Measure title: **Cycle motorway**

City: **Aalborg** *Project:* **Archimedes** *Measure number:* **51**

O Executive Summary

Creating good facilities for cycling is an important element in any strategy for sustainable transport. On a long term level, creating a city with a high level of bicycle use has positive effects both in terms of improved energy efficiency and improved public health in general.

This measure focuses on implementing a Cycle motorway on the central cycling link, connecting the city centre and the University that is located at opposite end of the ARCHIMEDES Corridor. The stretch is approximately 5 km. The stretch was chosen as it is one of the main routes for cyclists commuting between the city centre and the university area.

In order to achieve the objectives of the measure a concept for the cycle motorway has been developed. The concept is based on developing a cycle stretch with specific attention to the following three subjects: **Free flow conditions for cyclists, Traffic safety, and Visibility/service.**

The following initiatives have been implemented on the route; reorganization of cycle flow at bus stops, bicycle counter with electronic information for cyclists, automatic air pumps for cyclists at two different places on the stretch, lane lights for cyclists at one of the intersections, signposting of the entire stretch and a segregated bicycle filter lane.

Important evaluation results of the campaigns:

- The number of accident registered in 2011 is below the yearly average if one compares with the period from 2005 to 2009. However, the period after the construction of the cycle motorway is only one year which means that there are statistically uncertainties related to working with this relative short time, and no clear conclusions on the effect of safety can be given.
- The countings indicate that from 2009 to 2011 the number of cyclists on the route has increased by around 20-30%. The counts from 2012 indicate that the increase is stable and historic trends and countings from other places in the city indicate that the increase is related to the implementation of this measure.
- The conducted interviews also substantiate the countings implying that the route has had a positive effect on how much people cycle; 17% of the cyclists on the route indicate that the route has influenced the mode of transportation in favour of biking.
- Average stop time for trips to the university has been reduced by 10 seconds, while the average stop time for trips in the opposite direction has been reduced with 14 seconds.
- The general satisfaction with the cycle commuter route, the initiatives, the perceived speed level and the perceived level of safety are very high; 80 % of the respondents are familiar with the improved conditions in general and 90 % of respondents state that they feel safe when travelling on the cycle commuter route.

A Cost-Benefit Analysis has been conducted on the project. The overall conclusion is that the value of the capitalised benefits is enough to yield a satisfactory return on the Cycle motorway's capital costs. The project has an NPV of approximately €52,000. But in this figure is not included a share of the investments in the physical infrastructure amounting to €1,600,000; the project can sustain a share of €45,000 (3.4 %) of the investments in infrastructure and still have a positive NPV. Whether or not this is a fair share, affect the economic sustainability of the measure.

A Introduction

A1 Objectives and target groups

A1.1 Objectives

The measure objectives are:

(A) High level / longer term:

- To increase the number of trips on bicycles and thus improve energy efficiency and public health.

(B) Strategic level:

- To have a positive impact on modal choice in favour of cycling for students and other residents travelling in the corridor.

(C) Measure level:

(1) To improve the safety of the cyclist on the route including the experienced safety.
(2) To increase the number of cyclist by 5% on the route.
(3) To achieve quantifiable improvement in travel time on the route.
(4) To increase the visibility of cycling and thus increase the awareness of cycling.

A1.2 Target groups and target area

This measure focuses on implementing a Cycle motorway on the central cycling link, connecting the city centre and the University that is located at opposite end of the ARCHIMEDES Corridor. The stretch is approximately 5 km and is illustrated on Figure 1. The stretch was chosen as it is one of the main routes for cyclists commuting between the city centre and the university area. Before the reconstruction there were only painted cycle lanes on the stretch and no other special facilities for cyclists. The purpose of implementing this measure was to provide improved and safe cycling facilities for students and other users of the stretch.

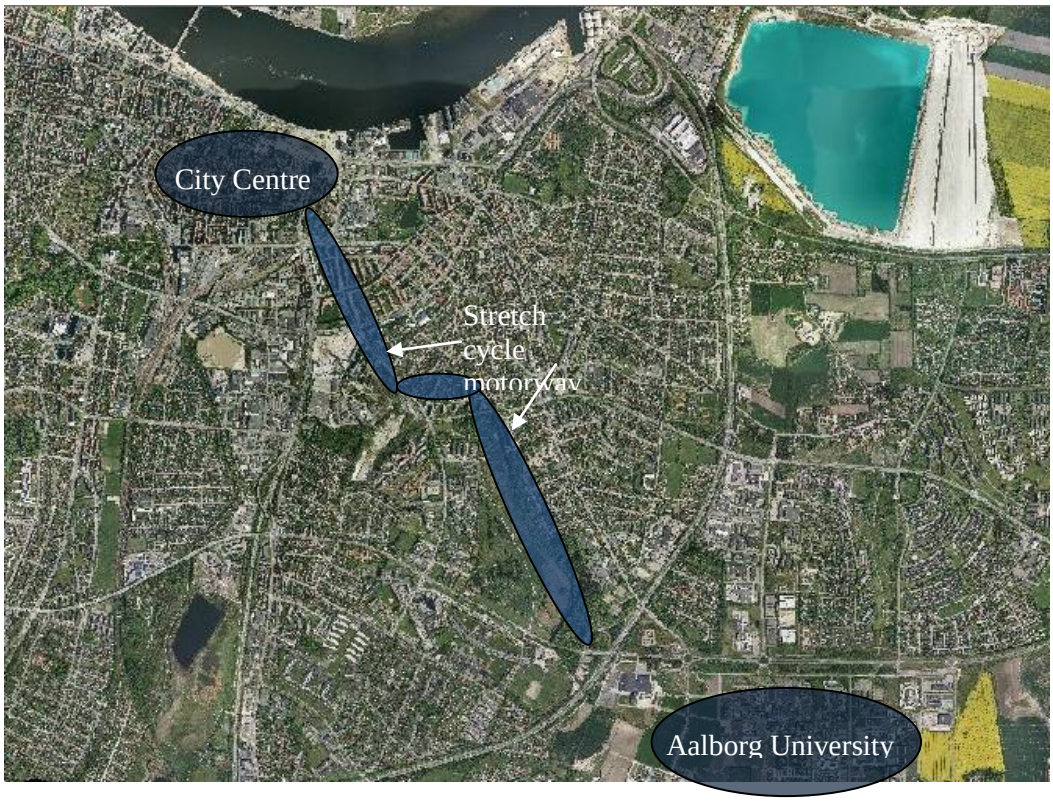


Figure 1: Map of the cycle motorway between the city centre and university area.

The cycle motorway will be targeted at:

- Students: A large number of students commute in the corridor and there is evidence that more and more students decide to use the car in preference to the bicycle. In order to break this trend it is necessary to address some of the barriers to cycling.
- In general present and potential bicycle users: The cycle motorway is intended to provide present and potential bicycle users with an attractive and safe commuter route for cyclist.

A2 Description

Creating good facilities for cycling is an important element in any strategy for sustainable transport. On a long term level, creating a city with a high level of bicycle use has positive effects both in terms of improved energy efficiency and improved public health in general.

The whole 5 km stretch from the city centre to the university area has been rebuild and upgraded from an ordinary cycle lane to a highclass Cycle motorway. A dedicated bicycle track has been established for a large part (approx 2 km) of the route combined with new solutions for cyclists at bus stops and a reorganisation of an intersection. The route goes through residential areas with a speed limit of 50 km/h on the main part of the route. The infrastructure work has been financed outside of the ARCHIMEDES project (an investment of approx. 1.6 million. Euro). The ARCHIMEDES project has contributed through staff time to design, plan and project management the implementation of the measures, and by financing special equipment, not usually part of a cycle path.

In order to achieve the objectives of the measure a concept for the cycle motorway has been developed. The concept is based on developing a cycle stretch with specific attention to the following three subjects:

- **Free flow conditions for cyclists:** The focus is on establishing a cycle stretch without unnecessary stops and detours. Recent Danish research has revealed that these factors are important in relation to the choice of the bicycle as a means of transport.
- **Traffic safety:** The route should be a safe route for cyclists.
- **Visibility and service:** Providing cyclists with extra services is seen as a way to increase the attractiveness of cycling. In addition, these extra services are a way of making cycling visible across the city, and thereby to promote cycling.

These focus areas have been the prerequisites in the design of the route and the choice of the different initiatives on the route, financed by the ARCHIMEDES project.

A3 Person in charge for evaluation of this measure

Name of person	Anne Marie Lautrup Nielsen
Name of organisation	City of Aalborg
Direct telephone	+45 9931 2307
e-mail	Aml-teknik@aalborg.dk

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **Use of new technology/ITS** – The measure included use of ITS in relation to for instance adjustment of the traffic signals and implementation of the lane light system.
- **New physical infrastructure solutions** – The route has been designed to suit the requirements of the cyclists. This includes facilities installed at the route including shortcut, automatic air pumps, and a bicycle counter.

B2 Research and Technology Development

Not relevant.

B3 Situation before CIVITAS

Figures from 2007 show that the modal share of cycling within the Municipality of Aalborg was 15%. National figures have indicated a decrease in cycling across Denmark in recent years and to counteract this trend, several initiatives including the cycle motorway have been implemented within the City of Aalborg.

Recent Danish research on the use of the bicycle has shown that it is especially shorter commuting trips (< 5 km) that can be changed to bicycle use. Therefore, working with creating good facilities for cyclists on shorter commuter trips in the city is seen as an important mean to reach these groups of cyclists.

B4 Actual Implementation of the measure

The measure has been implemented in the following stages:

Stage 1: Development of "tool box" with innovative bicycle initiatives *(15.9.08-summer 2009) – In this stage a tool box with possible initiatives on the route has been collected. In addition the topology of the route has been inspected to get an impression of the route and possible initiatives. As part of the initial planning phase a vision workshop was held with different groups of citizens and professionals being represented, which included a presentation from a hired professional used as inspiration. The purpose of the workshop was to develop new ideas on implementing a cycle motorway and to get feedback from the bicycle users on previously developed ideas.*

The participants represented a broad range of people and interest groups engaged in bicycle matters; from the students who cycle to the university daily and the local branch of Danish Cycling Association to the traffic police. Furthermore, a range of different professionals from the City of Aalborg involved in bicycle planning participated in the workshop. The workshop constituted a platform for further planning of the measure and in addition, the participants contributed with valuable inputs to improvements to some of the initiatives already discussed for the cycle motorway.

Stage 2: Design of the route and project engineering. *(Autumn 2009-14.06.10) – During winter 2009-2010 and spring 2010 the planning and drawings for the project were finalised. As part of this process the manufactures of technical equipment were contacted and contracts were signed. As part of the planning process an application was sent to the Danish Road Directorate in order to get approval*

for the lane light project, since this initiative, as a new and untried solution, needed dispensation from existing Danish legislation to be implemented. An approval to implement the project for a test period was obtained.

