



CiViTAS
Cleaner and better transport in cities

MIMOSA

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Measure Evaluation Results

UTR 7.2 City Distribution by boat

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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

Executive Summary

Truck-based freight distribution is a major concern in Utrecht's city centre. Heavy vehicles damage the historical culture heritage of the city and cause nuisance in the form of accidents, noise and air pollution. The city council has therefore introduced a number of vehicle restrictions in the inner city including time windows for freight traffic to deliver goods and a low emission zone. But, since good accessibility is crucial for the city's economic viability, it was also decided to expand the existing water transport with the introduction of a zero-emission electrical vessel to transport goods to clients, shops, bars and restaurants in the city centre.

The concept is known as the Beer Boat since the vessel initially transported mainly beer and beverages to catering businesses along the canals. The first diesel powered Beer Boat was launched in 1995 and was aimed solely at reducing damage to the historical infrastructures. In 2007, the city became aware of the additional sustainable effects of transport by water and the potential of electric mobility. The MIMOSA measure therefore consists of the implementation of a new electric vessel and a search for new customers and suppliers to increase transported volumes. Thereby, the measure was implemented through the following stages:

Stage 1: Implementation of a new zero emission boat (April 2008 – January 2010) Before the development and implementation of the zero emission vessel, a study was conducted to calculate the saved emissions compared to freight traffic and compared to the diesel powered vessel. The potential contribution of the (zero emission) Beer Boat to cleaner air in Utrecht was investigated, thus justifying its funding. Since January 2010 it navigates Utrecht canals.

Stage 2: Exploring the market to expand waterborne transport (January 2010-August 2010) Following the launch of the new zero emission boat, more transport capacity became available. Not only did the new boat have greater capacity than the old vessel, but the old vessel also remained available for new customers. A market survey and feasibility study to investigate the potential for new customers and new suppliers – not only catering businesses but also other branches - for waterborne transport in the Utrecht city centre was conducted. The study showed that there was enough potential to justify another vessel. It also showed that there were a lot of opportunities to expand the possibilities of waterborne transport by collaborating with different transporters. The market survey in 2010 was extended with a further exploration of the market in 2010 and 2011.

The Beer Boat is currently operating 6 times on 4 days per week, supplying more than 60 catering businesses. Market exploration showed opportunities to increase the volume of goods transported to current clients and two wholesale companies have shown interest in the service which could additionally increase the number of trips in the near future.

As a result of the MIMOSA electric Beer Boat, in the summer of 2011 the City of Utrecht signed a contract for another electric 'Multi Purpose Vessel'. This Multi Purpose Vessel replaced the existing garbage boat which had been running in Utrecht to collect garbage from businesses on the wharves. In April 2012, the 'Ecoboot' was launched. Further Expansion of the market for waterborne transport was postponed after the introduction of the 'Ecoboot'.

Because of its potential and good visibility, the Beer Boat was identified as focused measure. Additionally to the impact and process evaluations, a cost-benefit analysis (CBA) was conducted. The results of the impact evaluation showed that the implementation of the electric Beer Boat had immediate positive effects on air quality, noise, safety and overall liveability in the city centre. The **key-results** of the impact evaluation were the reduction of CO₂ emissions by more than 38 tonnes, NO_x emissions by 31kg and PM10 emissions by 6kg. For the total estimated city centre emissions this means a decrease in CO₂ emissions of 13%, NO_x emissions

| | | | | | |
|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

by 6% and PM10 emissions by 10% in the MIMOSA lifespan. In addition, the CBA concerned the entire Beer Boat lifespan of 30 years and mainly focused on implementation- and operating costs, revenues and emission effects. Overall, the Beer Boat measure is yielding a net present value (NPV) of well over €420.000 at a 3.5% discount rate. It is assumed that impacts that were not part of the CBA have additional positive effects and thereby further increase the calculated NPV.

The main barriers encountered during the implementation were logistical challenges which made the win of new customers for the Beer Boat difficult. Firstly, it is a challenge to find interested transport companies and suppliers, as transporters do not easily change their current schemes and delivery profiles. Logistical choices for chain stores are often made at their headquarters and implemented nationwide. A specific logistic solution for one city is often considered too difficult to incorporate. Secondly, some transport companies had already adapted to delivery restrictions or had made investments in their delivery chain involving truck delivery. For them this makes the Beer Boat not financially viable. The solution to this would be to approach these companies during periods when they are reconsidering their logistical or equipment choices. Thirdly, many clients can only accept/dispatch deliveries at certain times making the Beer Boat delivery route and schedule somewhat inefficient with a lot of waiting time during trips or trips are made twice as for instance staff from catering businesses next to each other are not present at the same time.

One of the main drivers for the implementation of the Beer Boat was the shape of the city centre (many canals, dense city centre, most shops, bars and restaurants located along the canals and close to each other) which provided ideal conditions for the services offered by the Beer Boat.

Some lessons could be learnt from the implementation of the Beer Boat which are relevant for implementing or further expanding waterborne transport in Utrecht or in other cities. Firstly, the benefits of using the Beer Boat could be increased by optimising Beer Boat delivery schemes and thereby decreasing its travel times, adapting renting prices to increase acceptance during start up phases. Secondly, transport companies should be informed of the current and future financial gains and the ease of using the Beer Boat. Thirdly, the benefits of using the Beer Boat could also be increased by increasing travel times and costs for road transport towards the city centre by e.g. increasing time and weight restrictions. However, these kinds of restrictive measures should be treated with great caution: although it might mean a shift towards transport by boat, it will also mean a (much) lower efficiency in road transport. Not all transport can and will be shifted to boats. In the end, cities should strive for efficient goods transport in a comprehensive way, considering waterborne and road transport as supplementary freight transport mode.

The most important criterion for **successful transfer to other cities** - besides the presence of waterways - is that accessibility towards clients must be severely difficult for road transport companies. In Utrecht this difficulty is mainly guaranteed by weight restrictions in the city centre, implemented to protect the historical basements and bridges in the city centre (restrictions

| | | | | | |
|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

implemented because of physical necessity, not to stimulate certain forms of transport). This means that transport companies have to use many small vehicles to make deliveries by road.

Also, the Beer Boat performs best in a compact infrastructure, with a dense distribution of clients along the canals. For Utrecht, the Beer Boat has made positive contributions to overall accessibility and liveability in the city centre, making important contributions to air quality, noise reduction, safety and congestion levels. This could also be a good solution for other cities with waterways available.

Due to the many positive effects of the Beer Boat concept it is considered one of Utrecht's most popular MIMOSA measures gaining much attention and recognition at the national and international level. The success of the measure and decision-makers' enthusiasms for the project ensures the expansion and the sustainability of the Beer Boat in a long-term perspective.

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|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

A Introduction

A1 Objectives

The measure objectives are:

(A) High level / longer term:

- Increase of modal split towards sustainable modes
- Improve air quality

(B) Strategic level:

- Increase the use of more energy efficient freight distribution

(C) Measure level:

- To achieve better use of the potential of waterborne transport for supplying the city in order to reduce freight traffic in the city centre and access routes through the Utrecht West area.
- To decrease road freight transport and resulting PM10, NOx and CO2 emissions in the city centre thereby reducing air pollution.
- To reduce the emissions of waterborne transport to almost zero in order to reduce freight transport emissions.

A2 Description

The city of Utrecht wishes to increase the use of sustainable modes of transport and to improve air quality. A way to achieve this is to increase the use of more energy efficient, clean freight distribution. This measure aims to expand existing waterborne transport with the Beer Boat from one to two boats and to replace the current diesel powered boat with electric zero emission boats.

In 1996 the municipality of Utrecht began to offer distribution in the city centre by boat: the Beer Boat. The municipality initiated the Beer Boat after brewers contacted the municipality to help find a solution for their transport problems on the main canal. To prevent damage to the historical vaults and wharves in the city centre, the city had installed weight restrictions on the roads alongside the canal. This meant that brewers had to transport their beverages – heavy goods – employing under loaded vans (in terms of volume), meaning a lot of inefficient trips to supply the bars and restaurants. Besides that the vans that delivered to the catering businesses in the city centre suffered from delays due to traffic jams and restrictive regulations for delivery in the city centre (delivery time regulations, weight regulations and by now also environmental regulations). The brewers also had problems with labour laws: when bars and restaurants are located at the wharves and vaults, goods have to be carried down small stairs, which Dutch labour laws don't actually allow. Therefore the brewers asked the city whether it was possible to transport their goods by boat. The city decided to operate a boat service itself and so the Beer Boat was born.

The Beer Boat runs through the canals in Utrecht and mainly supplies the catering business with beverages. Since 2005 the Beer Boat has also delivered cooled and frozen products. In addition to supplying the catering business the Beer Boat also performs incidental deliveries such as printing stones for lithographers and it's also possible to rent the boat e.g. for removals.

