Oberhausen Use case set up report

Pillar A+C

Deliverable	2.13
Authors	Stefan Thurm (STOAG) Julia Gesing (STOAG) Helmut Berends (Berends Consult)
Status (D: draft; F: final)	F
Document's privacy **(Public: PU; Private: PR)**	PU
Reviewed by	VDV/Berends Wolfgang Backhaus (RUPPRECHT)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636012.

SUMMARY SHEET

Programme	Horizon 2020
Contract N.	636012
Project Title	Electrification of public transport in cities
Acronym	ELIPTIC
Coordinator	Free Hanseatic City Of Bremen
Web-site	http://www.eliptic-project.eu/
Starting date	1 June 2015
Number of months	36 months
Deliverable N.	D 2.13AC
Deliverable Title	Oberhausen Use Cases set up report
Milestones	M6
Version	V3
Date of issue	24/02/2016
Distribution [Internal/External]	External
Dissemination level [Public/ Confidential]	Public
Abstract	This document describes the implementation of the Use Cases Oberhausen (Germany) in the framework of Pillar A (Integration of existing electric public transport infrastructure) and Pillar C (Multi-purpose use of electric public transport infrastructure). In exceptional case the Use Cases for Pillar A and Pillar C are described in one because the implemented technology and concept of both Use Cases are highly interlinked. Furthermore the document identifies the contribution of involved partners, describes the context conditions (like economical, geographical and urban; public transport service; general information about the Use Cases), determines the objectives (like expected impacts and Use Cases KPIs), identifies the risks, constraints and monitoring

criteria, and finally describes in detail the Use Cases and related work plan.

Keywords	Pillar A, Pillar C, Use case Oberhausen
Critical risks	

DOCUMENT CHANGE LOG

Version	Date	Main area of changes	Organisation	Comments
1	15/12/2015		STOAG	First draft.
2	23/02/2016	Review Pillar C leader	VDV/Berends	Revised draft
3	24/02/2016	Update chapter 5	STOAG	PreFinal version
6	24/02/2016	Fine tuning layout/ content	VDV/Berends	Final version
7	11/03/2016	Final review	RUPPRECHT	Released for publication

CONTRIBUTING PARTNERS

Company	Names	Company Info
STOAG (P13)	STOAG Stadtwerke Oberhausen GmbH	Public Transport Operator

Table of Contents

Overview Tables

Overview Figures

1. Executive Summary

The present Deliverable D2.13AC falls into the scope of WP2 ‘ELITPTIC Use Cases’ which aims to implement eleven (11) ELIPTIC use cases (either live demonstrations in operation or feasibility studies) to successfully integrate electric bus systems into the existing public transport infrastructure.

In order to achieve this aim the ELIPTIC Use Cases are grouped in three (3) pillars:

- Pillar A: Safe integration of e-buses by using existing electric public transport infrastructure,
- Pillar B: Innovative energy storage systems to increase operational efficiency, and
- Pillar C: Multi-purpose use of electric public transport infrastructure.

This Deliverable relates to Pillar A and C and deals with opportunity (re)charging of electric buses (Pillar A) and fast-charging stations for electric cars powered from the tram energy network (Pillar C).

This set up report gives a complete overview of both Oberhausen Use Cases and includes information about

- contribution of involved partners
- context conditions like economical, geographical, urban and public transport services,
- general information about the Use Cases,
- objectives like expected impacts and Use Cases KPIs,
- Identified risks,
- constraints and monitoring criteria, and
- more detailed description of the Use Case features and its related work plan.

2. Partner Contribution

Company	Sections	Description of the partner contribution
STOAG (P13)	All chapters	Compilation of the content (text, data, images, graphics) and preparation of the draft and final deliverable version

3. Context conditions

3.1. Economic, geographical and urban context of the Use Case

The city of Oberhausen is located in the heart of the Ruhr region, which can be regarded as the industrial centre of Germany. Oberhausen grew from an unimportant village to a large industrial town in the last century and became a city in 1874.Today's municipal area was created in 1929 by combining the then independent cities of Sterkrade, Osterfeld and Oberhausen.

Figure 1 – Oberhausen location within Germany[1]

Area size	~ 77 sqkm
Population	210,326 (31.12.2014)
North-South / East-West dimension	~ 15 km / 11 km
More information	www.oberhausen.de

Table 1 – Oberhausen's key figures

With a population of 210,000, Oberhausen is considered one of the medium-sized larger cities within the Ruhr region[2], which is now known as "Ruhr Metropolis". Situated in the federal state of North Rhine-Westphalia, the Ruhr Metropolis stretches across 116 kilometres from east to west and 67 kilometres from north to south. The region is criss-crossed by the rivers Emscher, Lippe and by the Ruhr, from which it got its name. Eleven (11) metropolitan cities and four (4) administrative districts are clustered in the Ruhr Metropolis; that is a total

[1] Source: https://en.wikipedia.org/wiki/Oberhausen
[2] Source: http://www.wfo-gmbh.de/index.php?id=38&L=1

number of 53 communities which are incorporated in the ‘Ruhr Regional Association’.[3] The Ruhr region is one of the five largest agglomerations in Europe with about 5.2 million people.