The following innovative ARCHIMEDES initiatives were chosen as part of the project:

- *Reorganization of cycle flow at bus stops*
- *Bicycle counter with electronic information for cyclists*
- *Automatic air pumps for cyclists at two different places on the stretch*
- *Lane lights for cyclists at one of the intersections*
- *Signposting of the entire stretch*
- *A segregated bicycle filter lane*

Stage 3: Implementation *(August 2010-June 2011) Implementation of the initiatives on the route. The initiatives are described in the sections below.*

Reorganization of cycle flow at bus stops

As described above the stretch has been renovated with dedicated cycle path and solutions at bus stops, improving cycle facilities along the stretch overall. Special attention has been given to improving the safety and free flow conditions for cyclists at the bus stops. The photos in Figure 2 illustrate a before and after scenario of how the dedicated cycle path passes a bus stop.

Figure 2: Before and after picture of how the dedicated cycle lane passes a bus stop.

Before the reconstruction, the cyclist had to either stop and wait behind the bus or pass the bus on the left side, which meant merging with the car traffic in the middle of the road.

In the new situation the cyclist can continue on a dedicated path without stopping. This is further made possible as an island has been established for waiting or exiting bus passengers. Having such an island between the standing bus and the cycle lane instead of letting the passengers step directly on the cycle lane changes the duty to give way from the cyclist to the bus passenger, letting the cyclist pass the bus without stopping.

Through the implementation of this measure both the safety for the cyclist and free flow is improved.

Segregated bicycle lane filter

As an initiative focusing specifically on improving the free flow conditions for cyclists, a segregated bicycle filter lane which allows cyclists to turn right without coming onto the intersection has been established at one of the important intersections for cyclist on the cycle motorway.

By allowing cyclists to turn right without waiting for a green light at the intersection the cyclists avoid unnecessary waiting time at the intersection. Therefore, the cyclists get a feeling of being prioritised and travel time is reduced as well.

Figure 3: Segregated bicycle lane filter.

Bicycle Counter

Along the southbound section of the cycle lane (towards the University) a bicycle counter has been installed. The purpose of the counter is to give cyclists valuable information during their journey, and thereby contributes to the fulfilment of the overall purpose of providing a high level of service and information on the cycle motorways. In addition, the counter increases the visibility of cycling for other road users.

The counter provides cyclists and other road users with information on the number of cyclists that has passed by on that day. The technology is based on senso-lines being placed in the asphalt of the cycle lanes.

The counter also gives information on the date and time, temperature, the speed of the cyclist passing and based on this speed, an estimated remaining travel time to the university. If the temperature is close to 0 degrees or bellow a snowflake indicator will appear on the display to make the cyclists aware of the risk of icy cycle lanes.

The counter can be followed live on the municipality homepage:

http://www.aalborgkommune.dk/Borger/trafik-og-veje/aalborg-cykelby/service-for-cyklister/Sider/Cykelbarometer_Hadsundvej.aspx

Figure 4: The bicycle counter installed at the cycle motorway.

Automatic Air Pumps

Two air pumps have also been installed on the route. The purpose of the air pumps is to make cycling even more attractive by providing the cyclists with extra services.

One of the pumps is located close to the bicycle counter and the other is placed at an intersection on the cycle motorway which is closer to the city centre, ensuring that a lot of cyclists pass the pumps every day.

The pumps have a built in compressor and by pushing the button and using the connecting pipe that fits different tyre valves, bike tyres are easily inflated.

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **Archimedes** *Measure number:* **51**

Figure 5: The automatic air pumps installed at the cycle motorway.

Lane Lights

To improve free flow conditions for cyclists a lane light initiative has been implemented at one of the intersections. The purpose of the initiative is to test whether the lights can improve free flow conditions for cyclists, and to evaluate how the cyclists experience this.

In the initiative 10 LED lights have been installed at a distance of between 50-140 m before one of the traffic light controlled intersections at the cycle motorway. In order not to distract cyclists approaching the intersection it was decided not to place lane lights closer than 50 m to the intersection.

The lights are installed in the cycle lane and are connected to the traffic light to ensure that if a cyclist follows the lights during a green wave and keeps up with the wave at a speed of 18 km/h they will reach the intersection during the green phase. Outside of rush hour a spool placed before the lights secures that the cyclists even start their own green light at the intersection – at other times the lane lights follow the traffic light that is time controlled.

Figure 6: The placement of the 10 LED light at the Cycle motorway and the lights during night time.

As a result of this initiative the cyclists are able to adjust their speed to the traffic light and thereby decrease waiting time at the intersection.

Signposting

To keep cyclists informed on their journey, the cycle motorway has been equipped with signs all the way from the city centre to the university area. The signs show that you are on the cycle motorway to the university (in Danish Universitetsruten, route nr. 100) and show the distance to the university or city centre.

Figure 7: Signposting of the cycle motorway.

Stage 4: Evaluation *(From June 2011- completed by spring 2012 (M44)) The measure has been evaluated from autumn 2011 to spring 2012. The evaluation tasks included both a survey on attitude, registration on the speed of the cyclists and additional counts of cyclists.*

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **Measure 52 –** City Bike Scheme in Aalborg: Both measures focus at providing good cycling facilities for students.
- **Measure 43** – Traffic Speed Reduction Zones in Aalborg: The measure is linked to the traffic speed reductions zones since they both focus at providing a safe and secure environment for cyclists.
- **BYPAD audit** – An important integration will be to the BYPAD audit carried out in all ARCHIMEDES cities.

C Planning of Impact evaluation

C 1 Measurement methodology

C1.1 Impacts and indicators

C1.1.0 Scope of the impact

The high level/longer term objective of cycle motorway is to increase the number of trips made on bicycles and thereby, improve energy efficiency and public health. The number of cyclists on the route and the attitude and awareness of the measure are seen as indicators of these changes.

On the measure level the objective is to improve the cyclist safety and travel time. These changes are covered by looking at accident statistics and data on travel time on the route.

C1.1.1 Selection of indicators

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	ECONOMY					
2a		**Costs**	Operating Costs	Operating costs	Costs per pkm	Euros/pkm, quantitative, derived or measurement
2b			**Capital Costs**	**Capital costs**	**NEW!**	**NEW!**
2c			**Maintenance costs**	**Maintenance costs**	**NEW!**	**NEW!**
	SOCIETY					
13		**Acceptance**	Awareness	Awareness level	Awareness of the policies/measures	Index (%), qualitative, collected, survey
14			Acceptance	Acceptance level	Attitude survey of current acceptance of the measure	Index (%), qualitative, collected, survey
		Safety	Safety	Perception of safety	Perception of safety when moving on the cycle route.	Index, qualitative, collected, survey

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **Archimedes** *Measure number:* **51**

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	TRANSPORT					
20		**Safety**	Transport Safety	Injuries and deaths caused by transport accidents	Number of accidents, fatalities and casualties caused by transport accidents	No, Quantitative, measurement
21		**Transport System**	Traffic Levels	Traffic flow by vehicle type - peak	Average vehicles per hour by vehicle type - peak	Veh per hour, quantitative, measured
22				Traffic flow by vehicle type - off peak	Average vehicles per hour by vehicle type – off peak	Veh per hour, quantitative, measured
26			Modal split	Average modal split-passengers	Percentage of passenger-km for each mode	%, quantitative, derived
			Travel Time	Travel time for bicycles	Average travel time for bicycles on the route in the corridor.	Minutes per trip, quantitative, collected.

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **Archimedes** *Measure number:* **51**

C1.1.2 Methods for evaluation of indicators

No.	INDICATOR	TARGET VALUE	Source of data and methods	Frequency of Data Collection
2a	Operating costs		Continually collection of the costs of operating the cycle motorway. This includes for instance the operation of electronic signposting and servicing the route.	Continually.
2b	Capital costs		Continually collection of the costs of establishing the cycle motorway. This includes the cost of establishing the planning initiatives.	Continually.
2c	Maintenance costs		Continually collection of the cost of maintaining the initiatives along the cycle motorway. This includes for instance maintenance of the electronic signposting.	Continually
13	Awareness level	Improved	Attitude survey covering the awareness of the measure conducted as stop interviews. The target group is cyclists that move in the area. These people were interviewed through stop interviews conducted on the stretch. In total nearly 300 cyclists participated. The respondents of the stop interviews consist of half women and men, about 60 % are 18-29 years old and nearly half of the respondents stated 'more than 8 km' as the length of their daily journey at the cycle motorway. In other words, the common respondent is a young daily commuter on the cycle motorway. The question form (in Danish) can be found in appendix A.	1 time. (General survey data has been used as before data)
14	Acceptance level	Improved	Acceptance level is uncovered by conducting stop interviews. As described in the LEP this indicator is combined with the same indicator for measure 42 provision for soft modes. The target group is cyclists that move in the area. These people were interviewed through stop interviews conducted on the stretch. In total nearly 300 cyclists participated. The respondents of the stop interviews consist of half women and men, about 60 % are 18-29 years old and nearly half of the respondents stated 'more than 8 km' as the length of their daily journey at the cycle motorway. In other words, the common respondent is a young daily commuter on the cycle motorway. The question form (in Danish) can be found in appendix A.	1 time. (General survey data has been used as before data)

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **Archimedes** *Measure number:* **51**

No.	INDICATOR	TARGET VALUE	Source of data and methods	Frequency of Data Collection
	Perception of safety	Improved	Perception of safety is uncovered by conducting stop interviews. As described in the LEP this indicator is combined with the same indicator for measure 42 provision for soft modes. The target group is cyclists that move in the area. These people were interviewed through stop interviews conducted on the stretch. In total nearly 300 cyclists participated.	1 time. (General survey data has been used as before data)
20	Injuries and deaths caused by transport accidents	Improved – level as corridor target: reduction by 10-15 % (equivalent to 3-5 accidents on a 5 year basis).	Injuries and deaths are continually collected in the City of Aalborg's statistics on accidents. Place and type of injury is collected.	Continually.
21/22	Traffic flow by vehicle type – peak/off peak	+5% increase in the number of bicycles.	Automatic cyclist counts are conducted on 2 different places along the route. At additional three places manual counts have been conducted. The automatic counts are conducted over a whole week and thereby give a more precise view of the cycle flow compared to manual counts that are only conducted over one day (a weekday from 7am-5pm). Originally all counts were planned as automatic counts. However, the municipality experienced problems with counts conducted in relation to other projects, due to the fact that automatic counts at roads broader than 10 m without a dedicated cycle lane showed out to be related with a high degree of uncertainty. Therefore, manual counts have been preferred at 3 locations on the route. To make the before and after counts comparable they are all conducted in May.	2 times. (Supplemented with additional data in 2012 for 3 of the 5 locations).
26	Modal split		Survey conducted trough stop interviews. The target group is cyclists that move in the area. These people were interviewed through stop interviews conducted on the stretch. In total nearly 300 cyclists participated. The respondents of the stop interviews consist of half women and men, about 60 % are 18-29 years old and nearly half of the respondents stated 'more than 8 km' as the length of their daily journey at the cycle motorway. In other words, the common respondent is a young daily commuter on the cycle motorway.	1 time.
	Travel time	Quantifiable	GPS longing of cyclist on the route. Travel time has been logged by	2 times.

