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## Measure Evaluation Results

### UTR8.2 Clean route planning for freight transport

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## ***Executive Summary***

Clean air, an accessible city, and sustainable growth are the main objectives of the Air quality Action plan of the City of Utrecht (ALU Actieplan Luchtkwaliteit Utrecht/ December 2009). Clean air is essential for the human health and vital for specific vulnerable groups of the population. If specific measures are not implemented in the city of Utrecht, the standards for air quality defined in the Action plan will not be met by 2015.

Within the CIVITAS MIMOSA measure, the city of Utrecht aims to elaborate a strategy to move a local air quality problem to a less vulnerable area where the standards for air quality are not exceeded. The measure “clean route planning for freight traffic” focused on defining a method to guide, in real-time, freight traffic along routes that are less congested, based on air quality measurement. Due to the complementary aspect, the implementation of this measure and the measure “regional traffic control centre (URT 8.1)” has been closely conducted.

The measure was implemented in the following stages:

**Stage 1: Feasibility Study** - (*September 2010 – April 2011*) An investigation in to the feasibility and available technical possibilities for clean route planning for freight transport. The feasibility study highlighted critical issues which justify that the concept of the measure - rerouting freight traffic in real-time according to local air quality index - contributes to reduce traffic pollution on the city level. Indeed, NO<sub>2</sub> emissions are 20 times higher by freight vehicles than by cars; heavy road freight traffic and buses emit more than double in road congestion than in fluent traffic. The results of the feasibility study were summarized in a report to provide a technical basis for the further stages of the measure.

**Stage 2: Design of a tool to guide freight traffic in real-time** – (*Jan. 2011 – April 2012*) First, the factors that have to be taken into account in the choice of most appropriate routing for a specific freight vehicle were selected. Then, the values of these factors which will influence the choice were determined. Influencing factors amongst others are travel time, fuel consumption (based on distance, speed and stops), the chance of meeting congestion, real-time traffic disturbance in the network and overall effect of the rerouting advice on the network. The rerouting advice is also restricted by the physical properties of the vehicle (e.g. length, weight, etc.). A route navigation software was designed to calculate the most appropriate itinerary for a specific freight vehicle in real-time. The overall objectives to develop the algorithm are to reduce the emissions due to freight transport on the city level, reduce and avoid road congestion, decrease fuel consumption.

**Stage 3: Development of the “Clean route planner for freight traffic”** (*April 2012 – November 2012*) Following a go/no go decision, work was carried out to test the standard route planner for freight traffic (the so called TLN-planner) that calculates emissions. The tests should lead to insight into how the planner performs, and if improvements are possible. The report should give the market detailed insight into how to develop an app which takes into account air-quality. A navigation application for cellular phones is already in production and is foreseen to be available on the market in late 2012/ early 2013.

As the measure consisted mainly on research and development of prototype activities, the **evaluation** is focused on the process which uncovered several **barriers** during the implementation of the measure. First, there was a lack of reliable technology to measure air quality as it is very difficult to measure, yet also to model actual air quality conditions. Secondly, an increase of local resistance among citizens living along the roads concerned by the measure has been observed (so-called NIMBY-effect).

Two **relevant drivers** support the implementation of the measure. The first driver was the existing awareness regarding local air pollution issue and the adoption of the Air Quality Plan by the city of Utrecht in 2009. The second driver was the establishment of a working group, called “Kracht van Utrecht”, which gathered citizens and experts to discuss and suggest proposals to the decision-makers during the process.

From the experience in Utrecht, **it is recommended** to actively involve the citizens and freight transport operators in the earliest stage of the process. A campaign to raise awareness of the air pollution issue on the city level and to present the objective of the measure could contribute to gain acceptance among citizens.

The measure is considered to be replicable in other cities, wherewith the city of Utrecht would like to point out that due to the linear relationship between air quality and health, a rerouting of freight traffic should aim at decreasing the emissions at the city level, not just single routes.

It is challenging to design a navigation tool for real-time freight traffic control. In this sense the measure contributed to encourage research and technology in an innovative field. The current results already are **promising for future developments**.

## A Introduction

### A1 Objectives

At several points in the City of Utrecht air pollution has to be controlled in order to avoid that the limits are passed. Diesel freight vehicles produce more polluting emissions, especially in congested circumstances. Rerouting freight traffic from specific routes and at specific moments of the day could help to respect the air quality limits and reduce the total emissions at city level. The measure objectives are the following:

#### High level objectives:

- Improve air quality.

