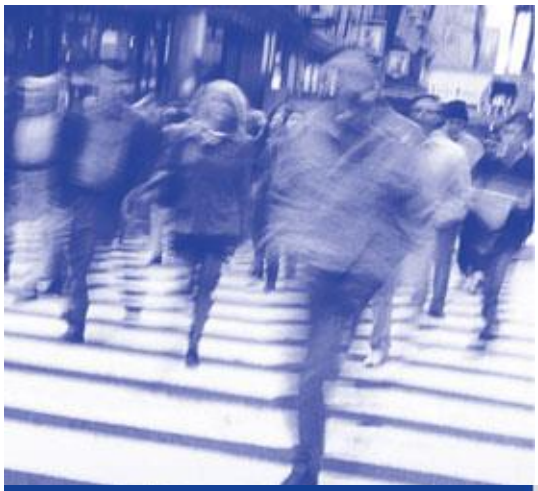

CiViTAS
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DYN@MO
AACHEN • GDYNIA • KOPRIVNICA • PALMA

Implementation Status Report A1.2:

Planning, implementation and effects of mobility packages on electromobile living

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Gisela Warmke	
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Oliver Kahl	
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Abstract

This implementation status report provides an overview of the activities which have been developed and implemented at the three housing areas of gewoge AG with regard to providing comprehensive mobility offers, since December 2012, as part of measure A1.2 “Electromobile Living” within the project CIVITAS DYN@MO.

The report details the selection of residential areas, the results of the tenant survey, how residents were addressed as well as the realisation of the mobile stations and the resulting outcomes. Furthermore, the obstacles and solutions encountered are also described.

Project Partners

Organisation	Country	Abbreviation
cambio Aachen – measure leader	Germany	DE
gewoge	Germany	DE
STAWAG	Germany	DE
City of Aachen	Germany	DE
ASEAG	Germany	DE
AVV	Germany	DE
RWTH Aachen / ISB	Germany	DE
FH Aachen	Germany	DE

Document History

Date	Person	Action	Status	Diss. Level
15.06.16	Gisela Warmke, Oliver Kahl	Finalising the report	Draft	TC
21.06.16	Marcel Braun	Proof-reading and final editing	Final	PC

Status: Draft, Final, Approved, and Submitted (to European Commission).

Dissemination Level: PC = Project Coordinator, SC=Site Coordinator, TC=Technical Coordinator, EM=Evaluation Manager.

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1 Introduction

Electric mobility plays a big role in Aachen. As included in the 2011 EC Transport White Paper there should be no more conventionally-fuelled cars in cities by 2050. The city of Aachen takes this objective seriously, e.g. the public transport provider ASEAG is switching to electric buses and, Velocity, a new, pedelec rental system (funded by the city of Aachen) is currently in its starting phase. Also, 10% of the vehicles of Aachen's largest car sharing provider cambio are already electric. The sales of e-bikes are rising substantially, and confirm the interest expressed in a survey conducted in 2014 that assessed the public interest in the development of electric drives (see: www.aachen.de/DE/stadt_buerger/verkehr_strasse/verkehrskonzepte/elektromobilitaet/_Ueberblick.html).

The research institutes of the RWTH Aachen and FH Aachen currently have many projects focusing on e-mobility and in turn, contribute to the spirit of optimism. Within the CIVITAS DYN@MO project, many individual research sources came together and are able to be interlinked.

Measure A1.2 "Electromobile Living" aims to combine the aspects of living and being mobile. The housing situation has a decisive influence on the mode of transportation for residents. The overall aim of this measure is to create attractive conditions for the transfer to an electro-mobile mobility network.

2 Background

The city of Aachen has developed in a somewhat ‘ring like’ manner around the medieval town. With increasing development over time, the city has formed three main ring roads. The two inner ring roads, the Grabenring and the Alleenring define the perimeters of the first and second city walls. The so called outer ring was created during the second half of the twentieth century as a bypass road.

Figure 1: Map of Aachen with six residential locations

Source: Map Basis: Microsoft Corporation; Data: cambio Aachen

At the beginning of the project, six residential locations of gewoge AG were selected and assessed for their suitability as project sites. Two of the residential areas are outside of the outer ring, three in the area between the Alleenring and the outer ring and only one in the city centre, close to the inner Grabenring.

The partners in this measure are:

- The city of Aachen (administration, political);
- Companies with municipal investments such as gewoge AG (home construction), ASEAG (public transport), STAWAG (utilities), AVV (transport association);
- The universities RWTH Aachen with ISB - Institute for Urban and Transport Planning and FH Aachen – Department of Civil Engineering, Urban and Regional Planning, Transport Planning and Technology.
- cambio Aachen (Stadtteilauto CarSharing GmbH) as the largest private-sector car sharing provider in Aachen.

Cambio, established 25 years ago, has a fleet of 144 vehicles, 50 stations and 7,000 customers. The 144 vehicles have replaced some 1,000 private vehicles. The *Bundesverband CarSharing* (German Federal Association for Car Sharing) along with many other experts believe that car sharing will continue to grow, even faster. In 2023, a projected increase of 215 cambio vehicles (this corresponds to 1,500 private cars) and 12,000 users are considered possible. In 2030, a projection of up to 400 vehicles (corresponding to 2,800 private cars) and 20,000 users are likely.

This constellation ensures that all major subject areas are represented within the measure.

3 Objectives of DYN@MO measure A1.2 Electromobile Living

The project aims to improve the urban living conditions of three of the gewoge AG residential locations in Aachen and its surrounding neighbourhood.

To make this possible, mobile stations with car sharing vehicles (especially electric vehicles) availability of bicycle stands, as well as pedelec test offers were to be established. At one of the current locations, the required electricity for the operation of electric vehicles is produced locally via a newly installed solar system.

The project aims to reduce trips with private vehicles and provide the residents with the opportunity to test electric mobility options. The establishment of bicycle parking facilities should make the shift to bicycles and pedelec easier.

In the CIVITAS DYN@MO project this measure is integrated on a strategic level with other measure, most prominently A1.1 Dynamic SUMP and A1.3 Sustainable Campus Mobility.

4 Site analysis and selection

Six home sites of gewoge AG were discussed and examined by all project partners for their suitability for the project. The main reasons for the selection were the proximity to the city centre, the quality of infrastructure and the population density of the district. Since one of the locations will have a photovoltaic system installed, the orientation of the roof to the sun was an important criterion.

4.1 Locations

4.1.1 Wiesental

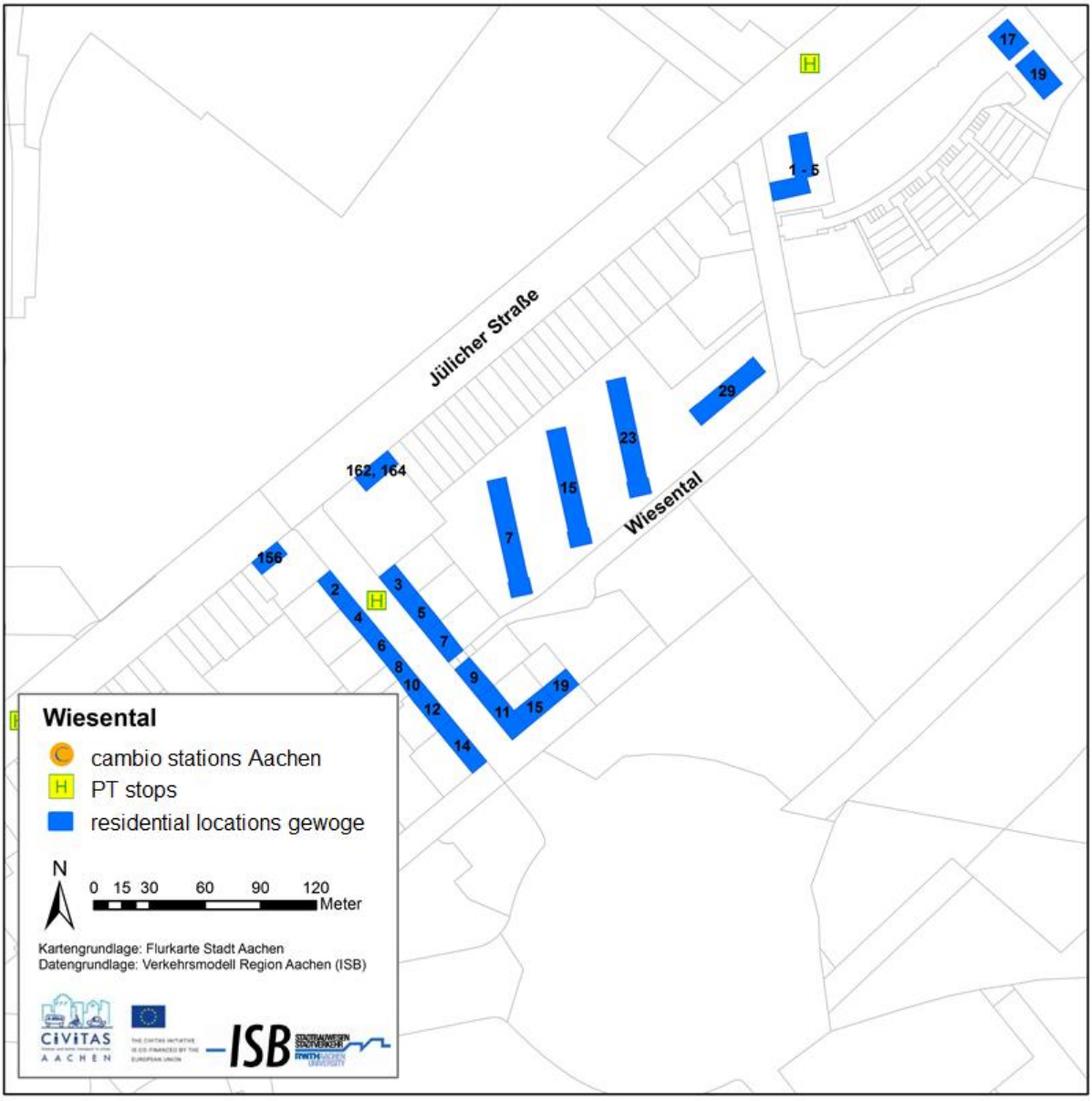


Figure 2: Map of Wiesental

Source: RWTH Aachen – Institute of Urban and Transport Planning

From cambio's perspective, the following points spoke **against** the inclusion of the site in the project:

- Located outside of the city centre area
- Low population density in the surrounding neighbourhood, large areas are occupied by industry
- Not integrated into the existing car sharing station network: the e-vehicle is not sufficiently complemented by the offer of conventional vehicles
- Inadequate diversity in the population demographic, low proportion of academics
- The use of the mobile offer (car sharing, bikes) by the company Zentis would be a necessary condition for the inclusion of the site in the project.

From gewoge's perspective, the following arguments spoke **for** the establishment of a mobile offer at this location:

- The housing supply would increase in value and, together with the planned refurbishment, would be a positive sign for the present residents.
- The existing area is to be expanded by the building area south of Jülicher Straße, resulting in a diversified population structure.
- The assessment of the public transportation system is moderate to good.
- The site received a positive assessment from STAWAG: The structural requirements for the establishment of a photovoltaic system and charging stations are good.
- The project complements the planned measures to upgrade the Aachen-Nord neighbourhood.