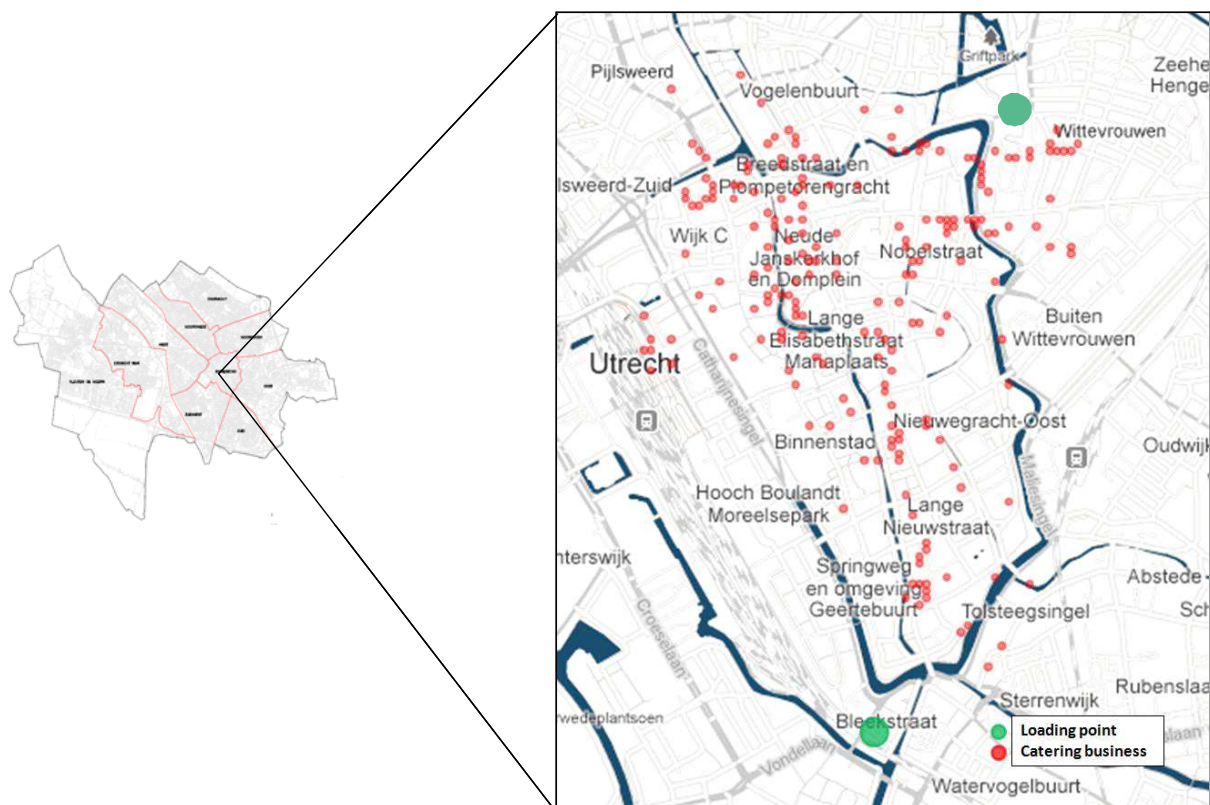
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|-----------------|---------------------------|----------|--------|
| Measure title: | City Distribution by boat | | |
| City: | Utrecht | Project: | Mimosa |
| Measure number: | 7.3 | | |

What is the Beer Boat and how does it work?

The original Beer Boat was a (diesel powered) vessel that ran once or twice a day from set points near the city centre (see map). There are three special loading places where large trucks can park to load / offload the boat. The Beer Boat was operated between 9:00 am and 4.00 pm and was also rented per hour, part of the day or whole day.

Goods were delivered in roll containers and the boat was assisted by a crane allowing the containers to be delivered both downstairs at the wharf level vaults and at street level. The Beer Boat has a capacity of 34 roll containers, which is equal to one large truck or 6 vans (or even more vans, if containers are heavily loaded and if you take the severe weight restrictions into account: then less containers per van can be transported). A representative from the suppliers is present to ensure that goods are delivered to the correct customers (see 'operating model' at the end of this section).

Figure 1 – Beer Boat delivery and loading points in Utrecht city centre



Source: City of Utrecht

The Beer Boat supplies, at the moment, almost 60 catering business companies (mostly pubs and restaurants). 60% of all deliveries are at the wharves and 40% on the streets above. The Beer Boat runs all year (in winter, the Beer Boat also functions as an ice breaker). The transport costs of the Beer Boat are comparable with the transport market, at least not higher. The boat can be rented for €85 an hour with a boatman. With regular customers contracts with price discounts are available.

Characteristics of the Beer Boat are:

- running times from Monday till Friday 9 am-4 pm
- three special loading points
- delivery in roll containers
- delivery both at the wharves and above at street level
- small and large deliveries possible
- possibility to rent per hour, part of the day or whole day

| | | | | | |
|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

Some of the advantages of the Beer Boat are:

- no delivery time regulations
- always on time (no traffic jams)
- environmental friendly

The Beer Boat is used intensively and since 2005 cooled and refrigerated goods are also being delivered. In 2009, the capacity of the Beer Boat was almost fully taken up by existing customers, but the same existing customers had also indicated that they would like to use urban waterborne transport even more. Thus there seemed to be market for at least a new vessel with a higher transport capacity, but maybe also enough market potential to operate a second vessel. However more customers were needed to justify the structural deployment of a second vessel. Therefore a market survey and a feasibility study were conducted to investigate the potential for new customers and new suppliers.

Figure 2 Beer Boat in progress



Source: City of Utrecht

This MIMOSA measure consisted of the implementation of a new electric vessel to replace the existing diesel powered vessel. Meanwhile the potential for new customers and suppliers was investigated to see if potential could justify a second vessel. If this was the case an operational plan would be developed and implemented. The idea was to first operate the 'old' vessel again and later either buy a new low emission vessel or adapt the old one to become low emission. However, in the meantime during the MIMOSA period, and based on the first successes of the electric Beer Boat, the Utrecht board decided to replace the diesel garbage boat with an electric version as well, as it would give immediate emission reduction. And if designed in the right way it would be possible to separate the garbage and – by means of special containers - use the boat not only for garbage collection but for all kinds of waterborne transport. Thus the development of the so called Multi Purpose Vessel began.

Because of this decision, during the MIMOSA period, priorities within the port department of Utrecht shifted from finding new clients in the inner city goods supply to developing the second electric vessel and expanding possibilities for waterborne garbage transport (e.g. also transporting household garbage instead of only garbage from companies). Expanding waterborne transport by gaining new customers in goods distribution for shops, bars and restaurants was delayed and postponed. Therefore the idea to offer more opportunities to serve new customers e.g. through closed containers (for clothing for instance) and the installation of cooled compartments was also postponed.

| | | | | | |
|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

This meant that the MIMOSA measure was limited to the implementation of the electric Beer Boat and growth in the existing market through increased capacity (however growth in capacity demand did not occur for all clients). The expansion of waterborne transport with new clients was not achieved within MIMOSA.

The aim of the measure was to contribute to less freight traffic on roads in the city centre and as a result also on access routes through the Utrecht West area, by doubling the distribution vessel capacity in the city centre compared to 2009; this aim was actually achieved by implementing the Multi Purpose Vessel, but not because of the MIMOSA measure. The aim was to increase freight volume transported by city distribution vessel by at least 50%. More waterborne transport and adaptation of the vessel(s) would also contribute to reduced emissions for the involved freight flows. This has not been achieved within the MIMOSA period but the potential has been proven.

Beer Boat operating model

The Beer Boat has always been operated by the municipality. Initially in 1996 this was simply because: when the brewers approached the city to find a solution for their transport problems, the city had a boat to offer that could be used for a pilot to see whether waterborne transport would offer a solution. This meant investment costs for the pilot could be kept low.

However, later, when the Beer Boat became a regular transport mode, the municipality also continued to operate the Beer Boat. There were two main reasons for this:

- The municipality could run the service on a neutral basis. This was very important for the initial customers, the brewers, who operate in a highly competitive market.
- Investment costs for a boat are high, meaning a big risk for commercial operators. However waterborne transport service is a necessity for Utrecht in order to keep the inner city viable and the bars and restaurants flourishing. Therefore the city decided to view this transport as a “service of common interest” (like public transport), justifying investments by the city itself, but with the goal to operate the service at a break-even point.

A commercial venture is still possible, but until now no commercial operator has shown serious interest in operating waterborne transport in Utrecht.

Since the municipality is not a transport company and the municipality is not allowed to transport goods for third parties, operation is based on hiring the boat and shipper per hour, half-day or day. This is the reason why a person from the supplier or transporter must always be on the boat: the responsibility for delivering the goods remains with the supplier/transporter.

This time-based model has up- and downsides. It is a good solution for the bigger suppliers and transporters, but it is relatively expensive if you have only small amounts of freight. It also means that only one supplier/transporter can be handled at a time. Transport would be more efficient if suppliers/transporters could combine their freight. But then either more persons have to be on the boat (one per supplier/transporter), or a transporter should formally take over the responsibility for transporting the goods of others. This means a more complex model.

B Measure Implementation

B1 Innovative aspects

The innovative aspects of the measure were:

- **New mode of transport operated**, within EU – transportation of beverages and fresh and frozen products in the city centre by (a zero emission) boat instead of trucks.
- **Targeting specific user groups**, regionally – expand the user group of the Beer Boat. The potential for new customers and new suppliers for waterborne goods supply was explored.

| | | | | | |
|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

B2 Research and Technology Development

The following research and technology activity took place:

- A **market survey and feasibility study** to investigate the potential for new customers and new suppliers – not only catering businesses but also other branches - for waterborne transport in the Utrecht city centre. The results of the study are reported in deliverable D.7.2.2. as follows:

The implementation phase and R&D phase of the measures have somewhat overlapped: the introduction of the new electric vessel took place earlier than expected: in January 2010 (instead of later in 2010). The market survey was not yet finished at the time of implementation. But now it could be used not only to decide operation of the old vessel as a second running boat, but first of all to better exploit the full potential of the new clean boat.

During the research and development phase, potential new customers from the catering sector were approached. Several companies showed an interest in the Beer Boat and requested more information. They were invited for a site visit to experience the full range of possibilities and to show that cargo other than food and beverages is also suitable for water distribution. Several customers indicated that they would like to make use of this mode of transport and in general it seemed as if there was a sufficient supply of goods to keep both the old diesel and new electric boat active full-time.

In summary, the main results of the market survey were:

- There seems to be a sufficient supply of cargo to also keep a second boat (either a new one or the 'old' Beer Boat) active in a structural way. In this regard, it is necessary however to place a cooling container on this older boat to meet customer requirements.
- The inventory of possible new cargo comes solely from the existing segment: catering businesses. New markets, such as the transport of clothing to city centre fashion shops, require further investigation and form an opportunity for new 'cargo packages'.
- The proposed collaborations with suppliers and transporters such as Gepu and Cargohopper received an enthusiastic response and were thought to offer many possibilities for new customers and market segments. Efforts were therefore made to continue collaborating with these suppliers and transporters.

The survey that was carried out provided clear angles for the future development of sustainable transport via waterways in the city of Utrecht and its surrounding region. Now that the market potential had proven promising, the search for more and new customers among catering businesses continued and new companies could be approached. For other segments, further investigation is still needed and will continue.

The cooperation with suppliers and transporters seemed promising: parallel to approaching new customers, there has been research into the possibilities of expanding the existing services. The Traffic & Transport department of the City of Utrecht has done this in a prize winning cooperation (Dutch Award for City Distribution) with Gepu (a wholesale company for catering goods, www.gepu.nl) and Hoek Transport who operate the Cargohopper, a clean city supply initiative (with narrow electric vehicles, www.cargohopper.nl) that is part of CIVITAS measure UTR 7.3. One of the ideas was to combine the strengths of the Beer Boat and Cargohopper and ensure that goods can be mutually exchangeable. This is now, in 2012, possible with the introduction of the Cargohopper 2, which can also transport roll containers. However due to the shift in priorities in the port department, exchanges between the Cargohopper and the Beer Boat are not yet taking place.

