Measure title: **Public transport priority system in Tallinn, automatic stop calls and information signs in vehicle**

City: **Tallinn** *Project:* **SMILE** *Measure numbers:* **12.5 and 12.6**

A Introduction

Tallinn is the capital of Estonia and the centre of culture, economy and higher education in the country. With its 380,000 inhabitants, Tallinn is also the largest city in Estonia. Since the independence of Estonia in 1991, Tallinn has experienced large changes. An economic downturn has been followed by rapid economic growth. This has have imposed large structural changes on the city and its transport system. The number of private cars has been growing rapidly and the collective transport network has not developed at the same pace as the private modes thus facing huge competition. Between 1990 and 2000 public transport use fell from 250 to 94 million and the modal share of public transport in Tallinn collapsed from 77% to 31%.

The quality of public transport has affected virtually everybody in the city, but most of all women, children and elderly people who are most dependent on it. The massive shift to private car use has worsened the city's environment dramatically. Furthermore the old part of the city has been graded as a UNESCO World Heritage Site and preventing damage caused by traffic is urgent.

One of the reasons for this damage is congestion in the city centre due to the growing number of private cars. This has caused deterioration in the public transport service: journey times are increasing and trips have become more irregular. Tallinn has only 3.5 km of public transport lanes and no signalling system with priority signals is in place.

The City of Tallinn is responsible for of planning the route network, service level planning, coordination of time schedules, ordering of services and providing information to passenger. Transport services are currently procured from two city owned companies (TAK and TTTK) and one private bus company (MRP).

Tallinn City Council has approved the "Sustainable Development Plan for Public Transport" and is actively promoting better public transport in accordance with this plan.

A1 Objectives

The two measures **"Public transport priority system in Tallinn" (12.5) and "Automatic stop calls and information signs in vehicle" (12.6)** share the same objectives, as the first measure in this cluster involves the upgrading of basic infrastructure and second measure involves supporting public transport quality. It is important from the aspect of both visual and quality of information dissemination, but does not decrease journey times.

The general goal of the measures is to interrupt the decline in the use of collective passenger transport services in Tallinn. It will also prevent further decrease through increasing efficiency and speed and improving the image of collective passenger transport.

The indirect goal is to decrease car traffic and congestion in the city centre and to reduce use of fossil fuels and emissions.

The objective of the measures is to increase the number and proportion of journeys made by public transport using bus priority systems, updating traffic signals, implementing customised traffic and travel information for public transport operators and to improve the attractiveness of the public transport system through improved passenger information (electronic inside and outside displays and equipment for automatic stop-calls, as well as electronic displays approving that this information was delivered and accepted by the driver).

The major operational project goal is developing, demonstrating and assessing an innovative set of integrated transport measures. The establishment of a priority system for buses and trolley-buses in order will increase the modal share of collective passenger transport. At least 384 vehicles in Tallinn's public transport fleet were provided with electronic displays and equipment for automatic stop-calls. The solution for implementing this measure has to be complementary e.g. it should offer the possibility of adding real-time passenger information systems in the near future.

The measure objectives are to:

- **Objective 1 –**Reduce congestion in the city centre and improve air quality
- **Objective 2** - Reduce journey times
- **Objective 3** - Reduce scheduled journey times
- **Objective 4** - Increase the number of public transport users
- **Objective 5** -Increase the level of satisfaction with the information provided to public transport users from 35% to 60%
- **Objective 6 -** increase the reliability of public transport
- **Objective 7** -improve the attractiveness of public transport system through improved passenger information (electronic displays and equipment for automatic stop-calls) in at least 384 vehicles in the public transport fleet.
- **Objective 8** - increase the number of disabled people using public transport by 100%
- **Objective 9 -** give additional information about routes to drivers based on GPS

A2 Description

The most problematic streets and junctions and the duration of peak time delays to public transport were identified. This allowed the project team to define the areas where a feasibility study of the priority system should be carried out, and to propose detailed solutions. Next, a strategy for the future public transport priority system was prepared, based around the desire for an open, centrally managed priority system that can be further developed into a real time management and control system for public transport.

Different solutions were considered, including;

- public transport lanes;
- signalling system, for example, priority signals for public transport through installation of traffic control equipment on 24 intersections, together with stopping directly before the signals;
- adjusted traffic control, for example new one-way streets with two-way traffic for public transport, removal of car traffic from tram tracks, double stopping lines; and
- Automatic passenger counting in a number of vehicles, in order to obtain information about passenger flow and to optimise the timetables.

Implementation of the priority system was linked to the road construction plan, as construction and reconstruction projects had to observe the requirements of the priority system. Also the needs of long-distance and county lines were taken into consideration as much as possible, in order to secure a region-centred approach. The route chosen for implementation was based on

a criterion that at least 15% (11 lines) of public transport lines would use it and the automatic passenger counting equipment would be installed in the same number of vehicles. A number of serious discussions dealing with the location of public transport priority systems were held, as there were a number of different options, but the planned amount was limited.
Traffic priority for trams was eliminated during the first phase, as the number of tram passengers is relatively low and there is already existing priority introduced on a number of track sections. Thus the number of additional passengers as a result of increased travel speed and reduced journey times was estimated to be minor.

The route and transport mode choice was made on a basis of existing travel disturbances as well as estimated decrease in a quality of services in the coming years. The routes with higher passenger volumes located close to the centre, especially on a central direction were evaluated as a priority. One of the important criterion was also the possible estimated number of construction works, and this was proved at a later stage, as the construction works were really only finished on one intersection.

Electronic displays and equipment for automatic stop-calls have been installed in order to substantially raise the quality of public transport in a straightforward and cost effective manner. The same technical solution (hardware and software) has been used for all public transport modes within the city (bus, tram and trolleybus).

Figure A2.1 *Location of intersections*

The solution implemented comprised of:

- on-board displays for route number, route destination, stop name and possible connections to other bus lines,
- Displays outside vehicles for line number and route description. There is a mix of displays with line number and route description and displays only with line numbers.
- Equipment for audible information (automatic stop-calls) on-board. The automatic spoken message for the name of the next stop is given when the vehicle leaves the previous stop and the name of the stop and connections are given when the vehicle actually stops.

B Measure implementation

B1 Innovative aspects

Innovative Aspects:

- New organisational arrangements or relationships
- Use of new technology/ITS.

The innovative aspects of the measure are:

- **New organizational arrangements: regionally** – Extensive collective transport systems have not been implemented in the new (eastern) EU member states. This unique large-scale demonstration will produce information on the effects of public transport priority in accession countries and provide recommendations for transfer of the experience.
- **Use of new technology/ITS, locally**

– A technical solution giving information about routes of public transport vehicles based on GPS has been installed

– A technical solution for passenger information has been installed inside and outside vehicles.

B2 Situation before CIVITAS

The modal share for public transport modes in Tallinn collapsed during the last ten years from 77% to 31%. One of the reasons was congestion in the city centre due to the growing number of cars. Journey times increased and trips had become more unpredictable. Tallinn had only 3.5 k of public transport lanes and no signalling system with priority signals.

According to a passenger survey carried out in 2003, 69% of public transport passengers were satisfied with public transport, but only 36% of passengers were satisfied with information. At the same time all buses bought in recent years (126 buses) have been equipped with external displays and all public transport vehicles were equipped with loudspeaker systems even if they lacked equipment for automatic stop calls.

B3 Actual implementation of the measure

The evaluation template covers two measures that were treated separately in the rest of the project in administrative terms, but from the evaluation perspective could be treated as one complex issue as they both relate to the improvement of the public transport system.

Technical implementation involved a number of different actions, some which were directly related to each other and some which were largely independent. Thus the actions under every measure could be handled as stages, as listed below:

Measure 12.5 was implemented in the following stages:

Stage 1: APC equipments *(01.06 – 31.10.2005)* - On the chosen 6 buses and 6 trolleybuses, equipment for automatic passenger count system was installed and software for analysis was worked out.

Stage 2: System Calibration and APC analyse software checking (15.09 – 12.10.2006)

Stage 3: Intersections (15.05 – 31.07.2007) – On 16 out of the 26 intersections equipment for the public transport priority system was installed.

Stage 4: Vehicles (01.05 – 31.08.2007) – On the 20 buses (out of 63) and 10 trolleybuses (out of 48) equipment for the public transport priority system was installed.

Stage 5: Vehicles (01.09 –- 30.11.2007) **-** Installation of equipment on the remaining TAK 43 priority buses and 38 TTTK priority trolleybuses

Stage 6: Traffic scheme (15.05 – 31.07.2007) – Traffic schemes for the priority system on the 26 intersections and around 10 km of public transport priority lanes are completed.

The measure 12.6 was implemented in the following stages:

Stage 1: Vehicles (01.01 – 31.03.2008) – On TAK 172 buses (+20 trailers), 41 TTTK trolleybuses, 52 TTTK trams and 27 MRP buses, equipment for passengers information systems was installed, including board computers, automatic stop calls and interior and exterior signs.

Stage 2: Software (15.05 – 31.07.2007) – Software for board computers was prepared in 80% of total volume and was finished on the 31st of August as planned.

B4 Deviations from the original plan

Declination from the preliminary plan was caused partly because of the quality of preparation works, but mainly because of a lack of experience in public tendering processes and the way that it was approached for this project. The creation of tendering rules and conditions was rather complicated, particularly because of the need to fix all technical details prior to issuing tender documents, as well as the rules and conditions for transferring and managing the system in a way that would guarantee and ensure a common approach for all project partners (separate operators implementing one system). The points here are as follows:

Deviations for the measure 12.5

- **Deviation 1: APC equipments** *(01.06 – 31.10.2005)* – the creation of the data analysis software had some problems and in its final form it was not a completely user friendly solution. In particular there were some mistakes based on wrong odometer data, which led to problems in matching counts with location points on the lines monitored and which caused additional problems in analysis.

- **Deviation 2: Intersections** *(15.05 – 31.07.2007)* – because of the breakdown of the tendering process, the main works were finished in May 2008, but some additional works are not yet finished. In some places the regulation of two neighbouring intersections was achieved with one common controller, which is why the possibility to install equipment at more intersection was planned. The rest of the devices will be used in the near future and it will be possible to extend the priority routeing in a logical way.

- **Deviation 3: Vehicles** (15.05 – 31.07.2007) –**-** because of the breakdown of the tendering process, the main works were finished in May 2008, but some additional works are not yet finished. A planned investment provides the possibility to install more public transport vehicles than originally planned.

- **Deviation 4: Traffic scheme** (15.05 – 31.07.2007) – the planned period proved too short to complete the works due to both the volume of work and some external interference factors associated with the ongoing function of the city.

Deviations for the measure 12.6

- **Deviation 1: Vehicles** (15.05 – 31.07.2007) – significant problems were encountered in the official public tendering process for the information systems, priority systems and associated software. In total, three appeals were received during the tendering procedure, which resulted in a delay of 4 months of signing the procurement contract which delayed the process of fitting the instruments.