The planned refurbishment measures will unfortunately start too late and will not come into effect during the lifetime of the DYN@MO project. However, it is noted that the experiences gained in the project could be implemented at this site at a later date.

4.1.2 Driescher Hof

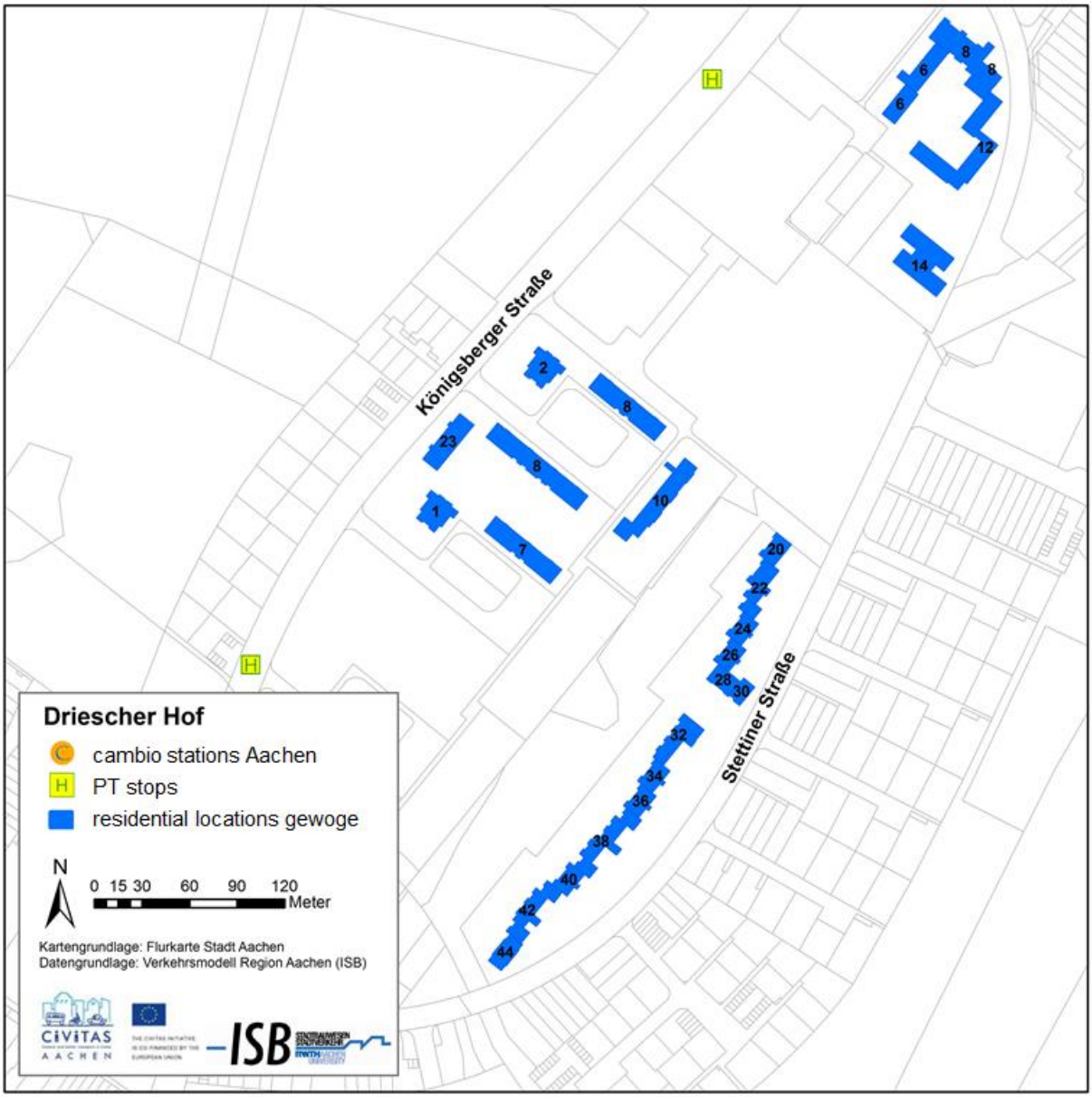


Figure 3: Map of Driescher Hof

Source: RWTH Aachen – Institute of Urban and Transport Planning

From cambio's perspective, the following points spoke **against** the inclusion of the site:

- Located outside of the city centre area
- Low parking demand
- Minimal integration into the existing car sharing station network
- Inadequate diversity in the population demographic, low proportion of academics

Little interest is expected since the demographic represents a higher dependency on automobiles than with higher earners.

The city of Aachen also regarded the inclusion of this site as problematic. The clarification of when and how such a mobility system can be feasible, as well as the annual costs thereof, need to be shared with the residents. This could offer the opportunity for a potential re-analysis of the concept.

The site is not intended for realisation within this project, but the survey will be carried out and used for comparative purposes.

4.1.3 Turpinstraße

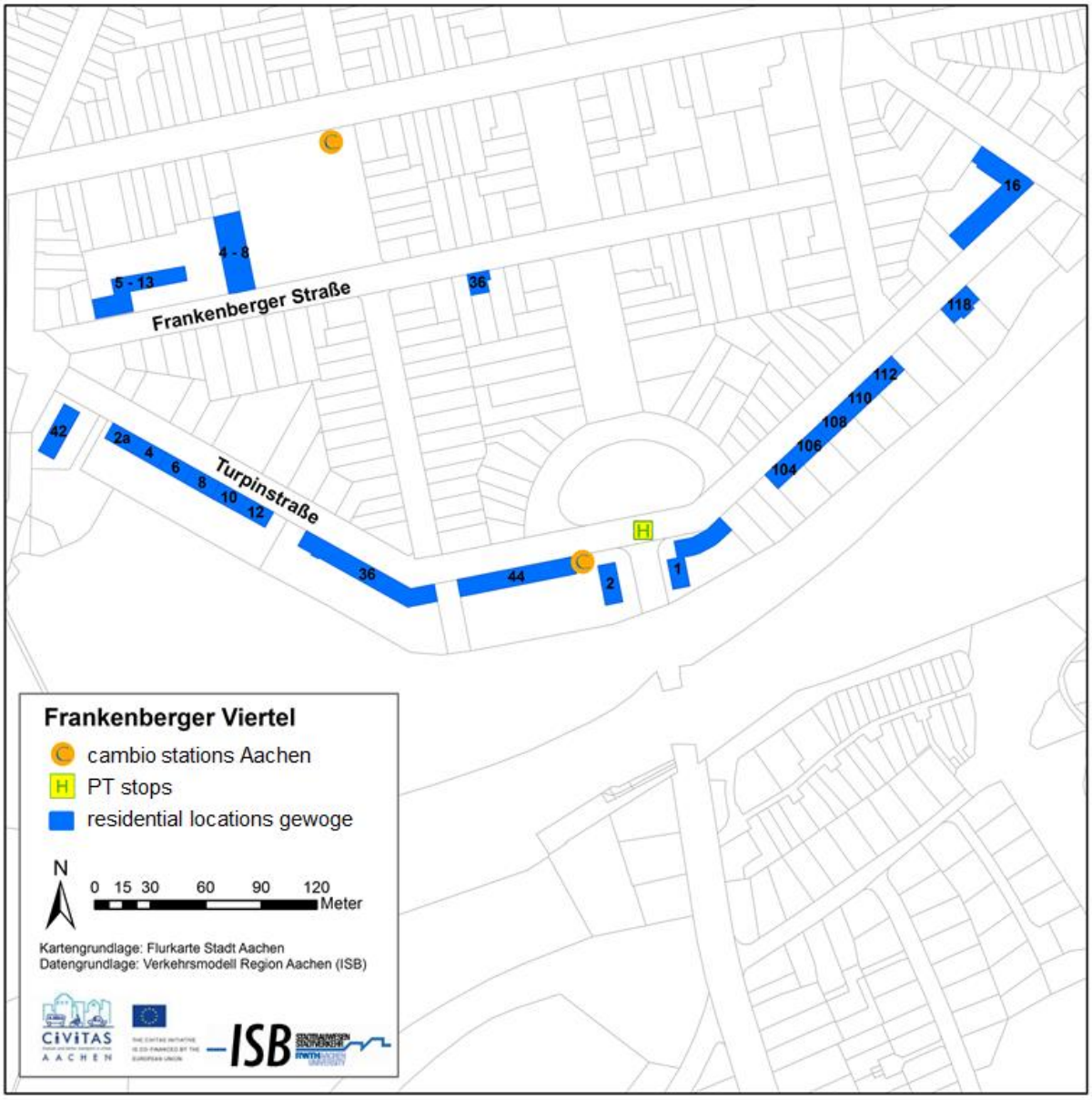


Figure 4: Map of Turpinstraße

Source: RWTH Aachen – Institute of Urban and Transport Planning

This location was considered by all project partners as having the highest potential, especially due to its location on the outskirts of the Frankenberger Quarter, good infrastructure as well as the local and structural conditions. It is expected that the population demographic will shift to a younger population in the future. Also, the required prerequisites are met for the installation of a photovoltaic system.