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|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

B3 Situation before CIVITAS

Utrecht city centre has many limitations for urban road freight traffic due to its historical centre and is also suffering from air pollution. A large area of the city is easily accessible via waterways. Since 1996 the municipality has operated a so called 'Beer Boat'. The catering sector (bars, pubs, restaurants, hotels etc.) has used this Beer Boat to deliver their supply in beverages, unique to the Netherlands and to Europe at this time. Since 2005 cooled, frozen and perishable fresh products have also been transported by the Beer Boat. The Beer Boat's capacity was almost fully used, while some customers had already indicated that they wanted to use urban waterborne transport more. To reduce the environmental impact of the Beer Boat, a zero emission boat was constructed, with greater transport capacity than the old one. This new boat became available in 2010.

At the same time the 'old' boat would be available for exploring new markets. The idea was that if successful the old boat would eventually be replaced by a new zero emission boat or adapted to become zero emission itself. However, in 2008 the known potential for existing and new customers lacked sufficient critical mass to justify the structural deployment of a second vessel. Thus there was a need for more customers, but it was unknown if there were any, and if so, what their requirements were for this type of transport.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Implementation of a new zero emission boat which substituted the old diesel vessel *(April 2008 – January 2010)*

In September 2007, Vuyk Engineering Rotterdam (www.vuykrotterdam.com) was commissioned to design a zero emission vessel. After the design was completed, a study was conducted to calculate the saved emissions compared to freight traffic and compared to the diesel powered vessel. In this way we investigated the (potential) contribution of the (zero emission) Beer Boat to cleaner air in Utrecht, thus justifying funding out of air quality improvement budgets.

In April 2008, this calculation study was completed. The results of the study were promising, as expected the Beer Boat provided considerable emission savings. When the existing Beer Boat was replaced by a zero emission boat, the savings in PM10 and CO₂ emissions would be doubled (Ecofys 2008). So it was decided to build and implement a zero emission boat and finance it partly with air quality improvement funds.

Between April 2008 and December 2009, the vessel was built (by Scheepswerf Bocxe Delft: www.scheepswerf-bocxe.nl). The new zero emission Beer Boat has been in service since January 2010.

Like the 'old' Beer Boat, the new vessel makes up to two rounds a day. The new Beer Boat took over all the regular deliveries of the old vessel, but because of increased capacity, could do this in fewer trips. In practice this means that the new Beer Boat needs only four days to transport what the old boat did in five days.

Stage 2: Exploring the market to expand waterborne transport *(January 2010- August 2010)*

Following the launch of the new zero emission boat, the old vessel became available for new customers. A market survey and feasibility study to investigate the potential for new customers and new suppliers – not only catering businesses but also other branches - for waterborne transport in Utrecht city centre was conducted. In June 2010, the results of this survey were reported in deliverable D.7.2.2 and are reported in section B2: Research and Technology development.

The study showed that there was enough long term potential to justify another vessel. It also showed that there were a lot of opportunities to expand the possibilities of waterborne transport through cooperation with different transporters.

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|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

The market survey in 2010 was continued with a further exploration of the market in 2010 and 2011. The idea was that this would ultimately result in using the 'old' vessel again. The following waterborne transport expansion routes were explored:

1. Expanding deliveries within catering business.
2. Expansion through deliveries of other goods like clothes or return flows like paper and plastic waste.
3. Expansion through cooperation with other suppliers and new partners like TNT (package transport) and waterborne transport from larger waterways outside the city of Utrecht.

From this study it became clear that in order to expand current deliveries to the catering business at least one cooling container would have to be added to the 'old' Beer Boat. Unlike Gepu (the catering supplier which was already a client of the Beer boat) other catering suppliers were not willing or able to invest in insulated roll containers. This addition of a cooling container was originally planned for end of 2010 / beginning of 2011. After this installation the 'old' vessel could be used for catering business. A first sketch of the cooling unit was made in 2010, however the final design and ordering of the unit was only possible once talks had been held with the potential users: guarantees of adequate usage of this new unit needed to be obtained, to justify the initial investment.

However, as previously stated, development plans within the municipal organisation changed. In the summer of 2011, the City of Utrecht signed a contract for a new electric Multi Purpose Vessel. The Multi Purpose Vessel is part of the European project Connecting Citizen Ports 21 (Interreg programme) and it replaced the existing garbage boat that was running in Utrecht to collect garbage from businesses on the wharves.

Expanding the market for waterborne transport as planned with the old Beer Boat was postponed and to be continued after implementation of the Ecoboot.

Figure 3 – Second electric boat Multi Purpose Vessel: Ecoboot



In April 2012, the Multi Purpose Vessel, called the Ecoboot, was launched. This new boat not only collects regular garbage, but also glass, paper and cardboard separated (in the old garbage boat nothing was separated). It can also transport extremely long or very heavy goods. Private individuals and companies can make use of the ship too. The ship

| | | | | | |
|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

is fully electric and its batteries are charged during the night. As it works with flexible containers after implementation this boat will also be available for the transport of goods other than garbage. The development of the Ecoboot is not part of the CIVITAS MIMOSA Beer Boat measure, however it increases the vessel transport capacity which was also an aim of MIMOSA.

The expansion of waterborne transport with other goods and the cooperation of other partners will still be adopted by the municipality, after the end of MIMOSA. Shops and transporters that use roll containers and are located at or near the wharves will still be approached, but later. Return logistics (garbage etc) will be taken into account then as well. This will however certainly take more time than expanding current deliveries.

If successful the Ecoboot will probably be used for these new markets: investment in the old 'dirty' diesel Beer Boat is not opportune anymore.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **UTR 7.3 Flexible access for cleaner freight transport** – has the same objective: To decrease road freight transport and the resulting PM10, NO_x and CO₂ emissions in the city centre. However allocation of results is not by measurements, only by calculation per measure.
- **Connecting Citizen Ports 21 (EU)** – brings together 7 major inland ports in Europe and intends to promote connectivity and sustainable transport by optimising the organisation of freight logistics and sustainable spatial development of inland ports (www.citizenports.eu).

There would have been a relation with measure UTR 7.4 Distribution Centre for Fresh and Perishable Goods as this had the same objective: to decrease road freight transport and resulting emissions. But since no new Beer Boat clients were recruited during MIMOSA and UTR 7.4 decided to focus on an area not located on the canals and no implementation took place for UTR 7.4 during MIMOSA, results in the end don't affect each other.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

This measure aimed at decreasing road freight transport and the resulting PM10, NO_x and CO₂ emissions in the city centre, better exploiting the potential of waterborne transport for supplying the city and reducing the emissions of waterborne transport to almost zero. Hence impacts on environment and transport will be taken into account. Verifiable results are less traffic on the roads in the city centre and as a result also on access routes through the Utrecht West area, doubling the number of vessels in the city (compared to 2009), increase in the freight volume transported by city distribution vessel (at least 50% compared to 2009) and reduced emissions for freight flows involved.

Because this measure is a focused measure, a Cost-Benefit Analysis (CBA) is part of the evaluation. From a costs and benefits perspective the measure may result in the following effects: the implementation of the zero emission boat will immediately result in a halt of emissions and a reduction in noise level. There are two effects if transport by Beer Boat increases. First the increased supply by boat will result in time savings for customers (roads no longer congested) and is resulting in revenues for the municipality (which operates the boat).

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|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

Secondly the decrease of on-street inner city freight transport will reduce revenues for other logistic companies who previously were in charge of supplying these customers. To measure the impact of UTR 7.2 on the city of Utrecht we report the impact of the implementation of the zero emission Beer Boat. The impact of the Beer Boat will not stop once CIVITAS MIMOSA is finished, but will continue throughout the boat's lifetime. For the CBA we calculated the results of the Beer Boat for an assumed lifetime of 30 years. This means we estimated the development of each indicator per year over 30 years. As a baseline we took the period before the old Beer Boat was implemented (1995) and pretended that not the old but the new zero emission boat was implemented. Thus we used the freight information of the old boat as an estimator. However along the way it turned out that no registered data were available in relation to freight loads (boat is rented per hour, not per transported volume) and the market situation was so competitive that this information was actually considered confidential. Therefore we could not use measured impact data. To overcome this problem for the CBA, different scenarios were calculated with estimated indicators. For this estimation we assumed that the number of trips and volumes transported in the future will never be lower than they were in the past, so lowest estimated results are the lowest possible. More detailed information about the scenarios and estimations can be found in the complete CBA report in the appendix. In this chapter we reported the direct impact results of the measure for the city of Utrecht and a summary of the CBA. For the impact evaluation the indicators in Table 1 were used.

| Utrecht no. | Pointer no. | Category | Impact | Evaluation Indicator | Source |
|-------------|-------------|-------------|-------------------|---|---|
| 1 | 8 | Environment | Emissions | CO ₂ emissions of road freight vehicles in the city centre and of the freight involved in the measure | City of Utrecht, Traffic & transport department |
| 2 | 10 | Environment | Emissions | NO _x emissions of road freight vehicles in the city centre and of the freight involved in the measure | City of Utrecht, Traffic & transport department |
| 3 | 11 | Environment | Emissions | PM10 emissions of road freight vehicles in the city centre and of the freight involved in the measure | City of Utrecht, Traffic & transport department |
| 4 | 25 | Transport | Freight movements | The number of goods vehicles and volume transported per week in the city centre and for the freight involved in the measure | City of Utrecht, Port department |
| 5 | 2A | Economy | Costs | Capital costs of the development and implementation of the new zero emission boat | City of Utrecht, Port department |
| 6 | 2B | Economy | Costs | Operation and maintenance costs per year of the existing and the new zero emission boat. | City of Utrecht, Port department |
| 7 | 1 | Economy | Revenues | Revenues from operating the Beer Boat | City of Utrecht, Port department |

Detailed description of the indicator methodologies:

- **PM10, NO_x, CO₂ emissions** – This measure aims to reduce PM10, CO₂ and NO_x emissions in the city centre. Therefore the PM10, CO₂ and NO_x emissions are reported. We report emissions on two levels:

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|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

