M 36
			PM10	kg/year	Calculations gas compared to diesel vehicle	Local WP leader + partners	M 36
Energy	Resource Consumption	Consumption/use of CNG	Average fuel consumption	Nm³ gas per year	Measured consumption	Local WP Leader in co-operation with the haulers	M 36
Society	Acceptance	User acceptance	Attitude	Degree of satisfaction per driver/operator and/or customer	interviews	Local WP leader + partners	M 36
		Acceptance	Attitude, No of meetings with public sector	No of meetings	Interviews, no of meetings	Local WP Leader	Continously
Economy	Cost-related	Costs	Cost of haulage	SEK /ton km, SEK per turnover	Interviews with haulage contractors, logistic companies and customers	Local WP Leader	M 36

7.6 Environmentally optimised river shuttle

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/Nuisance	Air quality	Particulate level	µg/m³	Calculated value	Local WP leader	M 36
		Emissions	NOx	kg/year	measuread and calculated values	Emissions data from engine. Fuels consumption.	M 36
			Total hydrocarbon emissions	kg/year	measuread and calculated values	Emissions data from engine. Fuels consumption.	M 36
			CO2 emissions	kg/year	measuread and calculated values	Emissions data from engine. Fuels consumption.	M 36
Society	Acceptance/benefit	User acceptance/ satisfaction	Satisfaction of passengers	Satisfaction compared to normal diesel ferry	Collected data, surveys and interviews	Local WP leader	M 36
		Operator acceptance	Satisfaction of personnel operating the ferry	Satisfaction compared to normal diesel ferry	Collected data, surveys and interviews	Local WP leader	M 36
	Awareness	Publicity	Media response	No and quality of media coverage	Collection of articles	Local WP leader	M 36
Transport	Quality of service	Technical reliability	Accessibility	Percentage malfunction	measured and calculated values	logbooks, reports Analyses by project management	M 36
Economy	Cost of service	Cost	SEK per passenger	Cost per passenger and per running hour	measurements from ticketing system, calculated against running costs of operations	Project management will analyse.	M 36

9.5 Incentives for improving the load factor in inner city freight transport

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/Nuisance	Emissions	NOx emissions	kg/year	measured and calculated values	TFK	M 20, M 36
			Particulate emissions	kg/year	measured and calculated values	TFK	M 20, M 36
Society	Acceptance	Supplier acceptance	Suppliers´attitude	Satisfaction among suppliers (haulers)	Collected data, questionnaires or interviews	TFK	M 12
	Awareness	Publicity	Media response	No of articles or reports	Qualitative, survey	TFK	Continuously, starting month 1
Transport	Transport system	Freight Movements	Number of and weight of the consignments	$n^{o\ \&\ kg}$/every 3 month and for a selected group of companies	Collected data	Selected group of customers, suppliers in the area	M 20, M 24 M 27, M 30, M 33, M 36
			v-km for distribution vehicles	Total number of V-km	Quantitative, counted for a selected group of haulers and shopkeepers	TFK	M 20, M 24 M 27, M 30, M 33, M 36
		Congestion level	Number of cars passing in and out of the zone during a certain time	Experienced congestion	Quantitative and qualitative, counted for a selected group of haulers	TFK	M 20, M 36
Economy	Cost-related	Costs	Investment costs for hauliers	euro/year	Qualitative, survey	TFK	M 20, M 36
			Investment costs for the City of Göteborg	euro/year	Qualitative, survey	TFK	M 20, M 36

10.5 Consumer driven goods management from a Mobility Centre Base

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/Nuisance	Emissions	NOx emissions	kg/year	measured and calculated values	National authorities and local vehicle measurements	M 42
Society	Acceptance	User acceptance/ satisfaction	Attitudes buyer and supplier	Level of satisfaction	Survey, interviews	Local WP Leader	M 20, M 40
	Awareness	Publicity	Media Response	No of articles, reports, seminars	Collected data	Local WP Leader	Continuously during the project
Transport	Transport system	Freight Movements	Lorry traffic in specific area	N° of trips/year	Questionnaires, quantitative data	Local WP Leader	M 42