4.1.4 Rosstraße

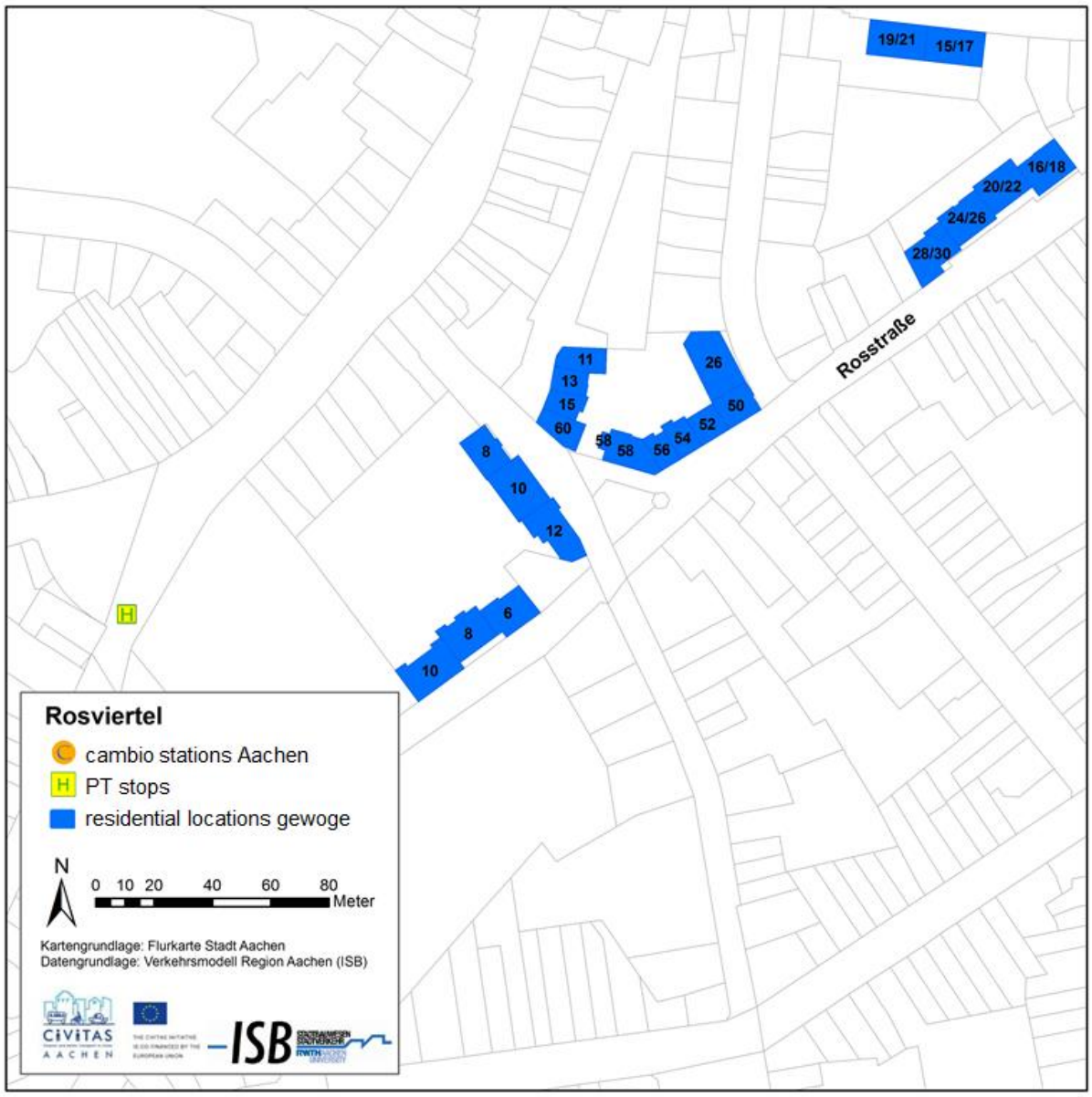


Figure 5: Map of Rosstraße

Source: RWTH Aachen – Institute of Urban and Transport Planning

The location of this site within the city centre was considered encouraging with its good public transport options. While the conditions on the property are not optimal, it would be possible to adapt them.

- The consideration of rearranging the garage entrance and to move the roller-door to the rear. This would result in the opening of approximately three parking places, which can be used for car sharing vehicles and bicycles.
- Bicycle parking racks and charging boxes can be provided in the garage for pedelecs.
- The access is not very visible from the street and would need to be clearly marked on the public walkway.
- The installation of a mobile station can be carried out parallel to the planned upgrade to the refuse container area where a new canopy is to be installed.
- Instead of having to install charging towers, STAWAG can install wall boxes, where the charging cable is permanently installed.

This site, with Turpinstraße is regarded as one of the favourites.

4.1.5 Herstaler Straße

Figure 6: Map of Herstaler/ Meerssener Straße

Source: RWTH Aachen – Institute of Urban and Transport Planning

This site was considered unsuitable. To date, there has been little interest in car sharing. The connection to the car sharing network is limited, also due to the sloping topography. There is little parking demand in this area.

4.1.6 Kullen

Figure 7: Map of Gut Kullen

Source: RWTH Aachen – Institute of Urban and Transport Planning

The site is located far outside the city centre, but already has a car sharing station on the northern edge of the site as well as a good public transportation system. The car sharing station has parking spaces allocated and are clearly visible on Schurzelter Straße and can be easily reached from the road.

The local situation is viewed as positive, although there is doubt as to whether the interest of residents can be sparked. The current investment plans aim to initiate a positive trend by modernising housing and improving facades.

4.2 Conclusion on site selection

Turpinstraße and Rosstraße were regarded as the sites with the highest potential and were therefore selected as project sites. Driescher Hof and Herstaler Straße were excluded. The ability of successfully establishing an e-mobility opportunity in Wiesental will only be assessed after the pending construction work and not during the lifetime of the DYN@MO project. Whether Kullen will be accepted as the third location in the project will be decided after the initial experiences with the first two selected locations.

DYN@MO Partner RWTH (Institute for Urban and Transport Planning) carried out an onsite assessment in early 2014 and compiled a document which summarises the facts. Noticeably in this document, the high average age of the residents is over 50 years. The only exception is Heerstaler Straße/ Meersener Straße with an average age of 46.4 years.

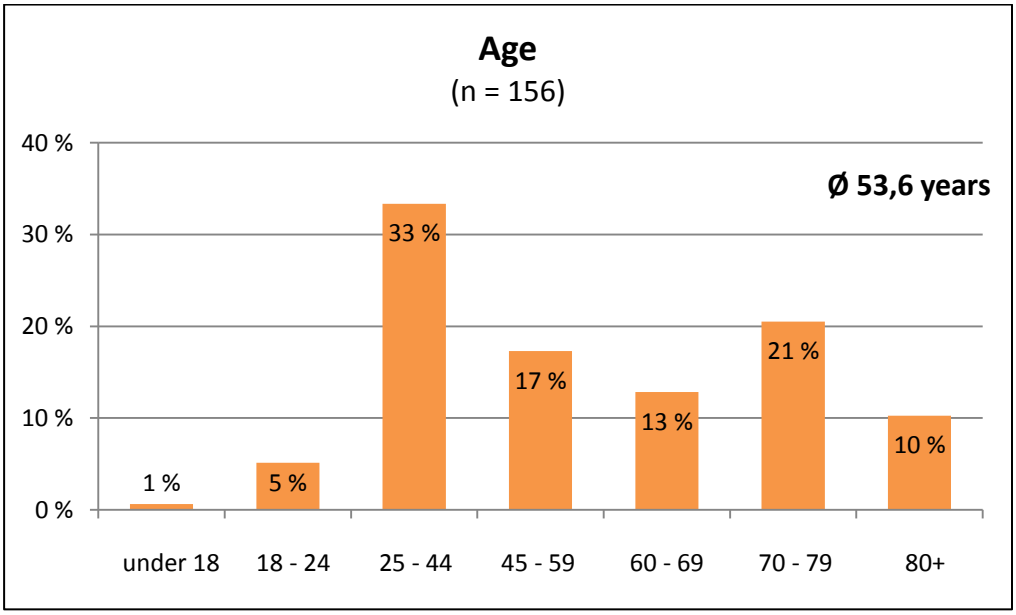


Figure 8: Age distribution of participants

Nearly half of the subject group is older than 60 years of age. The average age of the subject group is 53.5 year old.

Source: RWTH Aachen – Institute of Urban and Transport Planning

The results of the residents survey conducted by ISB, suggests that these residents will be difficult to reach. Overall, there is very little interest generated in the mobility survey with only 156 of 4,534 registered tenants participating in it. This represents a response rate of 3 percent. Only at “Turpinstraße” and “Herstaler Straße” there was a participation rate of over 10 percent.

The low participation rate of the resident survey, at first glance, provides no further arguments for the decision for the residential locations in the pilot phase.

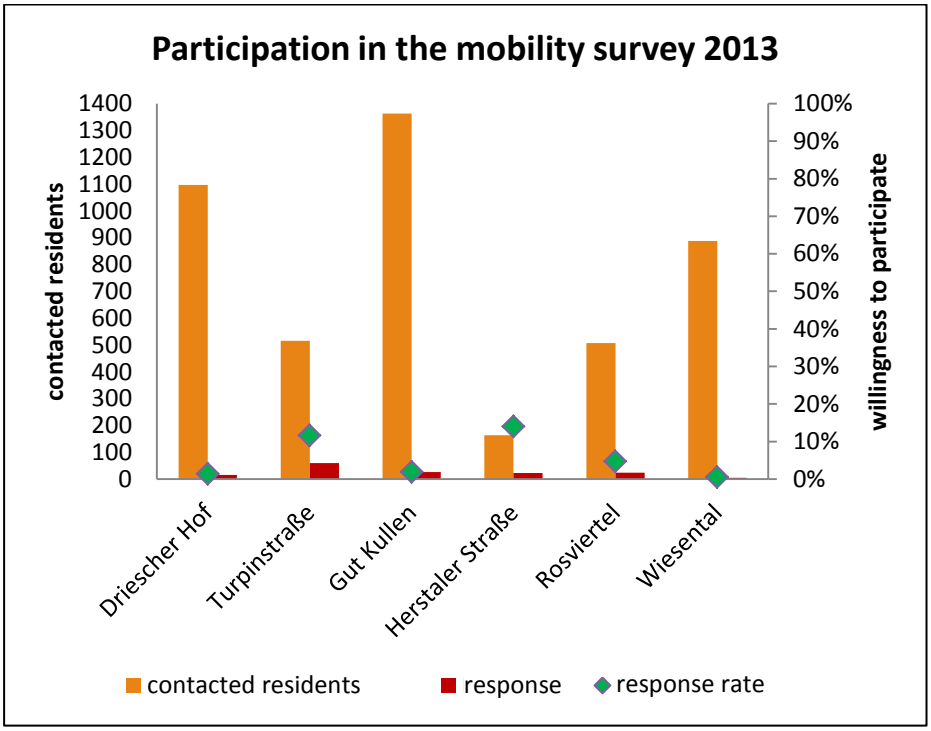


Figure 9: Participation in the mobility survey 2013

Resident participation in the survey shows a very low interest in the residents on the topic of mobility.

Source: RWTH Aachen – Institute of Urban and Transport Planning

5 Conceptualisation and preparation

The starting point for the measure team was the agreement that the available offer to the residents should be relevant in the areas of car sharing, rental bicycles as well as public buses and railway. In the measure it was planned that at the residential sites there will be e-car sharing stations, bicycle parking and charging infrastructure for cars and bicycles. The establishment of a photovoltaic system is intended to be available at the “Turpin” site. In addition, affordable testing possibilities for public transport, car sharing and e-bicycles are to be created.

Extensive structural measures were necessary for the establishment of the bicycle parking facilities, the e-car sharing station and photovoltaic system. Car parking spaces have been secured as well as the installed bicycle stands and loading boxes for pedelec batteries. The door system for the collective garage in Rosstraße had to be moved to provide unobstructed access to the car sharing station. The charging infrastructure, such as charging stations and wall boxes, has been installed. An additional covered bicycle parking facility with bicycle racks have been built outside the collective garage. It was planned in the measure that residents should be able to test out the various aspects of the mobile stations without substantial effort, including a test week with a pedelec on offer as well as a test month without registration fees and monthly fees including price reductions on the first three usages of the car sharing system. Furthermore, a cell phone ticket with a voucher for the use of the public transport has been offered. In 2015/2016 the offer has been complemented with monthly and weekly tickets in conjunction with a mobility consultation.

The Turpin site offers two special features. A charging box and four bicycle parking racks have been installed in a lockable single garage. The eight secure bicycle parking places can be rented inexpensively by the residents. The new photovoltaic system on the roof of the house in the Turpinstraße allows emission-free driving with the e-car sharing cars at the cambio station.

Figure 10: E-mobility and bicycles

6 Residents integration/ communication

Since the beginning, residents of gewoge AG have been informed about the project and the specific measure activities through various means. Articles have been posted in the local newsletters while posters and flyers have been distributed within the houses.