- Emissions of freight transport in the city centre as a whole: Calculation of emissions in the city centre is based on the number of freight movements in the city centre. Freight traffic emissions are calculated to kg/year.
- The emissions caused by the transport of the freight involved in this measure were calculated. Based on the freight movements (indicator freight movements), the emissions caused by the transport of the involved freight was calculated for both road transport and (diesel) Beer Boat transport. We assume that this road transport will be with vans because of the weight restrictions on top of the historical wharves. We take the characteristics of the cleanest possible Mercedes Sprinter model, so in reality the emissions of road freight traffic will possibly be higher than we assume. The emissions of waterborne transport are none for the zero emission boat. Emissions are calculated in kg/year and for CBA counted for 30 years.
- **Freight Movements** – The amount of freight transported and the number of trips by truck or Beer Boat per week, before and after implementation of the zero emission boat is reported. The municipality operates the Beer Boat and the Port department delivered most of this information. As it turned out that no real data about freight volumes are being registered by the Port department – since operation is based on renting time and not on volume – we had to use other sources. The structural clients of the Beer Boat can be divided into two groups: breweries and catering wholesalers. From one client, catering supplier Gepu, we received transport data. For the other four main clients – the brewers - we had to estimate the number of trips and transported load. This estimation was based on two observation days and information from the port department.
For total truck transport in the city centre we used the Utrecht Delivery profile 2009 and assumed that, if road transport was used instead of the Beer Boat, vans would have been used and the full capacity of these vans would have been used. We also used data on the general development in (freight) traffic flow. Freight movements are reported as number of trips and number of containers per year. In the CBA we calculated the total number of freight movements over 30 years (the boat's lifetime), with an estimation of transport development. For the measure results, we only take the MIMOSA period into account (2008-2012).
- **Capital costs** – Investment costs for the zero emission boat. Investment costs for the zero emission boat were obtained from the municipal Port department. The costs in euro were used to conduct the CBA.
- **Operating and renting costs** – Operational and maintenance costs for the beer boat per year. For the CBA we calculated the cost during the expected lifetime of the boat. We assume a lifetime of 30 years. These yearly costs in euro were obtained from the municipal Port department. We assumed that they will remain the same throughout the boat's lifetime. Besides these boat operation costs, there are renting costs for the Beer Boat clients. For the CBA we have taken these costs into account as well. For the measure results we only look at the operational costs for the municipality and not those of the clients.
- **Operating and renting revenues** – Renting revenues for the municipality per year of operating the Beer Boat. We assumed that the new boat will navigate 4 days a week with an estimated load of 30 containers per day. Using the Beer Boat means less operating costs for the companies involved, these saved operational costs are taken into account as revenues in the CBA. The revenues were used to conduct the CBA. For the measure results we only take the renting revenues into account.

Some indicators have changed compared to the original local evaluation plan; in 'C5 Appraisal of evaluation approach' these changes are explained.

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| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

C1.2 Establishing a baseline

As a baseline for the measure we take the situation prior to implementation of the zero emission boat in 2009. In 2009, the diesel Beer Boat was in service. This service began in 1996 and in 2009 the capacity of the Beer Boat was almost completely used, meaning weekly service hours were almost fully used (capacity here does not refer to freight load capacity) The Beer Boat is rented per hour and not by freight loaded. Whether or not the client who rents the boat uses full capacity is not being registered by the municipality. Therefore some measurements were taken and we calculated an average weekly load.

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| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

Freight movements

In 1995, without the Beer Boat, only road freight transport was available to catering businesses in the city centre. Since 1996 the Beer Boat has been in operation. As mentioned before, we unfortunately don't have any registered data in relation to freight volumes transported by the Beer Boat. The reason is that the Beer Boat is rented to costumers per hour and not by freight loaded.

For the breweries it was impossible to obtain data. As the beer market is very competitive, freight volumes are supposed to be confidential as it is production information. To overcome this problem we used two visual measurements of the number of roll containers transported by the Beer Boat in February 2012. With these indications and information from the Port department we estimated the freight volumes of the Beer Boat in 2009 in terms of transport for brewers. From measurements in February 2012, we calculated that the average number of roll containers per day was 30. The electric Beer Boat is in service for 4 days a week over which it makes 6 trips. Five of these weekly are for brewers, which equals 100 roll containers a week in 5 trips for the brewers. From the Port department we know that average freight volumes from the Beer Boat haven't changed much since 2001. The reason for this is that these four brewers combined serve virtually all bars and restaurants along the canal, so there are no big opportunities for growth (only shifts from one brewer to another). Therefore we assumed that the number of roll containers transported for the brewers by the old and new Beer Boat were the same; 100 roll containers. Unlike the new Beer Boat however the old diesel Beer Boat made 7 trips a week (6 for brewers). The Beer Boat is in service 52 weeks a year, which equals 312 trips a year for brewers. As one trip a week is for Gepu, in total this equals 364 trips a year.

In terms of catering wholesalers, data have been made available by Gepu, the only catering wholesaler using Beer Boat services on a weekly basis. Gepu started using the Beer Boat in May 2005.

Initially in 2005, they transported 15 (winter) to 20 (summer) roll containers, in one weekly trip. Since then, Gepu has been convincing bars and restaurants to make use of their Beer Boat delivery service, leading to a continuous growth in transport volume by boat. The environmentally friendly image and the reduction of car traffic were some of the points that convinced Gepu clients to use the Beer Boat delivery service. By 2009, Gepu had activated the full potential for Beer Boat transport amongst their clients: meaning 30 (winter) to 45 (summer) roll containers. This meant however that the boat capacity became a limiting factor in summer. The old diesel Beer Boat had a maximum capacity of 32 roll containers, the maximum capacity of the new zero emission boat is 48 roll containers. So in practice, Beer Boat transport in 2009 was limited to 32 roll containers in summer as well. The freight potential exceeding the boat capacity was sometimes transported by boat as well, in an extra Beer Boat trip, but most of the time by road transport. For the baseline number of roll containers in 2009 we took 100 a week for the brewers and 32 per week for Gepu, together this equals 132 roll containers a week, an equivalent of about 26 vans. A van can transport about 5 roll containers. In reality however it would be less, as vans would not be loaded this efficiently and for the brewers 5 roll containers in a van is too heavy in terms of weight restrictions.

| Utrecht no. | Pointer no. | Indicator | Freight movements by diesel powered Beer Boat 2009 | Freight movements vans 2009 | Total Freight movements city centre 2009 |
|--------------------|--------------------|---------------------------|---|------------------------------------|---|
| 4 | 25 | Number of trips | 364 | 23617* | 24990 |
| | | Number of roll containers | 6864 | 118086 | 124950 |

Source: Port department, City of Utrecht, 2012 and Utrecht delivery profile 2009, City of Utrecht
 * roll containers calculated to vans (5 roll containers per van)

For total freight movements in the city centre, we used the estimated freight load per week in the 2009 Utrecht delivery profile (14.700 m3 per week for 51 weeks a year). This was estimated as

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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

490 vans per week in freight load. If we assume a maximum of 5 roll containers per van, this equals 2,450 roll containers per week in total. In reality the vans would probably not be loaded this efficiently and the number of roll containers would be less. From this total load, each week 132 roll containers are transported by boat. In our calculation, the freight volume transported by Beer Boat is approximately 6% of all transported volume in Utrecht city centre.

Emissions

To calculate the emissions baseline we used the freight movements baseline as reported above. We have the following emission factors:

| Emissions | Van (g/km)* | Diesel vessel (g/l)** |
|-----------------|-------------|-----------------------|
| CO ₂ | 301 | 3045 |
| NO _x | 0,5*1,29 | 1,18 |
| PM10 | 0,5*0,13 | 0,2373 |

*source traffic department Utrecht (based on Mercedes Sprinter characteristics)
**source Ecofys 'Emissie besparing door inzet bierboot', 2008

We estimated that in 2009 there were 24,990 van trips per year. The average roundtrip of a van within the city of Utrecht is estimated as 8 km (Hogenberg 2012). We know that the diesel Beer Boat used 4,200 litre diesel per year.

| Utrecht no. | Pointer no. | Indicator | Emissions vans Utrecht city centre 2009 | Emissions diesel powered Beer Boat 2009 | Total emissions freight movements city centre 2009 |
|-------------|-------------|----------------------------|---|---|--|
| 1 | 8 | CO ₂ emissions | 56870 | 12789 | 69659 |
| 2 | 10 | NO _x emissions | 122 | 5 | 127 |
| 3 | 11 | PM ₁₀ emissions | 12 | 1 | 13 |

Source: own calculation

Costs and revenues

Prior to the implementation of the electric Beer Boat, the diesel Beer Boat was in operation. The baseline costs are the yearly costs for diesel, maintenance and the captain (operating costs). The revenues are the renting revenues per hour that the boat was rented. Rental costs for the diesel Beer Boat were €85 per hour in 2009 and operating costs were €70,000 per year (6/7 of the costs in 2010 as the diesel boat made one more trip).

| Utrecht no. | Pointer no. | Indicator | Baseline 2009 |
|-------------|-------------|------------------|---------------|
| 5 | 2A | Capital costs | 0€ |
| 6 | 2B | Operating costs | 70000€ |
| 7 | 1 | Renting revenues | 90000€ |

Source: City of Utrecht 2012

C1.3 Building the business-as-usual scenario

The expectation is that without a zero emission boat, road freight traffic trips to the city centre will grow as will PM10, NO_x en CO₂ emissions (although at a slower pace, due to engines getting cleaner and cleaner). The only thing that could temper the growth is the current economic crisis, but we don't yet know what quantitative impacts the crisis will have. We have made a forecast

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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

on the basis of national freight transport numbers in the past and the Utrecht city growth model which predicts freight transport growth in Utrecht between 2005 and 2030 will be 100%. An exponential regression function was used to estimate freight developments (Hogenberg 2012, see appendix). Figure 5 in the measure results part C2.4 shows exponential freight development from 2009 till 2012.

For the Beer Boat trips and freight loads the BaU scenario in 2012 would be the same as the baseline in 2009. BaU means there won't be any new customers and we assume that the average freight loads of the actual customers will stay more or less the same.

Emissions in BaU will be calculated based on freight growth in vans only. The transport volume for the Beer Boat will be the same as the baseline, since with BaU there won't be an electric boat (so no reduction in emissions), and the number of trips will stay the same, which is 364 and the Beer Boat uses 4,200 litre diesel a year. The potential extra demand for transport by boat cannot be dealt with by the old boat structurally (see the Gepu example in section C1.2), so has to be handled by road transport in BaU.