B5 Inter-relationships with other measures

The measure is related to other measures:

- **This is a cluster of measure 12.5 and measure 12.6**

Measure 12.5 provides a public transport priority system, which will improve the efficiency and speed of the public transport system in Tallinn. Measure 12.6 aims to build on this by improving the passenger experience by providing significantly improved information. Some indicators are inextricably linked between measures 12.5 and 12.6, especially in respect of changes in patronage.

C Evaluation – methodology and results

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1 *Indicators for clustered measures.*

NO.	INDICATOR	DESCRIPTION	DATA / UNITS
1	Average operating revenue	Ratio of total income divided by the vehicle -km	EEK/vkm
2	Operating costs	Costs per pkm	Euros/pkm, quantitative, derived or measurement
3	Vehicle fuel efficiency	Fuel used per vkm, per vehicle type	EEK/vkm, quantitative, derived or measurement
8	CO_2 emissions	CO_2 per vkm	G/vkm, quantitative, derived
9	CO emissions	CO per vkm	G/vkm, quantitative, derived
10	NOx emissions	NOx per vkm	G/vkm, quantitative, derived
11	Small particulate matter	PM10 per vkm	G/vkm, quantitative, derived
13	Awareness level	Degree to which the awareness of the policies/measures has changed	Index, qualitative, collected, survey
14	Acceptance level	Attitude survey of current acceptance with the measure	Index, qualitative, collected, survey
16	Relative travel cost	Percentage of the average public transport expenditures of the personal income	Qualitative, %
19	Quality of public transport service	Perception of quality of public transport services	Index, qualitative, collected, survey
21	Vkm by vehicle type - peak	Total run (km) per vehicle type per morning and evening peak hour	Vkm per morning and evening peak hour, quantitative, derived
22	Vkm by vehicle type - off peak	Total run (km) per vehicle type per off peak hour	Vkm per off peak hour, quantitative, derived
23	Average vehicle speed - peak	Average vehicle speed over fixed part of network during morning and evening peak hour	Km/hr, quantitative, derived
24	Average vehicle speed - off peak	Average vehicle speed over fixed part of network during off peak hour	Km/hr, quantitative, derived
26	Average modal split-PAX	Pkm per day and percentage of pkm for each mode	%, quantitative, derived
27	Average modal split-vehicles	Vkm per day and percentage of vkm for each mode	%, quantitative, derived
28	Average occupancy	Mean no. persons per vehicle/day	Persons/vehicle, quantitative, derived, measurement

Detailed description of the indicator methodologies:

- **Indicator 1** *Average operating revenue* – This indicator is calculated by the Tallinn City Transport Department based on the total revenue from all types of ticket sales covering all routes in Tallinn. Results are compiled based upon actual data supplied by the various operating companies and independent sales points. It is difficult to connect this indicator with this measure because the majority of ticket sales are by a monthly pass covering all lines (most people have a pass because it is economically beneficial), with few sales being on a journey by journey basis. Hence the operating revenue data is largely fixed and more affected by wider influences such as economic conditions than by improvements to the public transport system.
- **Indicator 2** *Average operating cost* – This indicator is calculated by the Tallinn City Transport Department based on the total cost data covering all operations in Tallinn. Results are compiled based upon actual data supplied by the various operating companies. It has been difficult to connect this indicator with this measure because it has not been possible for the operators supplying data to isolate costs for the vehicles running on priority lines from those which do not. Hence the data represents the whole fleet.
- **Indicator 3** *Vehicle fuel efficiency* – The indicator is calculated and based on data from the Department of Transportation, City of Tallinn. Data is expressed as fuel cost per km operated for the different public transport modes. It has not been possible to isolate definitive fuel / energy data for each mode because some of the operators consider this information to be commercially sensitive.
- **Indicator 8** *CO_2 emissions* – For data calculation the model TEMA 2000 was used and based on indicators 23, 24 and 27. CO_2 emissions produced by different vehicle categories of vehicles (passenger cars, light duty vehicles and heavy duty vehicles) on the basis of fuel consumption.
- **Indicator 9** *CO emissions* –For data calculation the model TEMA 2000 was used and based on indicators 23, 24 and 27. CO emission produced by different vehicle categories of vehicles (passenger cars, light duty vehicles and heavy duty vehicles) on the basis of fuel consumption.
- **Indicator 10** *NOx emissions* – For data calculation the model TEMA 2000 was used and based on indicators 23, 24 and 27. NOx emission produced by different vehicle categories of vehicles (passenger cars, light duty vehicles and heavy duty vehicles) on the basis of fuel consumption.
- **Indicator 11** *Small particulate matter* – For data calculation the model TEMA 2000 was used and based on indicators 23, 24 and 27. Small particulate matter produced by different vehicle categories of vehicles (passenger cars, light duty vehicles and heavy duty vehicles) on the basis of fuel consumption.
- **Indicator 13** *Awareness level* – Results for this indicator were obtained via a survey of public transport passengers. Interviews were carried out in November 2005 and April 2008. 400 people (all passengers who used public transport which ran on the dedicated lines for buses and trolleybuses) were interviewed in total.
- **Indicator 14** *Acceptance level* – Survey method was the same as for Indicator 13
- **Indicator 16** *Relative travel cost* – Results of this indicator were derived from Tallinn citizens' average income on the final quarter of 2007 (official statistical data) and their public transport use expenditures (monthly pass price at the same time).
- **Indicator 19** *Quality of PT service* – Survey method was the same as for indicators 13 and 14.
- **Indicator 21** *Vkm by vehicle type - peak* – Data collected by roadside counts during the peak periods (morning and evening) of a week day on the main priority route

- **Indicator 22** *Vkm by vehicle type -off peak* – Data collected by roadside counts during the peak hours on the main priority route
- **Indicator 23** *Average vehicle speed - peak* – Car speed data collected using the method "follow the leader" and GPS during peak periods (morning and evening) on a week day. Public Transport vehicles and speed data was collected using Automatic Passenger counters - electronic system, with optical sensors, odometer route recognition and software on the main priority route
- **Indicator 24** *Average vehicle speed - off peak* – Car speed data collected using the method "follow the leader" and GPS during the peak hours. Public transport vehicles and their speed was collected using APC on the main priority route
- **Indicator 26** *Average modal split-PAX* – Calculations based on indicators 27 and 28 car passenger manual counts and public transport passenger data based on APC
- **Indicator 27** *Average modal split-vehicles* – Calculations based on indicators 21, 22 and all day automatic traffic counts at different points of city but not coinciding with manual counts
- **Indicator 28** Average occupancy – APC data and calculations based on indicators 26 and 27

Table C1.2 *Data collection schedule*

Time for the study	Oct. – Nov. 2005	Oct. 2006	Oct. 2007	April 2008
Interview				
Sample size	400			400
Respondents	Public transport users on SMILE routes			Public transport users on SMILE routes
Aim	Baseline for indicators 13,14 and 19			After for indicators 13,14 and 19
Traffic counts				
Respondents	In 9 sections of streets during 9 hrs of the normal working day (7:00 – 10:00, 12:00 – 13:00 and 15:00 – 19:00)	In 9 sections of streets during 6 hrs of the normal working day (7:00 – 10:00, and 15:00 – 18:00)	In 9 sections of streets during 6 hrs of the normal working day (7:00 – 10:00, and 15:00 – 18:00)	In 9 sections of streets during 9 hrs of the normal working day (7:00 – 10:00, 12:00 – 13:00 and 15:00 – 19:00)
Aim	Baseline for indicator 9; 10; 11; 21; 26; 27 and 28	for indicator 9; 10; 11; 21; 26; 27 and 28	for indicator 9; 10; 11; 21; 26; 27 and 28	After for indicator 9; 10; 11; 21; 26; 27 and 28
Public transport users counting and trip time registration using APC system				
Respondents	All driving shifts for all public transport and SMILE routes have been measured during about one month	most of the driving shifts on important routes of SMILE have been measured during about one month	most of the driving shifts on important routes of SMILE have been measured during about one month	most of the driving shifts on important routes of SMILE have been measured during about one month
Goal	Baseline for indicator: 21; 23; 24; 26; 27 and 28	for indicator: 21; 23; 24; 26; 27 and 28	for indicator: 21; 23; 24; 26; 27 and 28	After for indicator: 21; 23; 24; 26; 27 and 28

Registration of car travel times with GPS device				
Respondents	12 – 16 car drives on parallel to SMILE routes during different periods			12 – 16 car drives on parallel to SMILE routes during different periods
Aim	Baseline for indicator: 23 and 24			After for indicator: 23 and 24

The 'before' situation was evaluated mainly based on special surveys carried out under SMILE activities. Some preliminary and parallel surveys were used also in a certain amount (passenger counts in Tallinn Tram project, annual traffic survey outside of SMILE routes in Tallinn)

Figure C2.1 *Public Schematic of the Automatic Passenger Counters (APC) system installed to 6 buses and 6 trolleybuses as a first step of the SMILE action.*

C1.2 Establishing a baseline

The baseline positions for Measures 12.5 and 12.6 were the situations before the measures were implemented in SMILE, i.e. the period 2005-2006.

C1.3 Building the business-as-usual scenario

Actual measurements of **2005-2006** were used to establish the recent trend line. Extrapolation based on this was used to establish the business as usual scenario for selected indicators. These results are presented in the graphs for the individual indicators in section C3. By taking this approach it is not possible to factor in the effect of the economic slow down in 2008 which is likely to have had an influence over a wider area than the measures themselves.

Figure C.1.2 shows the traffic flow changes on a SMILE route compared to the central area of Tallinn during the years which were used to build the business as usual scenario, as well as real changes for 2007 and 2008.