Figure 2 - Cities and administrative districts in the Ruhr Metropolis[4]

Oberhausen was largely focused on mining and steel production until the 1960s. Through the decline of the traditional industries of coal and steel, large areas of brownfield land was available in the middle of the town for further development.
So the idea came up to link the district ‘Alt-Oberhausen’ located in the South with the districts ‘Sterkrade’ and ‘Osterfeld’ in the North of the town, and create on the former brownfield land areas the so called 'Neue Mitte Oberhausen' (‘New Centre Oberhausen’). This area was one of the most successful urban renewal projects in Europe, with CentrO (opened in 1996) as its highlight. CentrO is a 119,000 sqm shopping mall (extension opened in 2012) with 220 retailers and the 2nd biggest food court in Europe (1,100 seats) and more than 35 million visitors annually.[5]

From April 1897 on the public transport system (tram and bus) was owned by the municipality. In the 1960s traffic planners regarded the tram network as inflexible and decided to opt for the more flexible bus network. The city of Oberhausen did the same approach and closed down the tram operation in 1968.
Due to the urban development project ‘New Centre Oberhausen’ the renaissance of the tram system was decided. In 1996 a right of way corridor commonly operated by tram and express bus services was opened between the central station, the ‘New Centre Oberhausen’ and the district Sterkrade. Through this integrated approach of transport planning and urban development accompanied by an extensive marketing campaign the number of public transport passengers could be increased significantly.

[3] Source: http://www.metropoleruhr.de/en/home/ruhr-metropolis/data-facts.html
[4] Source: http://www.metropoleruhr.de/en/home/ruhr-metropolis/data-facts.html
[5] Source: http://www.wfo-gmbh.de/index.php?id=37&L=1

The city of Oberhausen is part of the operation area of the transport association Verkehrsverbund Rhein-Ruhr (VRR) (see figure below). The VRR offers a common fare for all regional trains, trams and bus services (urban, interurban, express, overnight) and stretches from the Lower Rhine to the eastern Ruhr Area. It was founded on 1 January 1980, it is Europe's largest body of such kind[6], with more than eight (8) million people living in sixteen (16) cities and seven (7) counties over an area of about 7,300 sqkm, approximately 15,300 km of route network and 1.143 billion passengers a year.

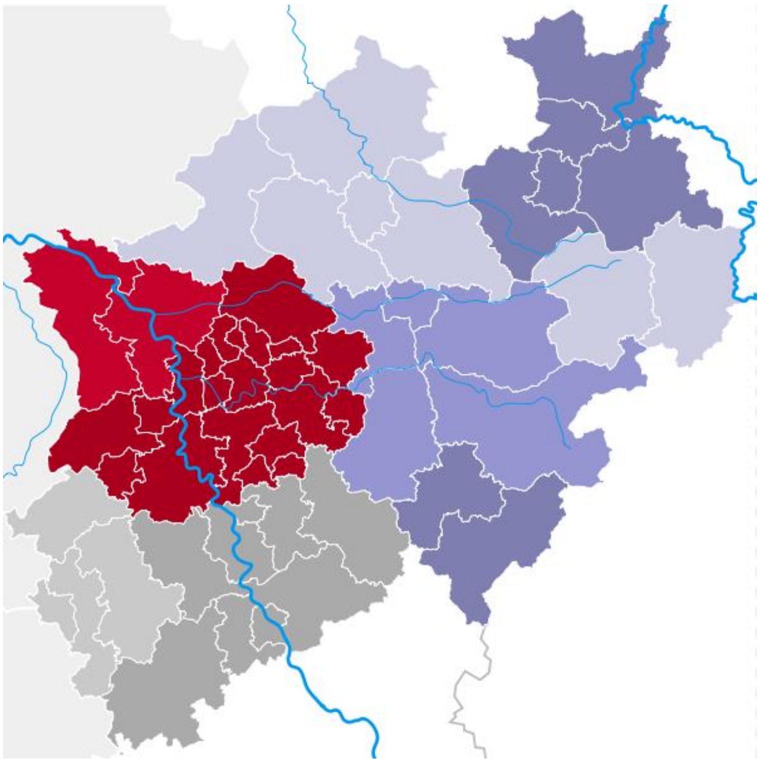

Figure 3 – VRR operation area within federal state of Northrhine-Westfalia[7]

In total thirty-eight (38) companies form the core element of the association and have to provide considerable services every day in order to cope with the approximately 279 million km operated annually by trains (regional, regional-express, suburban railway), suspension railway, driverless sky-train, trams/light rail, urban and trolley buses.[8]

3.2. PT service context

The 'STOAG Stadtwerke Oberhausen GmbH' (STOAG) is the local transport organization for the city of Oberhausen. It is a member of the regional transport association 'Verkehrsverbund Rhein-Ruhr' (VRR). The STOAG operates on a total line length of 578 km (status 2014/2015)

- 1 tram line,
- 7 express bus lines,

[6] Source: https://en.wikipedia.org/wiki/Verkehrsverbund_Rhein-Ruhr
[7] Source: https://de.wikipedia.org/wiki/Verkehrsverbund_Rhein-Ruhr
[8] Source: http://vrr.de/de/vrr/vu/index.html

- 20 city bus lines,
- 11 night bus lines.