Both the Business as Usual scenario (BaU) and the after situation are calculated and reported in the measure results section C2.

C2 Measure results

The results are presented under subheadings corresponding to the policy areas to which the indicators are related – economy, energy, environment, society and transport. In each paragraph the results are reported for the worst and best case scenario. Results are illustrated by graphs showing baseline, BaU and after situation for the impact of the Beer Boat measure between 2009 and 2012. Of course the impact of implementation of the zero emission boat continues after the CIVITAS MIMOSA period and continues throughout the Beer Boat's lifetime. For the results part in this report we only took the CIVITAS MIMOSA period into account. In cost benefit analyses costs and benefits throughout the Beer Boat's entire lifetime were calculated.

C2.1 Economy

The introduction of the electric Beer Boat imposes different costs and revenues for the city of Utrecht. In the table and graph below the costs and revenues for the CIVITAS MIMOSA period are reported.

The table below states that the purchasing costs for the electric Beer Boat were €600,000.-. After implementation the Beer Boat should have revenue of €200,000 in 7 years for the municipality (about €30,000 a year). The Beer Boat revenues are €90,000 each year and as we know the Beer Boat operates cost neutral, the operational costs are about €60,000. Table 6 shows costs and revenues per year. The Beer Boat is not profitable for the 4-year CIVITAS MIMOSA period, but we expect the Beer Boat to have a lifetime of 30 years. For the Beer Boat measure a cost benefit analysis was conducted as well. This CBA showed that in total the economic system will improve over these 30 years (the Beer Boat's lifetime) with worst and best case scenario values of respectively 0.2% and 1.7%. The Cost Benefit analysis showed that in its 30 year lifetime the Beer Boat will be profitable and is a low risk investment (see C2.6 and the appendix). One remark though: in Utrecht the investment can be considered low risk, due to the long lasting and stable relationships with big clients; without these links the investment would probably be considered more risky.

| Utrecht no. | Pointer no. | Indicator | 2009 | 2010 | 2011 | 2012 |
|-------------|-------------|-----------------|------------|----------|----------|----------|
| 5 | 2A | Capital costs | -600,000 € | 0 € | 0 € | 0 € |
| 6 | 2B | Operating costs | 70,000 € | 60,000 € | 60,000 € | 60,000 € |
| 7 | 1 | Rental revenues | 90,000 € | 90,000 € | 90,000 € | 90,000 € |

Source: Port Department, city of Utrecht, 2012

| | | | | | |
|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

| Utrecht no. | Pointer no. | Indicator | BaU | After | Difference After - BaU |
|-------------|-------------|-----------------|----------|-----------|------------------------|
| 5 | 2A | Capital costs | 0 € | 600,000 € | -600,000 € |
| 6 | 2B | Operating costs | 280,000€ | 250,000 € | -30,000€ |
| 7 | 1 | Rental revenues | 360,000€ | 360,000 € | 0€ |

Source: Port Department, city of Utrecht, 2012

C2.2 Energy

Not applicable.

C2.3 Environment

The direct environmental benefits from Beer Boat use come from a reduction in small delivery vans driving into the city centre. The new Beer Boat itself is not considered to have any impact on the environment in the study area. Effective emission reductions are given below. As the electric Beer Boat runs on green electricity (Eneco Ecostrroom 100% green: wind, water, sun and biomass energy, for electric power mix, see appendix), the emissions for the new boat are zero. All reported values are based on the cleanest possible diesel vans, meaning that real emission reductions might be higher. Figure 4 shows the development of different emissions for all freight transport in the city centre, assuming that all city centre transport is done with vans. In all graphs it is clear that introducing the zero emission boat gave immediate emission reductions. As there was only small growth in freight volume for the Beer Boat (and no growth in Beer Boat trips) and this small growth corresponds to a very small portion of total road freight traffic, emissions for road freight traffic follow virtually the same trend as BaU.

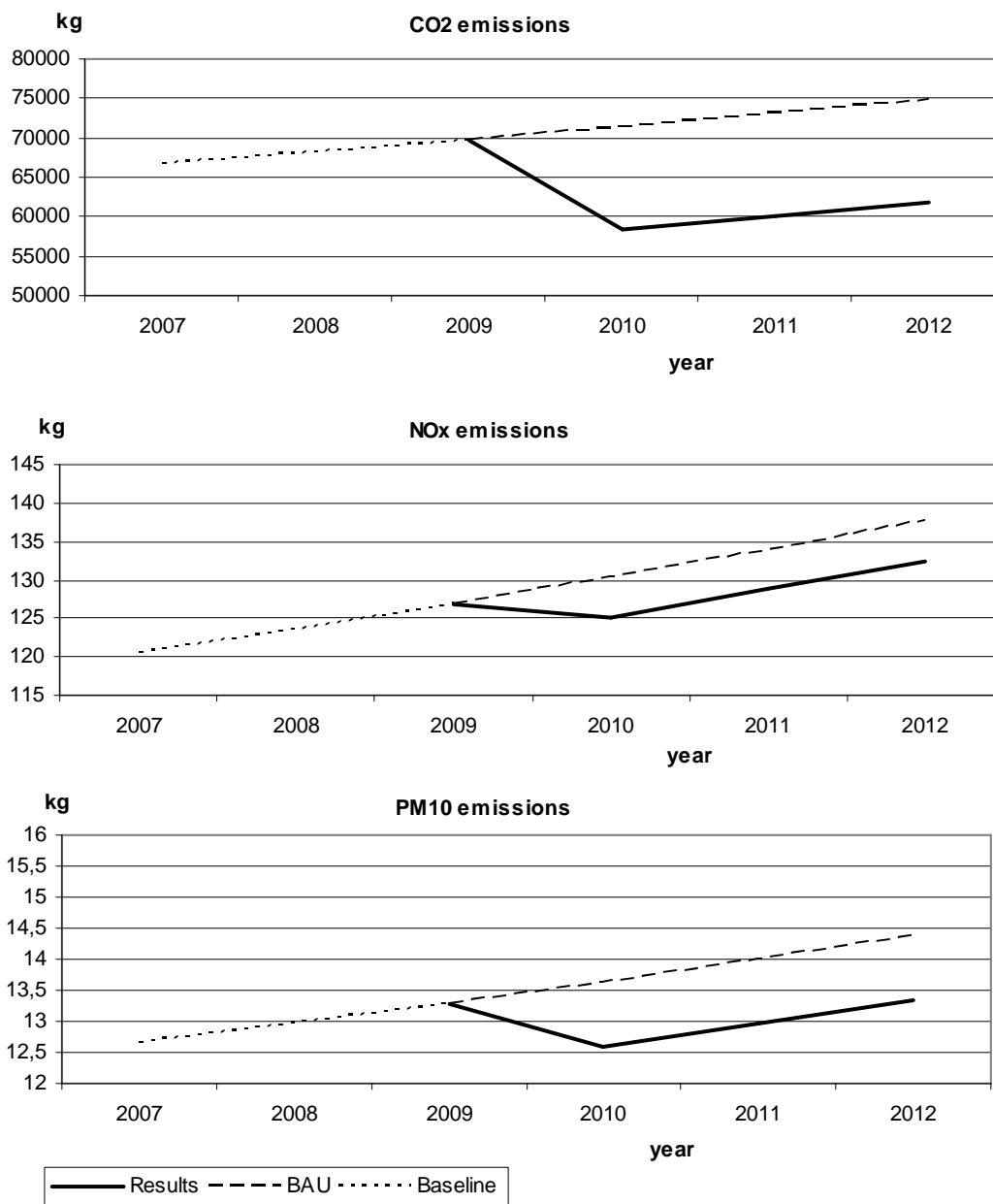
Table 8 shows that the implementation of the zero emission Beer Boat during CIVITAS MIMOSA reduced CO₂ emissions by more than 38 tonnes, NO_x emissions by 31 kg and PM10 emissions by 6 kg. For the total estimated city centre emissions this means a decrease in CO₂ emissions of 13%, NO_x emissions by 6% and PM10 emissions by 10%.

| Utrecht no. | Pointer no. | Indicator | BaU | After | Difference After - BaU | % |
|-------------|-------------|-------------------------------------|--------|--------|------------------------|------|
| 1 | 8 | CO ₂ emissions vans | 237621 | 237170 | -451 | |
| | | CO ₂ emissions Beer Boat | 51156 | 12789 | -38367 | |
| | | CO ₂ emissions total | 288777 | 249959 | -38818 | -13% |
| 2 | 10 | NO _x emissions vans | 524 | 508 | -16 | |
| | | NO _x emissions Beer Boat | 20 | 5 | -15 | |
| | | NO _x emissions total | 544 | 513 | -31 | -6% |
| 3 | 11 | PM10 emissions vans | 54,3 | 51,2 | -3,1 | |
| | | PM10 emissions Beer Boat | 4,0 | 1,0 | -3,0 | |
| | | PM10 emissions total | 58,3 | 52,2 | -6,1 | -10% |

Source: own calculation (van values based on Mercedes Sprinter characteristics)

| | | | |
|-----------------|---------------------------|----------|--------|
| Measure title: | City Distribution by boat | | |
| City: | Utrecht | Project: | Mimosa |
| Measure number: | 7.3 | | |

Figure 4 –Total emissions city centre freight transport



C2.4 Transport

The Beer Boat aims at reducing road transport in the city centre. However as expanding waterborne transport by attracting new clients after implementation of the electric boat has not yet succeeded, there is no significant road transport reduction (apart from a very limited reduction on a citywide level, no significant reduction in Gepu's summer operation). In relation to road and waterborne transport, the after situation is the same as BaU and BaU follows the baseline trend. The number of Beer Boat trips decreased as the electric Beer Boat has greater capacity while the freight volume stayed almost the same. The total number of roll containers transported by the electric Beer Boat during MIMOSA was 28,392. If we assume that a van can transport 5 roll containers each trip, this is a reduction of 5,678 van trips in the Utrecht city centre. This is almost 6% of total van trips in the city centre in the same period. Compared to BaU the freight volume transported by boat increased by 3%.