No.	INDICATOR	TARGET VALUE	Source of data and methods	Frequency of Data Collection
		improvements.	"chasing" cyclist on the route on different times during the day. Thereby it is possible to grasp a sufficient amount of different uses. 24 data collections have been collected pr. data collection. The data collections have been made at times of the year where seasonal variations (e.g. snow, icy roads) did not have an effect on the travel speed.	

C1.1.3 Planning of before and after data collection

EVALUATION TASK	INDICATORS INVOLVED	COMPLETED BY (DATE)	RESPONSIBLE ORGANISATION AND PERSON
After survey on awareness, acceptance, and perception of security	13,14,17,26	M44	City of Aalborg, Anne Marie Lautrup Nielsen
Continually collection of the cost of establishing the cycle motorway.	2a	M29	City of Aalborg, Anne Marie Lautrup Nielsen
Continually collection of the numbers and type of injuries and deaths on the route.	20	M46	City of Aalborg, Anne Marie Lautrup Nielsen
Before automatic cyclist counts on the route	21/22	M11	City of Aalborg, Anne Marie Lautrup Nielsen
After automatic cyclist counts on the route	21/22	M34	City of Aalborg, Anne Marie Lautrup Nielsen
Before travel time – GPS logs	….	M29	City of Aalborg, Anne Marie Lautrup Nielsen
After travel time – GPS logs	….	M44	City of Aalborg, Anne Marie Lautrup Nielsen
D12.2 Baseline and first results from data collection	All indicators	Month 34	
D12.3 Draft results template available	All indicators	Month 42	
D12.4 Final version of results template available	All indicators	Month 44	

C1.2 Establishing a baseline

Business as usual would be not to build the cycle motorway. Baseline data and historical data from the route have therefore been used to describe the business of usual scenario. During the planning phase in spring 2010 a before-count of cyclists was carried out and data on speed of the cyclists on specific parts of the route were collected in October 2011.

In addition data on injuries and deaths on the route is collected continuously. In terms of accidents on the route the number is relatively small with large yearly fluctuations. Taken the relatively short period after implementation into account it is acknowledged that it can be difficult to provide clear conclusions on the effect of the measure on traffic safety.

C1.3 Methods for Business as Usual scenario

Business as usual includes not establishing the cycle motorway. The City of Aalborg has historic cyclist counts in the city. These data has been used to establish a trend that describes how the development on the route would have been without the cycle motorway.

Figures from 2007 show that the modal share of cycling within the Municipality of Aalborg is 15%. National figures have indicated a decrease in cycling across Denmark in recent years and to counteract this trend, several initiatives including the cycle motorway have been implemented within the City of Aalborg during the ARCHIMEDES project period from 2008 to 2012.

On Figure 8 the development in the number of cyclists in Aalborg the last 10 years can be seen. As it can be seen the tendency from 2003 until 2007 is a decrease in the number of cyclists. The winters in the start of 2010 and 2011, were the coldest for decades and included many months with snow and cold days. The total numbers of cyclist these two years are thus heavily affected by an unusual low number of cyclists in the winter months. Analyses of a randomly selected counting station on the Limfjord bridge, one of the central cycle passages in Aalborg, shows that calculated on the non-winter months the rising trend from 2008 to 2009 continues in 2010 and 2011.
In the table below the bicycle traffic in 2010 and 2011, is compared to the bicycle traffic in 2008.

	Winter (Jan-Feb+Dec)	Spring (Mar-May)	Summer (Jun-Aug)	Autumn (Sep-Nov)
2010	-55%	-8%	+6%	+0,3%
2011	-23%	+1%	+1%	+11%

Table 1 Bicycle Traffic over seasons in 2010 and 2011 compared to 2008.

When one compares the variations across seasons it can be observed that the decrease in bicycle use in 2010 and 2011 entirely is related to decreases in the bicycle use during the winter months. In the summer and autumn months a slight increase can be observed.

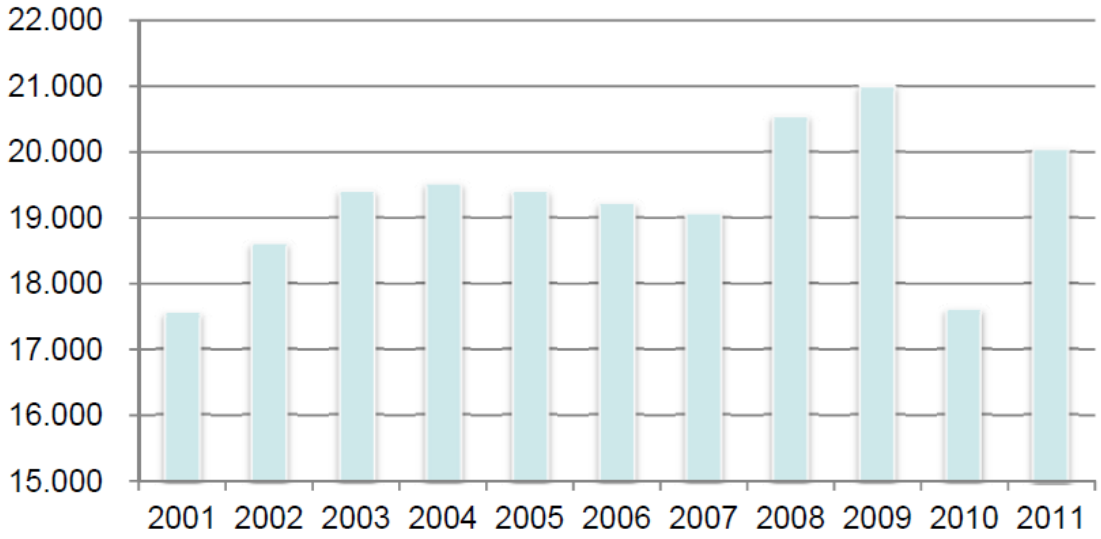


Figure 8: Development in the number of cyclists in the City of Aalborg the last 10 years. The numbers are based on the average daily number of cyclists on 14 permanent counting stations in Aalborg.

Recent Danish research on the use of the bicycle has shown that it is especially the shorter commuting trips (< 5 km) that can be changed to bicycle use. Therefore, working with creating good facilities for cyclists on shorter commuter trips in the city is seen as an important focus area.

C2 Measure results

The high level/longer term objective of cycle motorway is to increase the number of trips made on bicycles and thereby, improve energy efficiency and public health. The number of cyclists on the route and the attitude and awareness of the measure are seen as indicators of these changes.

The measure has focussed on improving cyclist safety and travel time combined with providing good service facilities for the cyclists. Therefore, these three areas have been in focus in the evaluation of the measure.

C2.1 Economy

The economy of the project is presented in relation to the cost benefit analyses in section C2.6.

Table C2.1.1: Summary of evaluation results in terms of economy

Indicator	Before (date)	B-a-U (date)	After (date)	Difference: After –Before	Difference: After – B-a-U
2a Operating Costs			Upgrade of existing infrastructure → no major extra cost		
2b Capital Costs			The capital costs that are directly linked to the Cycle motorway accumulate to €76,000. Apart from these costs is €1,600,000 in investments in the physical infrastructure.		
2c Maintenance Costs			No major extra maintenance costs.		

C2.2 Transport

Injuries and deaths caused by transport accidents

The City of Aalborg collects continuously data on accidents from police records. Included in the data are types of road users involved, place, time, and seriousness of accident. As mentioned the level of accidents fluctuates from year to year. As before data the number of accidents in a five years period from 2005 to 2009 has been used. The accidents have been mapped out and are shown on Figure 9.

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **ARCHIMEDES** *Measure number:* **51**

Figure 9: Accidents on the Cycle motorway between 2005 and 2009.

In total 55 accidents have been registered on the stretch in the period between 2005 and 2009. Cyclists or mopeds driving on the cycle lane have been involved in 27 of these accidents. Of 27 accidents with cyclists/mopeds involved 18 was with personal injury, while 9 was with only material damage.

The number of registered accidents on the stretch from 2011 where the cycle motorway was finished the main part of the year, until May 2012 was 6 in total. Of these 6 accidents 3 of them involved cyclists and one of them included a moped. Two of the accidents with cyclists included involved personal injury. The geographical location of the accidents can be seen on the Figure 10.

The number of accident registered in 2011 and first half of 2012 is below the yearly average if one compares with the period from 2005 to 2009 despite of the increased number of cyclists (see section below). However, the period after the construction of the cycle motorway is only one and a half year which means that there are statistically uncertainties related to working with this relative short time, and no clear conclusions on the effect of safety can be given.