Central part of the public transport network is a section dedicated for buses and trams only, partly elevated and priority over private transport at crossings. This section is a fast connection (max. operation speed is up to 80 km/h) between the central station, the 'New Centre Oberhausen' (linked with the CentrO – the biggest shopping mall and recreation centre in Europe) and the district Sterkrade.

In total 123 buses (72 articulated buses and 51 standard buses (status November 2015)) and 6 trams - which also operate to the neighbour town Mülheim - transport yearly more than 36.1 million passengers. About 400 staff members guarantee excellent connections and offer good service throughout the city area. The development of the ridership figures from the year 2008 to the year 2014 are as follows:

Year	Passengers (Mio)	Changes vs previous years
2008	40.2	
2009	40.0	0.5
2010	39.1	2.5
2011	38.4	1.8
2012	38.1	0.8
2013	37.0	2.9
2014	36.1	2.4

Table 2 - Development ridership figures STOAG (2008 to 2014)

Most of the bus lines serve every 20 or 30 minutes as is normal practice for the Ruhr-Area. Besides diesel buses (regular operated vehicle type and on an average not older than five years), two hybrid buses and two electric buses are in service.
The operation starts on weekdays (Monday to Friday) at about 4.00 am and ends at night at about 1.00 am. At the weekend the operation starts a bit later but in return the service at night is non-stop service on all eleven (11) night lines.

All buses operated by STOAG are low-floor vehicles and equipped with air-condition and devices to get priority at most traffic lights. In addition bus lanes at dedicated sections in the bus network and specific measurements at some traffic lights give priority to the buses. Furthermore transfer stations (e.g. connection with railway) and few further bus stops are equipped with real-time passenger information boards displaying the arrival time of each line stopping at that station.

The operation key figures of STOAG are (basis year 2014/2015):

Total number of lines (day/night)	28 / 11
Total line length	578 km
Total number of stations	334
Total number of buses (articulated/standard)	123 (72 / 51)
Total number of staff (driver, technical, administration)	391 (313 / 33 / 45)
Total number of transported passengers	36.1 Mio

Table 3 - Operation key figures 2014/2015 STOAG

3.3. Information about the Use Case

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

In urban bus systems mostly diesel vehicles are currently in operation. In order to reduce the dependency on fossil fuels and to reduce the nitrogen oxide, particulate matter and noise pollution in urban areas, the public transport operator Stadtwerke Oberhausen GmbH (STOAG) tries as other municipal owned public transport companies to introduce alternative urban bus drive systems.

Public transport by buses and trams plays a central role in the mobility concepts of the future in the city of Oberhausen. To meet the rising demand for mobility without negative effects on the environment, Stadtwerke Oberhausen GmbH in cooperation with transport association Verkehrsverbund Rhein-Ruhr (VRR) started on 4th October 2015 the operation of the two urban lines 962 and 966 with an electric bus (12m standard) on each line and hence completely converted both routes from diesel to electric mode. Also, all auxiliary equipment such as air conditioning and heating are powered electrically. For fast charging, the existing DC tram infrastructure is used to charge the battery buses in operation. The required charging stations have been built in late July 2015 at the Oberhausen-Sterkrade train station (line 962) and the station Neumarkt (line 966).

In Sterkrade the power is taken from the tram catenary by pantograph installed on the roof of the bus and at the station Neumarkt the charging energy is taken from the tram sub-station. Each charging operation takes place during the turning times at the terminus station and takes up to ten minutes. During regular operation charging at the depot is not required. As a result of this charging concept the traction batteries can be sized smaller, which results in less weight and cost-saving of the purchase price of a bus. Nevertheless, the battery capacity is dimensioned that in case of unforeseen events up to three charging cycles may be omitted.

Pillar C: Fast-charging stations for e-cars powered from the tram network

As known from studies one of the most important trust barriers for the purchase electric vehicles is the slow charging of the batteries. The existing DC tram infrastructure is also suitable for fast charging of vehicles from other means of transport. Hence the Energieversorgung Oberhausen AG (EVO) decided to demonstrate how fast charging stations for cars and vans can be implemented relatively cost effectively in cities with existing DC tram infrastructure and thus enhance the rapid introduction of electric vehicles.

At the Oberhausen-Sterkrade train station from November 2015 on cars and vans can be charged at three fast charging stations. The electricity is taken from the tram catenary and converted to a power output usable by the cars and vans. The special feature of these stations is that the batteries are loaded significantly faster than by a conventional technology.

4. Objectives

4.1. Objectives of the Use Case

The main objective of the Use Case Oberhausen is to prove that electric buses with interim charging can already deployed for everyday operation. To achieve this aim two electric bus lines will be set-up in the city centre area. The tests during the day-to-day operation should not just deliver practical experience about charging technology and its suitability and reliability, but also show the added value of an emission-free and low-noise vehicle and the integration of the charging technology into the urban environment.

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

- By this Use Case it is foreseen to prove the technical feasibility of how the existing DC power infrastructure (catenary installation, power supply substation) of the local tram network can be used for fast-charging of battery buses.
- In case of Line 966 the energy usage is provided by a substation which enables a weather-protected placing of the charging unit. In case of Line 962 the energy usage is enabled by the catenary used by the tram.
- Specific characteristics of both technical solutions are the significant voltage fluctuations (+20%/ to -30% in relation to the nominal voltage during operation).
- Answer will be sought to the following questions: Are high performance charging units available? How will these integrated in substations? How will charging units be connected to catenary systems? Which safety concept is necessary to exclude any hazards for passengers and driver staff?