#### Strategic level objectives:

- Achieve a better and more efficient use of the regional network and to improve reliability of travel times.

#### Measure level specific objectives:

- To determine the feasibility of guiding road freight traffic along routes that are most appropriate at that particular time, based on the real-time air quality situation.
- To adapt route planning based on real-time air quality situation.
- To improve the air quality in zones covered by the measure.

### A2 Description



Figure 1: Action Plan for Air Quality of the City of Utrecht

#### *Air quality in the city of Utrecht*

On December the 3rd 2009, the City Council of Utrecht approved the Action Plan for Air Quality. The objectives of this plan are clean air, an accessible city and sustainable growth. By this the city invests in a healthy environment and a liveable city. Good air quality is vital to the health of all citizens of Utrecht and especially for vulnerable people with higher health risks. In recent years, the city of Utrecht implemented many measures to improve the air quality, such as the introduction of clean buses and the low emission zone.

Nevertheless, extra efforts are necessary to meet the standards on air quality. Without further actions the air quality on a number of locations will not meet the national standards for air quality in 2015.

The large number of motor vehicles on the main routes in Utrecht affects the viability and the quality of life seriously. Finally, due to these air quality problems, projects that are essential for the future of the city, like the reconstruction of the central station area might be stopped if it is proven that they worsen the situation even further.

#### *Freight transport has a major impact on air quality in the city*

Heavy traffic circulates on the urban road network of the city of Utrecht irrespective of weather conditions and air quality. Air quality changes from day to day and varies from location to location. Compared to other vehicles, freight traffic vehicles contribute a lot to the decrease in air quality. When air quality limits are exceeded the emissions can be lowered by stimulating the use of cleaner vehicles or decreasing the number of driven kilometres. A third option is to move the

emissions to another area. It may be favourable for local air quality – depending on the weather situation – to guide road freight traffic along a certain route into the city on one day, and along a different route on another day.

Within this CIVITAS MIMOSA measure 'Clean route planning for freight transport', the city of Utrecht aims to move a local air quality problem to a less vulnerable area where the standards for air quality are not exceeded. In this way, this measure offers opportunities to prevent or limit locally and temporarily air quality problems. However this approach may not lead to higher emissions on city level.

The first part of this measure was to carry out a feasibility study that should determine how to reroute road freight traffic with the aim to improve air quality. By following these recommended routes, truck drivers will affect the air quality in a positive way.

In order to be able to follow the most appropriate route, a truck driver has to be informed what the most appropriate route in Utrecht is on the time he/she is driving in Utrecht. This means that:

1. the air quality measurements on the main roads and zones covered by this project have to be available continuously;
2. this air quality data has to be imported into the system(s) that plan or guide the routes of the truck drivers that drive in, to or from Utrecht, so they will be advised to take the most appropriate route;
3. and finally the truck drivers need to follow this guided route.

Truck drivers can get informed by means of roadside information, but also by in-vehicle information (for instance navigation and route guidance systems based on satellite navigation data).

The second part of this measure consisted of determining if it would be possible to guide the freight traffic with the help of a dedicated freight route planner App. It was determined whether it is possible to guide road freight traffic with this tool along more appropriated routes at particular times of the day. Following a pilot will be implemented (October 2012), yet due to timing its full impacts cannot be measured during the project period.

## **B Measure Implementation**

### **B1 Innovative aspects**

The innovative aspect of the measure is the **new conceptual approach**: road traffic management based on air quality; linking with navigation and route-guidance systems. Many navigations systems are on the market, yet applications that are specifically dedicated to guiding freight traffic; including “real time” information on road conditions are rather scarce.

### **B2 Research and Technology Development**

Research has been carried out on the feasibility of guiding trucks away from much polluted roads towards routes that are suffering less from emissions. An extensive and detailed "Feasibility Report on Clean Route Planning for Freight Transport" - Deliverable 8.2.2 – was produced (March 2011). Topics discussed within the report are:

- *On which type of emission should the focus be, when trucks are concerned?*

It was concluded that the focus should be on NO<sub>x</sub>, a local toxic emission that's heavily influenced by road traffic. 32% to 50% of the NO<sub>x</sub> emissions are due to road traffic. The influence of road traffic on PM<sub>10</sub> emissions is very little.

- *How should the real-time air quality be determined: based on models or by measurements?*

Because of the uncertainty in the available models, measurements are always necessary. In 2011 Utrecht measures NO concentrations at two locations, so up-to-date information is available. However, there are large variations measured throughout the day, indicating the complexity of the subject. The feasibility study proposes to determine a threshold for both measurement stations and then to use these as a basis for the variations at other locations in the city of Utrecht. When measurements exceed the determined thresholds, action should be taken.