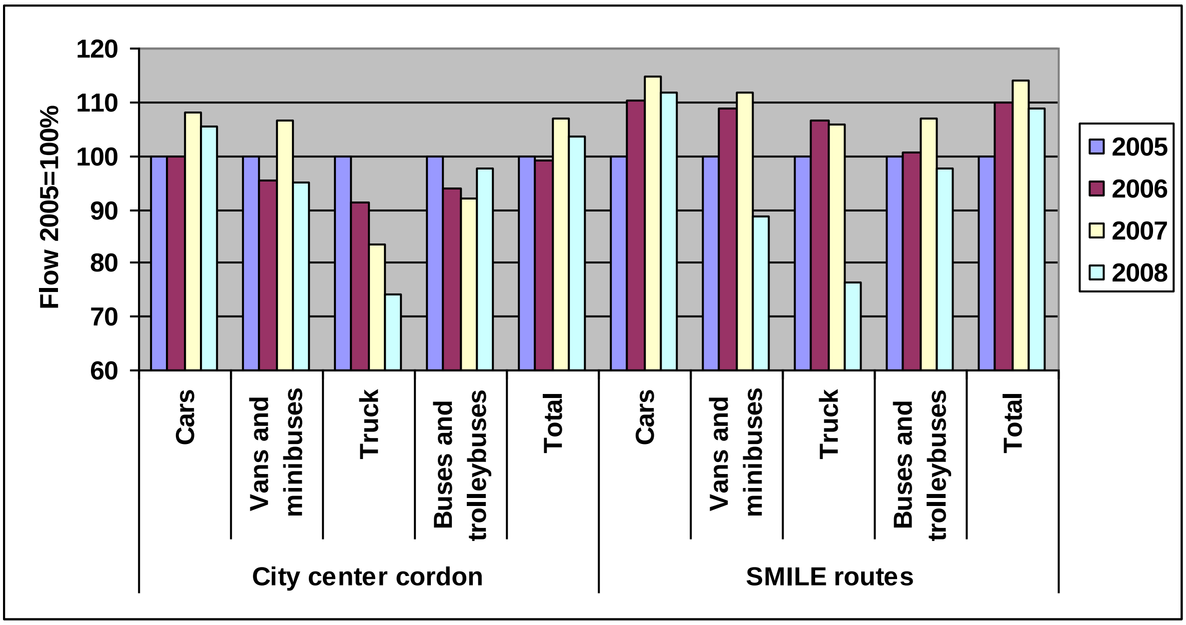


Figure C1.2 *Traffic changes trends*

C2 Measure results

An overview of the indicator changes during the project implementation (2005-2008) of both measures are listed as follows. The results are presented under sub headings corresponding to the areas used for indicators – economy, energy, environment, society and transport.

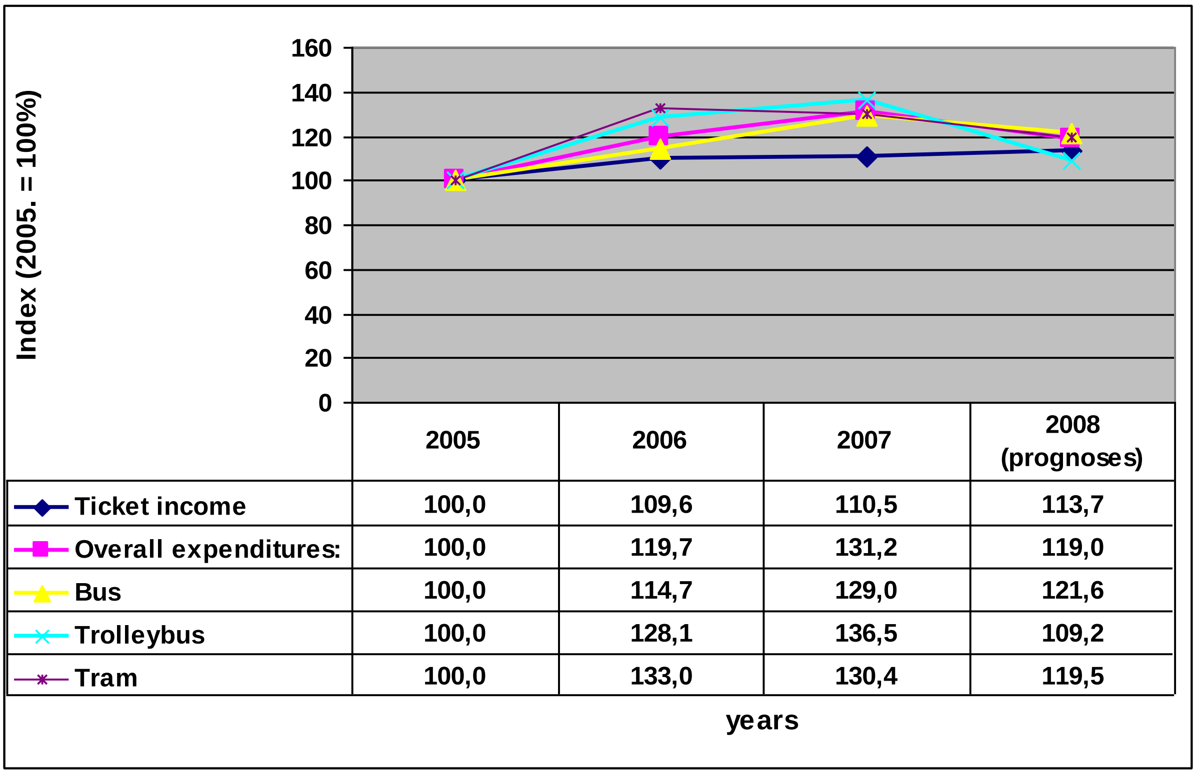
C2.1 Economy

- **Indicators 1 and 2** *Total and Operating costs* EEK/ vkm

Table C2.1 *Total and Operating costs* EEK/ vkm

	2005	2006	2007	2008 (prognoses)
Ticket income	7.52	8.24	8.31	8.55
Overall expenditures:	18.55	22.21	24.33	22.07
Bus	17.8	20.42	22.96	21.64
Trolleybus	18.15	23.25	24.78	19.82
Tram	24.08	32.02	31.41	28.78

EEK and EUR have a fixed rate of 1€ =15.6466.



	2005	2006	2007	2008 (prognoses)
Ticket income	100,0	109,6	110,5	113,7
Overall expenditures:	100,0	119,7	131,2	119,0
Bus	100,0	114,7	129,0	121,6
Trolleybus	100,0	128,1	136,5	109,2
Tram	100,0	133,0	130,4	119,5

Figure C2.1 *Index of Total and Operating costs* percent (2005 =100%)

Prognoses for 2008 showed the high decrease of public transport expenditures per v/km. The reason is that the Municipality reduced subsidies for this year by approximately 100 millions EEK, but the operating capacity is about the same.

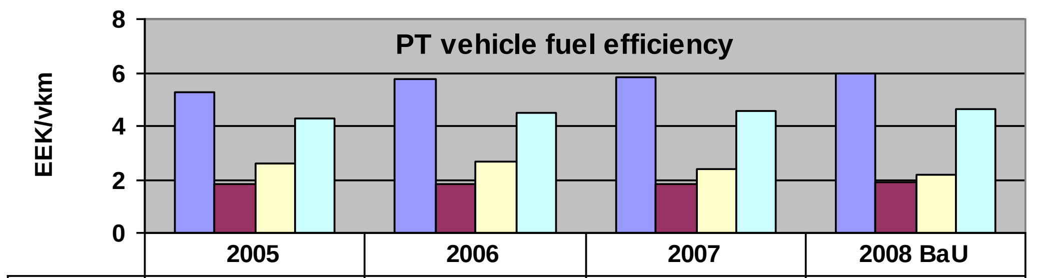
Explanation: ticket revenue will rise because tickets prices (including the ubiquitous travel passes purchased by the majority of the population) increased in 2008.
Original expenditure prognoses for 2008 are no longer correct, because additional payments have been made twice during 2008 to balance the budget. (Only from 05.01.2009 will it be possible to get the correct figures for 2008 expenditure.)

C2.2 Energy

Measure 12.5 would be expected to generate energy savings for buses because of the smooth traffic regime as a result of the priority system, but preliminary results are marginal. It is important that we notice increased energy consumption because of lower car traffic speeds. We can also follow a lower level of car use during the first months of 2008, which is probably based on slower economic growth and escalated increase of fuel prices, not so much with introduced measures.

Measure 12.6 should influence fuel consumption indirectly through an induced modal shift. Quantitative results for 2008 are not presented because the fuel price increased significantly each year At the same time bus companies replaced a large proportion of their old vehicle fleet with new buses which were not directly comparable in terms of energy efficiency and the purpose of this measure is not to evaluate the new buses but the priority and information system. These external factors are likely to outweigh any secondary impact from a change in passenger number resulting from the whole systems according to the SMILE project.

- **Indicator 3** *Vehicle fuel efficiency*



	2005	2006	2007	2008 BaU
Bus	5,29	5,74	5,83	5,93
Trolley	1,84	1,83	1,84	1,86
Tram	2,63	2,64	2,42	2,2
Average	4,26	4,5	4,58	4,66

years

Figure C2.2 *Public transport vehicle fuel efficiency*

C2.3 Environment

Measure 12.5 should have a direct influence on the environment. Every measure that increases the proportion of journeys by public transport influences the environment.

Measure 12.6 should influence the environment indirectly.

- **Indicator 8** *CO_2 emissions*

Taking the whole of the city centre as the area in which the measures are implemented for emission reduction, modelling purposes and vehicle kilometre values in the TEMA model (see annex 1) are presented in table C2.2

Table C2.2 *Total vehicle-kilometres*

	1000 vehicle-kilometre project scenario				
	Pass. car	Bus	Truck	Van	Total
2005	82 120	1 127	2 843	7 515	93604
2006	90 552	1 100	2 972	8 195	102819
2007	94 253	1 069	2 992	8 549	106863
2008	91 855	1 278	1 807	6 996	101936

The TEMA model yielded the following results for total CO_2 emissions by mode (Table C2.3).

Table C2.3 *Total CO_2 emissions by mode*

	CO2 emissions (tonnes) project scenario				
	Pass. car	Bus	Truck	Van	Total
2005	19 736	1 328	2226	2612	25902
2006	21 695	1 284	2269	2841	28090
2007	22 364	1 234	2213	2959	28771
2008	21 583	1 469	1289	2417	26758

And the following results in terms of CO_2 emissions per vkm by mode (Table C2.4).

Table C2.4 *CO_2 emissions per vkm by mode*

	CO2: g/vkm					
	Pass. car	Bus	Truck	Van	Total	Total (inc flows of trolley buses)
2005	240	1178	783	348	277	270
2006	240	1168	764	347	273	267
2007	237	1155	740	346	269	265
2008	235	1150	713	346	262	259

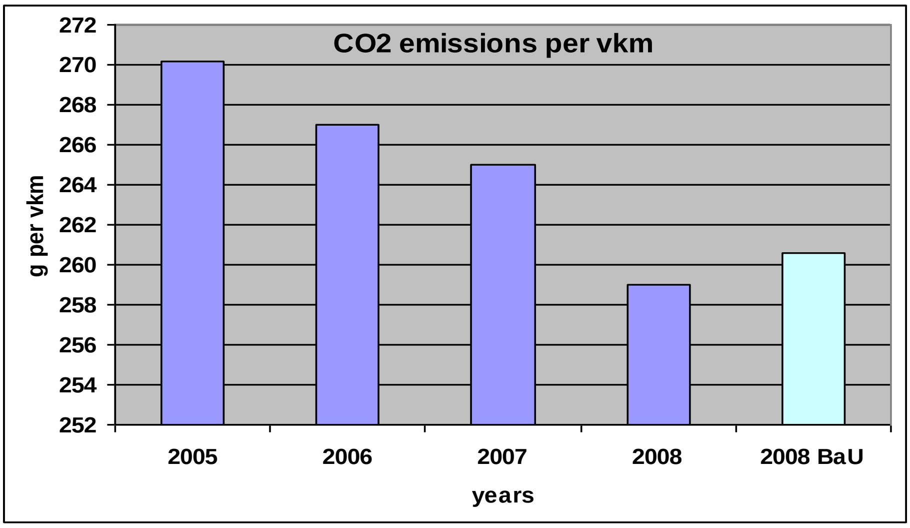


Figure C2.3 *CO_2 emissions during the period 2005 - 2008*

BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

It is apparent that there is a reduction in CO_2 emissions per vkm shown for cars, buses and trucks When combined with the total vehicle kilometre data this leads to an increasing trend in total CO_2 emissions from 2005-2007, which is reversed in 2008. This overall reduction in CO_2 emissions is largely driven by a reduction in car, van and truck vehicle kilometres driven in 2008, which when taken with a slight increase in bus kilometres driven leads to an increase in the proportion of total vkm for passenger cars. This is the driving force behind the reduction in the overall value for CO_2 emissions per vkm.