Pillar C: Fast-charging stations for e-cars powered from the tram network

- The intension is to demonstrate how the existing DC infrastructure of a local PT system (in this case a tram) can be used for the implementation of intermodal mobility solutions.
- It is foreseen to use already installed charging components for battery buses to generate the DC power supply needed for fast-charging of private e-cars and LEVs at a pick-up point.
- Answer will be sought to the following questions: Are charging units for 40-60 kW available to cope with variable DC voltage? How will these units be connected to the existing catenary system? How will the charging units for the private e-cars and LEVs be connected to the existing fast charging infrastructure for the battery buses? How will these charging units be protected against overvoltage and short-circuit currents?

By what means of safety concept is such area for (fast) charging of private e-cars, LEVs and battery buses to be equipped?

4.2. Expected impacts

The following preliminary list shows the interaction between each expected impact and the two Thematic Pillars:

Expected Impact	**Pillar A (Vehicle)**	**Pillar C (Infra-structure)**
Enhance the quality feeling and/or perception	X	X
Extend the lifetime and durability	X	X
Reduce the energy consumption	X	
Reduce the pollution and noise	X	
Simplify maintenance and repair work	X	
Increase the vehicle utilization (load factor, operating time)	X	
Increase the service reliability	X	X
Improve the urban integration/ quality of life	X	X

Table 4 – Expected impacts for Thematic Pillars (A and C)

4.3. Use Case KPIs

The performance of the Use Case lines 962 and 966 will be assessed by Key Performance Indicators (KPIs) as a part of WP3. The selected KPIs are both quantitative and qualitative and will be collected during two different periods ”No ELITPIC scenario” (before starting the Use Case testing phase) and “ELIPTIC scenario”(during the Use Case testing phase), in order to measure the impact of the measurements carried out. The period for data collection of both periods (“Before” and “During”) has been set as follows:

	No ELITPIC scenario (Before)	**ELITPIC scenario (During)**
Pillar A: Tram infrastructure for (re)charging e-buses	Jan 2015 – Jun 2015	Jul 2015 – May 2018July

	No ELITPIC scenario (Before)	ELITPIC scenario (During)
Pillar C: Fast-charging stations for e-cars	N/A	Jan 2016 - May 2018

Table 5 – KPI data collection periods (Before / During)

Differently to other Use Cases within the Thematic Pillars

- For the Use Cases Pillar A and Pillar C no economic perspective but an integrated system analysis (interaction existing power supply infrastructure and new fast-charging components) will be carried out.
- All indicators relating to vehicle technology, operation and components aren't relevant and won't be collected as Use Case Pillar C is a charging infrastructure only.

The KPIs to be collected for the Use Case Pillar A are listed as follows by grouping them by "KPI categories":

Staff

- Driving staff
- Drivers workload

Supply

- Passenger capacity
- Service coverage
- Daily supply
- Regularity
- Peak vehicles requirement

Maintenance

- Vehicle failures
- Days in workshop
- Durability of traction battery
- Durability of vehicles

Service

- Commercial speed
- Dwell time
- Journey time
- Round trip time
- Charging time

Demand

- Passenger demand

<u>Costs</u>
- Electricity costs for vehicles
- Electricity costs for traction
- Electricity costs for non-traction

<u>Consumption</u>
- Electricity consumption
- Electricity from renewable sources consumption

5. Risks

<u>Pillar A:</u>
The main risks identified by the Use Case partner STOAG for **Pillar A** are as follows:

Description of risk	Proposed risk-mitigation measures
- Difficulties in the technical implementation of the use of tram infrastructure (catenary and substation) for (re)charging e-buses	In case of outage of the e-buses or problems with the technical equipment, STOAG will ensure public transport services on both lines with diesel buses. The reasons for the outage would then be part of ELIPTIC's research analysis.
- The purchased vehicles won't fulfill the contracted requirements regarding operating range, availability and reliability.	Communication with the producer to find a solution

Table 6 - Description of Pillar A risks and proposed mitigation measures

Pillar C:

The main risks identified by the Use Case partner STOAG for **Pillar C** are as follows:

Description of risk	Proposed risk-mitigation measures
- Difficulties in the technical implementation of the fast-charging stations for e-cars powered from the tram network.	Communication with the producer to find a solution
- The installed infrastructure won’t fulfill the contracted requirements regarding availability and reliability.	Communication with the producer to find a solution

Table 7 - Description of Pillar C risks and proposed mitigation measures

6. Detailed description of the Use Case

6.1. Description of expected use case features, establishing the link among use case conditions, objectives and background

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

The transport association Rhine-Ruhr (VRR - Verkehrsverbund Rhein-Ruhr) and STOAG had started on 4th October 2015 a project, in which by means of the existing DC tram infrastructure electric buses will be loaded during operation. The charging energy is either taken transformed from the tram catenary at the train station Sterkrade (bus line 962 – route see figure 4) or from the sub-station at the station Neumarkt (bus line 966 – route see figure 5). Part of the concept is that during regular operation charging of the electric buses at the bus depot is not required.