Since there have been hardly any reactions to the printed media, focus was placed on personal contacts. Residents at all selected locations were invited to take part in resident consultations, individual training in the use of the cambio e-vehicles and invited to participate in focus groups. Particularly committed tenants were selected for discussions in small groups, in the hope that they would create further interest in their environment. For the opening of the first car sharing stations, tenants were invited for a drink and to test drive the electric vehicles and pedelecs. The new mobility options were then shared with the tenants in a relaxed environment in Turpinstraße with grilled sausages and drinks. In addition to the tests of the electric cars, the bicycle repair service was presented. A mobility contest was organised where the residents were able to socialise.

Although the atmosphere was relaxed and friendly, little interest in the new offers was established, even though the bicycle parking facilities were completely registered and accepted within a short time space.

In the third year of the project a new attempt was made to enter into conversation with the tenants. The offers for public transport and car sharing were changed to be significantly simpler and more attractive. A free three-month bus pass for the city of Aachen and a car sharing test month with a credit sum of 25 Euros, without registration and base fees, was introduced to increase interest.

The prerequisite for residents to be able to make use of this offer was to complete a questionnaire before the test and to report about their experiences after the testing phase. In June 2015, trained mobility consultants visited the residents of all three residential sites in order to present them with the new opportunities.

Of the 309 residents that the measure team met personally, 76 people, i.e. 25 percent were willing to fill in the questionnaire together with the mobility advisor. Most of the interviewees were interested in the use of the bus tickets. The interest in car sharing and renting of pedelecs was expressed vaguely and ultimately seldom used. Disappointingly, few of the testers (11) were actually prepared to report about their testing experiences. Only 12 of the volunteers continued as promised and/ or were available for a final interview.

After these sobering results, the approach was considered critical. As a second attempt, the measure team extended the personal contact approach to the entire Frankenberger Quarter. This area (size of district: 0.51 km^{2*}, number of residents: 7,916[*]) experiences high parking density (registered cars: 3,215[*]) and will shortly receive an extension of the resident parking zone. The people are therefore particularly aware of the issues pertaining to mobility. By use of urban slogans “Frankenberger - clever mobile” a content reference was made.

[*]Source: City of Aachen – Statistisches Jahrbuch 2014

No deterring interviews were made at the initial contact, but rather some selected questions were asked. While the test deals for car sharing and pedelec rental remain the same, a free bus ticket was only issued for a week, in order to keep the costs manageable.

The personal contacts with residents of the quarter started at the end of October 2015 and lasted until mid-December. Of the 541 contacted people, 146 were interviewed. 29 people were interested in testing the bus tickets, three interested parties wanted to try car sharing and five for pedelecs. All in all, the interest remains limited.

Both the personal visits to gewoge tenants as well as with the residents in the surrounding neighbourhood are associated with high expenditure. The training and support of the mobility scouts and the home visits throughout the district were very labour intensive. The success of the activities remains significantly below expectation. Many of the residents were obviously not happy to be directly contacted at their apartment door. The situation made them highly cautious and they did not want to discuss such questions on the door.

The third form of contact was an information stand at the edge of the weekly market located in the centre of the Frankenberger Quarter in April 2016. Information about the stand was provided via a leaflet that was distributed throughout the district in advance. Although the weather conditions were poor, the six consultants could hardly keep up with the interest from the public.

Of the 90 approximate discussions, more than 2/3 were successful. 67 people were enthusiastic about the trial offers. A total of 37 public transport tickets, 23 pedelec rentals and 19 car sharing test months were agreed upon – all within three hours. The binding, written contract with the interested parties includes the consent for an interview after the trial period. The stand visitors appeared to be very motivated. They obviously appreciated the contact and did not feel pressured as partly experienced during the interviews at the front door.

Resulting from the large success of the information stand, the opening of the car sharing station in Turpin in May 2016 was used as an opportunity to offer a further information stand. Again, there were numerous enthusiastic talks, but only four additional test deals were a result thereof.

Compared to the previous stand, the interest was very low. It is difficult to assess whether the front door contact attempts were able to arouse interest and potentially contributed in part to success of the first information booth.

The possibility to seek contact in an informal and self-initiated manner clearly increases the likelihood of taking part in a trial period. The location at the market square on Saturday mornings and the time to expand the residents' parking zone were well chosen. The newly opened car sharing station was located too far away from the weekly market to be accidentally perceived by visitors. The distribution of the announcement flyer was perhaps not as effective since many potential customers had already been at the information booth beforehand.

Figure 11: Voucher for a car sharing test month

Figure 12: Voucher for a pedelec test week

Interviews tenants gewoge AG (all 3 residential locations) – June 2015	
1. Round	
76 households agreed to be interviewed	
59 interested parties for trial offers	
Redeemed vouchers:	26 for public transport
	0 for car sharing
	? for pedelecs*
2. Round	
12 interviews (partly per telephone)	
11 travel diaries received	

Table 1: Data interviews tenants gewoge AG

***** Lender provided no data

Source: RWTH Aachen – Institute of Urban and Transport Planning

Campaign Frankenberger Quarter – Autumn 2015	
1. Round	
146 households agreed to be interviewed	
Redeemed vouchers:	27 for public transport / 2 group tickets
	3 for car sharing
	5 for pedelecs
2. Round	
23 of 50 persons interviewed (partly per telephone)	

Table 2: Data Campaign Frankenberger Quarter

Source: RWTH Aachen – Institute of Urban and Transport Planning

Action	Rating	Why
Focus group	unsuccessful	Is perceived as a theoretical subject. Lack of personal involvement. They have no motivation to act.
Mobility survey of all three sites	satisfactory	High personnel effort and great reluctance on direct contacting at the apartment door.
Leaflet	satisfactory	It is hardly noticed by many residents and perceived as advertising.
Residents fete Frankenberger Quarter	moderately successful	Only a small group is willing to have a discussion on the aspects of mobility.
Station opening Frankenberger Quarter	satisfactory	Low participation of the residents but generates a lot of media attention.
Station opening Rosviertel	satisfactory	Low participation of the residents but generates a lot of media attention.

Action	Rating	Why
Mobility consulting Frankenberger Quarter	successful	As a result of discussions on the introduction of resident parking the inhabitants of the Frankenberger Quarter were sensitized and open to the issue.
Info stand Frankenberger Quarter	successful	Interested inhabitants had the possibility to decide themselves to contact the promoter.

Table 3: Rating of the activities

7 Implementation

The establishment of the two car sharing stations and bicycle parking in the Frankenberger Quarter (**Turpin** station) and in the Rosviertel (**Rosstraße** station) took place simultaneously in April 2014. The opening of the car sharing station in the district of **Gut Kullen** occurred approximately one year later, in June 2015.

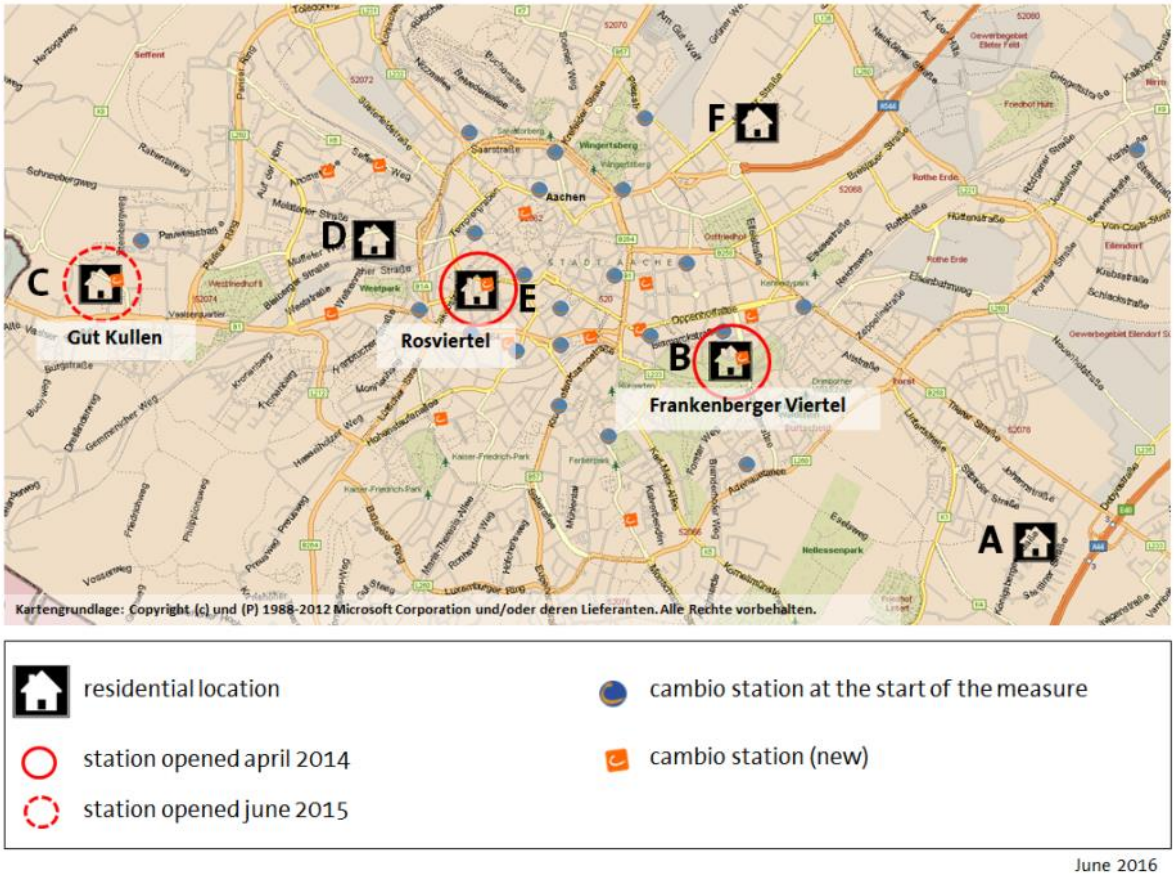


Figure 13: Map of residential locations

Source: Map Basis: Microsoft Corporation; Data: cambio Aachen

7.1 The locations and their particulars

7.1.1 Frankenberger Quarter

The mobility service at the site Frankenberger Quarter has the most extensive range of products and services. According to the service concept, the existing car sharing station in Turpin has a conventional vehicle, which will be supplemented by a charging station and two electric vehicles. Initially, 2 x two-seater Smart ED III will be used. Early in 2015, one of the two-seater Smart vehicles was replaced with the five-seater Renault Zoe.