In terms of relating this to the measures, it appears that the most likely influence here is the economic slowdown, which is driving the changes in overall vehicle km numbers. However, it is encouraging that the CO_2/vkm figures for each individual mode have decreased.

- **Indicator 9** *CO emissions*

The TEMA model yields the following results for total CO emissions by mode (Table C2.5).

Table C2.5 *Total CO emissions by mode*

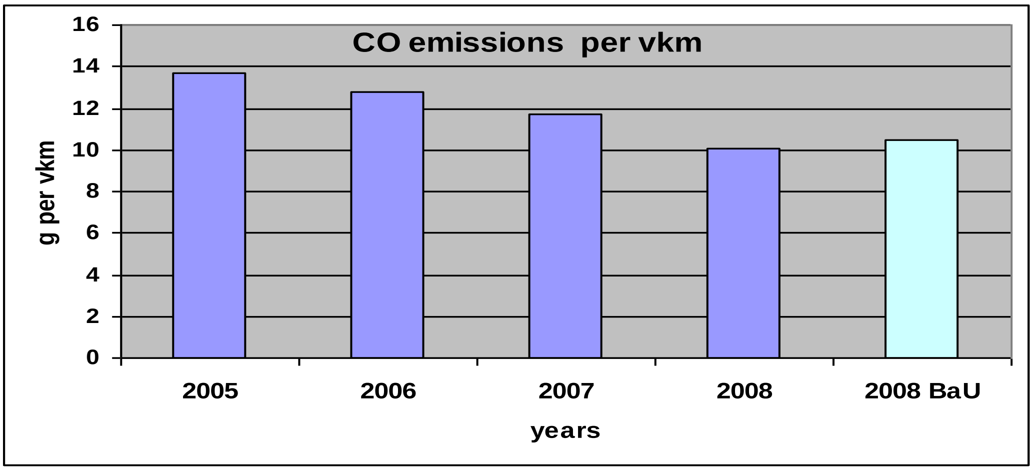
	CO emissions (tonnes) project scenario				
	Pass. car	**Bus**	**Truck**	**Van**	**Total**
2005	989	37	215	73	1314
2006	1 040	31	205	77	1353
2007	998	22	177	75	1271
2008	889	18	89	56	1052

:

And the following results in terms of CO emissions per vkm by mode (Table C2.6).

Table C2.6 *CO emissions per vkm by mode*

	CO/vkm					
	Pass. car	Bus	Truck	Van	Total	Total (inc flow of trolleybuses)
2005	12.0	32.9	75.5	9.7	14.0	13.8
2006	11.5	28.0	68.9	9.4	13.2	13.0
2007	10.6	20.4	59.0	8.8	11.9	11.7
2008	9.7	14.1	49.1	8.1	10.3	10.2



BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.4 *CO emissions during the period 2005 – 2008*

- **Indicator 10** *NOx emissions*

The TEMA model yielded the following results for total NOx emissions by mode (Table C2.7).

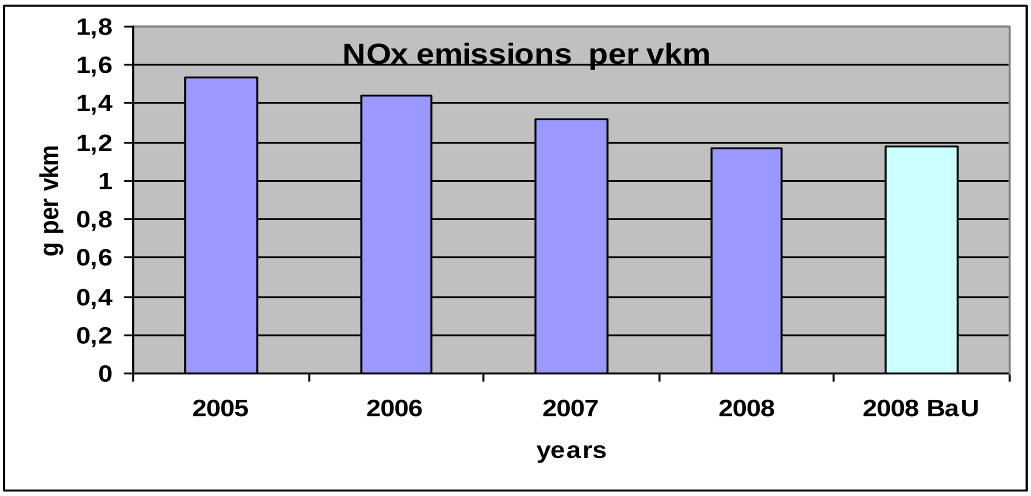
Table C2.7 *Total NOx emissions by mode*

	NOx emissions (tonnes) project scenario				
	Pass. car	Bus	Truck	Van	Total
2005	93	15	27	12	147
2006	97	14	27	13	151
2007	92	13	25	12	143
2008	81	15	14	9	120

And the following results in terms of NOx emissions per vkm by mode (Table C2.8).

Table C2.8 *NOx emissions per vkm by mode*

	NOx/vkm					
	Pass. car	Bus	Truck	Van	Total	Total (inc flow of trolleybuses)
2005	1.1	13.1	9.5	1.6	1.6	1.5
2006	1.1	12.7	9.0	1.5	1.5	1.4
2007	1.0	12.4	8.5	1.4	1.3	1.3
2008	0.9	12.0	7.8	1.3	1.2	1.2



BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.5 *NO_x emissions during the period 2005 – 2008*

- **Indicator 11** *Small particulate matter*

The TEMA model yields the following results for total PM10 emissions by mode (Table C2.9)

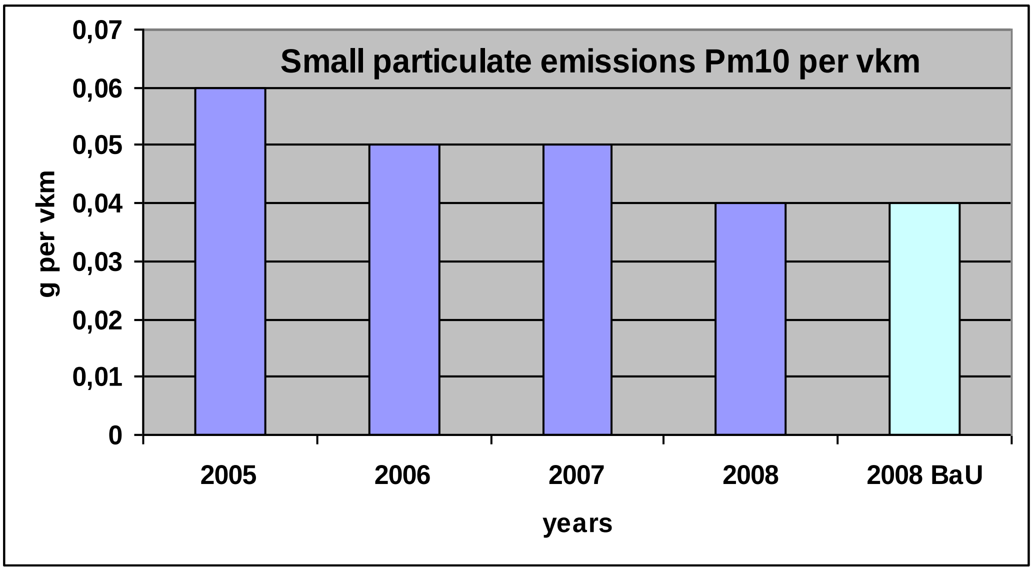
Table C2.9 *Total PM 10 emissions by mode*

	PM10 emissions (tonnes) project scenario				
	Pass. car	Bus	Truck	Van	Total
2005	2,3	0,6	1,5	0,9	5,4
2006	2,5	0,5	1,5	0,9	5,5
2007	2,5	0,5	1,4	0,9	5,2
2008	2,3	0,6	0,7	0,6	4,2

And the following results in terms of PM10 emissions per vkm by mode (Table C2.10).

Table C2.10 *NOx emissions per vkm by mode*

	PM10/vkm					
	Pass. car	Bus	Truck	Van	Total	Total (inc flow of trolleybuses)
2005	0.03	0.50	0.54	0.12	0.06	0.06
2006	0.03	0.49	0.50	0.11	0.05	0.05
2007	0.03	0.48	0.46	0.10	0.05	0.05
2008	0.03	0.47	0.41	0.09	0.04	0.04

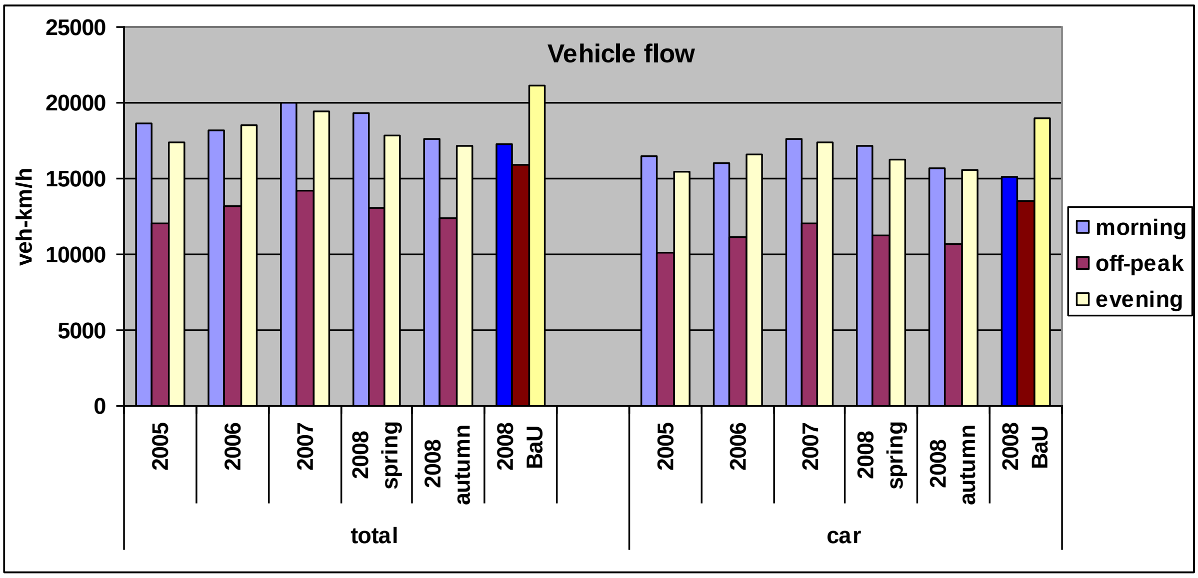


BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.6 *Small particulate emissions during the period 2005 – 2008*