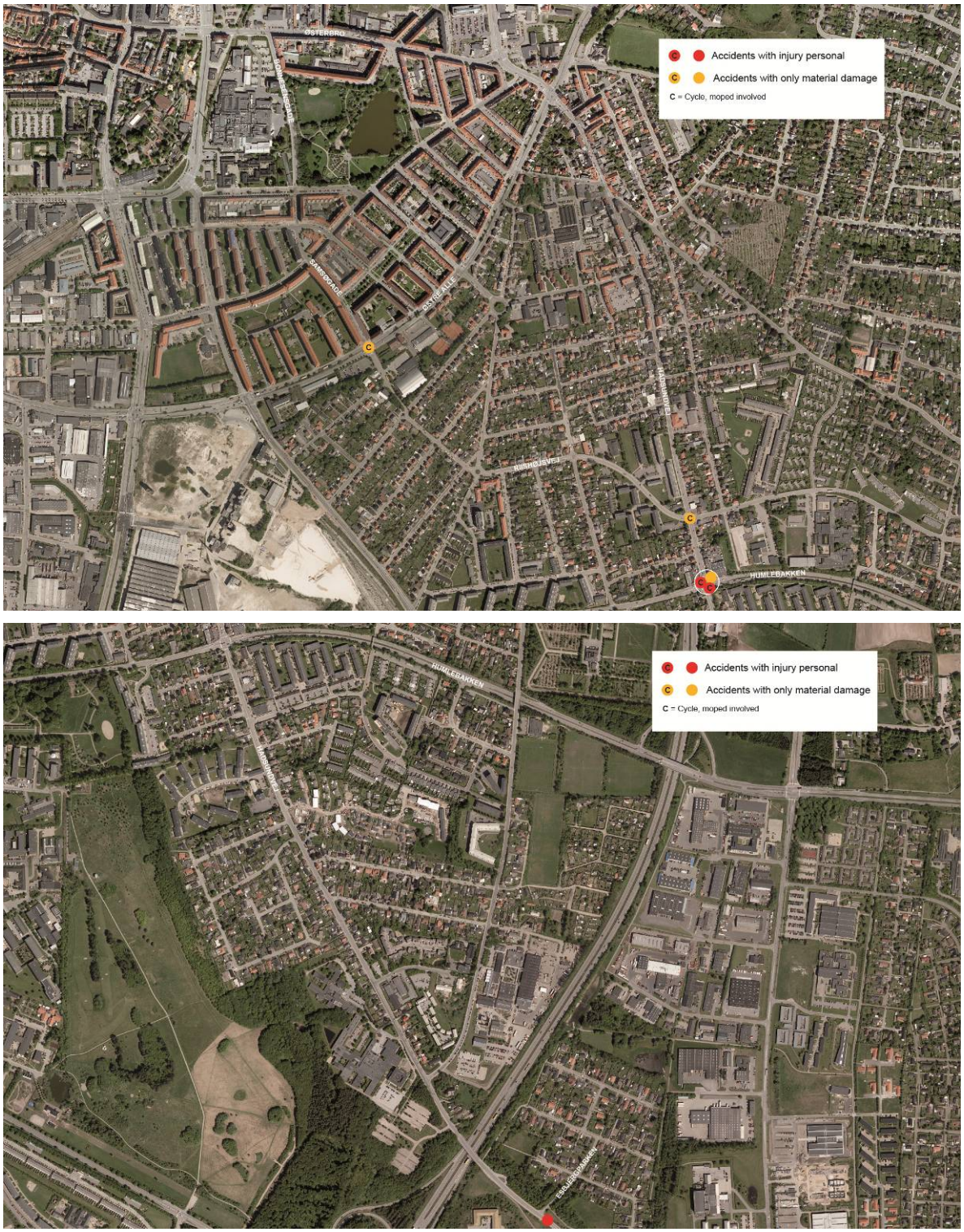
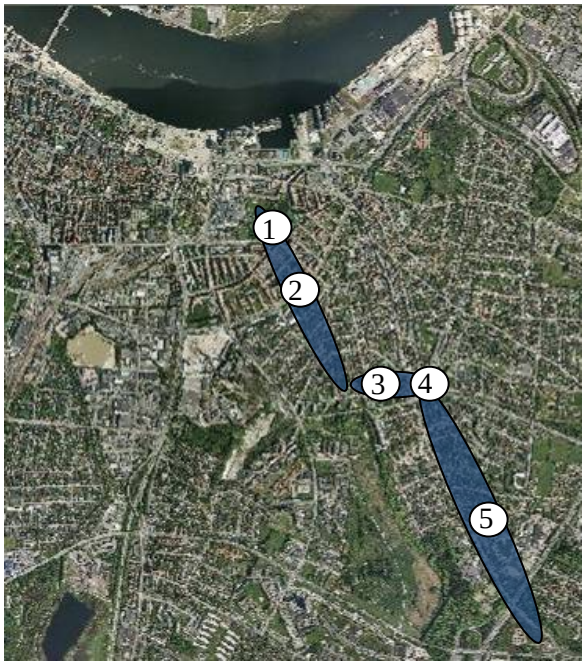


Figure 10: Accidents on the Cycle motorway in 2011 and first part of 2012 (until May 2012).

Traffic flow – Number of Cyclists

The number of cyclists has been counted on 5 different locations on the stretch. The counts have been geographically distributed on the whole stretch from the city centre to the university area. The type of counts have been made in relation to the type of road since automatic counts with tubes give the best results if it is a narrow road not wider than 10 m with dedicated cycle paths.



Number on Map and Place	2009 - May	2011 - May	Development (%) 2009 to 2011	2012 - May	Type of Count
1) Bonnesensgade between Østerbro-Fyensgade	540	660	+ 22,2 %		Manual count
2) Samsøgade between Østre Alle-Sjællandsgade	770	940	+ 22,1 %	1050	Manual count
3) Riishøjsvej at Bernstoffsgade	900[1]	1165	+ 29,4 %		Automatic with tubes.
4) Hadsundvej between Riishøjsvej-Humlebakken	---[2]	1495	---	1450	Manual count
5) Hadsundvej at Ritavej	681	690	+ 1,3 %	660	Automatic with tubes

Figure 11: Placement of counts and results of the counts.

[1] Number from May 2008.

[2] Number from September 2009, but the count showed an unrealistic high number of cyclists due to problems with the counting equipment.

The counts have been conducted in May in order to avoid seasonal changes related to weather conditions etc., except one at Hadsundvej between Riishøjsvej and Humlebakken. Before counts were made in 2009 and after counts have been made in May 2011. To further qualify the counts additional counts were conducted at selected points of the stretch.

Looking at the counts in 2009 compared to 2011 there seems to be an increase in the number of cyclists from 2009 to 2011 by around 20-30%. The counts from 2012 seems to be more or less at the same level as in 2011 and thus indicate that the increase is stable. In addition, compared to the general development described in section B3 that adjusted for the seasonal changes seems to be almost stable, the main part of the increase seems to be related to the implementation of the measure.

Modal Split

To uncover changes in modal split the respondents at the stop interview survey were asked whether the cycle motorway had influenced how much they bike. Construction of the cycle motorway has influenced the mode of transportation in favour of biking for 17 % of the respondents. In addition these respondents were asked about how they travelled before the cycle motorway. More than 6 % used to travel by bus and 4 % have replaced the journey by car with biking.

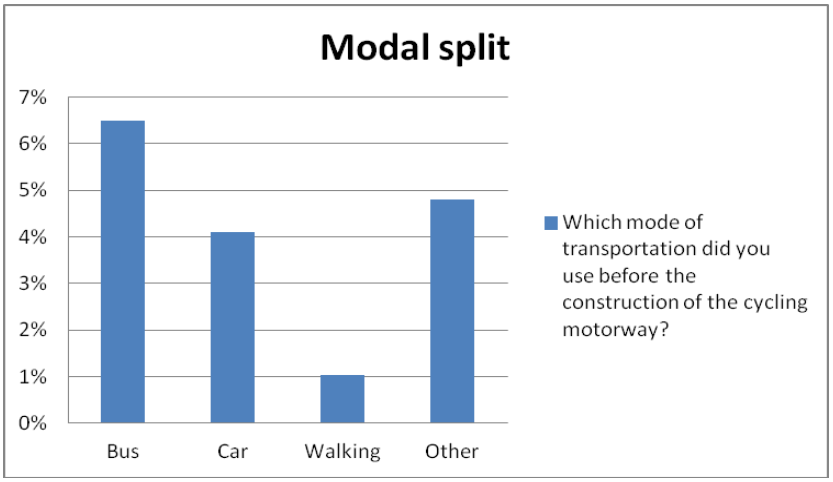


Figure 12: The cycle motorway has influenced the mode of transportation in favour of biking for 17% of the respondents.

Travel Time

The purpose of the data collection of travel speed data is to evaluate and document the effects of the initiatives on the cycle commuter route in terms of free flow condition. The purpose of looking at travel speed is to evaluate the effects of the establishment of e.g. the segregated bicycle lane filter, lane lights, the returned duty to give way and the bicycle lanes behind bus stops.

The before data is collected one day in the autumn 2010 and the after data is collected one day in may 2012. Both times the data is collected in the periods between 8.00-10.00, 12.00-14.00 and 15.00-17.00.

The evaluation is methodologically based on 'Chasing Cyclists', where random cyclists are followed with the single purpose of mapping their travel time on the given stretch. The follower was equipped with a GPS logger/Smart Phone, which logged the actual position and current speed at a frequency of 1 log pr. second (1 hertz).

The investigation is based on 24 cyclists each time, in total 48 trips. Based on the cyclists' position at the stop marks and the speed towards it, the stop times are deselected manually.

Before the evaluation results are presented some source of errors should be mentioned:

- Uncertainties in the selection of followed cyclist (there is a significant difference between travel time and travel pattern for e.g. a fit cyclist and a senior citizen). Looking at the stop times instead of the travel speed is though perceived as a way to reduce the effect of which type of cyclists that is followed.
- Uncertainty in the GPS receiver's position- and travel speed recognition (the exact position is +/-25 m by GPS logger and even more for the Smart Phone)
- When a 'chase' begins the follower starts the travel at 0 km/h which results in a more explicit acceleration than the followed cyclist experience.
- The estimation of the stop times are not consistent (the stop times are estimated manually and a significantly difference in cyclists deceleration patterns has been registered. Some reduces the speed a long way before the intersection while others go with full speed followed by a hard brake just before the stop line.)
- On multiple trips the stretch has been abandoned even before it was completed and the follower continued the trip trying to remain the same speed.

However, using GPS loging is perceived the most accurate way to create travel time data.

The average stop time on the whole stretch from Østerbro to the biking track at the cycle motorway is measured to 1 minute and 4 seconds before the implementation of the measure. After the implementation the stop time is reduced to 54 seconds in average. Thereby, the average stop time is reduced with 10 seconds.

In the opposite direction the average stop time is measured to 55 seconds before the implementation of the measure. After the implementation of the measure the stop time is reduced to 41 seconds. Thereby the stop time has been reduced by 14 seconds.

It can be seen that it is especially the stop time at the intersection where the segregated bicycle filter lane has been implemented together with the reorganised intersection

Table C2.2.1: Summary of evaluation results in terms of transport

Indicator	Before May 2009	B-a-U (date)	After May 2011	Difference: After –Before	Difference: After – B-a-U
20 Injuries and deaths caused by transport accidents	In the period 2005-2009 55 accidents were registered on the stretch. 27 of these included cyclists.		During 2011 6 accidents were registered on the stretch. 3 of these included cyclists.	Too short time period after to make sound conclusions on the effect on the accident level.	
21/22 Traffic flow by vehicle type – peak/off peak	See table above.	Stable development.	See table above.	Level of cyclists in 2009 compared to 2011 shows an increase around 20-30%	
26 Modal Split				17% of the cyclists on the route indicate that the cycle motorway has had an positive	

				effect on how much they bike.	
Travel Time	Average stop time for trips to the university is measured to 1 minute and 4 seconds. Average stop time for trips to the city centre is measured to 55 seconds.		Average stop time for trips to the university is measured to 54 seconds. Average stop time for trips to the city centre is measured to 41 seconds.	Average stop time for trips to the university is reduced by 10 seconds. Average stop time for trips to the city centre is reduced by 14 seconds.	

C2.3 Society

An attitude survey on awareness, acceptance and safety was conducted during spring 2012.

Initially, the respondents were asked whether they know that the City of Aalborg has improved the conditions for biking from the city centre to the university. 80 % of the respondents stated that they are familiar with the improved conditions - this indicates a high awareness of the measure.

More specifically, the respondents were asked about their knowledge of certain initiatives along the cycle commuter route. As Figure 13 shows, especially three initiatives are well known: The bicycle pump at Hadsundvej, the bike counter at Hadsundvej and the lane lights before Humlebakken/Hadsundvej. At the other hand, around half of the respondents are unfamiliar with the reversed duty to give way at Bonnesensgade/Fynsgade and the bicycle pump at Bonnesensgade. Many replied that the position of the biking pump is inapt which makes it hard to notice.