- *What is the link between air quality and health (damage)?*

Because there is a linear relationship between air quality and health, it was concluded that all measures have to aim at decreasing the emissions at the city level, not just single routes. As to say only rerouting of freight traffic that leads to an overall decrease of NO<sub>x</sub> emissions is considered useful. Rerouting which leads to emission levels below the regulatory level on single routes, but in absolute terms increase the NO<sub>x</sub> emissions at city level are out of an overall health perspective not desirable. This is explained with the following graphs:

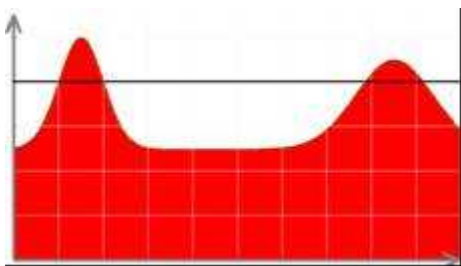


Figure 2 limits are not respected at certain times of the day on a specific route

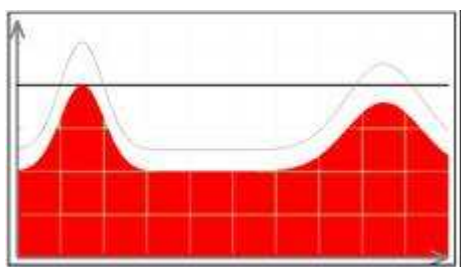


Figure 3 Limits are respected at certain routes by lowering the emissions

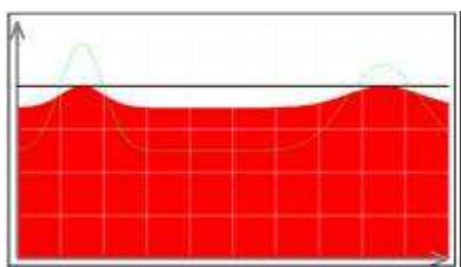


Figure 4 limits are respected, yet the overall emissions are higher due to extra kilometres of rerouting

- *What are the desired changes in traffic flow, and how can that be achieved?*

The feasibility study draws a number of other recommendations, which are:

1. not to focus only on the vulnerable routes but take the whole transport network into consideration when implementing measures;
2. to lower the speed limit on vulnerable roads;
3. It is neither effective nor sufficient to base dynamic measures only on air quality models. Often high concentrations can be predicted a day in advance. Making use of existing air quality measuring stations is considered to be a better alternative;
4. Stick to the following order of traffic management: inform, re-route and then dose. This on the condition that on the alternative route the same traffic flow can be maintained;
5. Active traffic management in terms of spreading incoming traffic has an important effect (>10% reduction of traffic) and is profitable especially on network level, resulting in improvements on multiple roads;

In terms of the envisaged rerouting of freight traffic during periods of congestion the report concludes that the focus should be on NO<sub>x</sub> concentrations. Compared to a passenger car, freight traffic has 20 times higher NO<sub>x</sub> emissions. During congestion in a city, the concentrations are 1.5 times higher than in a situation without congestion. Heavy road freight traffic and buses more than double their emissions in a situation with congestion.



When rerouting the city determined that the emissions of a medium or heavy truck in stagnant traffic on a route of 1 kilometre are equal to:

- the emissions of a medium or heavy truck on a detour of 1.5 kilometre on a route under normal urban circumstances (non-congested);
- the emissions of a medium or heavy truck on a detour of 2.5 kilometres in a congested situation.

These rules form the basis for the design of the alternative routes of freight traffic on a given time of the day, depending on the presence of congestion on the routes. The feasibility study finally concludes that guidance of freight traffic through navigation software can be a good solution, yet that an in-depth reflection has to be executed.