12.7 Promoting the introduction of clean vehicles in public and private fleet

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/Nuisance	Emissions	Fossile $C0_2$	Ton/year	calculated values	Number of sold clean vehicles	30, 42
	Number of cars	Emissions	Number of clean vehicles	Quantity of cars	Number of sold private clean vehicles in the region of Göteborg and number of clean vehicles in the municipal fleet.	Number of sold clean vehicles	30, 42
Society	Acceptance	User acceptance/ satisfaction	Attitudes buyer and supplier	Level of satisfaction	Survey, interviews	Local WP Leader	42
	Awareness	Publicity	Website visits	Number of website hits	Collected data from website	Local WP Leader	Continuously during the project

12.8 Introduction of clean waste collection vehicles

Evaluation Area	Evaluation Category	Impact	Indicator	Description	Methods of measurement	Sources of data	Time of measurement
Environment	Pollution/Nuisance	Emissions	NO_x emissions	kg/year	Emission measurement on vehicle in real traffic situation	Local WP Leader	M 29
			PM	kg/year	Emission measurement on vehicle in real traffic situation	Local WP Leader	M 29
			CO	kg/year	Emission measurement on vehicle in real traffic situation	Local WP Leader	M 29
			HC	kg/year	Emission measurement on vehicle in real traffic situation	Local WP Leader	M 29
			CO_2	kg/year	Emission measurement on vehicle in real traffic situation	Local WP Leader	M 29
		Noise	Noise	Operational mode LAeq/La1s dBA	Measured levels	Local WP Leader	M 27
Energy	Resource Consumption	Consumption/ use of CNG	Average fuel consumption	Nm³ gas per year	Measured consumption	Local WP Leader	M 29
		Consumption/ use of electricity	Average electricity consumption	kWh per year	Measured consumption	Local WP Leader	M 29
Society	Acceptance	User acceptance/ satisfaction	Attitudes drivers	Level of satisfaction	Interviews	Local WP Leader	M 42
	Awareness	Publicity	Media Response	No of articles, reports, seminars	Collected data	Local WP Leader	Continuously during the project

Transfer Guide to METEOR

	METEOR **Measure-level Result Template**		**TELLUS Göteborg** **Evaluation on demonstration measure level**
The Measure	M1: Measure objectives	Refer to the project's "Description of Work" for the measure objectives. In case the measure objectives have been changed over the course of the project, for example in the "Inception Report" or the "Local Evaluation Plans", please indicate these changes. Furthermore, changed objectives may be considered below in the process evaluation section (M12) in the "lessons learned block" of this template.	2.3 Objectives
	M2: Description of the measure	Describe what the measure was about. Provide a comprehensive and easy-to-understand (i.e. not a "technical") measure description, if possible, not exceeding 200 words.	2.1 Demonstration Design 2.2 Transport Plan Context
The Implementation	M3: Innovative aspects	Refer to the measure fiches in the project's "Description of Work" where "innovative aspects" are already mentioned. Any updates compared to the information provided in the "Description of Work" should be reported.	2.4 Ex-ante evaluation
	M4: Situation before CIVITAS	Refer to the measure fiches in the project's "Description of Work" where the situation before CIVITAS "innovative aspects" is described.	2.4 Ex-ante evaluation and situation before TELLUS
	M5: Design of the measure	Refer to the measure fiches in the project's "Description of Work" and, if applicable the Projects Implementation Report in order to report on the design of the measure.	2.1 Demonstration Design 3 Implementation process
	M6: Actual implementation	Describe which activities were carried out to implement the measure.	3 Implementation process