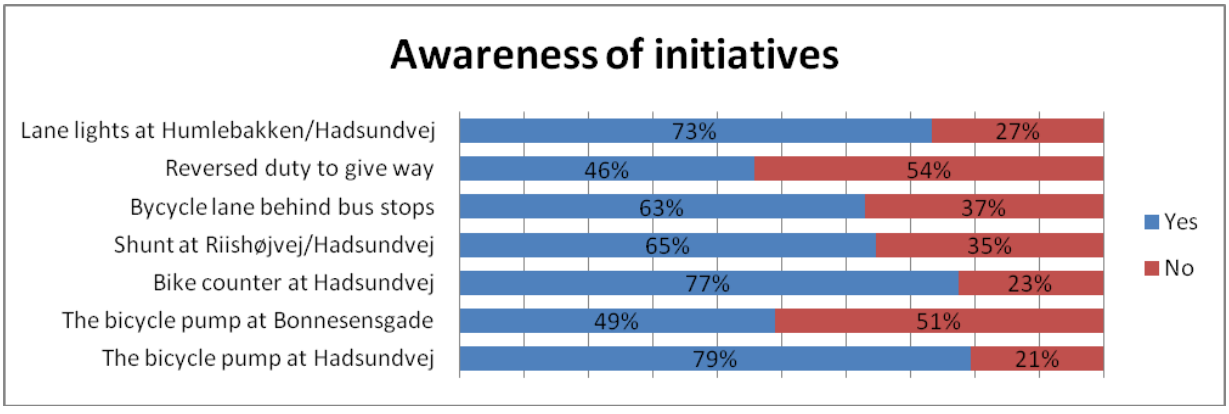


Figure 13: Awareness of initiatives. The most known initiatives are: Lane lights, bike counter, bicycle pump at Hadsundvej. The least known are: reversed duty to give way, bicycle pump at Bonnesensgade.

Bicycle pumps, Hadsundvej and Bonnesensgade

35 % of the respondents reply that they use the bicycle pump at Hadsundvej compared to 18 % at Bonnesensgade. This should also be seen in relation to that the number of cyclists in Bonnesensgade as described above is around 700/day, while the number at Hadsundvej is about twice as many. Regarding the utilisation of the pumps, the most common answer is that the pumps are used more seldom than once every month. In order to assess and evaluate the perceived importance of the initiatives a scale from 1-10 has been applied in the interview survey. '1' corresponds to the lowest possible importance, while '10' corresponds to the highest importance possible. Hence, it is possible to calculate 'the average importance' as well as visualise the 'importance-meter', where the lighter colours reflect the highest importance.

The average importance of the bicycle pump is 5.75 for the one at Hadsundvej and 5.36 for the pump at Bonnesensgade. In general, the low variety of the answers indicates a moderate attitude towards the importance of the biking pumps. Overall, these results indicate that the bicycle pump at Bonnesensgade is less frequently used and is perceived less important than the similar pump placed at Hadsundvej.

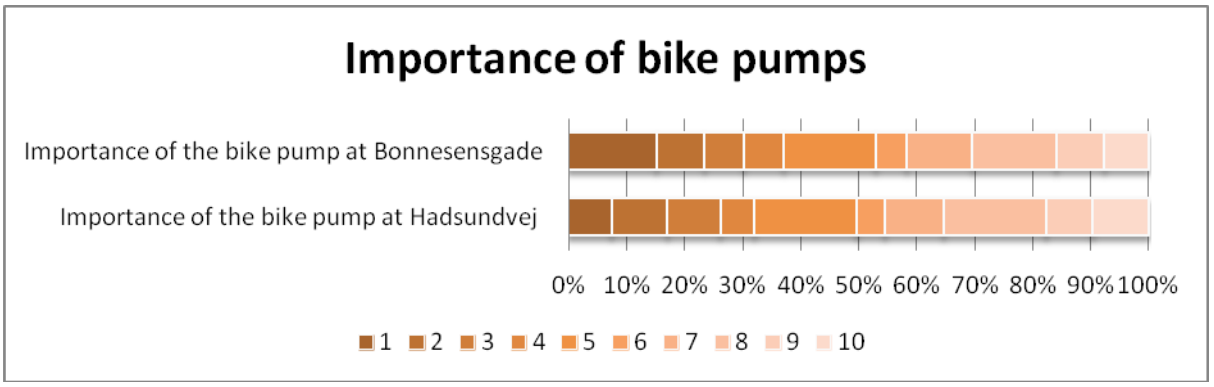


Figure 14: The perceived importance of bike pumps is medium: app. 5.5.

Bicycle counter at Hadsundvej

Regarding the importance of the bicycle counter at Hadsundvej the two most common answers were 1 and 5. This can be translated to 'It is not important' and 'Somewhere in between'. The least answered numbers where 9 and 10 and this supports the result that the bicycle counter is not perceived that important. The average importance is 4.63 which is the lowest average importance compared to all other initiatives along the cycle commuter route.

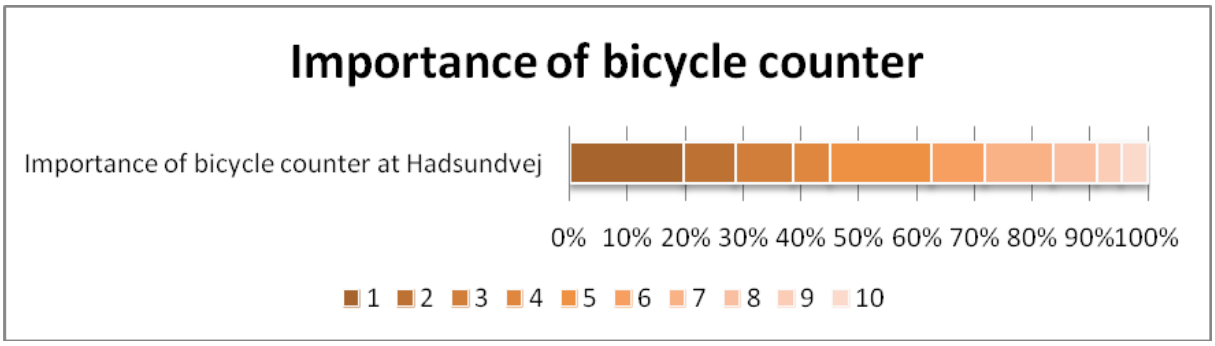


Figure 15: The perceived importance of the bicycle is medium: app. 4.5.

Segregated bicycle lane filter for cyclists, Riishøjvej/Hadsundvej

57 % of the respondents agree that the segregated bicycle lane filter for cyclists at Riishøjvej/Hadsundvej has made it faster to bike on the route between Aalborg city centre and the campus area at Aalborg University. Only 9 % disagreed in the same statement. The average importance is very high, 7.85, and the most common answer regarding the importance is 10. Summarised, the initiative has resulted in significant improvements and the respondents acknowledge the initiative as very important.

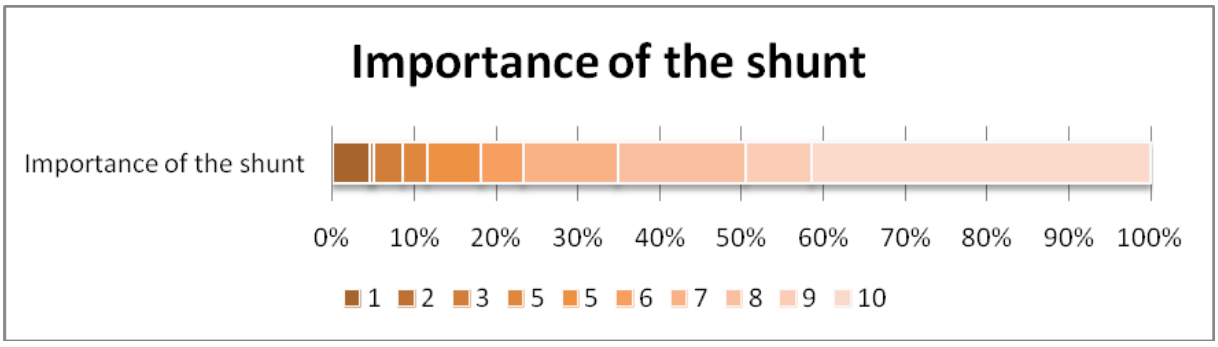


Figure 16: The perceived importance of the segregated bicycle lane filter is very high: app. 8.0.

Bicycle lane behind bus stops and behind bus bays, Hadsundvej

49 % of the respondents agree with the statement that the bicycle lanes behind the bus stops and bus bays on Hadsundvej has made it faster to travel along the route from the city centre to the university area compared to 13 % who disagree. 54 % agree that the experienced safety is increased compared to the situation before the initiative was established, while 11 % disagree. The importance of the bicycle lanes behind the bus stops and behind the bus bays is very high as the average score is 8.88. This is the highest average importance recorded. Summarised, these results imply that experienced pace and safety has increased significantly compared to the before situation at Hadsundvej.

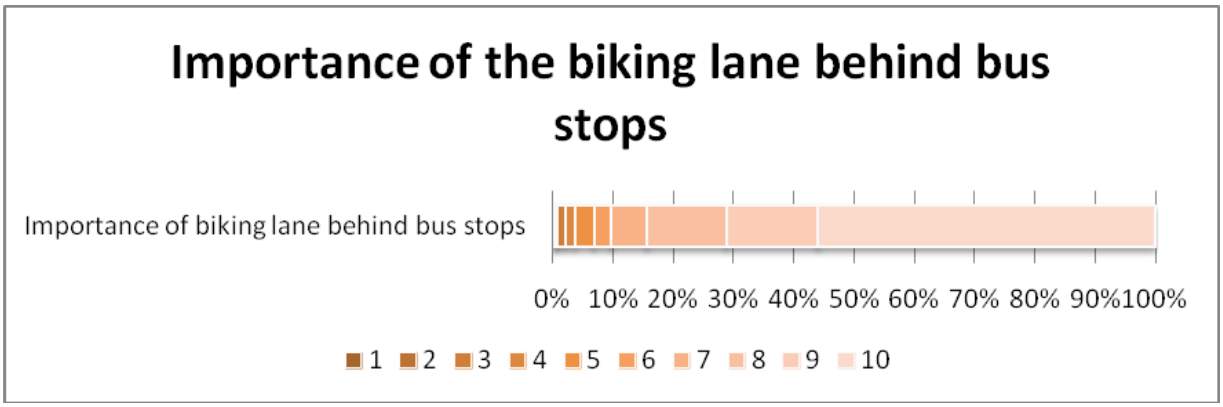


Figure 17: The perceived importance of the biking lane behind bus stops is very high: app. 9.0

Reversed duty to give way, Bonnesensgade/Fyensgade

29 % of the respondents agree with the statement, that the rebuilding of the intersection has made it faster to travel on the cycle commuter route while 17 % disagree. Regarding the statement that the rebuilding has influenced the perceived safety positively, the answers are distributed evenly between 'agree' and 'disagree' (22 % and 23 % accordingly). In general, most respondents answered 'Don't know' to the effects of the rebuilding of the intersection. Many respondents commented that many road users seem to be insecure, uncomfortable and unaware at this particular intersection and accidents seem unavoidable. The slightly moderate attitude towards the intersection is reflected in the average importance of the initiative at 6.09. Although most respondents agree that the rebuilding of the intersection is important the average is held original plan by the 6 % replying the lowest score, 1.