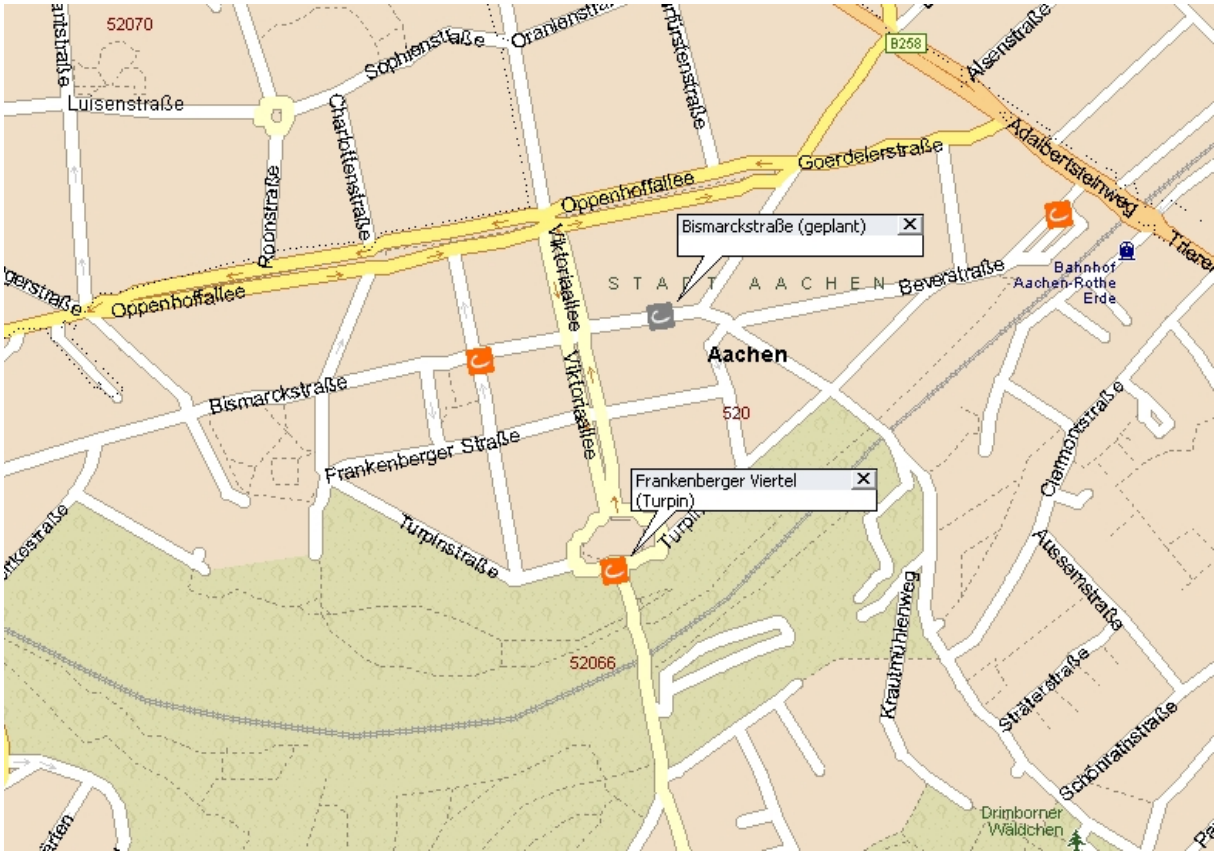
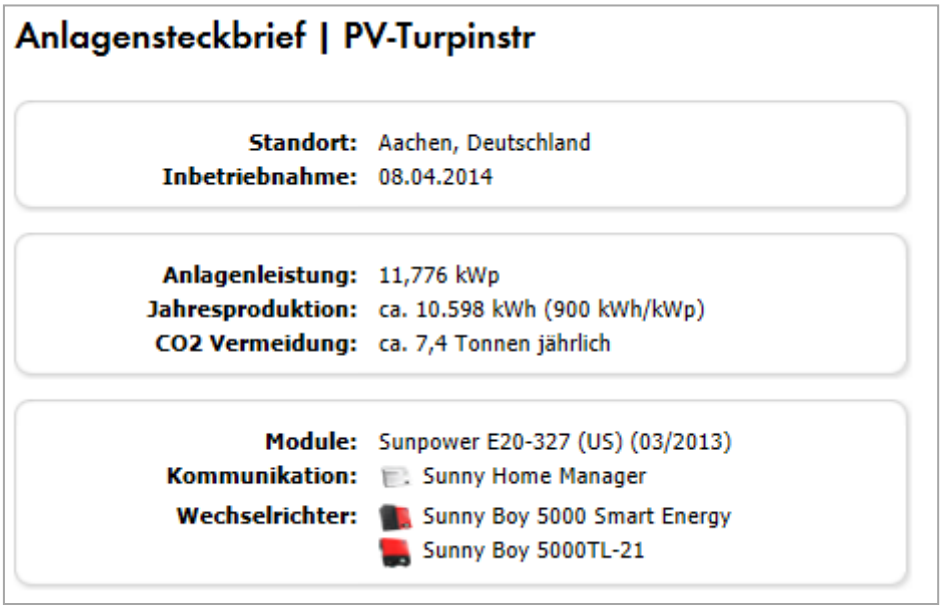


Figure 14: The Turpin station in Frankenberger Quarter and the surrounding environment.

The charging station for electric vehicles is powered by the new photovoltaic system installed at this residence with a generating capacity of 11.78 kWp. The electricity generated is both used for direct charging of the electric vehicles, and is stored in a 2 kWh buffer battery. All excess power is supplied to the public grid.



Anlagensteckbrief | PV-Turpinstr

Standort:	Aachen, Deutschland
Inbetriebnahme:	08.04.2014
Anlagenleistung:	11,776 kWp
Jahresproduktion:	ca. 10.598 kWh (900 kWh/kWp)
CO2 Vermeidung:	ca. 7,4 Tonnen jährlich
Module:	Sunpower E20-327 (US) (03/2013)
Kommunikation:	Sunny Home Manager
Wechselrichter:	Sunny Boy 5000 Smart Energy
	Sunny Boy 5000TL-21

Figure 15: Fact sheet of the photovoltaic system

A single garage for cars was converted into a safe, weather-proof storage facility for bicycles with a charging box for pedelec batteries. The eight bicycle parking spaces were all rented after a short period of time.

7.1.2 Rosviertel

At the Rosstraße site, exclusive electric vehicles (two-seater Smart ED) are available in the covered entrance area of the large garage. Two wall boxes were installed for charging purposes.

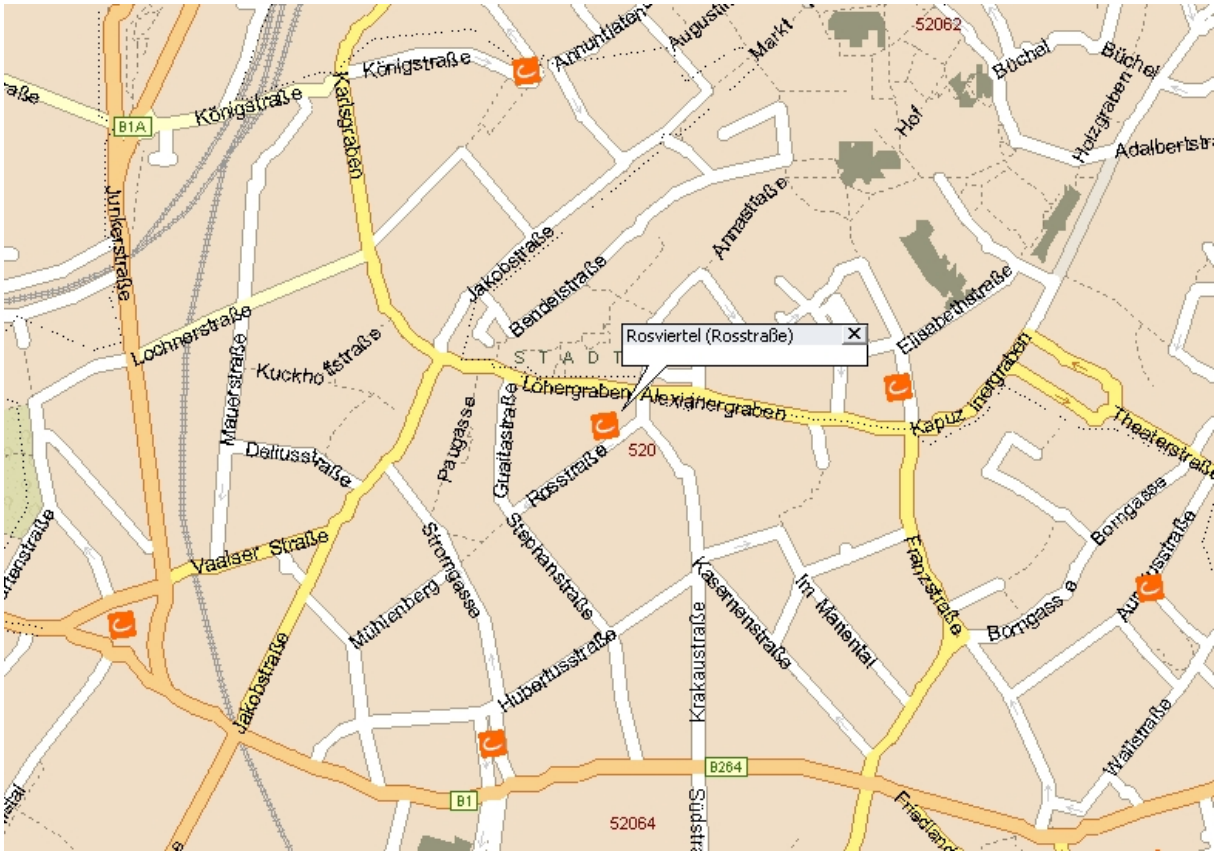


Figure 16: The station Rosstraße in the Rosviertel and the surrounding environment.

Two bicycle stands required for the 4 x bicycles are installed next to the car sharing area. Additional bicycle stands and a charging box are located in the communal garage, which is accessible only to the renter of a car parking space. For tenants without parking space, a new covered bicycle parking facility will be built in early 2016. This will be located outside of the communal garage and is accessible independently.

7.1.3 Gut Kullen

The car sharing station in the Gut Kullen district opened in mid-June 2015 with a conventional and an electric vehicle. At the end of October 2015, the Smart ED (two-seater) was replaced by a Renault Zoe (five-seater).

The additional establishment of a bicycle parking for the residents of gewoge is not considered necessary as there is already sufficient availability of the bicycle stands at the doorways. The addition of two bicycle racks next to the car sharing station is still to be realised.