| | | | | | |
|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

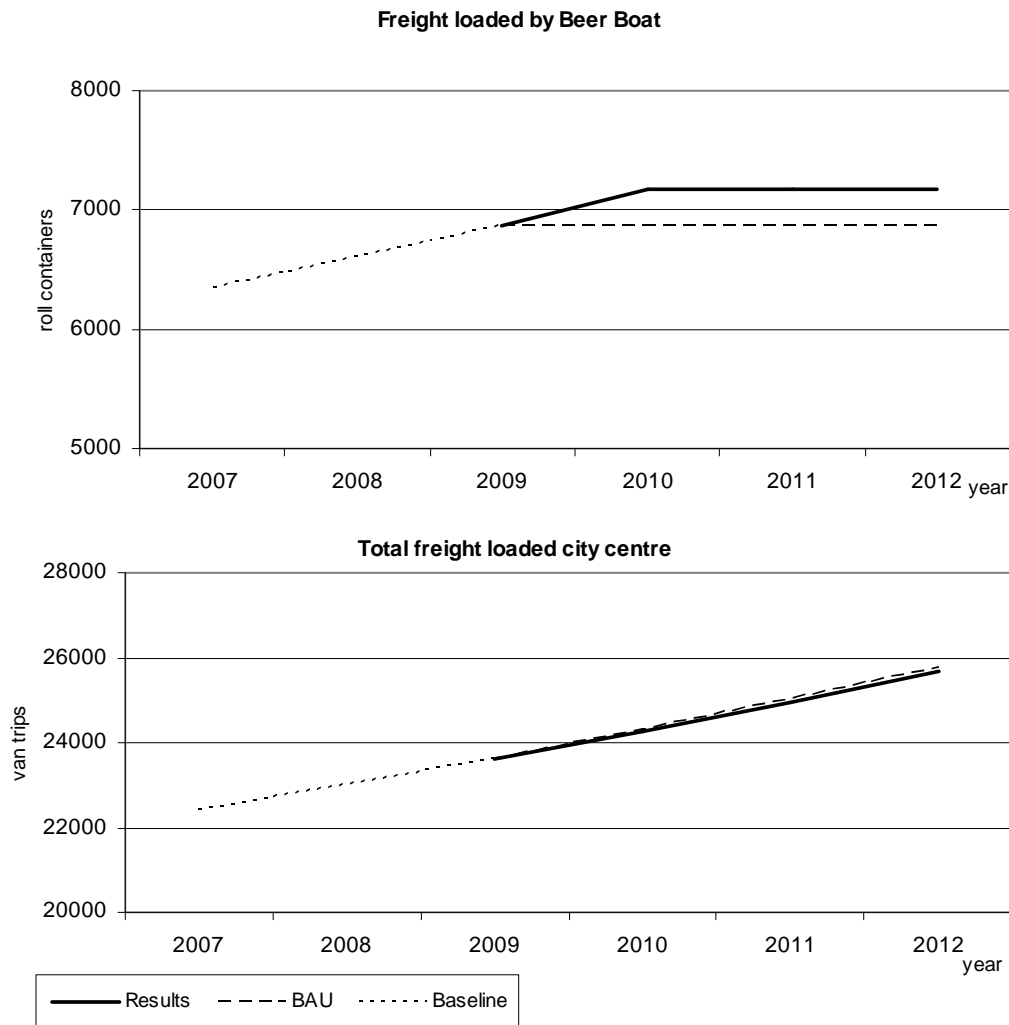
In table 9 the number of trips and the freight loaded is shown. We can see that the electric Beer Boat hasn't had any significant impact on the total freight transported in the city centre as expanding the market (and the freight volume) has yet to succeed. The growth in waterborne transport by Gepu means 187 less delivery vans on the city centre streets during CIVITAS MIMOSA. Compared to the total number of delivery van trips, the impact is very small.

| Utrecht no. | Pointer no. | Indicator | BaU | After | Difference After - BaU | % |
|-------------|-------------|-----------------------------------|--------|--------|------------------------|------|
| 4 | 25 | Delivery van trips | 98680 | 98493 | -187 | 0% |
| | | Beer Boat trips | 1456 | 1300 | -156 | -11% |
| | | Number of roll containers by van | 493399 | 492463 | -936 | 0% |
| | | Number of roll containers by boat | 27456 | 28392 | 936 | 3% |

* The number of Beer Boat trips is lower, but as the capacity of the new boat is larger, the freight volume (roll containers) stayed the same.

Figure 5 shows the development of freight movements in Utrecht city centre calculated in total van trips and the development of roll containers transported by Beer Boat. As the freight volume transported by Beer Boat freight didn't grow significantly, the trend for the results is the same as in the case of the business-as-usual scenario.

Figure 5 – Impact number of trips city centre freight transport (vans)



| | | | | | |
|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

C2.5 Society

Not applicable.

C2.6 Cost-benefit Analysis

Due to measure implementation delays and the launching of the Multi-purpose Vessel as a replacement for the garbage boat, the old vessel has not yet been made operational to explore new markets in the study area. This meant that from the original evaluation plan, only the switch from a diesel-powered vessel to an electrical vessel (and a very small switch from road to waterborne transport by Gepu) could be evaluated. However, this would yield very little usable information on the actual success of the measure because the main measure goal was to achieve a change in modal split for freight transport.

Therefore, it was decided to conduct a CBA for the initial implementation of a Beer Boat in 1996. Hereby a BaU-scenario without a Beer Boat was being compared to an after-scenario with a Beer Boat. Because this evaluation plan started in 1996, not all necessary the data were available. Therefore, the following assumptions were made:

- A zero emission vessel was implemented in 1996
- Vehicle restrictions were already imposed in 1996 (which was the case)
- All transport companies use the same vehicles to make deliveries
- Fixed volumes per trip are being transported by trucks and the Beer Boat

These assumptions made evaluating easier because less specific data on how cargo is transported were required. Furthermore, the assumptions put the CBA in a more current perspective which yielded more usable information. Also, it was assumed that a city interested in the Beer Boat concept would now most likely be interested in buying an electrical vessel and not a diesel-powered one; therefore the assumption of the implementation of a zero-emission vessel in 1996 was made. It was also assumed that interested cities had already introduced, or were thinking about introducing, vehicle restrictions.

The lifespan of the Beer Boat is 30 years, meaning that data on future Beer Boat and truck use had to be estimated. For the BaU scenario it was assumed that all cargo was transported with vans operating at full capacity. The future transported cargo was estimated based on forecasting models from the city of Utrecht. The BaU model included operational and emission costs and yielded total discounted costs of well over 42.5 million euro's over a 30 year period. Of these costs approximately €274,000 were emission costs.

Estimations of after-scenario indicators were highly dependent on the number of yearly Beer Boat trips. However, the future development of the number of Beer Boat trips was very difficult to estimate because of a complex interaction between measure barriers and drivers. Therefore, future Beer Boat trips were modelled using a worst-case, best-case system. In the worst-case model it was assumed that the current number of Beer boat trips, around 6 trips on 4 days per week, would stay the same in the future, implying low acceptance. For the best-case model it was assumed that the number of trips would reach a maximum of 12 trips per week quickly, implying high acceptance.

In the CBA the following impacts and stakeholders were evaluated:

- Financial changes for the city of Utrecht, which is the operator of the Beer Boat
- Financial changes for the logistics companies, who are the users of the measure
- Emission changes (CO₂, NO_x and PM₁₀) in the city centre for households due to a change in modal split

Additional impacts, such as effects on noise, safety, congestion levels and infrastructure damage could not be estimated. However it was considered very unlikely that the Beer Boat measure would have negative effects on these excluded impacts.

The accumulated CBA results, at a 3.5% discount rate, are shown below:

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|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

| | Worst-case | Best-case |
|-------------------|------------|-----------|
| Households | 9.505 € | 14.153 € |
| Utrecht | 80.687 € | 427.732 € |
| Logistics | 14.446 € | 297.797 € |
| Sum | 104.639 € | 739.682 € |

| | Worst-case | Best-case |
|-----------------------------------|------------|-----------|
| Emissions | -3.5% | -5.2% |
| Economics | -0.2% | -1.7% |
| Inner city truck reduction | -4.3% | -7.2% |

The results show that the Beer Boat measure yields positive effects for all stakeholders. Also, although the NPV's are small compared to BaU, effective results on emissions and truck reduction are notable. The most important conclusion that can be drawn from the CBA results is that even at low transport volumes, the Beer Boat is cost-efficient.

Both models rely on worst case scenario values in determining monetised CBA-values. This includes e.g. high values for Beer Boat operating costs and low truck travel times towards the inner city (which yields a minimal profit gain from using the Beer Boat for logistics companies). It was also assumed that freight trucks would operate at full capacity which means that actual truck trip reductions might be higher. Therefore the worst-case model is considered to be very robust towards changes in data that influences the NPV sign. Also, because the NPV's are positive, the exclusion of certain impacts has no effect on the NPV sign since it is not assumed that discarded impacts have negative effects.

The low sensitivity of the worst-case NPV emphasizes that the Beer Boat is a very low risk-investment for a city.

C3 Achievement of quantifiable targets and objectives

| No. | Target | Rating |
|---|--|--------|
| 1 | Less freight traffic on roads in the city centre, and as a result also on access routes through the Utrecht West area. | 0 |
| 2 | Doubling the number of vessels in the city centre compared to 2009. | 0 |
| 3 | Increase of the transported freight volume by city distribution vessel by at least 50% compared to 2009. | 0 |
| 4 | Reduced emissions for freight flows involved. | * |
| NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded | | |

The Beer Boat has contributed to the very important objective of cleaner air (mainly locally along the canal; citywide the air quality effect of the boat is small). Introduction of the zero emission boat immediately decreased emissions from waterborne transport. Overall the Beer Boat has also lowered freight traffic in the city centre. But as we already had a diesel powered Beer Boat before and the freight load of the old vessel and the new boat didn't change a lot, the zero emission boat itself has yet to contribute to a reduction in freight traffic.