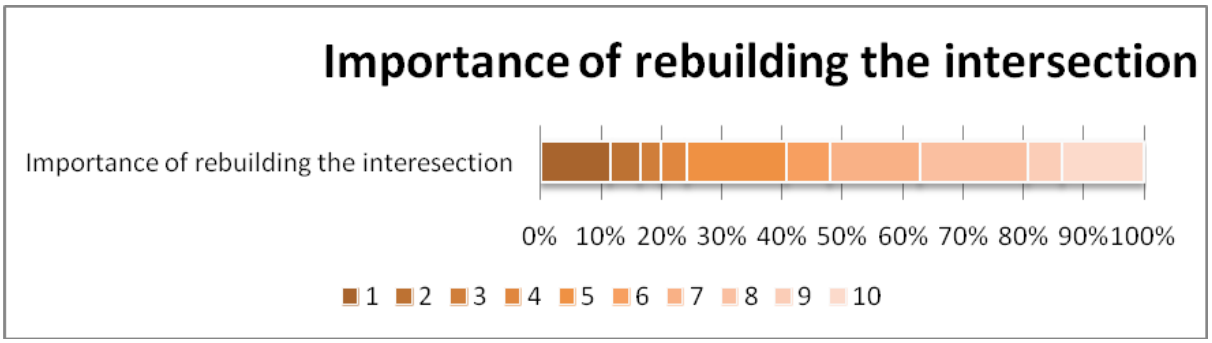


Figure 18: The perceived importance of the rebuilding of the intersection is high: app. 6.0.

Lane lights in the bicycle lane before the intersection, Humlebakken/Hadsundvej

The respondents are equally divided regarding the green lane lights in the bicycle lane just before the intersection at Humlebakken/Hadsundvej. 32 % agree in the statement that the lane lights have made it faster to bike through the intersection, 34 % disagree and 34 % answered 'Don't know'. However, 47 % state that they orient after the guiding green lights while 26 % do not. The average importance of the lane lights is 5.46 yet the division is more pronounced. Most (12 %) reply that the lane lights are not important at all (1 on the scale) while the second most frequent answer is quite important (8 on the scale). Yet, the lane light is a relatively new initiative and they were implemented only a few weeks before the survey took place which might help explain the strong division.

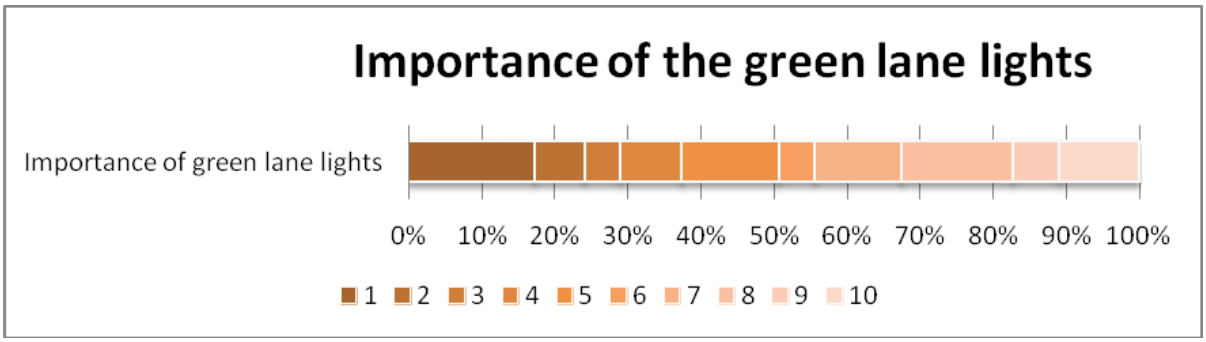


Figure 19: The perceived importance of the green lane lights is medium: app. 5.5

General impression

In sum, the overall satisfaction with the cycle commuter route in general is high as 84 % reply a general satisfaction. The average satisfaction is 7.88. The same share state a general satisfaction with the initiatives implemented on the cycle commuter route, where the average satisfaction is 8.10. 84 % experience a fast travel from A to B when biking on the route and the average perceived speed level is 8.08. Finally, 90 % of respondents state that they feel safe when travelling on the cycle commuter route, and the average level of safety is 8.30.

Compared to numbers on satisfaction obtained through a general survey in 2005[3] the cyclists in general rate the cycling facilities with a satisfaction level of 73%. Thereby, the satisfaction level of the cycle commuter route is a bit more positive. In addition, this survey reveals that in general 73% feel safe when they cycle in Aalborg. Compared to this, the cyclists on the commuter travel route feel safer than cyclists do in general based on their statements in the survey in 2005.

[3] General telephone survey based on the answers of 330 cyclists in Aalborg made in 2005.

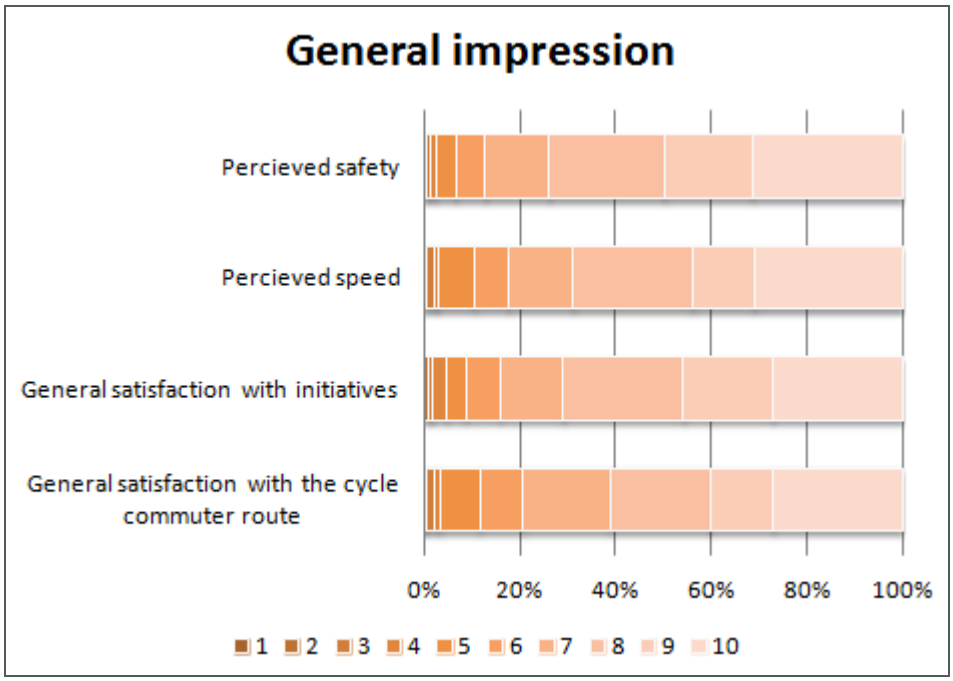


Figure 20: The satisfaction with the cycle commuter route in general, the initiatives, the perceived speed level and the perceived level of safety: app. 8.0-8.5.

Table C2.5.1: Summary of evaluation results in terms of society

Indicator	Before (date)	B-a-U (date)	After May 2012	Difference: After –Before	Difference: After – B-a-U
13 Awareness			80 % of the respondents are familiar with the improved conditions in general.		
14 Acceptance			84 % reply a general satisfaction with the initiative.		
Safety			90 % of respondents state that they feel safe when travelling on the cycle commuter route.		

C2.6 Cost benefit analysis

Appraisal case, relevant alternatives and base line case

The project includes as described in B4 establishing a cycle motorway from the city centre to the university area located approx. 5 kilometres from the city centre. The business as usual case would result in that the cycle motorway was not planned – however the route would still be one of the main cycle routes to the university area and would therefore still require maintenance and operation.

Agent	Implications
Cyclist on the route	The cyclists already using the route are expected to benefit from the project in terms of travel time savings and a better perception of the safety on the route. This group of cyclists already uses the route and their health benefits are therefore not perceived to be affected by the cycle motorway project. Furthermore, the possibility to use the improved route is also believed to constitute a recreational value and an improvement in the perceived safety for the individual users.
New cyclist on the route	New cyclists on the route will, depending on their previous mode of transport, experience either travel savings or travel costs. In addition, this group will is also experience health benefits.
Non users	Due to the expected modal shift from private car and/or public transport to cycle, traffic congestion is expected to decrease. However, implementing the cycle motorway has also included restrictions for the cars and buses (e.g. narrower roads, reversed duty to give way) and these restrictions could have a negative effect on traffic congestion. Therefore, car and public transport users are expected not to be affected by the measure.
Rest of society	The cycle route is expected to result in an improvement of the safety on the route. This improvement will lead to a possible reduction in the number of accidents, but as described above it is too early to make clear conclusions on this. The rest of the society will also benefit from improved air quality due to the reduced emissions derived from an increased use of bicycles and the corresponding decrease in motorised traffic. However, this impact is not considered material. Furthermore, there is an image value in establishing a cycle motorway.
Local authority	The local authority is responsible for the implementation and the maintenance of the project. Therefore, the local authority will be responsible for the capital and operation costs.

Figure 21: Main parties affected.

The following conducts a cost benefit analysis (CBA) of the Cycle motorway in Aalborg as it is described above. The overall objective of this CBA is to evaluate the costs and benefits of the project and be able to indicate whether the investment that is made into this project results in satisfactory returns.

C2.6.1 Evaluation period for CBA

In order to evaluate the project its key impacts have been compared to a "business as usual" scenario, since this cycle motorway is upgrade of an already existing cycling route.

The POINTER guidelines on conducting CBA on projects aiming at creating better and cleaner transportation in cities, suggests that projects including investments in infrastructure should be evaluated over a period of 10 to 15 years. Since the cycle motorway does include minor investments in the cycling infrastructure this CBA will be conducted over a period of 10 years.

The European Commission (EC) suggests that non-cohesion countries apply a social discount rate (SDR) of 3.5 %. Furthermore, the base year for discounting, and the price base, will be set to 2008. Finally, an exchange rate of 750 DKK/100 EUR is applied when relevant, all externalities are discounted using a GDP deflator and all other prices are discounted using the consumer price index (CPI).