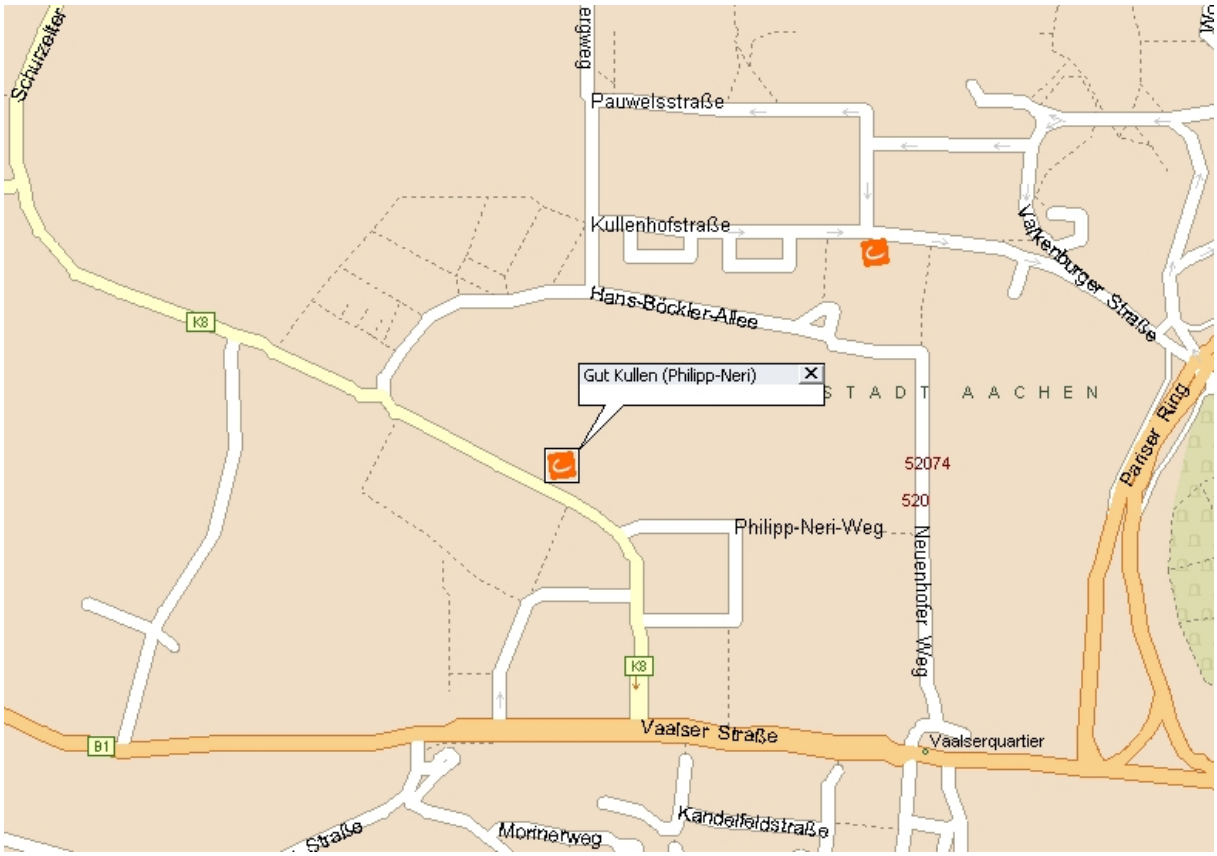


Figure 17: The car sharing station Philipp-Neri in the Gut Kullen quarter and the surrounding environment.

Figure 18: cambio station Gut Kullen

8 Impact and evaluation

At first glance, all three residential locations have a lot in common in terms of the population demographic, the amenities in the immediate vicinity and the accessibility of the public transport network. However, differences exist in the closeness of the district to the city centre and the location within the existing car sharing station network. While Turpin and Rosstraße are near to the centre of Aachen, Kullen is located about five kilometres away in a suburban area of the city. Accordingly, the parking pressure in Gut Kullen is much lower than in the other two districts. The sites show a large diversity to the responses of the resident survey at the beginning of the project. Overall, participation in the survey was rather low. Based on the sum of all participants, 42 percent of the participants were from the residential area **Turpin,** while 17 percent were from **Rosstraße** and **Kullen** representing 13 percent of those interviewed.

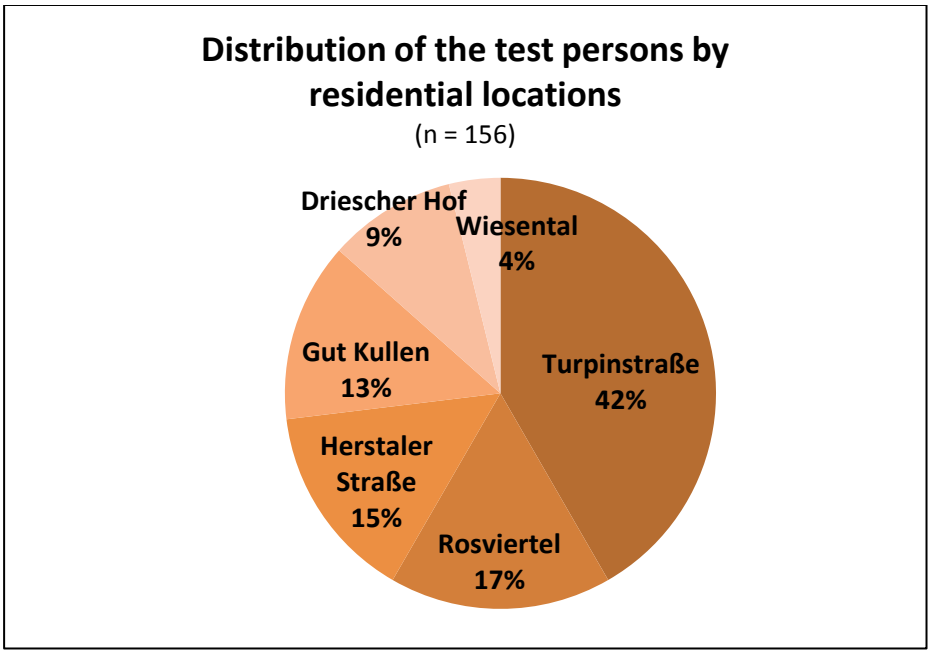


Figure 19: Distribution of the test persons by residential locations

Source: RWTH Aachen – Institute of Urban and Transport Planning

8.1 The districts

The **Frankenberger Quarter** was created in the early twentieth century as an urban expansion area and still has a high proportion of buildings listed as monuments from this time period. After the Second World War, these residential buildings were poorly maintained and therefore, neglected. During the late sixties, students discovered the houses to be affordable and having charming living spaces. Today, most buildings have been renovated and the district has become a sought-after inner city residential area with a high proportion of graduates and ecologically oriented residents.

Turpinstraße and the residential buildings of gewoge AG are on the outskirts of the Frankenberger Quarter. The residents are, to a large extent, people of a more mature age. Currently, the housing supply of gewoge AG, especially after modernization, is increasingly popular with younger people. While the houses themselves, built around 1960, do not have the old building flair, they benefit from the high quality of living in the Frankenberger Quarter.

The low supply of plots in this area distinguishes this residential location from the two other locations in the project. Of the 315 residential units, just 35 garages are available for rent, i.e. only a maximum of 11 percent of households are able to rent a parking space in the immediate environment of their home.

The **Rosviertel** is even closer to the city centre than the Frankenberger Quarter. This area too has a relatively high proportion of old buildings. As a residential area, it is less uniform and has a number of visual breaks due to post-war development. The proportion of green areas is particularly low in this quarter.

The average age of the residents in the gewoge building is 57.6 years, the highest of all six sites. The average rent is significantly lower than at Gut Kullen and in the Frankenberger Quarter, at 4.61 Euros. The residents here are likely to rely on a more affordable rent. Experience shows that it is difficult to attract people with lower incomes for new mobility concepts such as car sharing.

The district **Gut Kullen** emerged in the early 80’s and has over six hundred residential units, making it the largest in this project. Its location on the outskirts of the city centre distinguishes the district significantly from the other two residential locations. Being very close to the University Hospital Aachen, it benefits from easy access to public transport. Compared to the other two residential locations, the area is equipped with many garages and a total of 518 parking spaces. Here, there is a low demand for car parking spaces. For bicycles, numerous racks are available.

8.2 The solar station in Frankenberger Quarter

The photovoltaic system for powering the charging station is located on the roof of the adjacent residential building. The total supply since it went into operation on 8 April 2014 is much higher than that required to power the electric vehicles, thus, resulting in 13,461 MWh being supplied to the power grid (see table below). This indicates that even with an increase in vehicle occupancy, the energy requirement could be covered by the photovoltaic system.

Output:

Year	Direct consumption	Battery charge	Grid feed	Total
2014 (Apr.-Dec).	0,573 MWh	0.449 MWh	7,357 MWh	8,370 MWh
2015	1,144 MWh	0,798 MWh	9,275 MWh	11.215 MWh
2016 (Jan.-Mar.)	0,211 MWh	0,179 MWh	1,250 MWh	2,158 MWh
			Total Output	21.743 MWh

Consumption:

Year	Direct consumption	Battery discharge	Mains supply	Total
2014 (Apr.-Dec).	0,573 MWh	0,417 MWh	1,107 MWh	2,098 MWh
2015	1,144 MWh	0,696 MWh	2,878 MWh	4,717 MWh
2016 (Jan.-Mar.)	0,211 MWh	0.156 MWh	0.937 MWh	1,467 MWh
			Total Consumption	8.282 MWh

Table 4: Data solar station

An example of the graphical representation in 2015

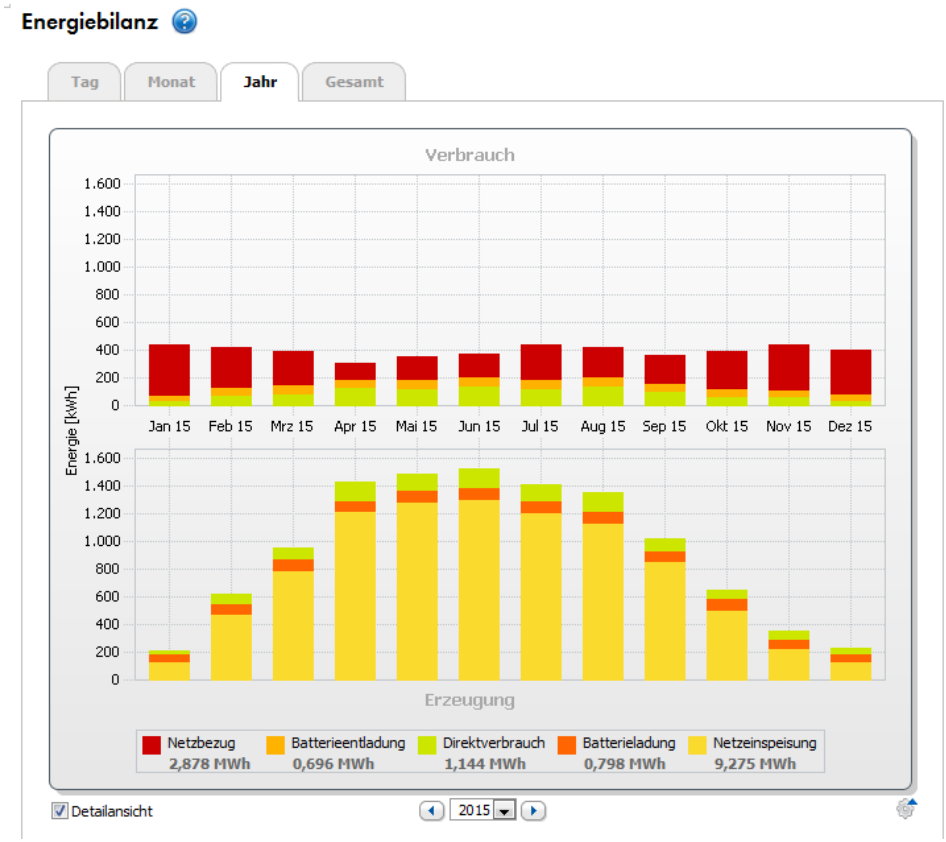


Figure 20: Energy Balance 2015

Illustrated are the supply and demand values for the year 2015 with the photovoltaic system and the charging station. For the most part, the solar power output is fed into the public grid and then again consumed by the charging station from the grid. This results in the grid being used as a “buffer”. Mathematically seen, the unused energy is available as locally generated renewable electricity to the general public.

The solar station is a future-oriented, vivid example of how close living and mobility may be joined together. Where and how one lives can greatly affect the overall energy balance.