#### *Use of dedicated freight traffic navigation software and App*

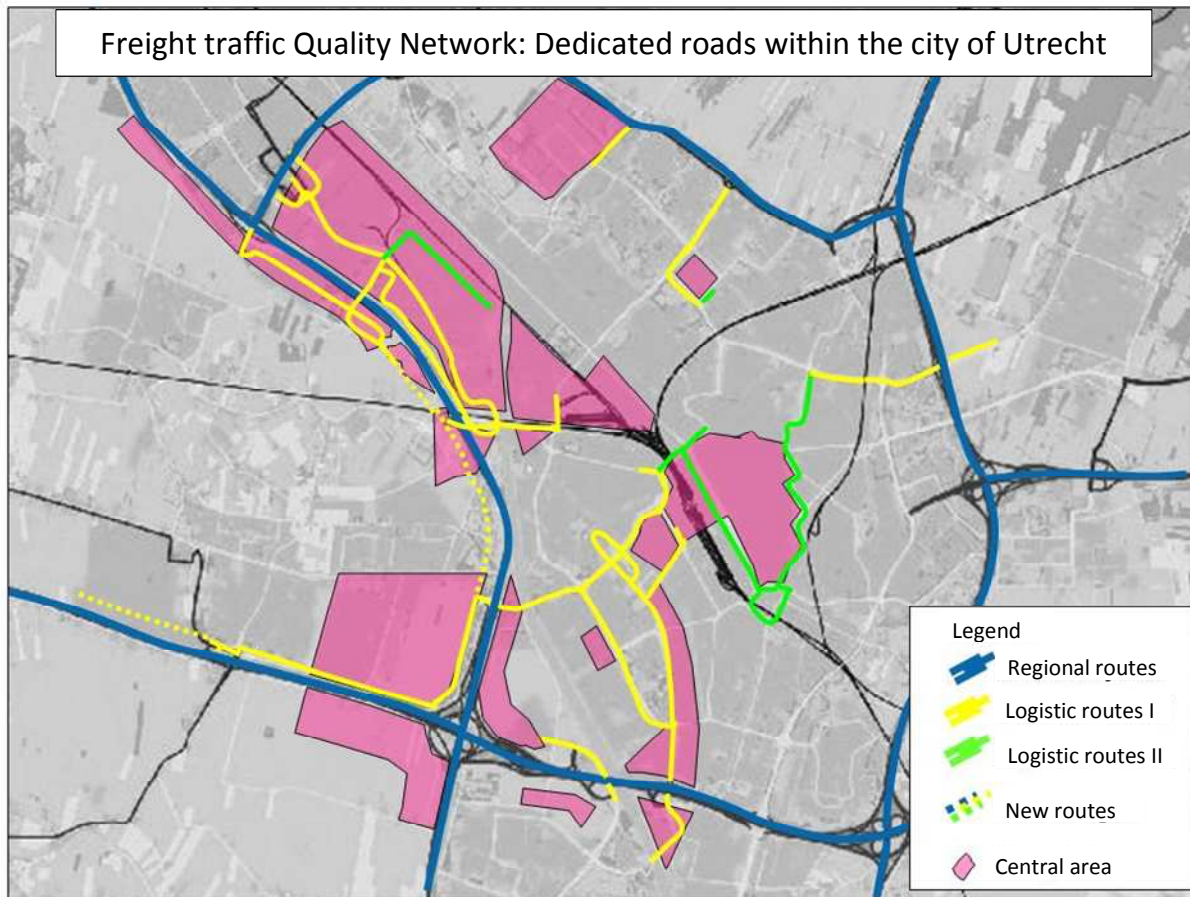
It concludes in terms of measures to be taken that a software-based navigation solution has several large benefits when guiding traffic along alternative roads. A software-based navigation solution is favoured over single use of roadside information signs, as it has several large benefits:

- It can be adjusted to the current situation at all times; not only related to air quality but also to road works, traffic jams, travel times etc. ;
- It is generic so other cities can also benefit from it (only the source data is different);
- Opposed to dynamic route information systems (that are physically fixed and only on certain roads), a navigation system continuously follows the truck driver and can integrate current needs;
- No extra physical objects need to be installed.
- Navigation systems are cheaper than physical solutions such as route info panels. However, the current navigation software for trucks can still be much improved and apps for mobile phones are not yet suitable for freight traffic

Further research on the navigation software and application formed a solid basis for guidelines on how to tackle the problem of air quality problems caused by trucks and other heavy traffic in an urban area. The city of Utrecht has three favoured routes for freight traffic coming and leaving the city centre. They are part of the dedicated freight traffic network (figure 5) and presented below:

- Direction “east part of the centre”: A27 - Biltse Rading - Kardinaal de Jongweg - Blauwkapelseweg - Kleine singel;
- Direction “west part of the centre”: A2 - Martin Luther Kinglaan - Weg der Verenigde Naties - Graadt van Roggenweg - Westplein - Daalsetunnel;
- Direction “west part of the city center (option 2)”: A12 - Europalaan - Overste Den Oudenlaan - Graadt van Roggenweg - Westplein – Daalsetunnel.