Due to political decisions, the personnel available to work on increasing the waterborne transport market in the city were required to work on implementing the Multi Purpose Vessel to replace the old diesel driven garbage vessel. So in the end there are two zero emission vessels on the city centre canals, but freight load has yet to increase. The Multi Purpose Vessel was not part of CIVITAS MIMOSA. Compared to 2009 the city of Utrecht now has 4 vessels (2 diesel driven and two zero emission vessels) instead of two, but only the 2 clean vessels are in use. As we didn't succeed in increasing the number of clients and the freight volume of existing clients only rose slightly, it was not necessary to use another vessel. The Multi Purpose Vessel is developed to transport not only garbage but all kinds of freight as the garbage is loaded in removable containers. In the future it is more likely that this vessel will be used when freight increases rather than the old diesel powered Beer Boat.

| | | | | | |
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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

C4 Up-scaling of results

During the CIVITAS MIMOSA period, Beer Boat capacity was not completely used. The electric Beer Boat now navigates 6 times a week over 4 days with 132 roll containers. The maximum service possible would be 6 days a week with two runs per day and 36 roll containers (full capacity) per trip, which equals 432 roll containers each week.

The following upscaling is possible:

- **Extending the delivery area:** The delivery area could be extended by combining boat transport with other transport such as the Cargohopper. The Cargohopper is an electric/solar mini train which delivers goods in the city centre; the Cargohopper is part of MIMOSA measure UTR 7.3.
- **Exploring new markets:** The market could be expanded with more clients. There is enough capacity in the Beer Boat and there are still a lot of other entrepreneurs like shopkeepers near the canal, who could use waterborne transport. The city did approach clients, during MIMOSA, to ask if they were interested in using the Beer Boat, but clients didn't offer their freight immediately and the city didn't actively approach them afterwards as they were busy introducing the multipurpose Ecoboot. This boat can also transport frozen and perishable products, which opens up new markets to the initiative. Two food wholesalers have already expressed interest in using this multipurpose vessel.
- **Goods bundling:** Beer Boat delivery could be made more (cost) efficient. The Beer Boat doesn't operate at full capacity and often makes the same trip twice because different wholesalers do not want to share the Beer Boat when supplying catering goods. This is the result of the strong competition between different breweries, but also of the operating model. If the search for new markets is successful, it would be worthwhile for Utrecht to research the possibility of adapting the operating model and making goods bundling between different transporters possible, for instance by connecting the urban distribution centre (UDC) concept to the Beer Boat model.

C5 Appraisal of evaluation approach

Although the city itself owns the Beer Boat, it turned out to be very difficult to collect real data. As the city rents the boat per hour and not for the freight loaded, we don't have any data about the freight load of the boat per week, month or year. As the brewers' market is very competitive, they were not prepared to give load information. Data could have been collected by the city from the start of MIMOSA in 2008, but this wasn't organised, due to the sensitivity in the breweries market. Only some data from one client, a catering wholesaler, became available. Therefore the evaluation changed from a demonstration based evaluation which would be based on real measured effects to a more decision based evaluation practice with hypothetical assumptions and estimated results. This meant that the introduction of waterborne transport with a zero emission vessel with a lifetime of 30 years was evaluated. And as there are specific demands/regulations for road freight vehicles in the city centre it was possible to make a good estimation of the characteristics of the road freight transport for BaU. At the same time this means that these regulations, and the local circumstances in Utrecht with bars and restaurants on a lower level than street level, were very important in calculating these results.

In the end the estimated evaluation approach seems to be a useful approach, as for other cities it is interesting to see if introducing a zero emission boat for waterborne transport can be profitable and under which circumstances. If impact was measured only for the CIVITAS MIMOSA period and with real data, the impact would have been much smaller as only a few years would have been measured despite the fact that impact will continue after MIMOSA (the lifetime of the zero emission Boat is about 30 years) and real impact would also be smaller, as there was already a diesel powered vessel in use for waterborne transport. In the case of real

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|----------------|---------|---------------------------|--------|-----------------|-----|
| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

impact evaluation, this would be more about the accountability of CIVITAS MIMOSA, while in the conducted evaluation approach the impact of a zero emission boat is estimated. More in-depth examination of the evaluation approach including Cost Benefit Analysis, can be found in the appendix ('Evaluation of energy-efficient freight distribution measures. A case study from CIVITAS MIMOSA' by J.Hogenberg, 2012).

Before conducting the evaluation we considered including two more indicators: acceptance level of the Beer Boat delivering in the city centre and the total traffic flow in Utrecht West. Acceptance level was included in the feasibility study in the RTD part of the measure. As acceptance wasn't an issue yet with the old diesel Beer Boat and acceptance was no direct objective, we left this indicator out of the impact evaluation. The second indicator left out was total traffic flow in Utrecht West, as we didn't expect to see much difference in freight transport due to the implementation of the zero emission boat alone and there are a lot of other factors that influence freight traffic numbers. Besides this we only had one year of traffic counting data in which vans were also counted separately (2010). To use this for the impact evaluation we would have had to make an estimation of the van traffic numbers in the past. Considering that the freight volume transported by Beer Boat nearly increased during the evaluation period that would not have made sense. Therefore for the impact evaluation we left this indicator out. For future evaluation and reporting however it is recommended to continue counting vans separately in the following years.

C6 Summary of evaluation results

The key results are as follows:

- Introduction of a zero emission vessel gave **immediate emission benefits** of 38 tonnes saved CO₂, 31 kg saved NO_x and 6 kg saved PM10 emissions, during the CIVITAS MIMOSA period. As the Beer Boat has a longer life time, emission savings will continue in the future.
- A zero emission vessel is a **low risk investment in Utrecht** as the client base is big enough and stable and there are many profits. The net present value lies between €104,639 and €739,682 for its total lifetime (30 years) with a discount rate of 3.5%. Although this is not very high, all stakeholders have a positive net present value. Furthermore, the Beer Boat is already profitable with very low freight loads.
- **Road vehicle restrictions and local circumstances are helpful, if not necessary** to make waterborne transport an attractive alternative.

C7 Future activities relating to the measure

Efforts to expand waterborne transport will start up once again at a later stage, by looking for new customers and trying to increase freight from existing customers. Shops and transporters that use roll containers and are located at or near the wharves will be approached. Return flows will be taken into account as well. Both the electric Beer Boat and the new Ecoboat will be available for this. The case of Gepu shows how things could have developed if new clients had been acquired. When Gepu started using the Beer Boat growth was significant: Gepu started to transport all goods for their clients alongside the channel that they previously delivered by van. By opting for the Beer Boat transport service, they obtained more transport capacity that they could use without extra cost (because renting prices of the boat are based on time and not on volume, so transporting extra volume is relatively cheap). And Gepu could capitalise upon this extra capacity because the Beer Boat proves to be a unique selling point: many people, including bar and restaurant owners, like the idea of waterborne transport instead of road transport.

The same pattern would likely have occurred with new clients, if they were acquired during MIMOSA period: first switching their existing road transport to the boat; then making use of the

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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

good image of waterborne transport to attract new customers for their goods and increasing the transported volume (thus increasing profitability for the Beer Boat client).

D Process Evaluation Findings

D.0 Focused measure

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| | 0 | No focused measure | |
| 4 | 1 | Most important reason | The highly innovative nature of the measure with respect to technique, consortium, process, learning etc |
| 1 | 2 | Second most important reason | The measure fits into the EU policy towards clean urban transport (five pillars of the EU Green Paper) |
| 2 | 3 | Third most important reason | The measure fits into the city policy towards sustainable urban transport and / or towards sustainability in general |

D.1 Deviations from the original plan

The deviations from the original plan comprised:

- **No expansion of waterborne transport (August 2010- December 2012)** - The market survey in 2010 was continued by a further exploration of the market in 2010 and 2011. The idea was that in the end this should result in using the 'old' vessel again. But another development changed plans. In the summer of 2011, the City of Utrecht signed a contract for a new electric Multi Purpose Vessel. This Multi Purpose Vessel is part of the European project Connecting Citizen Ports 21 and it replaced the existing garbage boat that was running in Utrecht to collect garbage from businesses on the wharves. This made investments in the old 'dirty' diesel Beer Boat inefficient. Furthermore the implementation of the Multi Purpose Vessel took up a lot of the city's waterborne transport officers' time. Expanding waterborne transport with other goods and the cooperation of other partners took more time than expected and it was not possible to achieve this at the same time within existing personnel capacity. Expanding the market for waterborne transport as planned with the old Beer Boat was postponed and to be continued after implementation of the Ecoboot. In April 2012, the Multi Purpose Vessel, called the Ecoboot, was launched.
- **No adaptation of the 'old' vessel to a zero emission boat (January 2012- April 2012)** - When waterborne transport had been expanded and the old diesel powered vessel was running with enough capacity, the vessel was to be adapted to a low emission vessel or a second zero emission vessel would be purchased. Expansion of the market didn't happen. Still a second zero emission vessel has been launched, in the form of the Multi Purpose Vessel. Extra freight volumes can be delivered with the Multi Purpose Vessel in the future.

D.2 Barriers and drivers

D.2.1 Barriers

Overall barriers

These overall barriers hindered the wider implementation and potential of the measure.

- **Receiving clients do not really care about transport mode** - Transportation costs represent in most cases only a fraction of the price of the consumer product, which is also often invisible. Therefore shop owners care less about the costs of delivery (one of the strongest selling arguments of making use of the boat services), and in most cases they also do not really care about the way it is transported (although many people do like the concept of waterborne transport).

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|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

- **Less efficient transport as boat is rented by one wholesaler a time** - Different wholesalers/brewers do not want to share space on the boat (for example two competitive beer producers). They are afraid of losing their clients to the competitor. So this means in reality that the boat often does a trip twice, one for each client, even if it would be possible to have economies of scale by combining the goods. Transport rates are per hour of use, instead of based on freight volume.
- **Transporters already adapted to restrictions** - Some shop/bar/restaurant owners/transporters already adapted to the delivery restrictions of Utrecht, by making investments in their own vehicles and the supply chain. Many of these investment costs have yet to be written off. This led them to decide not to change, at least for the time being, to the boat solution. These companies should be approached again when they are on the verge of making new investment decisions; the issue is figuring out when this will be.

Preparation phase

No barriers other than those mentioned as overall barriers occurred during the preparation phase.