8.3 The car sharing stations

The success of a car sharing station is usually evaluated on the basis of the time utilisation (percent per 24 hours) of its vehicles. To compare the use of electric vehicles with that of conventional vehicles, the sum of the travelled distances per month is used.

8.3.1 Frankenberger Quarter

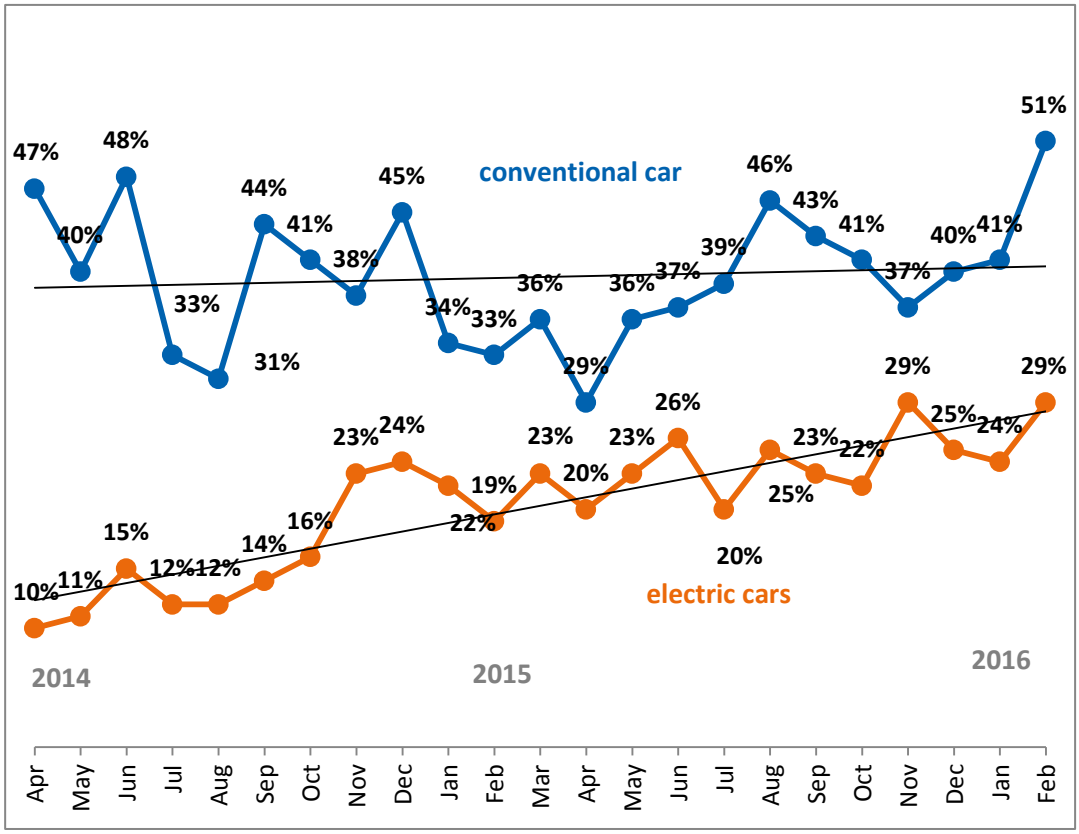


Figure 21: Utilisation Turpin station

The development of such utilisation shows that the e-vehicles are still used considerably less than the conventional vehicles. However, while the first half of the year shows a utilisation of e-vehicles of between 10% and 15%, the utilisation has since then almost doubled. The utilisation depicts curves that show a trend of an increasing shift from conventional to electric vehicles.

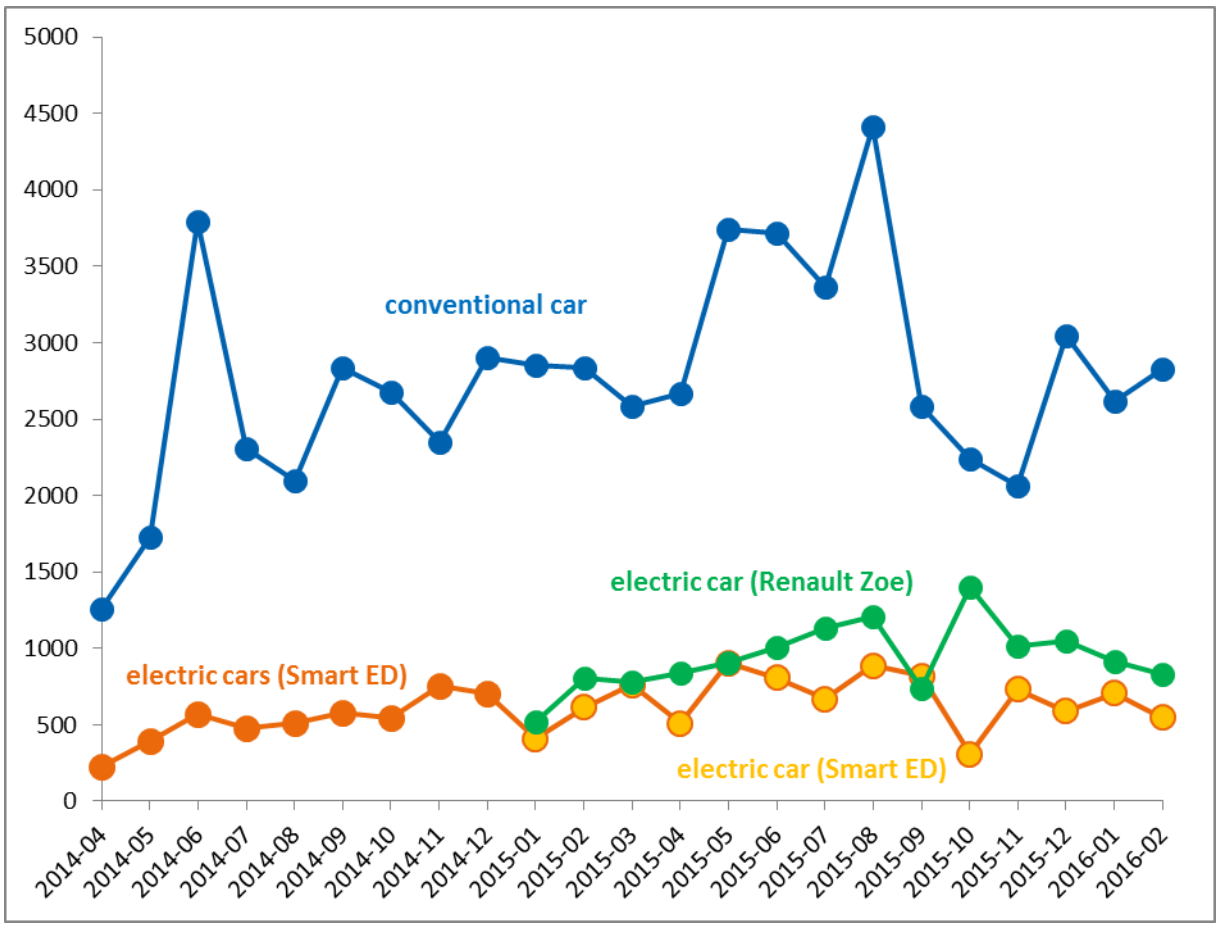


Figure 22: Mileage Turpin Station

A similar trend can be seen when assessing the mileage graph. The conventional vehicle covers 74 percent more per month than an e-vehicle. The replacement of a Smart with a Renault Zoe early in 2015 depicts an increase in the usage curve of electric vehicles as more clearly observable.

8.3.2 Rosviertel

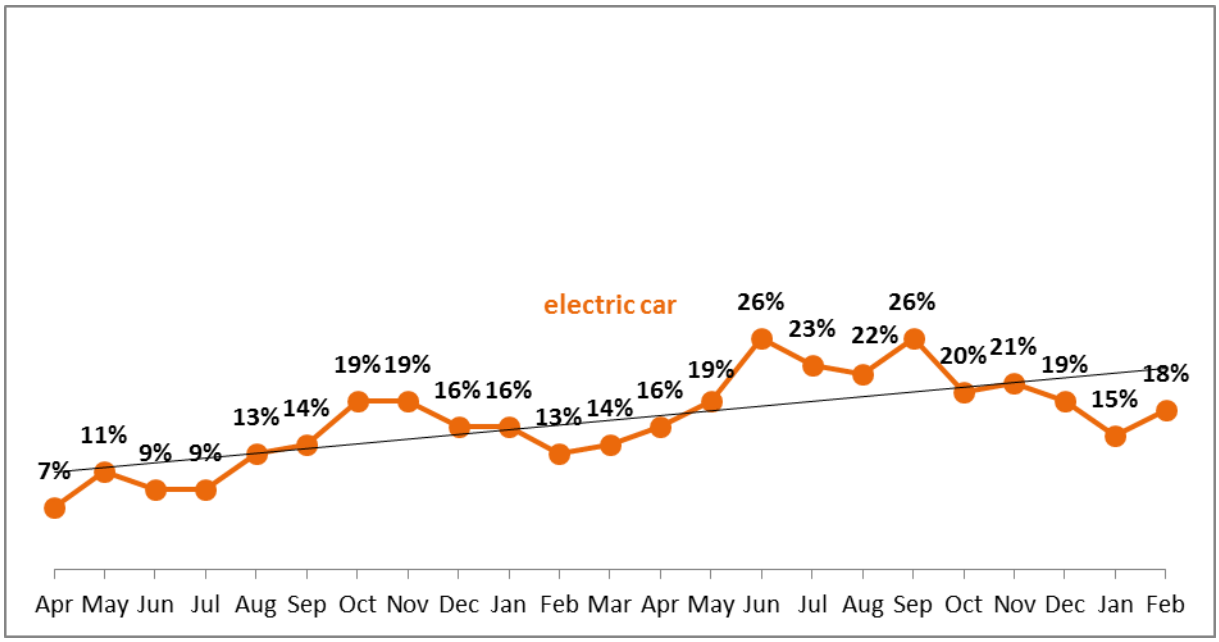


Figure 23: Utilisation Rosstraße station

The utilisation of e-vehicles increases in a similar manner to that in Frankenberger Quarter. The direct comparison with a conventional vehicle cannot be drawn since there are only e-vehicles at this station.

Experience has shown that in the winter months there is a significant decrease in the frequency of bookings that correlates with the seasons. The same phenomenon can also be observed in this utilisation curve.