**Figure 5 freight traffic road network of the city of Utrecht**

The internet based route planner of the city of Utrecht has already a special option for freight traffic. Besides indicating the dedicated routes, the App will advise the best route on the basis of vehicle characteristics, and real time updated information on road works and network conditions.

More specific the following objectives were defined for the App:

1. It should lower the total level of emission of freight transport at city level;
2. Decrease traffic at points of congestion, and locations that are almost congested
3. Avoid, and avoid worsening of congestion (congestion leads to higher emissions than in situation of non-congestion). Congestion can be caused by roadwork, events (e.g. large fairs), and/ or have other sources;
4. Decreasing of fuel consumption. On an equal distance, and travel time one route can be more favourable in terms of fuel consumption than others. This leads also to lower costs for the respective transporter.

In the example below there are the route indications of 5 popular route planners. In terms of timing they are more or less equal. More significant changes can be found in terms of environmental aspects.



**Figure 6 Route indications of 5 popular route planners**

The goals of the route planner can be put down in an algorithm that calculates routes on the basis of:

- Travel time,
- Preferred routes (as for example defined by the freight traffic network (figure 5)),
- Fuel consumption as a result of distance, stops and speed,
- Level of congestion/ change of developing congestion,
- Roadwork,
- Influence on surrounding environment,
- “Real-time” traffic disturbance in the network,
- Freight traffic restrictions (presence of environmental zones, height and weight restrictions).

Following a tender process the development of the work started by the end of June 2012. A first version was presented and leads to the following graphs. Please note that this still only a test version.