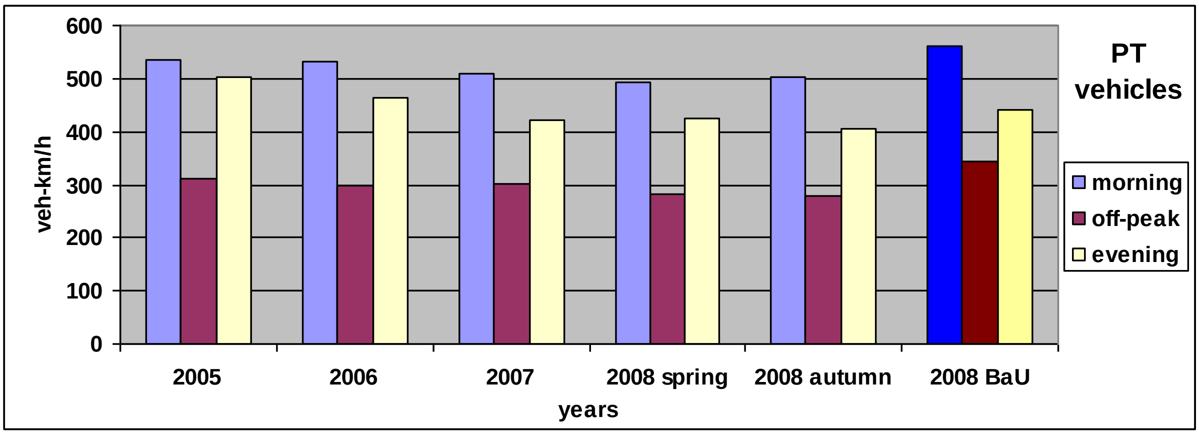
C2.4 Transport

- **Indicators 21 and 22** *Vkm by vehicle type – peak and off-peak*



BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.7 *Vkm by vehicle type – peak and off-peak during the period 2005 – 2008*

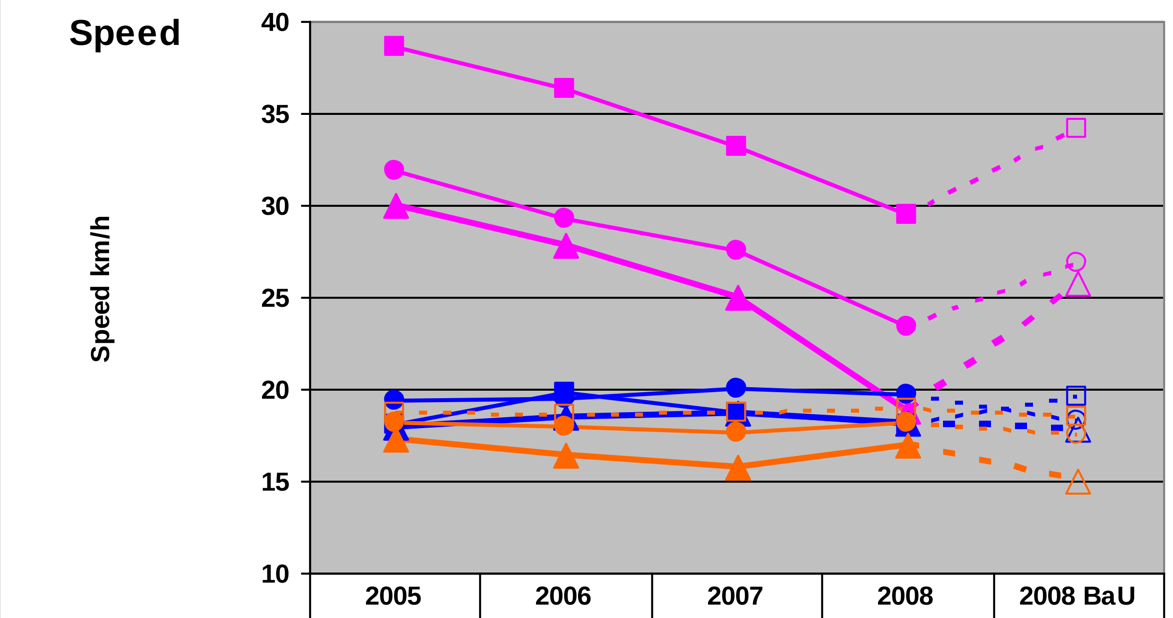


BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.8 *Public Transport Vkm*– peak and off-peak during the period 2005 – 2008

Figure C2.7 shows that the majority of vehicles on the selected transport route are cars, both before and after the introduction of the priority routes. The reduction in car traffic in 2008 is reflected in the reduction in the total number of vehicles on this route. The traffic forecast of the total traffic as well for the car traffic based on 2005 and 2006 traffic or Business as usual scenario was in a good harmony with existing traffic situation for the morning peak period, when the differences in the off-peak and evening peak periods were noticeable.

- **Indicators 23 and 24** *Average vehicle speed – peak and off peak hours*



	2005	2006	2007	2008	2008 BaU
car, morning	31,8	29,2	27,5	23,4	26,8
car, off-peak	38,6	36,3	33,1	29,5	34,1
car, evening	30,0	27,8	25,0	18,8	25,8
bus, morning	19,3	19,5	20,0	19,7	18,3
bus, off-peak	18,0	19,8	18,7	18,0	19,6
bus, evening	17,9	18,5	18,7	18,2	17,8
trolley, morning	18,2	17,9	17,6	18,1	17,5
trolley, off-peak	18,7	18,6	18,7	18,9	18,5
trolley, evening	17,3	16,4	15,8	17,0	15,0

BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.9 *Average vehicle speed – peak and off peak hours during the period 2005 – 2008*

The data in Figure C2.9 showed that in general the speed data for public transport is marginally better than expected in the business as usual scenario for 2008. (The exception to this is off peak bus travel.) In contrast average car speeds have dropped at all times of the day in comparison to the business as usual scenario for 2008. The business-as-usual scenario was created based on two preliminary years, when a much smaller decrease was planned compared to what actually occurred.

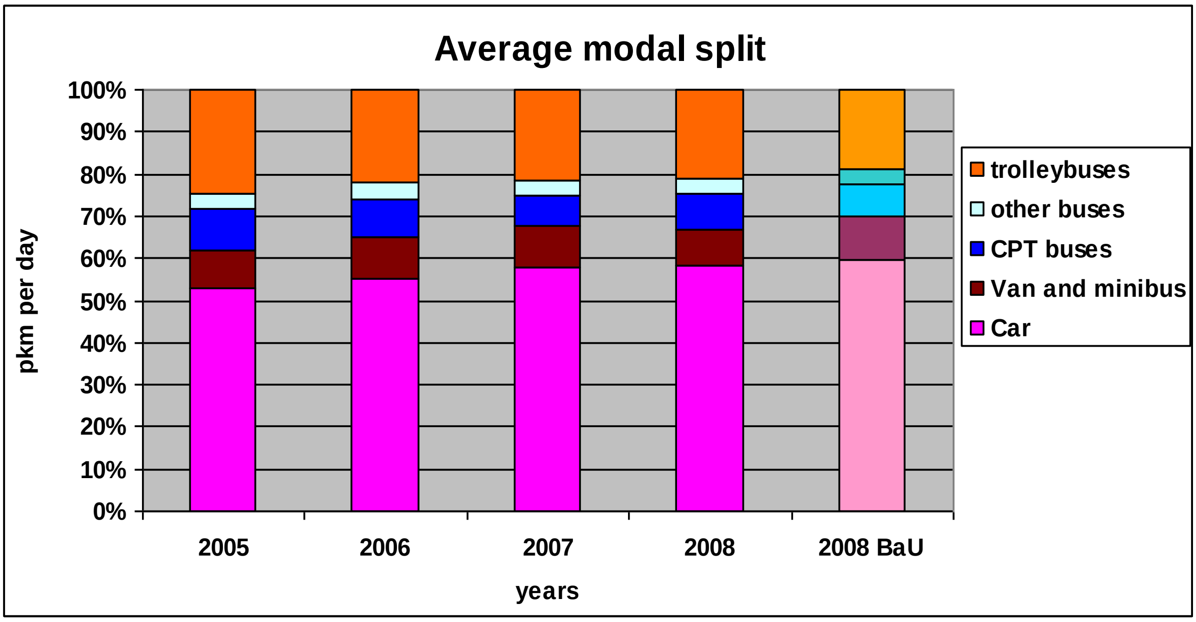
- **Indicator 26** *Average modal split-PAX* - Average pkm/day

Table C2.11 *Average modal split-PAX* - Average pkm/day

Type of vehicle	2005	2006	2007	2008	2008 BaU
Car	303734	334919	348650	339739	388264
Van and minibus	51469	58630	60251	47920	66443
CPT buses	54249	55218	43801	49563	50517
other buses	20483	22147	21483	22600	23362
trolleybuses	142074	134206	130514	122159	122106
Total	**572010**	**605120**	**604699**	**581981**	**650692**

Table C2.12 *Average modal split-PAX percent*

Type of vehicle	2005	2006	2007	2008	2008 BaU
Car	53%	55%	57%	59%	60%
Van and minibus	9%	10%	10%	8%	10%
CPT buses	9%	9%	7%	8%	7%
Other buses	4%	4%	4%	4%	4%
Trolleybuses	25%	22%	22%	21%	19%
Total	**100**%	**100**	**100**	**100**	**100**



BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.10 *Average modal split-pkm*

The passenger kilometre data in Figure C2.10 indicates that there has been a slowing in the general decline in use of public transport in 2008 in comparison to the business as usual scenario for 2008. This is most noticeable for the trolleybuses and public transport buses. In fact, the modal split data in 2008 is almost a complete repeat of the data in 2007 in terms of % split.