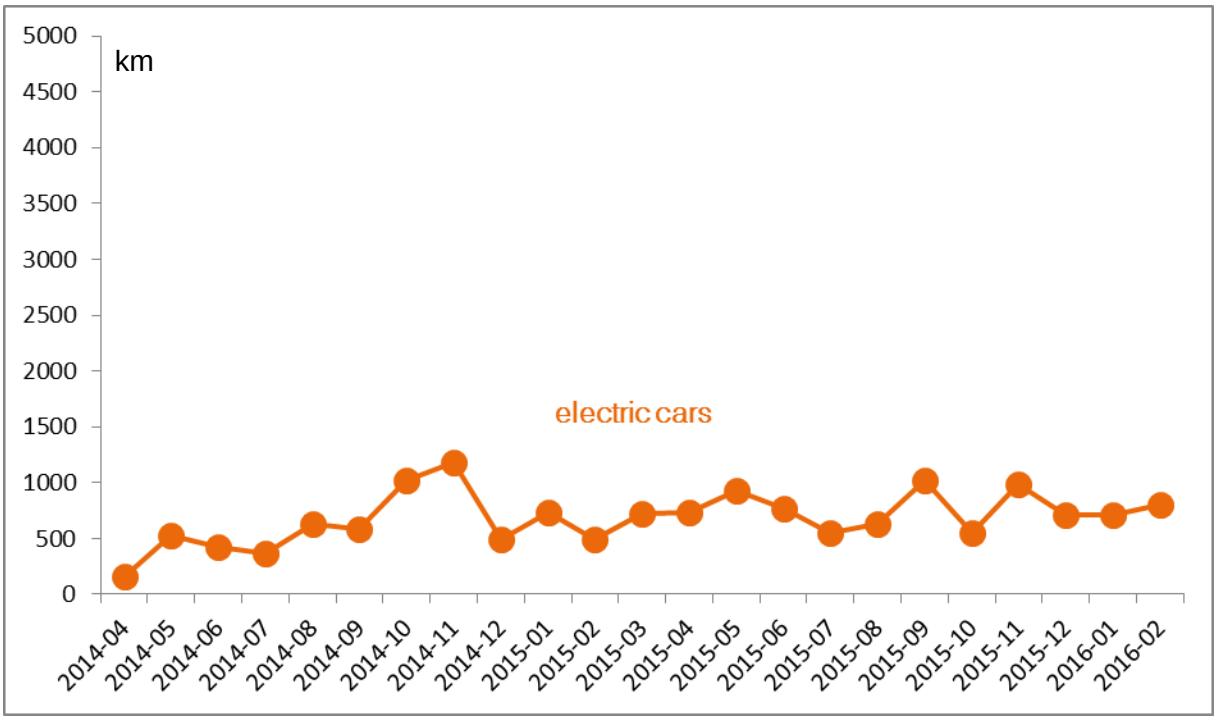


Figure 24: Mileage Rosstraße station

The kilometres remain somewhat constant after an initial period of approximately three months.

8.3.3 Gut Kullen

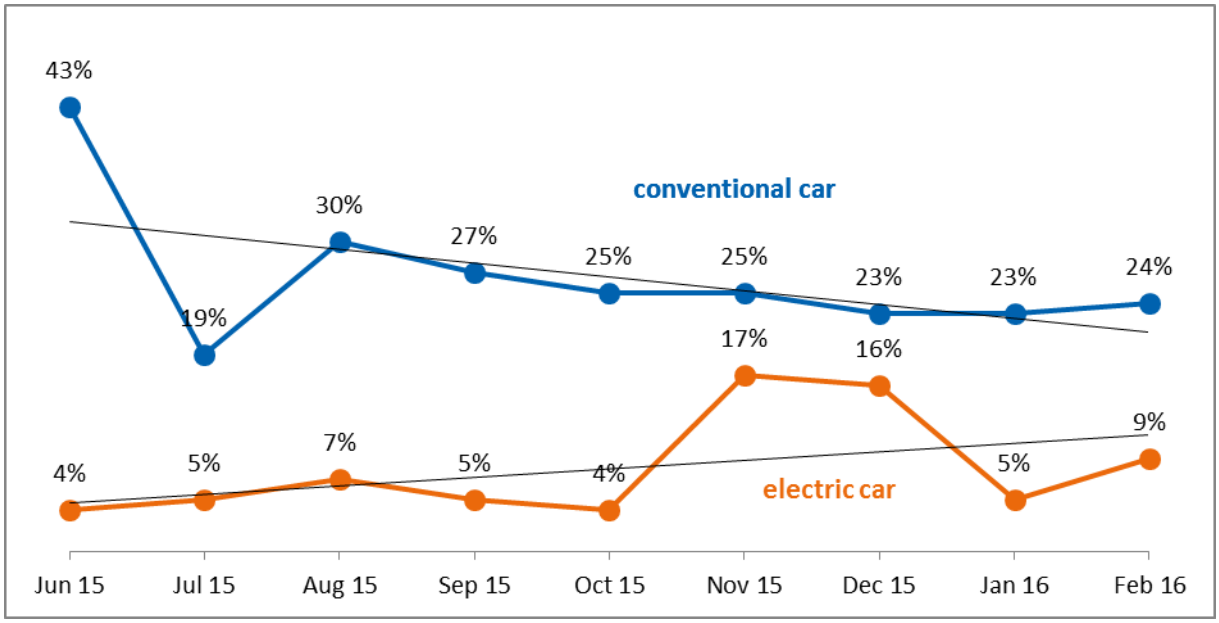


Figure 25: Utilisation Kullen station

At the beginning, Kullen station was equipped with a conventional vehicle and the electric vehicle Smart ED. The utilisation of the e-vehicle remained at a very low level within the first few months. At the end of October 2015, following the example of the Turpin station, the two-seater was replaced by a Renault Zoe with five seats. This is followed by an unusually sharp increase in use, possibly due to special requirements during the festive season and during the holidays.

Overall, the utilisation of the e-vehicle is also lower compared to the conventional vehicle, but in recent months is not as significant as usually shown. Compared to other car sharing stations both vehicles remain below the expected usage rates. This too is reflected in the mileage.

After nine months, it is possible to observe a rising trend in the usage. For the summer 2016 it is planned to increase the number of users through further publicity.

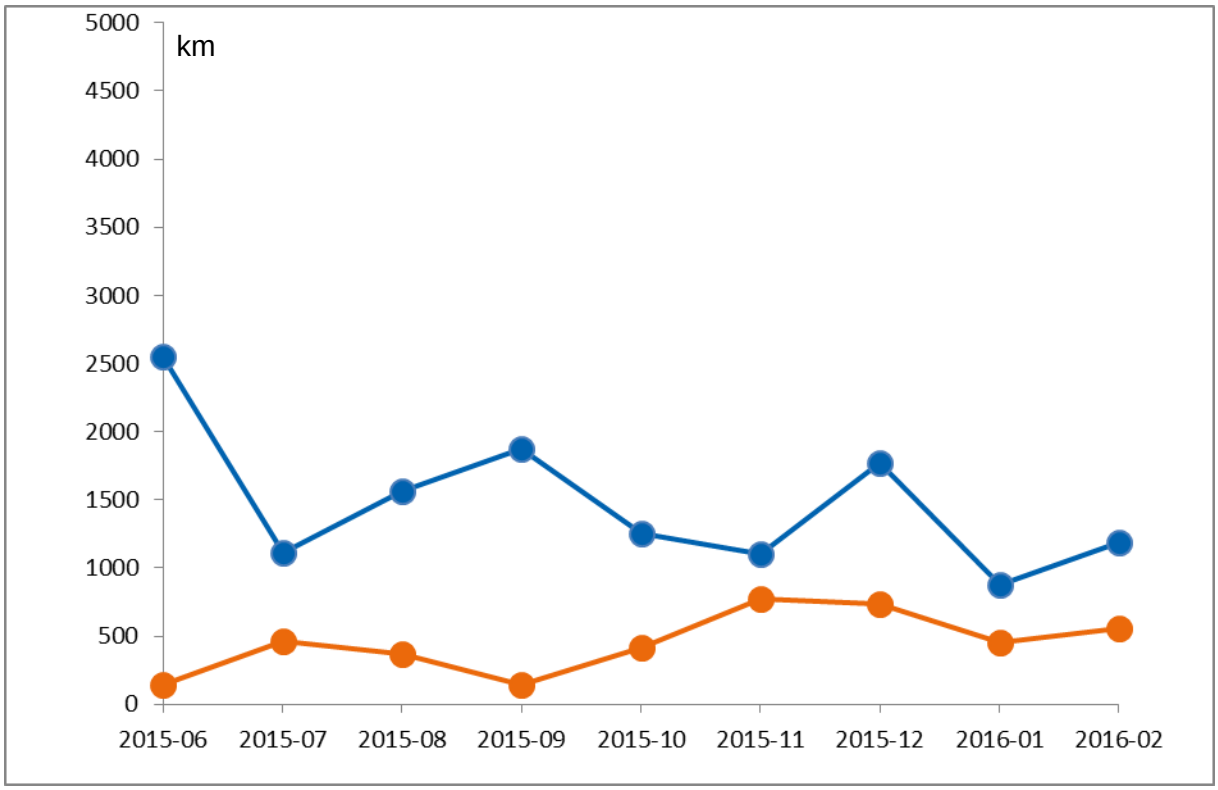


Figure 26: Mileage Kullen station

The mileage at Kullen station shows that the implementation phase of nine months is too short to draw a clear conclusion. In contrast, at Turpin and Rosstraße a positive trend can be clearly seen. The trips with the e-vehicles are slow yet steadily increasing.

The Renault Zoe is the clear favourite in the electric cars. Bookings are 20% more likely than those of the Smart ED. The usage, duration and distances of the individual trips are, however, comparable.

Positively, the initial scepticism of the customers towards the new technology is gradually decreasing.

8.4 All about the bicycle

The bicycle parking facilities at the two urban residential sites proved to be very successful. Both the newly established bicycle garage at the Turpin station and the newly built bicycle rack outside of the communal garage on Rosstraße were adopted in the shortest possible time. Among the parked bicycles, there are however only a few pedelecs and correspondingly a low usage of the charging boxes for batteries.

As one can see, the need for safe and secure storage space for bicycles, especially in urban areas is considerable. This is regarded as one of the preconditions for an increase of the number of pedelecs in the future.

8.5 Residents integration and communication

It became obvious that it is extremely difficult to come into contact with the tenants of flats rented by gewoge AG. By early 2016 a total of ten customers had become cambio car sharing customers, of which six of them are still existing customers. To date, only the bike stands are self-perpetuating. Test offers, mobility counselling and participation rates are rarely used. Mobility services as an integral part of the lease and possibly also of the rent (similar to renting an underground parking space with an apartment), could not be realised to date, but remains a vision for the future, with a realistic opportunity of implementation. The requirement is a mentality shift; not only of the tenants, but also among all the project partners. Given this, an important first step could be done through this measure.

9 Conclusion

The change from the idea of one's own car towards a multi-modal mobility behaviour can only succeed if the appropriate conditions are created in advance. This includes counselling and awareness of the residents regarding this matter, storage facilities for bicycles and the development of mobility services. Only then can the switch gradually take place. For example, many car journeys can be replaced by cycling. Anyone wanting to use his/ her bicycle often needs a good durable bike that is weatherproof with safe parking. Only when this condition is met, is the choice of the bicycle sensible.

Within this measure, good conditions for the transition have been created. Mobility consultations were carried out, testing opportunities were created, bicycle stands and car sharing stations as well as the direct supply of two car sharing electric vehicles (powered by solar energy) were made available. The introduction of public transport tickets to tenants has been planned and has a good chance of being implemented in the future together with new construction projects. The cooperation of all partners has been successful and will provide a solid basis for the transfer to other residential locations and future projects.

Activation and sensitisation of gewoge residents have only just begun. Nevertheless, the new offers were quickly adopted by the inhabitants of the various city districts and the benefits are obvious for the entire respective districts.

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