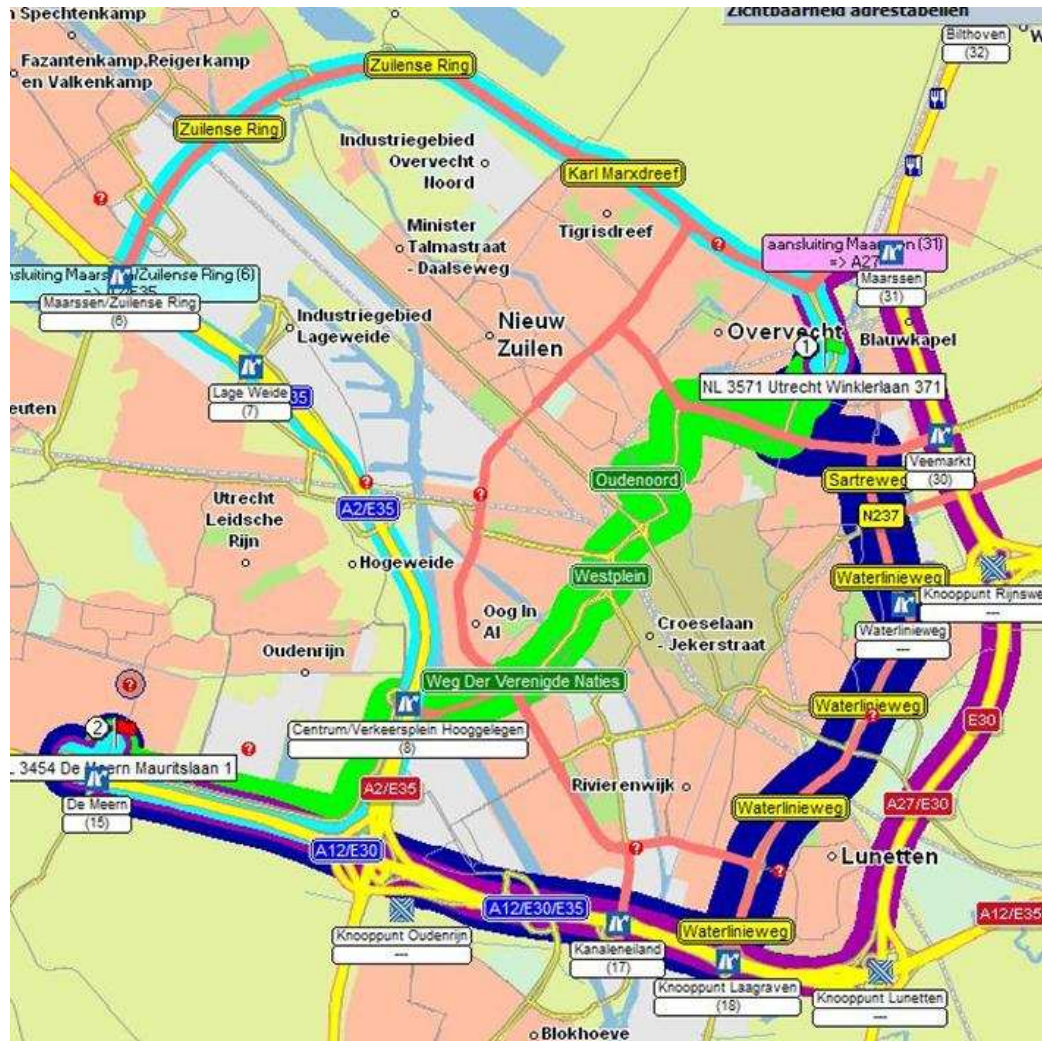


Figure 7 test version of the clean route planner for freight traffic

Several routes are presented (green, blue and purple) and can be distinguished on the basis of estimated:

- Travel time (in minutes)
- Distance (in Km)
- Average speed
- Fuel use (in litres)
- NOx (in grams)

The preferred route can then be chosen by the operator on the basis of the best balance of factors. The data exists both for small freight and heavy duty (40 tonnes) vehicles. Besides the standard available vehicle emission data, some basic data of the chosen routes taken into account are possible traffic speed at different road sections, number of traffic lights, turnabouts without traffic lights.

### **B3 Situation before CIVITAS**

Freight traffic circulates on the urban road network of the city of Utrecht, irrespective of weather conditions and air quality. Freight traffic is focussed on taking the fastest route and often based on the combination of the experience of the chauffeur and a navigation system. Neither fuel consumption nor emissions are during these situations an issue.

### **B4 Actual implementation of the measure**

This measure started in month 18. The measure was implemented in the following stages:

**Stage 1: Feasibility Report on Clean Route Planning for Freight Transport (September 2010 – April 2011)** In order to develop a tool that would allow influencing the routes taken by freight vehicles based on the real-time air quality situation, first a feasibility study had to be carried out. An extensive literature research study to determine the feasibility of the project was finalized by April 2011 (Deliverable 8.2.2). Within this study it was investigated if it would be possible to guide road freight traffic away from polluted roads towards routes that are suffering less from emissions, based on the real-time quality of the air (measured pollution levels). See for more details section B2.

**Stage 2: Research on the feasibility of an app in solving local air quality problems (Jan. 2011 – April 2012)** - an extensive research to determine the feasibility of a navigation app for the smartphone. This involves the investigation of the factors determining the best routing for freight vehicles when taken into account the issue of air quality. Influencing factors are among other travel time, fuel consumption (based on distance, speed and stops), chances to meet congestion, and overall effect of the rerouting advice on the network. An optimal weight for each factor has to be determined. The rerouting advice is also restricted by the physical properties of the vehicle (e.g. length, weight, etc.). The ultimate goal is to guide the freight traffic in such a way that the chauffeur will use it with confidence, while the environmental result is maximized. This stage must lead to the decision whether or not to build an app for the smartphone.

**Stage 3: Development of the “Clean route planner for freight traffic (April 2012 – November 2012)** Following a go/no go decision work is carried out to test the standard route planner for freight traffic (the so called TLN-planner) that calculates emissions. The tests should lead to insight in how the planner performs, and if improvements are possible. The report should give the market detailed insight how to develop an app which takes into account air-quality.

### **B5 Inter-relationships with other measures**

The measure is related to one other measure which is:

- **UTR 8.1 Traffic Control Centre**; the clean route navigation will get data from several sources. The TCC will keep an eye on it. Possibly insight from the TCC camera's, and traffic management scenario's will be transferred to the app.

## C Impact Evaluation Findings

Besides the evaluation methodology the impact evaluation findings are not applicable. This measure aimed at preparing the ground for the implementation of a rerouting device for freight transport at given routes in the city centre taking into account the “real time” level of congestion, and air quality. To evaluate if this goal was reached, results of the feasibility study and following research processes are of interest, leading to the actual construction of the App. As the application will only be available from November 2012 onwards, its impacts can only be presented on some single routes and trips.

### C1 Measurement methodology

#### C1.1 Impacts and Indicators

This measure aims at improving the air quality through guiding road freight traffic along routes that are most appropriate at that particular time, based on the real-time air quality situation. The feasibility of this approach will be determined within this measure.

To measure the impacts the following indicators on transport and environment are used.

#### Indicators:

1. **Air quality conditions with a focus on NO emissions.** In the city of Utrecht the air quality is measured permanently at three locations. These stations are managed by the national institute of public health and environment (RIVM Rijksinstituut voor Volksgezondheid en Milieuhygiëne). These traffic emission measure stations are part of the national network of air quality measure stations. At the map below the locations of these stations are visualised.