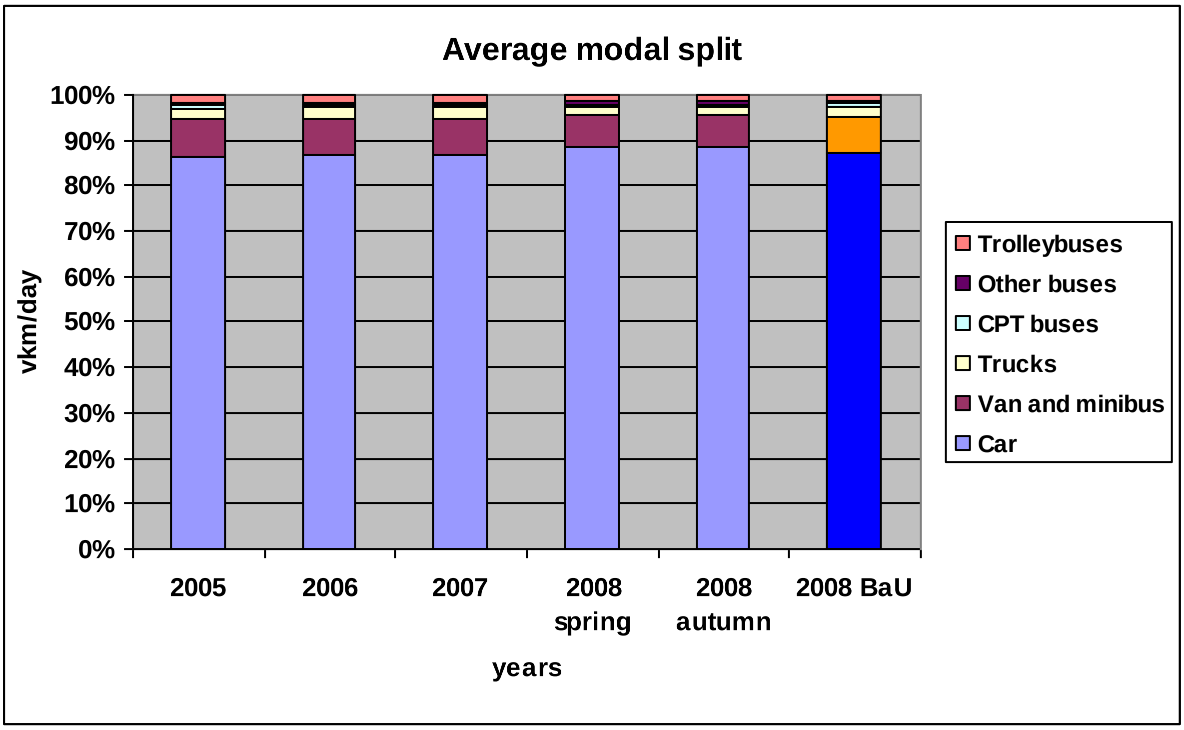
- **Indicator 27** *Average modal split-vehicles* - Average vkm/day

Table C2.13 *Average modal split-vehicles vkm/day*

Type of vehicle	2005	2006	2007	2008 spring	2008 autumn	2008 BaU
cars	**224988**	**248088**	**258260**	**251658**	**246013**	**287603**
vans and minibuses	21588	23452	24100	19168	19187	26577
trucks	6476	6913	6843	4950	4940	7628
CPT buses	2132	1965	2083	1850	1955	1856
other buses	1280	1384	1488	1650	1689	1557
trolleybuses	4384	4508	4761	4123	4041	4716
Total	**260848**	**286310**	**297534**	**283399**	**277825**	**329938**

Table C2.14 *Average modal split-vehicles (percent)*

Type of vehicle	**2005**	**2006**	**2007**	**2008 spring**	**2008 autumn**	**2008 BaU**
Car	86.3%	86.7%	86.8%	88.8%	88,5%	87.2%
Van and minibus	8.2%	8.2%	8.1%	6.8%	6,9%	8.1%
Trucks	2.5%	2.4%	2.3%	1.7%	1,8%	2.3%
CPT buses	0.8%	0.7%	0.7%	0.7%	0,7%	0.6%
Other buses	0.5%	0.5%	0.5%	0.6%	0,6%	0.5%
Trolleybuses	1.7%	1.6%	1.6%	1.5%	1,5%	1.4%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**



BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

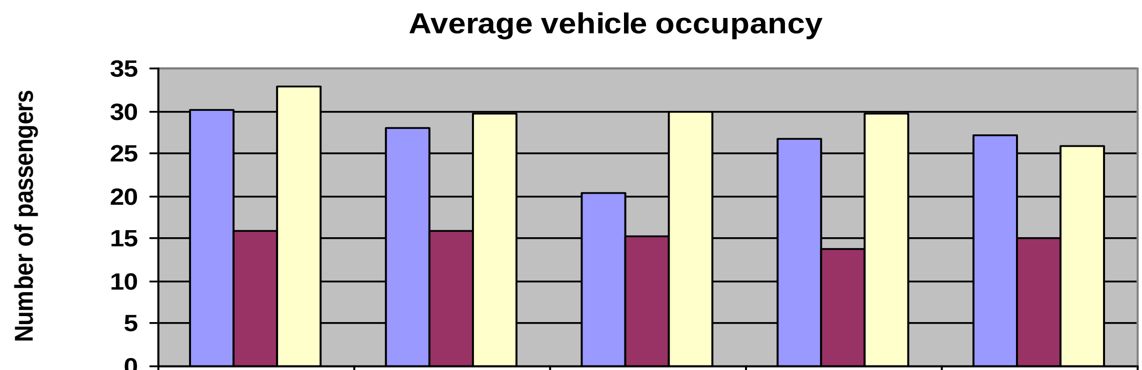
Figure C2.11 *Average modal split-vkm*

The vehicle kilometre data in Figure C2.11 indicate that both cars and buses have taken a slightly increased share of total traffic in 2008 compared with the business as usual scenario for 2008. This is because the proportion of commercial vehicles (vans, trucks and minibuses) has decreased compared with 2007 and the business as usual scenario for 2008, which could be related to the economic slow down in 2008.

- **Indicator 28** *Average occupancy*

Average occupancy data for cars, vans and coaches (regional, intercity, tourism and others) is based on external survey data. The constant data is used for first two classes. Car occupancy was surveyed as well under this project, where the occupancy was between 1.32 and 1.41.

cars	1.35
vans and minibuses	2.5



	2005	2006	2007	2008	2008 BaU
PT buses	30,2	28,1	20,3	26,8	27,2
other buses	16,0	16,0	15,2	13,7	15,0
trolleybuses	32,9	29,8	29,9	29,6	25,9

BaU – calculations for the business-as-usual scenario in comparison with the actual data for 2008

Figure C2.12 *Average occupancy*

There were some reasons why bus occupancy rate decreased in 2007. For example:

- on line 17a more buses were added in comparison with 2006, but the number of passengers carried decreased temporarily (it is now back at the same level as at 2006); and
- the number of passengers carried were at a low level on lines16, 23, 23A, 46 and 48, but the number of buses didn't change in 2007.

C2.5 Society

- **Indicator 13** *Awareness level*

Results for indicator 13 in respect of measure 12.5 are shown in Table C2.10.

Table C2.15 *Awareness level of the Measure, indicator 13 (%) of Measure 12.5*

Answers	2005	2008	Changes
Completely aware	19	51	+ 32
Partially aware	48	16	- 32
Not aware	33	33	- 0

Complete awareness has raised by32%. In 2005 less than 1/5 of citizens interviewed were completely aware of the measure. By 2008 this had increased to half of respondents. However, it seems that it is those who had partial knowledge of the system who have become aware, and there is no evidence of a change amongst those who do not know about the bus priority system.

Results for indicator 13 in respect to Measure 12.6 are shown in Table C2.11.

Table C2.16 *Awareness level of the Measure, indicator 13 (%) of Measure 12.6*

Answers	2005	2008	Changes
Completely aware	62	71	+ 9
Partially aware	34	13	- 21
Not aware	4	17	+ 12

Complete awareness has increased by 9%, but at the same time proportion of the passengers who had no knowledge of the measure rose too, which is surprising and difficult to explain.

- **Indicator 14** *Acceptance level*

Results for indicator 14 in respect Measure 12.5 are shown in Table C2.12.

Table C2.17 *Acceptance level of the Measure, indicator 14 (%) of Measure 12.5*

Answers	2005	2008	Changes
Very high acceptance	17	52	+ 35
Moderate acceptance	36	11	- 25
Neutral	10	5	- 5
Moderate antagonism	3	4	+ 1
Very high antagonism	33	30	- 3

Very high acceptance level has risen by 35%, which is very positive result.
It increased mainly because the second category – moderate acceptances, decreased a lot. The total of the two accepting categories only increased by 10%.

During the interviews respondents were asked about their emotional opinion of the measure "priority lines for buses and trolleybuses". In particular, respondents were asked to name the main factors why this measure is or is not very effective. The main answers are in the next table.

Table C2.18 *Main factors influencing the Measure (%)*

Cars use the priority PT lines	31
Priority lines don't influence PT service level	13
Measure has been operated too short time to have opinion	11
Other comments	15

Results for indicator 14 in respect to Measure 12.6 are shown in Table C2.14.

Table C2.19 *Acceptance level of the Measure, indicator 14 (%)*

	2005	2008	Changes
Very high acceptance	26	58	+ 32
Moderate acceptance	53	11	- 41
Neutral	10	9	- 1
Moderate antagonism	6	4	- 2
Very high antagonism	5	18	+ 13

Very high acceptance level has risen by 32%, which is a positive result. It rose mainly because the second category – moderate acceptances, decreased a lot. The total of the two accepting categories decreased by 9%.

It is also evident that the level of very high antagonism to the stop calls and information system between 2005 and 2008. We feel that this could be a result of raised expectations which have not been satisfied amongst a proportion of the population.

During the interviews, respondents were asked about their emotional opinion of the measure "Automatic stop calls and information signs in vehicles". The main answers are in the next table.

Table C2.20 Main factors influencing the measure (%)

I don't watch them	46
There is often wrong information (name of the stops are shifted)	22
Advertisements are not interesting	13
Local people know anyway, foreigners can't understand the information	4
Other comments	15

- **Indicator 16**

Relative travel cost for regular users of Tallinn's public transport is on average 2% of personal income.
It is 2% of a respondent's personal income if ticket is purchased using the new ID smartcard system which offers user discounts and 2% if the ticket is purchased using cash.

- **Indicator 19** *Quality of PT service*

The four sub-indicators evaluated under indicator "Quality of the service": Results are in the next table.

Table C2.21 Quality of service (%)

		2005	2008
Trip distance	*very important*	18	46
	important	51	38
	slightly important	28	14
	unimportant	2	1
	can't say	1	1
Time keeping	*very important*	58	64
	important	37	30
	slightly important	4	5
	unimportant	0	0
	can't say	0	0
Information in vehicle and stop call	*very important*	27	62
	important	60	27
	slightly important	9	8
	unimportant	3	2

		2005	2008
	can't say	0	0
Vehicle comfort	*very important*	23	54
	important	48	39
	slightly important	23	5
	unimportant	4	0
	can't say	2	0

Results of the 4 sub-indicators have increased, when comparing 2005 and 2008. The biggest increase is for "information in vehicle" and "stop call".

General conclusion of the indicator 19 is that public transport users evaluated the quality of service very highly all ready at 2005. However over 3 years, at 2008 their opinion about public transport service levels is noticed much more. This opinion must be considered by politicians and decision makers, in order to get more citizens to use public transport.