The power transmission takes place by means of a swing-conductively pantograph which is placed on the roof of the bus. Through regular recharging during the turning time at both terminus stations (Sterkrade and Neumarkt) the traction batteries can be relatively small and thus saves weight and costs of the deployed buses. All auxiliary equipment such as air conditioning and heating are powered electrically. Nevertheless the battery capacity is dimensioned that in case of unforeseen events up to three charging cycles may be omitted.

The electric buses will run every hour with a turning time of 17 respectively 14 minutes. The effective turning time is set with 10 minutes and the charging capacity with 220 kW. In winter, 25 kW of charging power for heating of a heat accumulator are used during the charging time. As a result the attainable driving distance is accordingly with the charging capacity of 220 kW from 19.3 km to 28.9 km and during winter operation with 195 kW charging capacity from 17.1 km to 25.7 km.

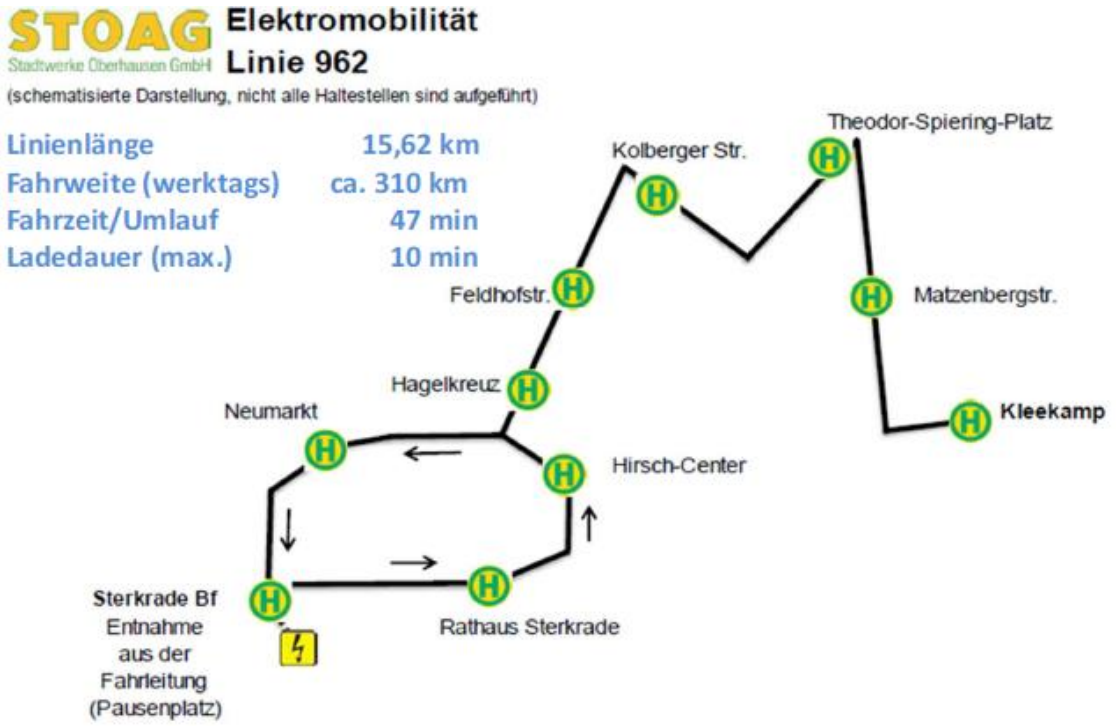

Figure 4 – Use Case Bus Line 962 (source: STOAG)