Figure 8 Location of the air quality measure stations in the city of Utrecht

Other indicators prove not to be feasible due to the lack of a physical implementation of the application before November 2012.

## C1.2 Establishing a baseline

The baseline is a situation before implementation and is represented by the levels of NO<sub>x</sub> presented in the following graphs (Figure 9 and 10).

Grafiek Constant Erzeijstraat NO<sub>2</sub> ([Stikstofdioxide](#))



Figure 9 Measured emissions at the “Constant Erzeijstraat” measurement station

As can be seen NO<sub>x</sub> is only measured at two stations in the city. In the graphs below is presented for a given period the fluctuations on NO<sub>x</sub> measurements for the baseline year 2010.

Grafiek Kardinaal de Jongweg NO<sub>2</sub> ([Stikstofdioxide](#))

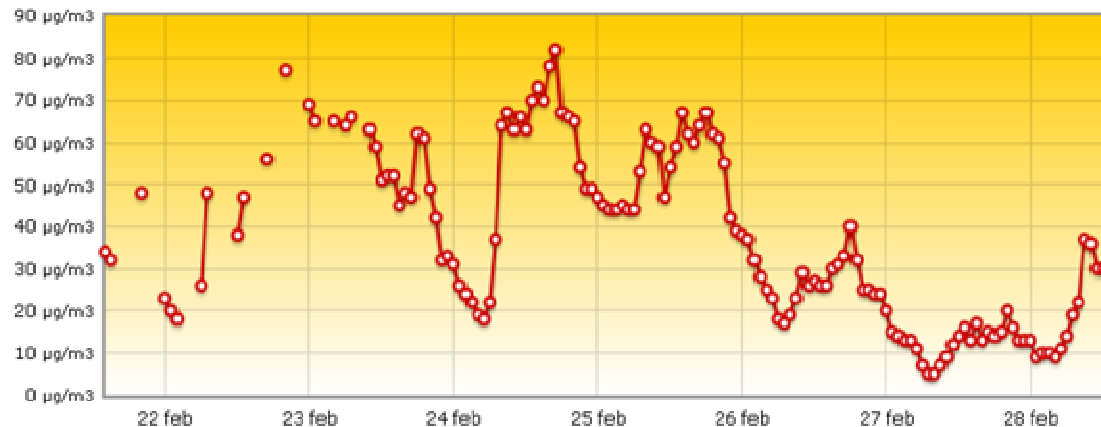


Figure 10 Measured emissions at the “Kardinaal de Jonweg” measurement stations

On the graphs can be seen that there are large variations, not only at different times of the day, but also between days, especially in relation to the first graph (Kardinaal de Jongweg). Here more traffic is passing by, on average 25.000 to 30.000 vehicles). Alongside the station of the second graph (Constant Erzeijstraat) about 12.500 to 15.000 vehicles pass by on a daily basis. It is therefore expected that therefore the second graph presents relatively better the background concentration (NO<sub>x</sub> emissions due to other sources). In terms of course the two graphs resemble. In order to be able to predict emissions on other locations or on another moment of time it is expected that the levels can be estimated on the basis of these variations. Additionally at 40 locations NO<sub>2</sub> en PM<sub>10</sub> are absorbed in special tubes to get insight at monthly bases.

The changed emissions of the road freight vehicles on the different involved roads can be calculated by using models, using also the two stations above as control stations. These levels

are assumed to be at the different routes in the city, in accordance with the levels measured by the two measurement stations before implementation.

### **C1.3 Building the business-as-usual scenario**

Without this measure the road freight vehicles will not adapt their routes according to the air quality conditions, so air quality will not be changed/ improved, and due to the expected increase in traffic levels even worsen. On the other hand freight vehicles coming into the city of Utrecht get cleaner, partly because of the instalment of “low emission zone” restrictions and other freight vehicle restriction measures in Utrecht, but also most of the other Dutch cities. As this is difficult to quantify it is assumed that the business as usual scenario is equal to the baseline situation.

## **C2 Measure results**

The impact evaluation findings and the other following considerations are not applicable (see heading point C).



## D Process Evaluation Findings

### D.1 Deviations from the original plan

Due to the step by step approach there is no serious deviation from the original plan. Stage 2 has started later due to some budget problems little related to the measure. From January 2012 on the project was again on full speed. In line with the plan the clean route planner for freight traffic will be available in November 2012.