	M7: Deviations from the plan	Report on any deviation from the plan laid out in the “Description of Work”. From an evaluation perspective, it will be important to explain such deviations from the original plan, for example, if a measure was moved from one workpackage to another or if it needs to be explained why only a part of the measure could be implemented. If a conflict between the dissemination and the evaluation purpose of the template is perceived, indicate any "sensitive" information that should not be made public.	3 Implementation process 5 Conclusions
The Evaluation	M8: Method of measurement	• Provide an overview of the evaluation indicators used; • Describe the various evaluation activities carried out; • Report on the data sources, i.e. which “tools” (interviews, questionnaire, task observations, etc.) were used; • Describe the frequency of measurement (how often, when, during which period of time, etc.) and in which form data are available (for example time series data)?	4.1 Evaluation methods 4.2 Impacts
	M9: Achievement of quantifiable targets	Refer to quantifiable targets identified in the “Description of Work” and compare the actual achieved results with the originally envisaged targets. A tabular comparison would be sufficient. In case quantifiable targets have been changed over the course of the project, for example in the “Inception Report” or the “Local Evaluation Plans”, please indicate these changes. Furthermore, changed targets may be considered in the process evaluation section (M12) in the “lessons learned block” below.	4.2 Impacts 5 Conclusions
	M10: Achievement of evaluation-related milestones	Compare milestones formulated in the “Description of Work with actual achievement, for example: community travel plan completed. In case milestones have been changed over the course of the project, for example in the “Inception Report” or the “Local Evaluation Plans”, please indicate these changes. Furthermore, changed milestones may be considered below in the process evaluation section (M12) in the “lessons learned block” of this template.	3 Implementation Process

	M11: Report on the measure results	In this main, most elaborated and thereby expected to be longest section of the measure-level result template: • Report, discuss, interpret evaluation results; • Provide facts and explain them; • Elaborate on the actual contributions to measure objectives; • Describe whether there is a need for supplementary measures (not only within CIVITAS) to make the measure (more) successful; • Describe the potential up-scaling of the measure; • Offer visual presentations, for example graphs, maps, tables, etc.3 Information about achievements of quantifiable targets and/or milestones has been provided above (M9 and M10), however, in this section a textual explanation of the achievements is sought. Where possible units measured and results obtained should be referenced back to CIVITAS Core Indicators by stating indicator numbers in brackets (see METEOR Deliverable D2 "Assessment Framework and Evaluation Guidelines for Data Collection"); Where applicable, measures should contain the reference number used in the Local Evaluation Plans.	4.2 Impacts 5 Conclusions 6 Scenario
Lessons Learned	M12: Barriers and drivers of the measure implementation/ Process evaluation	The information provided in this section will be particularly useful for determining the transferability potential of the measure. Measure Leaders are asked to: • Provide a description of the measure context; • Elaborate on political/administrative, societal, economical, technical, and other factors influencing the measure implementation in a negative (barriers) or positive way (drivers); • Provide any other background information on the conditions prevailing during the measure implementation (process evaluation information), including changed objectives (see M1), quantifiable targets (M9) or evaluation-related milestones (M10).	3 Implementation process 5 Conclusions

	M13: Interrelationships with other measures	No templates need to be completed for the package level, since this level may not apply to every city, if, for example, only a handful measures are implemented in a city which are not in any way grouped or packaged. Nevertheless, it will be an imported part of the evaluation-, and more specifically the transferability-exercise, to analyse interrelationships between measures which complement each other and thereby form a group or package. List and explain the interrelationship of the measure with other complementary measures implemented in the CIVITAS city. Provide an assessment concerning the extent of the interrelationship between measures by choosing one of the following two categories: a) Low interrelationship or b) High interrelationship.	5 Conclusions
	M14: Lessons learned	CIVITAS is interested in identifying particularly successful measures with a high potential for replication and take up by other cities. This kind of information may directly lead into policy recommendations. Therefore, in this section: • Provide an assessment whether you consider the described measure to be a take-up measure for other cities. Explain why or why not? • Explain what the specific good lessons learned are. • Explain what the specific bad lessons learned are. • Formulate specific recommendations for cities considering replication or take-up of the measure as well as for other actors and the European Commission.	7 Recommendations 5 Conclusions