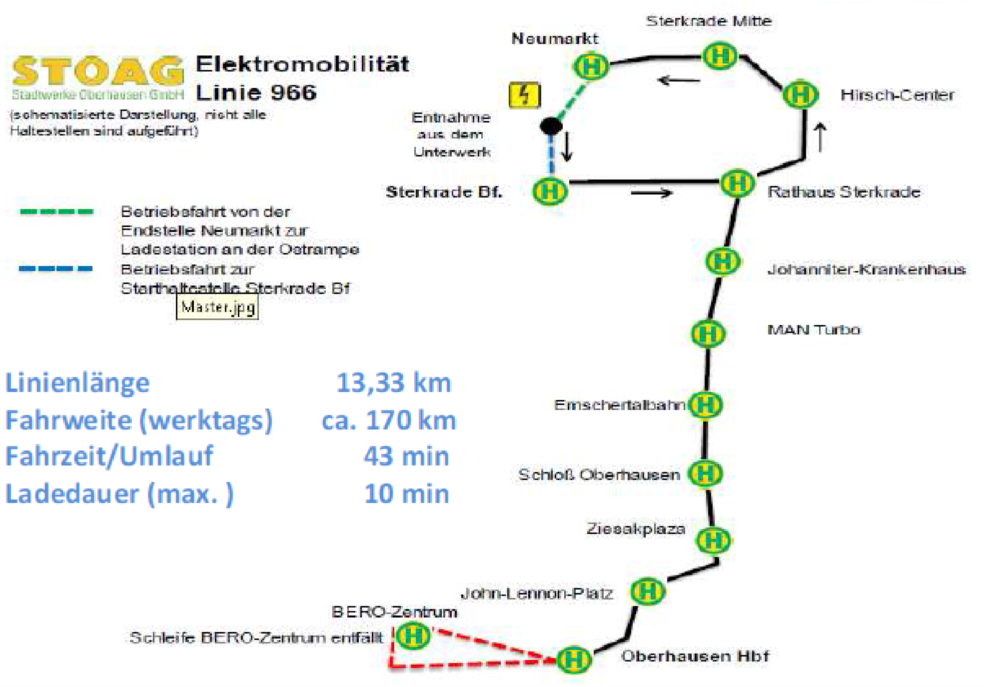

Figure 5 – Use Case Bus Line 966 (source: STOAG)

The deployed electric vehicles – one standard 12m bus for each bus line – are SOLARIS Urbino 12 with low-floor technology and air conditioning systems to maintain the usual standard for urban buses operated by STOAG. The drive takes place by the electric wheel hub motor ZF axle AVE 130 with two asynchronous motors.
The battery cells are provided by the manufacturer A123 and have storage capacity of 200 kWh. The charger is supplied by the company Ekoenergetyka and the pantograph by the company Schunk. The charging infrastructure has been implemented by the company Siemens.

The following table shows the assigned tasks for the involved partners in both Use cases (Pillar A and C):

Involved Parties	**Assigned Task**	**Pillar A (Vehicle)**	**Pillar C (Infra-structure)**
STOAG	Public transport operator, Use Case coordinator	**X**	**X**
SOLARIS	Bus vehicle manufacturer	**X**	**X**

Involved Parties	Assigned Task	Pillar A (Vehicle)	Pillar C (Infra-structure)
Ekoenergetyka	Charger	X	X
Siemens	Charging infratructure	X	
Wiegand & Partner Spiekermann	Planning consultancy	X	
VRR (transport association Rhine-Ruhr)	Funding body	X	X
City of Oberhausen	Monitoring construction work	X	X
EVO (local energy supply provider)	Power supply		X
RWE (energy group)	Billing portal		X

Table 8 - Assigned Tasks for Involved Parties

For the line 966, the charging energy is taken from the sub-station at the station Neumarkt (see figure 6 and 7). This solution not only has the advantage of sharing the existing medium-voltage switchgear, the converter transformer and the rectifier of the sub-station, but also allows the weather-proof placement of the charger in the sub-station. Hence there is no additional space (probably subject to approval) required, except for the mast and integrated charging device.

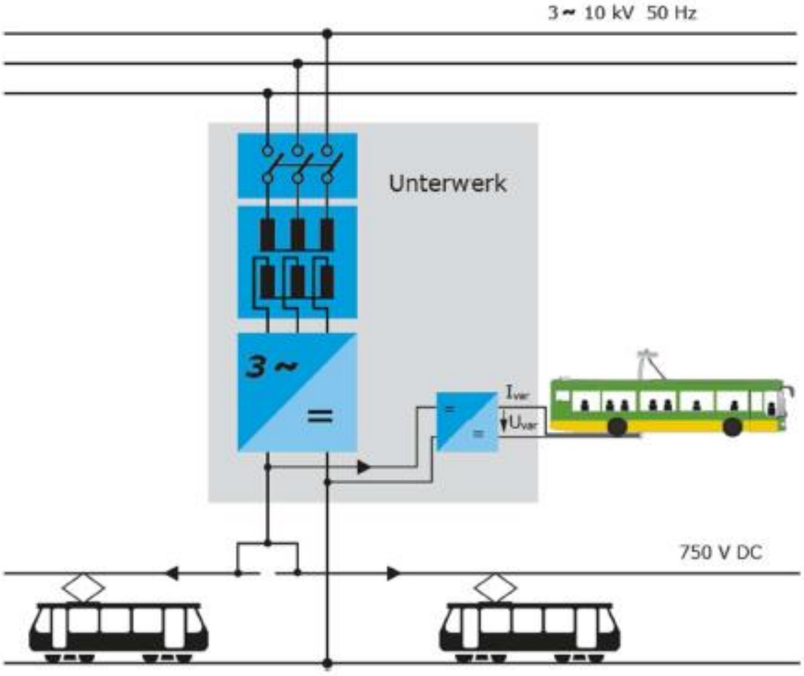

Figure 6 – Schematic Sketch of the Bus Charging from the Tram Sub-station at the Station Neumarkt (source: Müller-Hellmann)

Figure 7 - Pantograph on top of the SOLARIS Bus Roof and Charging Infrastructure at the Station Neumarkt (source: STOAG)

The charging energy for the line 962 is taken from the tram catenary at the train station Sterkrade (see figure 8 and 9). This solution is especially used in the immediate vicinity of the tram catenary where several waiting positions for electric buses are available and sufficient space for the implementation of charging devices for electric vehicles of other means of transport is available.