C3 Achievement of quantifiable targets

No.	Target	Rating
1	Reduction of congestion in the city centre and to improve air quality	0 ★
2	Reduction of travel time	NA*
3	Reduction of scheduled journey times	NA*
4	Increase in the number of public transport passengers	★
5	Increase in the level of satisfaction of public transport users and level of satisfaction with the information of public transport users from 35% to 60%.	★
6	To increase reliability of public transport	NA
7	To improve the attractiveness of public transport system through improved passenger information	★★
8	100% increase of the disabled people in public transport	NA
NA = Not Assessed 0 = Not achieved ★ = Substantially achieved (> 50%) ★★= Achieved in full ★★★= Exceeded		

* - because of the late introduction of the measure, public transport vehicles drive with free timetables and some decrease of the time spent existed. Unfortunately the measure's influence was too short in order to make important decisions, as the part of the street network in the centre of Tallinn was closed for reconstruction. Even though public transport can pass through the closed area the situation is not typical and comparable. Only in autumn 2008 will it be possible to start data collection for the creation of new timetables. Surveys made under SMILE-project can give us certain hopes.

1. The congestion in the centre increased significantly, mainly as a result of increase in car traffic. At the same time the number of traffic lanes for cars decreased somehow. This is a significant decrease in average speed of cars. (see Figure C2.9). At the same time there was some links were the car traffic conditions even improved a little, which could be explained by traffic division characteristics. An improvement in air quality could be explained by rapid renovation of the car fleet, rather than traffic conditions improvement. Since October 2008 and up to June 2009 it is impossible to survey any objective change on SMILE routes as one of the key sites of SMILE routes is closed for traffic for construction of an underground car park and the dedicated bus lines does not work completely as planned. The total car usage in Tallinn was estimated to decrease during 2008.

2. As the system introduction was delayed, the time period for evaluation was too short, as the normal traffic was not used with specific new conditions. Thus it was also impossible to carry out some special surveys, in order to introduce new timetables for public transport. The reasons mentioned above mean similar surveys could be carried out before the fall of 2009.
3. Same reasons as listed above
4. The car ownership increase has reduced as a result of the economic situation (see Figure C3.1). Some additional surveys show even some slight decrease in the autumn of 2008. That is why public transport usage was also increased, but this does not to explain the positive effect of SMILE project.
5. It could be estimated that the satisfaction with public transport quality has increased because of the new information devices in public transport vehicles from one side and the harmonisation of the outlook of vehicles and a bigger share of new vehicles
6. Same as 2 and 3 above.
7. Same as 5 above
8. See key result 5.

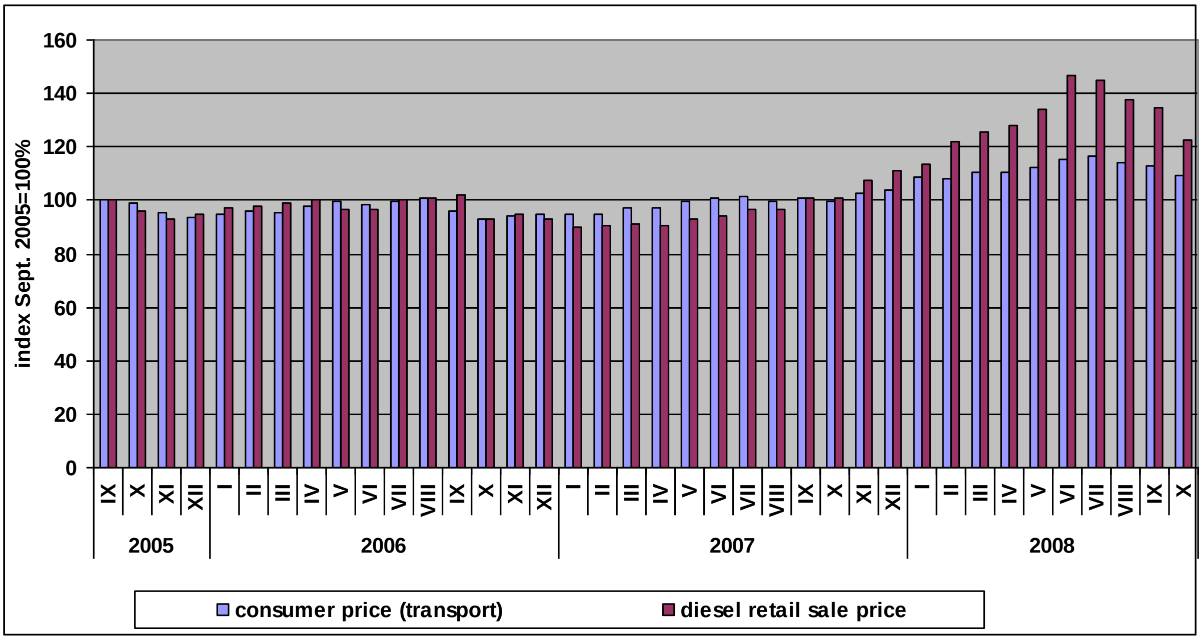


Figure C3.1 *Change of consumer price in transport sector (Statistics Estonia) and retail sale price of diesel (unofficial) during the evaluation period*

C4 Up-scaling of results

Measure 12.6, information and stop calls, has been applied to the vast majority of the public transport fleet and so there is little opportunity for further immediate up-scaling. Any new vehicles purchased in the future will be equipped with this system as standard.
Some scope exists to implement Measure 12.5, the priority system, more widely. By 2015, it would be practical to upgrade all buses and lines. However, they only have a 2 year financial plan, so it is impossible to plan that far ahead. EC funding is still important to Tallinn and actual implementation in the future may well depend on where EC money can be directed.

C5 Appraisal of evaluation approach

The indicators for evaluation were adequate, but the influence of the Measures was rather modest. The sharp deceleration in economic growth and the rapid increase in fuel prices, starting from the beginning of 2008, are likely to have a more significant influence on issues such as traffic levels.

The timing of the evaluation process was too early in relation to the time when the implementation finished (because of the delays that resulted from the formal state procurement process and the instrument fitting process). The final result would have been more objective, and allowed the public to develop clearer opinions of the measure, if the evaluation process could take place later when people had become accustomed to the new system. Some more detailed questions could have been added to the questionnaire.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1** – the most obvious direct result is a reversal of the speed decrease on SMILE routes for trolleybuses - the 2008 value is 2 km/h is higher on evening peak hour compared with the Business-as-usual scenario and comparable with the value from 2005. At the same time car speeds on same route decreased by 11.2 km/h compared with 2005. The reasons here are based on real car traffic growth on the one hand, as well as the increased use of bus lanes, which causes a decrease in a number of car lanes in certain cross sections.
- **Key result 2** – Objective 4 - the previous steady decline in the modal share of public transport (in terms of passenger kilometres) has been halted in 2008. However, the measures implemented have not managed a significant reverse in the trend.
- **Key result 3** – Objective 5 - Increase level of satisfaction with the information of public transport users from 35% to 60%. This objective is almost completely fulfilled.
- **Key result 4** – Objective 7 - To improve the attractiveness of public transport through improved passenger information is fulfilled. Interview results showed that public transport users generally approved of it. Interviewed people evaluated this measure as very effective, although there was also evidence that the measure led to polarised views as to whether the measure was effective or not.
- **Key result 5** – Objective 8 - 100% increase of the disabled people in public transport. In December 2007 the EU financed project "Public Transport Systems' Accessibility for People with Disabilities in Europe" finished. Estonia took part in this project. The interviewed people from various different organisations estimated that the accessibility of public transport passenger information is good in Tallinn. Overall opinion was that this measure should increase public transport usage by disabled people, especially inhabitants with visual and hearing impairments. But currently there is no evidence of disabled people public transport usage before the measure implementation or today.

D Lessons learned

D1 Barriers and drivers

D1.1 Barriers

- **Barrier 1** – Repeated failures with state procurement proceedings were the main reason why the instrument procurement, installation and assignment process didn't follow the timetable.
- **Barrier 2** – However, the failings in the procurement process were in part the result of poor specification and planning of the tasks to be carried out, which could have avoided subsequent problems. For example, some of the new instruments didn't come together properly to fit to the new system due to incompatible specifications which required modifications to be made. (There was even a proposal to change the numbering of all bus lines to overcome one problem, which was of course was impossible.)
- **Barrier 3** – The limited number of local experts in this field available to participate in the Measures
- **Barrier 4** – Different priorities of different departments of the Municipality led for example, to one dedicated public transport lane not being constructed and a number of construction works at one of the key priority junctions beginning just a few months after of the introduction of the priority system. This had a major negative influence on the general functioning of the system. As some important archaeological finds were made during these works, it is possible that during the autumn of 2008 additional transportation surveys will not be made and new timetables will not be introduced.
- **Barrier 5** – Problems with existing infrastructure caused problems to the smooth implementation and operation – for example sewerage and water supply construction sites at Paldiski mnt, poor quality of the road pavement at Rävala pst, construction at Kentmanni str, which was an obstacle in introducing the full planned traffic scheme at Estonia Blvd.
- **Barrier 6** – Problems with subcontractors, who were not able to deliver the activities to the planned timetable and deadlines.
- **Barrier 7** – Big problems with APC usage, especially in TTTK, where the company management was not in control and where it appeared that it was the trolleybus drivers who actually dictated the shift planning. As a result some routes were not driven using the vehicles that had been specifically equipped with the APC system. This barrier was basically political as the manager of the municipal company was a political figure who did not have strong technical or management expertise.
- **Barrier 8** – The political leadership of the Municipality of Tallinn are not convinced about the benefit to the city and have been much uninvolved. There was some talk about public transport priority, but real plans and actions are far away from this rhetoric.

D1.2 Drivers

- **Driver 1** – The project has been driven by officers in the city council, who have had to convince politicians at every step. Attempts were then made to raise public awareness in order to influence / put pressure on politicians, but this had limited success.
- **Driver 2** – The prospect of EU co-financing was of course crucial in convincing politicians to sign off the scheme.

D2 Participation of stakeholders

- **Stakeholder 1 –** Tallinn's Transport Department plays the leading role throughout the CIVITAS SMILE process
- **Stakeholder 2** – TAK, TTTK and MRP are the principal participants as they are the operators of public transport vehicles in which the systems have been installed.
- **Stakeholder 3** – The main contractor selected through the tender process turned out to be a disappointing choice, because in spite of previous corporate experience the chosen contractor did not have enough technical knowledge to carry out the tasks of the project to time and budget.