C2.6.2 Method and values for monetarisation

As described above the key impacts of the project are:

1. Capital costs
2. Maintenance costs
3. Traffic flow - number of extra cyclists
4. Reduced number of accidents
5. Travel time
6. Perception of safety
7. Image value

Concerning bullet 2 it has not been deemed necessary to estimate the maintenance costs of the cycle motorway. The reason is that it is assessed that the maintenance costs are the same after the measure has been implemented as in the business as usual scenario. From this follows, that maintenance costs of the Cycle motorway will not affect the net present value (NPV) of this measure.

With regards to third bullet it is estimated in section C2.2. above that 17 % of the users of the Cycle Motorway, are using it because of the project. Of these 17 %, 35 % used to travel by bus, 24 % used to travel by car, and the rest either walked or used some other form of transportation. It is assumed that on average 5 km. of transportation has been transferred per cyclist. This might be a rather rough assumption since the extra traffic on the route is transferred from a number of different transport modes such as car, bus, walking and also from alternative cycle routes. But in order to build on available monetarisation methods of this externality it is necessary to make this assumption. In the report "Samfundsøkonomiske analyser af cykeltiltag - metode og cases" by COWI (2009) it is estimated that there is a benefit of €0.21 and €0.43 from transferring one bus passenger and one car passenger to cycling per km, respectively. This estimation includes inter alia benefits from:

- Improved health
- Effects on climate changes
- Reduced number of accidents
- Reduced wear of the physical infrastructure etc.

Bullets 5, 6 and 7 are external impacts and as such they need to be monetised if included in the calculation of the project's net present value. Itt has not been possible to measure the changes in travel time, as they are perceived relatively small (approx. 10 seconds pr. trip), this impact is therefore not included in the calculation of the NPV.

With regards to bullet 6, the perception of safety is, as described above, difficult to measure at this time, as measures only cover one year. Furthermore, monetisation of the improved perception of safety is difficult. However, the improved perception of safety is still of relevance for this analysis, and should therefore be taken in to consideration in the final evaluation of the project.

Concerning bullet 7, monetising the improved image value is also very complex. But it seems a valid assumption that this project will have a positive effect on the image of the Municipality of Aalborg. The issue will be addressed in the summary.

C2.6.3 Life time cost and benefit

Table C2.6.1 illustrates the timing of capital costs of the project:

Table C2.6.1 Capital cost in the evaluation period (not discounted)

	Cases for comparison	Cost

2010	CIVITAS measure	-€78,667
	Reference case (or BAU)	€0
2011	CIVITAS measure	€0
	Reference case (or BAU)	€0
2012	CIVITAS measure	€0
	Reference case (or BAU)	€0
2013	CIVITAS measure	€0
	Reference case (or BAU)	€0
2014	CIVITAS measure	€0
	Reference case (or BAU)	€0
2015	CIVITAS measure	€0
	Reference case (or BAU)	€0
2016	CIVITAS measure	€0
	Reference case (or BAU)	€0
2017	CIVITAS measure	€0
	Reference case (or BAU)	€0
2018	CIVITAS measure	€0
	Reference case (or BAU)	€0
2019	CIVITAS measure	€0
	Reference case (or BAU)	€0

As it is seen from the table above the capital costs that are directly linked to the Cycle motorway in Aalborg accumulate to €79,000. These costs cover the following:

1. Lighting
2. Signage
3. Segregated bicycle lane filters
4. Airpumps
5. Turnstiles
6. Planning

Apart from these, costs are €1,600,000 in investments in the physical infrastructure. But considering that the lifetime of the infrastructure investments exceed the lifetime of this project, it is argued that only a share of this investment should be allocated to this project. Since it is difficult to assess what this share should be, the investment will not be directly included in the CBA, it will rather be addressed in the summary.

Table C2.6.2 below illustrates the magnitude and timing of the monetised effects from the increase in traffic flow on the cycle motorway:

Table C2.6.2 Savings from transferring persons to bike users on cycle motorway (not discounted)

	Cases for comparison	Benefit
2010	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2011	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2012	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2013	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2014	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2015	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2016	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2017	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2018	CIVITAS measure	€15,500
	Reference case (or BAU)	€0
2019	CIVITAS measure	€15,500
	Reference case (or BAU)	€0

It is seen from in the table above that it is estimated that there is a benefit to the society of €15,500 per year in the 10-year period the measure is evaluated over. The benefit is calculated based on the following:

1. Counts of cyclists, on the route that has been upgraded, after the implementation of the measure, showing an average daily traffic of 864 cyclists, of which 17 % are using it because of the implementation of the measure.
2. Considering that the counts have been made in May, it is reasonable to assume that the numbers are too optimistic to use for winter periods as well. To correct for this, it as assumed that the increase is realised on average 120 days per year.
3. As mentioned above, it assumed that of the extra cyclists, 35 % corresponds to a transfer of 5 km. of bus transportation to 5 km. of bicycle transportation with a benefit to society of €0.21 per km, and 24 % corresponds to a transfer of 5 k. of car transportation to 5 km. of bicycle transportation with a benefit to society of €0,43 per km.

C2.6.4 Compare the lifetime costs and benefits

There are two measurable key impacts from the City Bike Scheme in Aalborg; capital costs and savings from transferring bus passengers to the cycle motorway. Capital costs are only incurred in the project's first year, whereas the benefits are incurred in every year of the project. The capital costs appear to be in a good relationship with the benefits.

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **ARCHIMEDES** *Measure number:* **51**

Table C2.6.3 Lifetime cost/benefit of CIVITAS measure (discounted)

	Capital cost	Savings from transferring persons to bike users on the Cycle motorway	Total cost	Total Benefit	Cumulated cost
2010	-€76,000	€14.922	-€76,000	€14.922	
2011	€0	€14.417	€0	€14.417	-€61.078
2012	€0	€13.929	€0	€13.929	-€46.661
2013	€0	€13.458	€0	€13.458	-€32.732
2014	€0	€13.003	€0	€13.003	-€19.274
2015	€0	€12.564	€0	€12.564	-€6.270
2016	€0	€12.139	€0	€12.139	€6.293
2017	€0	€11.728	€0	€11.728	€18.432
2018	€0	€11.332	€0	€11.332	€30.160
2019	€0	€10.948	€0	€10.948	€41.492
Total	-€76,000	€128,440	-€76,000	€128,440	€52.440

Table C2.6.4 Lifetime cost/benefit of the reference measure/case (discounted)

	Capital cost	Savings from transferring bus passengers to the Cycle motorway	Total cost	Total Benefit	Cumulated cost
2010	€0	€0	€0	€0	€0
2011	€0	€0	€0	€0	€0
2012	€0	€0	€0	€0	€0
2013	€0	€0	€0	€0	€0
2014	€0	€0	€0	€0	€0
2015	€0	€0	€0	€0	€0
2016	€0	€0	€0	€0	€0
2017	€0	€0	€0	€0	€0
2018	€0	€0	€0	€0	€0
2019	€0	€0	€0	€0	€0
Total	€0	€0	€0	€0	€0

C2.6.5 Summary of CBA results

The overall conclusion is that the value of the capitalised benefits is enough to yield a satisfactory return on the Cycle motorway's capital costs. The project has an NPV of approximately €52,000. But in this figure is not included a share of the investments in the physical infrastructure amounting to €1,600,000; the project can sustain a share of €45,000 (3.4 %) of the investments in infrastructure and still have a positive NPV. Whether or not this is a fair share, affect the economic sustainability of the measure.1.

Aside from the benefits that can be monetised, there are a number of key impacts that cannot, though they are still important. Almost 300 interviews have been conducted in order to, amongst other things, uncover the effect the cycle motorway has on the users' perception of safety on the route. On a score from 1 to 10 on the question do you "feel safe when biking on the cycle motorway?" more than 30 % say 10, and almost 90 % give a score of 6 or above. When asked about how satisfied the interviewees are "with the cycling motorway" more than 25 % give a score of 10, where 10 is highest, and almost 85 % give a score of 6 or above.

This indicates that there is a high level of satisfaction and perceived safety from implementing the cycle motorway, which should also be taken into accounting when looking at the NPV-calculations of the monetised impacts.

Finally, it can be argued that Aalborg's image as an environmental conscious city is improved which might increase the population's feeling of pride and with the local government. And furthermore it might increase, or be a prerequisite for, the migration of people, companies and students in Aalborg. These impacts are not easily quantified, but should none the less be taken into account when evaluating the success of the measure.

C2.6.5.1 Sensitivity analysis

In order to test the robustness of the conclusion a sensitivity analysis on select key impacts has been carried out. If any one of the following bullets were to be realised, the NPV of the project will turn negative:

1. The applied SDR is larger than 20 %.
2. The increase in daily traffic, which is realised 120 days per year, is reduced to 511 from 864 cyclists.
3. The benefit to society of €0.21 og and €0,43 per km. is reduced by 41 %.

Based on this sensitivity analysis it is argued that the overall conclusion, as laid out above, is robust.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To improve the safety of the cyclist on the route including the experienced safety.	★★[4]
2	To increase the number of cyclist by 5% on the route.	★★★
3	To achieve quantifiable improvement in travel time on the route.	★★
4	To increase the visibility of cycling and thus increase the awareness of cycling.	★★★

NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%)
★★ = Achieved in full ★★★ = Exceeded

C4 Upscaling of results

The following upscaling scenario will be taken into account in the evaluation:

- Cycle motorways are established at other central cycle routes in the city.

In Aalborg there would be basis for establishing cycle motorways at 5 other routes. These 5 routes all share the characteristic of being commuter routes that would connect the city centre with larger residential areas and/or industrial areas making the viable cycle commuter routes in the city.

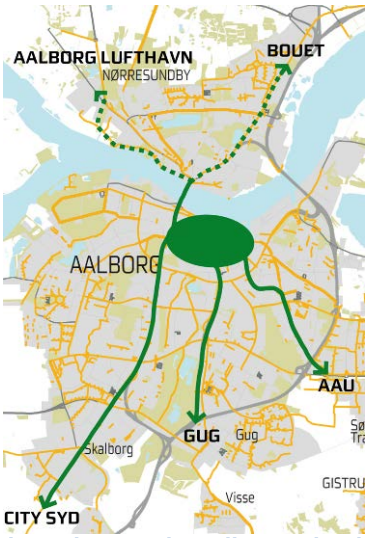


Figure 22: Placement of the possible cycle ways in Aalborg. The three illustrated with a solid line are already implemented or being implemented right now. While the two with a dotted line are planned.

[4] 90% of the cyclists feel safe on the route. In terms of accident level the time period is too short to make any clear conclusions.

The number of cyclists differs between the routes and also between the different parts of a route, and the initiatives required would also have to be tailored to the specific requirements at the route. However, implementing a cycle motorway concept with focus at initiatives related to the three focus areas; free flow conditions, safety, and visibility/service is expected to result in similar results as for this measure.