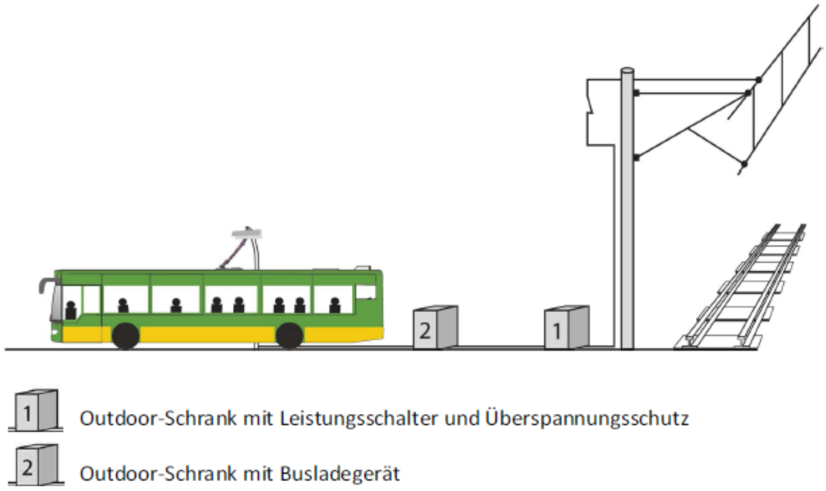

Figure 8 – Schematic Sketch of Bus Charging from the Tram Catenary at the Train Station Sterkrade (source: Müller-Hellmann)

Figure 9 – Images from the Train Station Sterkrade (source: STOAG)

Pillar C: Fast-charging stations for e-cars powered from the tram network

The following figure 10 shows the basic concept for the fast-charging infrastructure for electric cars and light commercial vehicles as well as electric buses at the train station Sterkrade. Via an unlockable two disconnectable circuit-breaker (see cabinet no 1), an overvoltage protection and a catenary mast disconnecting switch the fast-charging devices for the electric bus and the three charging stations for the road vehicles are connected with the tram catenary.

The energy is taken from with 750 V DC tram catenary and transformed in the cabinet no 1 (see figure 10) for the three (3) fast-charging stations powered with 50 kW.

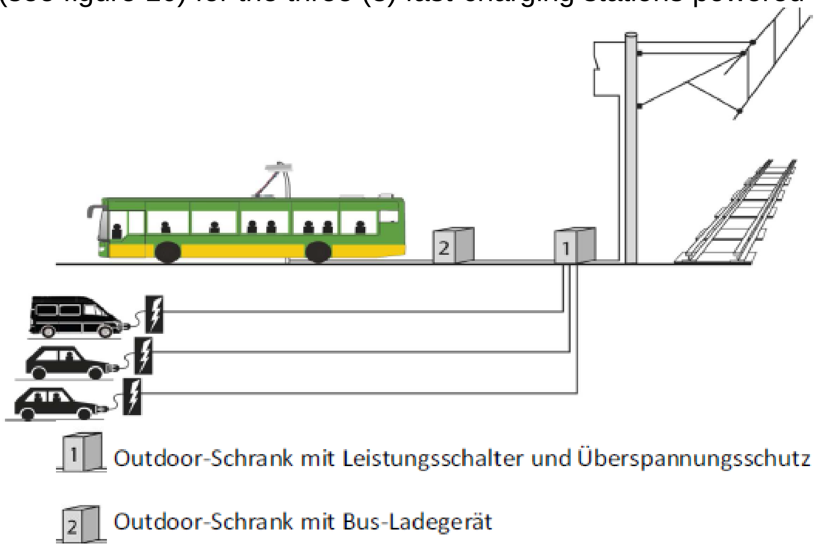

Figure 10 _ Schematic Sketch of Fast-charging for e-Vehicles from the Tram Catenary at the Train Station Sterkrade (source: Müller-Hellmann)

6.2. Use Case constraints

The Use Case constraints can be summarized as follows:

Pre-instruction and briefing of trainers, drivers, technical experts and maintenance staff by the bus manufacturer (in this case SOLARIS) and supplier companies (Medcom, Schunk, ZF Friedrichshafen AG) about specifics of the electric vehicle type are needed beforehand.

The aim is to train all 313 drivers and 33 workshop workers (mechanical and electric staff) in the operation and maintenance of the electric vehicles. The overall aim and purpose of the trainings is: “To impart knowledge and stimulate skills and expertise in energy efficient, eco-friendly and safe driving of electric vehicles”.

6.3. Use Case monitoring criteria

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

Data loggers were installed by the vehicle manufacturer on the vehicle. The data loggers will from July 2016 continuously monitor the buses on miscellaneous parameters (see KPIs described in chapter 4.3). The logged data will be analyzed via an online platform accessible for the Use Case leader and vehicle manufacturer.

Pillar C: Fast-charging stations for e-cars powered from the tram network

The local energy supply provider collects diverse data from the fast-charging stations through the billing system.