D3 Recommendations

- **Recommendation 1 –** Better preparation for future similar project applications is very important in order to guarantee the introduction of all planned activities to time and budget. The first stage in this process involves better knowledge and understanding of the required public procurement processes, which if not followed properly can lead to challenges and delays.
- **Recommendation 2 –** Linked to recommendation 1 is the need to have better technical knowledge of the technical solutions to be implemented. This applies to the in-house knowledge of the contracting organisation (in this case Tallinn City Council). This is necessary to ensure the appropriate level of technical specification is included within the tender documentation and subsequent project scheduling and contract management. Linked to this is a need to ensure that the tender is let to companies that can clearly prove their technical expertise. In order to help with this there is currently a need in Estonia for greater involvement of international experts who could advise on the technical specification, management and selection of contractors. In hindsight this process would have worked better if a shortlist of appropriate international contractors, with background and experiences for this type of project, prior to the tender being published.
- **Recommendation 3** – Supplying public transport vehicles with automatic stop calls and information signs is part of the measures, thus insuring a better level of service. It should be complemented with loudspeakers on the outside of vehicles which will give to people with visual impairments information about the line number and running direction of arrived vehicles.
- **Recommendation 4** – looking back, it was not a good idea to fit the new equipment in all old vehicles as some of them will soon be removed from service because of their age.
- **Recommendation 5 –** It is very important to fix all duties and tasks of project managers during the first stages of the project as well as agreeing the tasks and duties of different partners including deadlines. General working tables should be created for the data.

Working in the SMILE project has basically given a number of new experiences, but most probably every new project has some specific character where all details could not be planned.

D4 Future activities relating to the measure

There is a desire among officials within the city hall to implement the priority system more widely on the main access routes to the city. This will depend on political decisions in relation to budget priorities which are at present are not known.

The priority system should then be developed further to be complemented by real time information systems.

There will be a challenge to see if the theoretical possibility to use the systems fitted to old vehicles that are withdrawn from service in the near future can be fitted to new vehicles that are introduced to the fleet. This may depend on whether the vehicles introduced are brand new, in which case they may be fitted with information signs and automatic stop calls devices as standard (although system compatibility is a further issue that would need to be addressed), or are second hand, in which case reusing the systems may prove more straightforward.

TEMA 2000 (for ESTONIA)

Introduction to the model

This model calculates emissions from Estonian road or rail transport.
The user is to enter traffic data for the project/area where emissions are to be calculated.
For road transport, the user also needs to enter the speed distribution.
If the speed distribution is unknown the estimated average speed distribution can be applied.
The user should consult Interim Report 2 describing the assumptions made for the calculations.

Colours

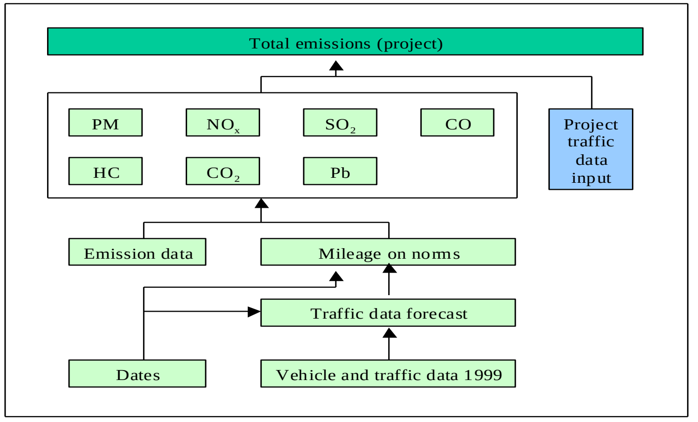
Blue figures/text: Level 1 headings and data entered into the model.
Green text: Headings at level 2.
Black figures: Calculated from other figures.
Grey figures: Data which are not directly used in the calculations.
Pink figures: Uncertain data or figures.
Yellow cells: Cells for entering user data.

Terms

The term "Russian" defines old Russian vehicles.
Any potential new Russian vehicles will in the future have to comply with
the European emission norms in order to fulfill the legal requirements in Estonia.
Therefore the term "Western" refers to vehicles fulfilling the EURO and Pre-EURO norms.

Structure

The model structure is illustrated in the figure.



Sheet content

Sheet name	*Purpose of sheet*
Total emissions (project)	Total change in emissions with the project effects. Total emissions in the project scenario. Total emissions in the base case.
Project traffic data input	Here the user enters traffic data for each mode of transport both in base case and the project scenario over the planning period (1999-2030). The split of traffic on speed should be indicated in percent both in the base case and in the project scenario. Otherwise average composition of speed can be chosen by clicking the button in the bottom of the sheet.
PM	
NOx	
SO2	The average emission factors of particulates/NOx/SO2/CO/HC/CO2/Pb over the planning period are shown
CO	for each mode of transport and for each speed from 20 km/h to 110 km/h (80 km/h for busses and trucks)
HC	and the average composition of speed.
CO2	
Pb	
Mileage on norms	Estimated split of mileage/vehicles on types in each year from 1999-2030. This split is used to weigh together emission factors of specific vehicles.
Traffic data forecast	Background data for calculating the figures in sheet "Mileage on norms".
Vehicle and traffic data 1999	Data on composition of the vehicle fleet and the estimated mileage of passenger cars.
Dates	Dates for legal introduction of the European emission norms in Estonia.
Emission data	Basic emission factors of specific vehicles for different speeds. These factors are aggregated in the sheets PM, NOx, SO2 etc.

Example of emission norms TEMA 2000 (for ESTONIA)

	Nitrogen oxide emissions (NOx) gram pr. km - average							
	Passenger car		**Bus**		**Truck**		**Van**	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1999	2,03	0,69	7,48	13,54	7,00	14,18	3,37	1,11
2000	1,95	0,67	7,33	13,37	7,00	13,52	3,32	1,07
2001	1,88	0,65	7,17	13,21	7,00	12,86	3,26	1,04
2002	1,76	0,61	6,87	12,91	7,00	12,03	3,18	0,97
2003	1,63	0,57	6,57	12,37	7,00	11,04	3,10	0,89
2004	1,55	0,54	6,06	11,96	7,00	10,20	3,01	0,85
2005	1,47	0,52	5,56	11,55	7,00	9,35	2,91	0,81
2006	1,39	0,50	5,05	11,14	7,00	8,51	2,82	0,77
2007	1,26	0,46	4,14	10,65	7,00	7,64	2,61	0,71
2008	1,13	0,42	3,23	10,15	7,00	6,77	2,40	0,65
2009	1,01	0,39	2,32	9,66	7,00	5,90	2,20	0,59
2010	0,90	0,36	2,01	8,88	7,00	5,46	1,95	0,55
2011	0,79	0,34	1,71	8,11	7,00	5,03	1,71	0,50
2012	0,68	0,31	1,40	7,34	7,00	4,60	1,47	0,46
2013	0,58	0,28	1,09	6,57	7,00	4,16	1,23	0,42
2014	0,47	0,26	0,79	5,80	7,00	3,73	0,98	0,38
2015	0,42	0,24	0,72	5,46	7,00	3,55	0,87	0,36
2016	0,37	0,23	0,65	5,13	7,00	3,36	0,75	0,34
2017	0,32	0,22	0,58	4,79	7,00	3,18	0,63	0,32
2018	0,27	0,20	0,51	4,46	7,00	3,00	0,51	0,30
2019	0,22	0,19	0,44	4,13	7,00	2,82	0,40	0,28
2020	0,21	0,19	0,40	3,93	7,00	2,72	0,37	0,27
2021	0,19	0,18	0,37	3,74	7,00	2,61	0,34	0,27
2022	0,18	0,18	0,33	3,54	7,00	2,51	0,32	0,26
2023	0,16	0,18	0,30	3,35	7,00	2,41	0,29	0,26
2024	0,14	0,17	0,26	3,15	7,00	2,31	0,26	0,25
2025	0,13	0,17	0,23	2,96	7,00	2,21	0,23	0,25
2026	0,11	0,16	0,19	2,77	7,00	2,10	0,21	0,24
2027	0,10	0,16	0,16	2,57	7,00	2,00	0,18	0,24
2028	0,08	0,16	0,12	2,38	7,00	1,90	0,15	0,23
2029	0,07	0,15	0,09	2,18	7,00	1,80	0,12	0,22
2030	0,05	0,15	0,05	1,99	7,00	1,70	0,10	0,22

	Carbon monooxide emissions (CO) gram pr. km - average							
	Passenger car		**Bus**		**Truck**		**Van**	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1999	13,94	1,00	115,42	3,32	122,60	3,58	22,72	1,59
2000	13,51	0,96	113,05	3,27	122,60	3,37	22,46	1,52
2001	13,07	0,92	110,68	3,22	122,60	3,16	22,19	1,46
2002	12,29	0,84	105,98	3,13	122,60	2,92	21,74	1,32
2003	11,50	0,75	101,28	3,04	122,60	2,68	21,28	1,19
2004	11,00	0,71	93,42	2,91	122,60	2,44	20,72	1,12
2005	10,50	0,67	85,56	2,79	122,60	2,19	20,16	1,06
2006	10,00	0,63	77,70	2,66	122,60	1,95	19,61	0,99
2007	9,21	0,58	63,50	2,51	122,60	1,71	18,21	0,90
2008	8,42	0,53	49,30	2,36	122,60	1,47	16,80	0,82
2009	7,63	0,47	35,09	2,22	122,60	1,23	15,40	0,73
2010	6,97	0,44	30,37	2,01	122,60	1,13	13,77	0,67
2011	6,30	0,40	25,65	1,80	122,60	1,03	12,13	0,61
2012	5,64	0,36	20,93	1,58	122,60	0,94	10,50	0,55
2013	4,98	0,32	16,20	1,37	122,60	0,84	8,86	0,49
2014	4,32	0,29	11,48	1,16	122,60	0,74	7,23	0,43
2015	3,97	0,28	10,42	1,11	122,60	0,71	6,44	0,42
2016	3,61	0,26	9,35	1,06	122,60	0,69	5,65	0,40
2017	3,26	0,25	8,29	1,01	122,60	0,66	4,86	0,38
2018	2,90	0,24	7,22	0,96	122,60	0,63	4,08	0,37
2019	2,55	0,23	6,16	0,91	122,60	0,61	3,29	0,35
2020	2,43	0,23	5,67	0,89	122,60	0,59	3,08	0,35
2021	2,31	0,23	5,17	0,88	122,60	0,58	2,87	0,34
2022	2,20	0,22	4,68	0,86	122,60	0,57	2,66	0,34
2023	2,08	0,22	4,19	0,84	122,60	0,56	2,45	0,34
2024	1,96	0,22	3,70	0,82	122,60	0,54	2,25	0,33
2025	1,85	0,22	3,20	0,80	122,60	0,53	2,04	0,33
2026	1,73	0,21	2,71	0,79	122,60	0,52	1,83	0,32
2027	1,61	0,21	2,22	0,77	122,60	0,50	1,62	0,32
2028	1,50	0,21	1,73	0,75	122,60	0,49	1,41	0,31
2029	1,38	0,20	1,24	0,73	122,60	0,48	1,21	0,31
2030	1,27	0,20	0,74	0,72	122,60	0,47	1,00	0,31