C5 Appraisal of evaluation approach

The following aspects are important leanings during the design and completion of the evaluation of this measure:

- The conduction of the evaluation survey through stop interviews on the route proved to be a valuable way of getting direct information on how the cyclists perceive the cycle route. However, this way of doing evaluation through interviews is a time consuming process that requires that a number of for instance student assistant are hired. The use of smart phone evaluation could be the future.
- In order to be able to make sound conclusions in terms of reduction of accidents on the stretch a longer time period (minimum 5 years) after the construction is necessary. However, this is not related to the evaluation method, but the overall evaluation context.

C6 Summary of evaluation results

Important evaluation results of the measure are:

- The number of accident registered in 2011 is below the yearly average if one compares with the period from 2005 to 2009. However, the period after the construction of the cycle motorway is only one year which means that there are statistically uncertainties related to working with this relative short time, and no clear conclusions on the effect of safety can be given.
- The countings indicate that from 2009 to 2011 the number of cyclists on the route has increased by around 20-30%. The counts from 2012 indicate that the increase is stable and historic trends and countings from other places in the city indicate that the increase is related to the implementation of this measure.
- The conducted interviews also substantiate the countings implying that the route has had a positive effect on how much people cycle; 17% of the cyclists on the route indicate that the route has influenced the mode of transportation in favour of biking.
- Average stop time for trips to the university has been reduced by 10 seconds, while the average stop time for trips in the opposite direction has been reduced with 14 seconds.
- The general satisfaction with the cycle commuter route in general, the initiatives, the perceived speed level and the perceived level of safety are very high; 80 % of the respondents are familiar with the improved conditions in general and 90 % of respondents state that they feel safe when travelling on the cycle commuter route.
- The most known initiatives are: Lane lights, bike counter, bicycle pump at Hadsundvej. The least known are: reversed duty to give way, bicycle pump at Bonnesensgade. The low knowledge about the bicycle pump at Bonnesensgade could be related to that the number of cyclists here are lower than on Hadsundvej.
- Biking pumps and bike counter are perceived as medium important.
- 57 % of the respondents agree that the segregated bicycle lane filter for cyclists at Riishøjvej/Hadsundvej has made it faster to bike on the route between Aalborg city centre and

the campus area at Aalborg University. Only 9 % disagreed in the same statement. The initiative is perceived as very important.

- 49 % of the respondents agree with the statement that the bicycle lane behind the bus stops and bus bays on Hadsundvej has made it faster to travel along the route. The initiative is perceived as the most important of all initiatives.
- 32 % agree in the statement that the lane lights have made it faster to bike through the intersection, 34 % disagree and 34 % answered 'Don't know'. However, 47 % state that they orient after the guiding green lights while 26 % do not. People are divided regarding the stand towards this initiative which is reflected in the perceived importance as medium.

C7 Future activities relating to the measure

The implemented initiatives on the route will continue to be in operation after the ARCHIMEDES project as well.

The concept focusing on free flow conditions, traffic safety and free flow conditions are in the process of being implemented on two other stretches in the city.

In addition, another two stretches are planned to be upgraded in 2013-2015. These stretches thereby build on both the concepts developed in the ARCHIMEDES project and the experiences with the specific initiatives in the cycle motorway measure.

D Process Evaluation Findings

D.0 Focused measure

	0	No focussed measure
	1	Most important reason: City policy: *The City of Aalborg works continually with providing the cyclist with good facilities. The cycle motorway has taken this work a level further.*
	2	Second most important reason: Innovativeness of measure: *The cycle motorway included a range of innovative initiatives that constitutes best practice within the bicycle field on European level.*
	3	Third most important reason: Transferability: *Working with investments in improving infrastructure for cyclist is a focus in a broad range of European countries.*

D.1 Deviations from the original plan

The measure has overall been implemented as planned. However a couple of deviations occurred during the project:

- **Delay of the measure due to an unusual strong winter**: The construction work started in August 2010 and was expected to be finished by the start of December 2010. The construction works included establishment of a dedicated bicycle track along a main part of the stretch. The ARCHIMEDES initiatives were either installed in relation to this work or depended on finalisation of this work. Had the winter been a normal winter, the project would have been finished in December 2010, but in the middle of November the first snow fell and a lasting period of frost started. This put the construction work on hold. Very unusually for Denmark, the frost lasted more or less without pause until March. Even though the continuation of the construction work was attempted on additional occasions, the work had to be paused from the middle of November 2010 to March 2011. The construction was finished by spring 2011. It is not perceived possible to prevent these kinds of delays in planning of the measure.

- **Delay of the lane light system:** The initiative was implemented in spring 2012 and was delayed due to that it had to wait for another project at the intersection to be implemented. In addition the project has a very innovative character, since there is now knowledge of a similar system any were. It was perceived necessary to implement these two projects simultaneously, to avoid double work and secure an easy implementation.

D2 Barriers and drivers

During the planning and implementation of this measure some specific barriers and drivers have been experienced.

One of the initial barriers experienced from the start of the planning phase was that a new knowledge base had to be developed, since the project included initiatives that the municipality had no previous experience with. It, therefore, takes extra time to develop some of the initiatives. The planning of the project has to a higher degrees includes research on best practices.

Another barrier was that some of the innovative initiatives required formal acceptance from other authorities. A formal acceptance required that an application with a comprehensive description of the initiative was produced. This procedure required extra focus and resources in the planning phase. Furthermore, it requires extra time in the overall planning of the project.

A last barrier was as mentioned the weather conditions, that affected the construction work. The timeline for the construction work was planned to secure sufficient time to finish the project before the winter, but the unusual early winter was not foreseen. The early winter has delayed the project with 4 months compared to the Original plan. It is though not perceived possible to mitigate these kinds of delays.

One of drivers experienced during the project was the results of the stakeholder workshop. The stakeholder workshop constituted a base for the engagement in and common understanding of the project. The workshop gave both new ideas and new perspectives on the project from the invited stakeholders. Therefore, the workshop was a base for the further planning of the project. The workshop was a common starting point for the internal working group both in terms on ideas and engagement in the project.

Another important overall driver for the project was the extra grants to cycle improvements on the route. Grants outside of the ARCHIMEDES project to development of the cycle network in relation to the route have been advanced. Therefore the cycle network in the area was improved in general. The cycle lane in the network has therefore been improved in general.

D2.1 Barriers

Preparation phase

- **The measure includes initiatives that are innovative (technological) -** New knowledge base had to be developed, thus the planning of the project had to a higher degree included research on best practices and extra time for development had to be implemented in the time planning.
- **Formal acceptance of initiatives (organizational) -** Some of the innovative initiatives required formal acceptance from other authorities. This procedure required extra focus and resources in the planning phase. Furthermore, it required extra time in the overall planning of the project.

Implementation phase

- **Weather conditions (planning)** - As mentioned the timeline for the construction work was planned to secure sufficient time to finish the project before the winter, but the unusual early winter was not foreseen. The early winter has delayed the project with 4 months compared to the original plan.

Operation phase

- No barriers experienced.

D2.2 Drivers

Preparation phase

- **Stakeholder workshop (planning)** – The workshop gave both new ideas and new perspectives on the project from the invited stakeholders. In addition, the workshop was a common starting point for the internal working group both in terms on ideas and engagement in the project.

Implementation phase

- **Extra grants to improvement of cycle infrastructure (political/strategic)** – Outside of the ARCHIMEDES economy grants were given to improve the cycle network in the area in general. This gave the opportunity to make large improvements on the route.

Operation phase

- No barriers experienced.

D.2.3 Activities

Preparation phase

- **Securing innovativeness of the measure (technological)** – The planning of the project has to a higher degree included research on best practices and formal accept of the implementation of the measure. For this extra time and resources was dedicated to the project.

- **Getting new ideas (planning):** A workshop was used as the base for the further planning of the project. The workshop was a common starting point for the internal working group both in terms on ideas and engagement in the project.

Implementation phase

- **Mitigating the effects of the strong winter on the time plan (planning)**– The time plan included additional time to handle the effects of a normal winter, e.g. had the winter been a normal winter, the project would have been finished in December 2010, but in the middle of November the first snow fell and a lasting period of frost started. It is though not perceived possible to mitigate these kinds of delays.

Operation phase

- No activities undertaken.

D.3 Participation

D.3.1. Measure Partners

- **City of Aalborg** – Responsible of the planning and implementation of the measure. The planning and implementation of the measure involved different divisions of the Technical Department of Aalborg City.

D.3.2 Stakeholders

- **Cyclists (including The Danish Cyclist Federation) – and other stakeholders–** Participated in a visions workshop placed in the initial planning phase.

- **Danish Road Authority –** The lane light system required approval from the Danish Road Authority.

- **Providers of equipment for the route –** Providers of equipment for the route (e.g. air pumps, counter, lane lights) were important stakeholders in the process, since a large part of the initiatives demanded innovative product development.

D4 Recommendations

Some of the lessons learned through this initiative can be transferred to other countries. However, one should be aware about the context e.g. how are the infrastructure facilities for cycling in the starting point. The approach and the initiatives implemented as part of this measure demand that the city has well developed infrastructure for cyclists and a cycling culture in place in order to be successful. For instance implementing service facilities without providing the basic infrastructure for cyclists will not have an effect on the number of cyclists within the city.

D.4.1 Recommendations: measure replication

- **Recommendation 1:** Working with cycling infrastructure on several service levels, is a way to develop an already well developed cycle network and take your cycle network to a higher level.
- **Recommendation 2:** Hard measures "go hand in hand" with soft measures. The evaluation shows a high awareness about some of the soft measures e.g. the lane lights and the air pumps. This shows that these kind of soft measures function as a way of branding cycling.
- **Recommendation 3:** Developing a conceptual framework focussing on free flow conditions, traffic safety and visibility/service was a way to guide our work and develop meaningful initiatives.

D.4.2 Recommendations: process

- **Recommendation 1:** The stakeholder workshop in the planning of the measure constituted a base for the engagement in and common understanding of the project. The workshop gave both new ideas and new perspectives on the project from the invited stakeholders, both important aspects when working with innovative measures.

Measure title: **Cycle motorway in Aalborg**

City: **Aalborg** *Project:* **ARCHIMEDES** *Measure number:* **51**

E Summary time schedule

		YEAR 1												YEAR 2												YEAR 3												YEAR 4											
Task No.	**Task name**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
6.1	Cycle motorway in Aalborg																																															
Evaluation tasks																																																
Survey on awareness, acceptance, modal choice, and perception of security																																															
Collection of costs																																															
Cyclists counts																																															
Collection on data on injuries and deaths - continually																																															
Establishing a business as usual scenario and upscaling scenario.																																															
Travel time surveys																																															
Learning History Workshops																			x											x														x				
Process evaluation report																				x												x												x				
Deliverables																																															
M12.1 Draft MLEP									x																																						

D12.1 Final MLEP													X																																			
D12.2 Baseline and first results																																		X														
D12.3 Draft results Temp																																														X		
D12.4 Final result temp																																																X