7. Use case work plan

7.1. Use Case development logic

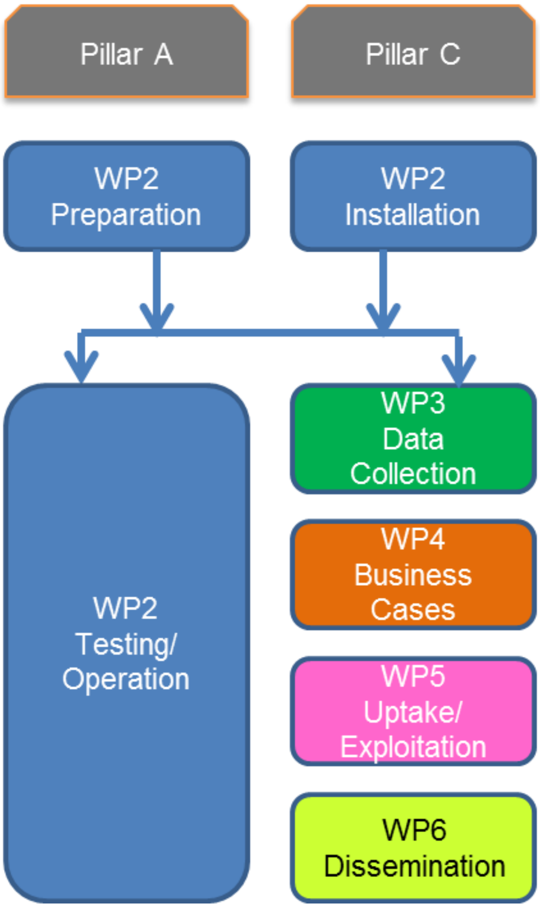

Figure 11 – Use Case Development Logic (Pillar A and C)

7.2. Work plan

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

The following work plan contains the main Use Case Pillar A activities:

No	Action	Total PMs	Staff 1	Staff 2	External	Start-month	End-month
1	Preparation and implementation data collection (ELIPTIC scenario)	0.25	Staff from Technical and Operational Units (Maintenance, Supervision etc)	Staff from Administrative Units (Marketing, Planning)	Vehicle manufacturer (Solaris), charging infrastructure (Siemens)	6 (Nov 15)	36 (Jun 16)
2	Preparation e-buses for testing phase	0.5	Staff from Technical and Operational Units (Maintenance, Supervision etc)	Staff from Administrative Units (Marketing, Planning)	Vehicle manufacturer (Solaris), charging infrastructure (Siemens)	4 (Sep 15)	13 (Jun 16)
3	Close monitoring of daily vehicle operation & data collection	2.0	Staff from Technical and Operational Units (Maintenance, Supervision etc)	Staff from Administrative Units (Marketing, Planning)	Vehicle manufacturer (Solaris), charging infrastructure (Siemens)	14 (Jul 16)	36 (May18)
	In total	**2.75**					

Table 9 – Work Plan (Pillar A - Vehicle)

Pillar C: Fast-charging stations for e-cars powered from the tram network

The following work plan contains the main Use Case Pillar C activities:

No	Action	Total PMs	Staff 1	Staff 2	External	Start-month	End-month
1	Preparation infrastructure for testing (catenary link)	0.1	Staff from Technical and Operational Units (Maintenance, Supervision etc)		Local energy supply provider (Plus EVO), City of Oberhausen	3 (Aug 15)	4 (Sep 15)
2	Close monitoring of charging infrastructure & data collection	0.65	Staff from Technical and Operational Units (Maintenance,	Staff from Administrative Units (Marketing, Planning)	Local energy supply provider (Plus EVO), billing	14 (Jul 16)	36 (May18)

			Supervision etc)		system (RWE)		
	In total	**0.75**					

Table 10 – Work Plan (Pillar C - Infrastructure)

7.3. Detailed timeline

Use Case Oberhausen (Pillar A + C)				
Work Plan Schedule and GANTT (15/12/2015)				
			Start	**End**
No	**Action**	**Pillar**	**Month**	
1	Delivery D2.7.1 'UC Set-up Report' (Draft Version)	A + C	5	6
2	Delivery D2.7.1 'UC Set-up Report' (Final Version)	A + C	6	7
3	Preparation Data Collection	A	6	13
4	Preparation e-Buses Testing	A	4	13
5	Preparation Infrastructure Testing (Catenary Link)	C	3	4
6	Monitoring & Data Collection e-Buses Operation	A	14	36
7	Monitoring & Data Collection Charging Infrastructure	C	7	36
8	Delivery D2.7.2 'UC Set-up Report' (Final Version)	A	29	32
9	Delivery D2.7.2 'UC Set-up Report' (Final Version)	C	29	32

Project Month																																			
2015					**>>**		**2016**	**>>**											**2017**	**>>**											**2018**	**>>**			
J	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

Table 11 – Work Plan and Schedule (GANTT Chart) for Pillar A and C

The above work plan contains the schedule for tasks/ activities for both Oberhausen Use Cases (Pillar A and C)

8. Expected results

For both use cases the following principles apply: no economic perspective but an integrated system analysis (interaction existing power supply infrastructure and new fast-charging components).

The expected results for both Oberhausen Use Cases (Pillar A and C) are described as follows divided by Thematic Pillar:

Pillar A: Use of tram infrastructure (catenary and substation) for (re)charging e-buses

The expected results are:

- Gain experience of the operational reliability and availability of the two e-buses
- Gain skills and knowledge about the specific energy requirement (battery, auxiliaries) for the e-buses

Pillar C: Fast-charging stations for e-cars powered from the tram network

The expected results are:

- Gain experience of the operational reliability and availability of the charging infrastructure.
- Get information about the awareness and acceptance by Public Transport (PT) and non-PT users.