Implementation phase

- **Difficult to find new clients** - It is a challenge to find interested transport companies and suppliers, as transporters do not easily change their actual schemes and delivery profiles. Logistical choices for chain stores are often made at their headquarters and nationwide. A specific logistic solution for one city is often considered too difficult to incorporate. The concept and its possibilities still suffer from a lack of information and a lot of hesitation on behalf of the transporters and wholesalers remains. The project team have noticed that too often it is thought that it is not possible to transport a certain good by boat, while in reality it can be transported using this alternative mode of transportation. A lot of convincing is required and this takes up a lot of time.
- **Accessibility for road transport** - Many goods flows can be handled perfectly by road transport within the weight and delivery time restrictions for trucks in Utrecht city centre. Road transport in these cases is relatively easy and cheap, meaning there is no big driver for these goods for a shift towards waterborne transport. The restrictions for heavy goods and for flows that are heavily affected by the time windows favour the Beer Boat.
- **Fundamental discussion about public service versus distorting competition** - A fundamental discussion about whether this type of service should be seen as a public service or as distorting competition arose. The argument in favour of a public intervention is the necessity to offer boat services in order to make some deliveries while preserving the historic elements in the city centre (reducing the number of transport movements). Since (as appeared in Utrecht at the start of beer boat services) market parties are unable to offer this kind of service (e.g. because of high initial investments), the municipality steps in, like in public transport. The argument against is that if only one wholesaler/ transporter is using the service, this could provide the respective wholesaler with a competitive advantage (but this is at the moment not the case, as the service is open to all transporters/ wholesalers). A second argument is that this could block the entrance of a commercial boat operator, as the municipality of Utrecht only has to reach the break-even point and is not interested in or allowed to, make profits (thus not completely market conforming, though profits in transport are generally quite low). In this way the rates might be lower than if a market party was offering this service. The argument that the city initiative could block the entrance of a

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| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

commercial boat operator on the market does not however seem to be justified. When examining the case of Amsterdam where a commercial boat operator has tried to set up freight transport by boat, it has proven to be rather difficult. This is partly due to the physical circumstances. In Utrecht some of the delivery addresses are at water level, whereas in Amsterdam most deliveries have to take place at street level. In Utrecht the alternative mode of transporting by truck is more complicated, due to narrower streets. In Utrecht the delivery addresses are also more concentrated.

Operation phase

- **Less efficient transport as receiving customers are not present** - Receiving shop and bar owners do not always adapt correctly to the new form of delivery (e.g. not being present to receive the goods), making boat transport less efficient than it potentially could be.
- **Limitations on type and place of deliveries** - It is true that not all types of cargo can be taken on board. There is also a limited delivery range. In relation to the latter the distance between the unloading point and the shop has to lie within certain limits – also legally due to labour laws (as in Dutch labour laws there are restrictions on the weight and distances that freight may be carried by workers).

D.2.2 Drivers

Overall Drivers

- **City centre truck restrictions** – Important drivers for the boat service are the limited access in terms of time and weight for delivery by truck to the city centre. Furthermore there are a large number of one-way streets for motorised traffic, which also create favourable conditions for the development of boat delivery services.
- **City centre characteristics** - The shape of the city centre (many canals, dense concentration of bars, restaurants and shops in the city centre, many of them located along the canals) provides the ideal conditions for the beer boat and new electric boat service.
- **Historical heritage and air quality** - The need to restrict traffic above the canal cellars (preservation) and Utrecht's air quality problems favour the implementation of the beer boat services;
- **City of Utrecht as operator** - The neutral status of the boat operator, i.e. the city of Utrecht, favours the contacts with the potential transporters/ wholesalers.
- **No profit targets** - The fact that the provided services only have to recover the costs favours the development of the beer boat.
- **Project team** - A highly motivated project team is considered an important driver for the measures.

Preparation phase

- **Discussions and work at political level about freight action plan** – Even though this resulted in some uncertainty regarding the availability of budgets (especially for other measures), this action plan provided the opportunity to reserve extra budget for a second boat, which we would need if new customers were found.

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|-----------------------|----------------|----------------------------------|---------------|------------------------|------------|
| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

Implementation phase

- **Labour law** – An additional argument for implementation of waterborne transport in Utrecht came from Labour laws, in which there are maximum weight restrictions for workers to carry. Some of Utrecht's delivery addresses are at water level. Delivery by truck would mean transportation of the barrels down and up stairs – which is not actually allowed according to Labour laws – whereas transportation by boat means transportation at equal level and therefore no carrying of heavy weights up and down stairs.

Operation phase

- **Financial benefits** - Larger transporters and suppliers are making more rational cost related decisions, which should favour the boat services over truck delivery. Also financially the boat services are more attractive than delivery by truck, given the imposed delivery restrictions in the city centre, certainly in the case of large volumes.
- **Environmental benefits** - The electric boat running on green energy and even the 'old' beer boat have environmental advantages (noise reduction, CO2 reduction) over truck and van delivery, which favour the development of these services due to their green image.

D.2.3 Activities

Preparation phase

- **Survey among clients and suppliers** - Linked to the expected barrier of insufficient interest from the side of the clients/ suppliers a survey was carried out to see if this risk would materialise. It was finally concluded that this risk would not materialise. On the contrary it proved to be necessary to even reserve extra budget in the Air quality action plan for a second boat.

Implementation phase

- **Cooperation with local chamber of commerce** – As seen above most barriers are related to the hesitance of the stakeholders. Therefore it was decided to collaborate with the chamber of commerce. The local chamber of commerce encouraged the participation of stakeholders in a number of ways including the organisation of a seminar with all potentially interested parties, both private and public. This increased the sense of urgency and made transport companies more interested in starting to use clean services such as the beer boat or Cargo hopper.

Operation phase

- **Maintain political attention** – The continuous contact with, and information provided to the decision-maker helped to sustain and progress the 'beer boat' measure.

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| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

D.3 Participation

D.3.1. Measure Partners

- **City of Utrecht** – Port department, operates the Beer Boat, captain and port master.
- **City of Utrecht** – Traffic & transport department, responsible for freight policy plans like the freight action plan.
- **City of Utrecht** – Traffic & transport department and department of research and statistics, responsible for evaluation of the measure.

D.3.2 Stakeholders

- **Involved suppliers** - the brewers and wholesaler(s) who rent the Beer Boat to bring beer, other drinks and food to the catering businesses at the wharves in Utrecht city centre: Heineken, Grolsch, Inbev, Bavaria, Gepu.
- **Catering businesses** – catering businesses on the wharves in Utrecht city centre that are supplied by the Beer Boat.
- **Shop owners**- shop owners in the Utrecht city centre near the canal were approached to explore and expand waterborne transport.
- **Transport companies** – Hoek Transport, owner of Cargohopper 1 and 2, has been approached to explore if they saw possibilities for cooperation, thus increasing the potential of Beer Boat Transport. Possibilities were identified, certainly after the implementation of Cargohopper 2, but have not (yet) been capitalised.

D.4 Recommendations

D.4.1 Recommendations: measure replication

- **Restrictions for road transport** - Environmental reasons and preservation of the city centre has led the local government to promote freight transport by boat. In Venice it is simply impossible to offer more efficient transport in any other way. In Utrecht it is the strict regulations on freight transport by truck imposed to preserve the city centre which have favoured freight transport by boat. The imposed weight loads necessitate the use of special trucks. The advantage offered by environmental zones is however thought to be only temporary as sooner or later standard trucks will be adapted to meet the relevant environmental restrictions. The most important reason for the success of the 'Beer Boat' measure relates to the restrictions (regulations and physical circumstances) imposed on alternative transport by truck.

As a result of the restrictions upon road transport, freight transport in the city centre of Utrecht is cheaper by boat. In other words: restrictions are a very effective means to stimulate modal shift. This might lead to the conclusion that imposing restrictions is always good, but that is not the case: although they might lead to a shift towards transport by boat, it will also mean a (much) lower efficiency in road transport. Not all transport can and will be shifted to boats. In the end, cities should strive for efficient goods transport as a whole, meaning efficient waterborne AND road transport. If it is possible to stimulate waterborne transport without imposing (tighter) restrictions, for instance by capitalising time savings or image building when using transport by boat, this in most cases is preferable over regulations.

- **Thorough market and feasibility study** - It is recommended to execute upfront a thorough market and feasibility study. The study should clearly identify the potential of

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| Measure title: | | City Distribution by boat | | | |
| City: | Utrecht | Project: | Mimosa | Measure number: | 7.3 |

the intended freight services by boat. It should clearly identify the target group and market. Studies should also include an investigation of the limits of such a service e.g. in terms of legislative and physical restrictions. The feasibility study should also identify the potential interests and resistance against such a measure of stakeholders (i.e. transporters, wholesalers, local shops).

- **Start with low tariffs** - In a case where such a service does not yet exist it is very useful for the city to take responsibility for the market start-up, this allows the service to be offered with tariffs that only have to cover the costs. It does not need to make a profit. Having said that it is not necessary to keep this a public service forever, private party takeover is not impossible.
- The present concept of the “beer boat” is **transferable in cases where factors constraining** other forms of transport are present. These could be:
 - The physical environment (narrow streets; concentration of freight destinations, other physical restrictions and advantages that favour transportation by boat) with potentially added as a consequence weight load restrictions imposed by regulation;
 - The transportation environment: presence of traffic congestion, long travel times within the city and/or time window restrictions
 - Environmental restrictions (even if it is thought that this will only be temporarily advancing for the Beer Boat) imposed by environmental restrictive regulation.

If there is good accessibility for other means of freight transport, the concept of the Beer Boat is thought to only be economically feasible in the case of larger transport volumes, using larger boats, waterways and freight transports.

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

- **More cooperation between different transport solutions** - One lesson learned is in relation to the agreed cooperation with the city Cargohopper (electric mini train of measure UTR 7.3). A respective measure should not be developed on its own without taking into account its surroundings. The clients/ suppliers look at the activities of the city as a full package. The city itself should therefore also foster cooperation between different measure goals .
- **Take time to convince potential users** – When setting up freight transport by boat, it being a new form of transportation, a lot of time has to be put into the approaching, explaining, and convincing of potential users, and related stakeholders. The offer of some free 'test trips' are considered very useful in this respect.
- **Search for a local stakeholder** - Urban freight transport is a highly competitive market. Part of a good strategy concerning the promotion of freight transportation by boat is to search for the local stakeholder for which the new service offers financial advantage. The Utrecht project team think that this should ideally be the transporter.
- **Make public interest in the measure visible** - The boat service is being directly offered by a public authority it is of utmost importance to make visible the public interest in offering such a freight transportation service, and how it does not interfere unnecessarily with the market, but rather helps to create a new one.

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| <i>Measure title:</i> | | City Distribution by boat | | | |
| <i>City:</i> | Utrecht | <i>Project:</i> | Mimosa | <i>Measure number:</i> | 7.3 |

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