### D.2 Barriers and drivers

#### D.2.1 Barriers

Some minor barriers occurred in the process towards the realisation of the feasibility study, this included:

- **A need for a more detailed specification of the objectives** - The initial idea was that routing freight traffic away from locations with a bad air quality would solve the problem. Based on the feasibility study it became clear that the measure should focus on the emissions for the whole city. Focussing on the problem locations is only partially solving the issue. This insight had strongly influenced the nature of the measures to be taken, as to say just rerouting was not enough, it should also lead to less emissions at an overall city level (Phase 1).
- **Local resistance on specific routes where freight traffic is guided trough** - NIMBY- (not in my back yard) effects are now apparent, and possibly will still grow in the coming years. Individuals focus on their own local air quality-problems, and do not care if this might result in problems elsewhere in the city (Phase 1 and 2).

#### D.2.2 Drivers

A number of local context factors fostered the realisation of the choice for the development of a route planner, and its realisation.

- **Local air quality problems and necessary counter initiatives** - the local air quality problems and following developed Air Quality plan of the city of Utrecht can be seen as a driver for the initiation of a number of initiatives, like this freight traffic rerouting measure (Phase 1 and 2).
- **New technological developments** – other software like Google Maps traffic and Google Maps navigation showed that real time traffic information on travel speed can be used and is available for the Dutch network. This information can be used to divert freight traffic from congestion areas (Phase 2).
- **New technological developments** - Additional functionality in a popular Dutch software program Local traffic Control makes it possible to change capacity and speed of road segments where road works take place, during the period of these roadworks. Navigation software can now also make use of it (Phase 2).
- **Involved stakeholder participation** - The “Kracht van Utrecht” (a group of citizens and experts in Utrecht) and the policy document “Action plan Air Quality” made it clear that congestion should not be tamed with just constructing additional roads. Additional roads

are the last measure to be taken based on the so-called “ladder van Verdaas”. This made it clear that a more clever management of traffic is a preferred solution (Phase 1 and Phase 2).

- **Availability of data and measurement stations** - Utrecht measures the air quality at two locations, so real up-to-date information is available. Furthermore, NO<sub>2</sub> and PM<sub>10</sub> are integrated in the Dutch smog standard and this provided a good basis for monitoring as well (Phase 2).

### D.2.3 Activities

Following the identified barriers and drivers, a number of activities were executed to progress with the work towards the realisation of freight traffic navigation software.

- **Full use of available software** - integration of the additional functionality of Local Traffic Control in the determination of the specification of the App to get a better grip on the effects of road works (phase 2).
- **Convincing stakeholders** - Convincing stakeholders that the focus should be on developing navigation software instead of implementing roadside information panels (Phase 1 and 2).

## D.3 Participation

### D.3.1. Measure Partners

The following partners were involved in the process of the determining of the feasibility, and development of the App for rerouting freight traffic in the city of Utrecht.

- **City of Utrecht** – Partner in the CIVITAS Mimosa project, responsible for transport and traffic issues within the city boundaries;
- **Local chamber of Commerce** - Partner in the CIVITAS Mimosa project, as a representative of the local commerce. They are a partner and in general consulted when it concerns freight traffic related projects.

### D.3.2 Stakeholders

- **Local transport operators** – the actors that finally have to follow the rerouting advices
- **Traffic control centre partners** – the application will influence the traffic that is managed from the traffic control centre

## D.4 Recommendations

### D.4.1 Recommendations: measure replication

Two major recommendations can be made in relation to the measure replication.

**Replication of the freight traffic rerouting with dedicated navigation software** - The measure is considered to be replicable in all other metropolitan areas where local congested routes exist, and where freight traffic is part of the problem. The software is in principal everywhere applicable, only the basic data inputs are changing.

**Objective of rerouting freight traffic** – Due to the linear relationship between air quality and health, a rerouting of freight traffic should aim at a decreasing of the emissions at the city level, not just single routes (see point B2).

### D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

**Technical constraints and active control strategies** - There are several technical limitations to link precise air quality measurements with active control strategies. In Utrecht the air quality is constantly measured at two locations, so up-to-date information is available for those places. A modelling is needed to link these “real-time” air quality measurements to air quality levels at other locations. Other controls can be executed on a monthly basis. Furthermore, NO<sub>2</sub> and PM<sub>10</sub> are integrated in the Dutch smog standard and this provided a good basis for monitoring as well. Similar constraints will have most likely to be solved in other cities.

**Changed behaviour of freight transporter following the rerouting advice** – Freight transporters may not follow rerouting advice. It is projected that this can be solved (at least partly) by a clear communication strategy and information campaigns, and close cooperation with transportation companies.

## E References

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