



MZA Warsaw Use case set up report

Pillar A

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SUMMARY SHEET

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Abstract	Undertaking necessary means to overcome procedural barriers which today make impossible for the bus operator to use catenary of tram operator for the purpose of (re)charging of the EV. MZA Warsaw shall carry out all the procedure: legal (permits and agreements) and technical (project and execution), allowing to build and use EV charger for the Project purposes which will be powered through the infrastructure of the municipal tram company. MZA Warsaw is to utilize the catenary to supply power for opportunity chargers for e-buses.. Our partner, PIMOT is to focus their research efforts on evaluating quality and efficiency of chosen solutions, technical and operational issues related with the implementation of the use case. Together with PIMOT, MZA Warsaw will evaluate existing and available solutions on market with regard to the type of charging equipment suitable for our EV's.
Keywords	e-bus, bus charger, catenary, EV
Critical risks	

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0.2	7 December 2015	Review of document	UITP	
0.3	15 December 2015	Review of document	MZA Warsaw	
1	22 February 2016	Review of document	UITP	
1	23 May 2016	Review of document	RUPPRECHT	

CONTRIBUTING PARTNERS

Company	Names	Company Info
PIMOT	Bogusław Pijanowski Anna Kieracińska Antoni Szumanowski	PIMOT Automotive Industry Institute R&D company. The research partner PIMOT will research on quality, technical and operational issues related to the implementation of the use case.
UITP	Yannick Bousse	The International Association of Public Transport
MZA Warsaw	Janusz Bosakirski	Warsaw Municipal Bus Company – Public Transport Operator

ACRONYMS

EV: Electric vehicle

MZA: Miejskie Zakłady Autobusowe

PTA: Public transport authority

PTO: Public transport operator

TW: Tramwaje Warszawskie

URE: National Energy Regulation Office

VKM: Vehicle kilometer

ZUDE: National Office for Energy Projects

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1. Executive Summary

This summary is to give insight into general outline to the concept which is being developed in the field of the Use Case designated to MZA Warsaw.

MZA Warsaw contributes into the project together with its consortium partner, PIMOT - Automotive Industry Institute R&D.

The Use Case is to be applied in the context of the highly urbanised landscape of the municipal area of the Capital City of Warsaw, which is one of the largest, most attractive to business and fastest developing cities in Europe with great demand and high supply of various means of public transport. The core of the public municipal transportation system is a diesel powered network of bus lines with daily use of about 1500 buses, with a well-developed tram network, suburban rail system and most importantly two metro lines Blue (N-S) and Red (E-W) which are the backbone of public transportation system. All of these means of public transportation create a well-managed and supervised tight network of multimodal public transportation system of the Capital City of Warsaw. The Strategy set by City Hall for major development in the next 20 years is of low or zero emission environment friendly public transport. One of our target is to utilize the catenary to supply power for opportunity chargers for e-buses. Currently the above solution is not executable due to lack of proper rules. The main problem is to successfully struggle through all the law regulations.

2. Partner Contribution

PIMOT is the document leader for the Warsaw Use case set up report. UITP and Rupprecht Consult has reviewed the document.

Company	Sections	Description of the partner contribution
PIMOT	Entire document	The research partner PIMOT will research on quality, technical and operational issues related to the implementation of the use case. Together with PIMOT, MZA Warsaw will evaluate existing on market, type of charging equipment suitable for our EV's.
UITP	Entire document	Review of document
MZA Warsaw	Entire document	MZA Warsaw shall carry out all the procurement: legal (permits and agreements) and technical (project and execution), allowing to build and use EV charger for the Project purposes which will be powered through the infrastructure of the municipal tram company. MZA Warsaw is to utilize the catenary to supply power for opportunity chargers for e-buses.

3. Context conditions

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

The proposed procedure is unique in Poland. None of the Public Transport Operators is using the catenary or power grid substation for opportunity charging of the EV's. Only these companies which operate trams and buses (together) can use their tram network, to power their EV's through the chargers plugged to the catenary power grid, without any additional permits and legal procedures except for these related to its construction.

To succeed with our Use Case MZA Warsaw first of all must obtain dedicated approval from the National Energy Regulatory Office (URE). Achieved results from our Use Case could become an inspiration for other cities, not only in Poland. Our experiences are going to be highly valuable for the majority of the market operators in the pursuit of opportunities to benefit from the municipal power grid, owned by the City Hall. Municipal infrastructure can provide more than sufficient basis for the creation and further development of a network of charging stations for e-buses used by the PTO's.

3.2. PT service context

Present means of public transport, which are in great majority diesel powered, must be substituted one to one by a low or zero emission vehicles. The development of municipal public transport based on electric buses will provide more comfort to passengers and great advancement in application of environment-friendly means of transport. Progress in this field is related with the development of the charging stations network and support from the authorities, especially in the field of exploitation of municipal infrastructure owned by City Hall.

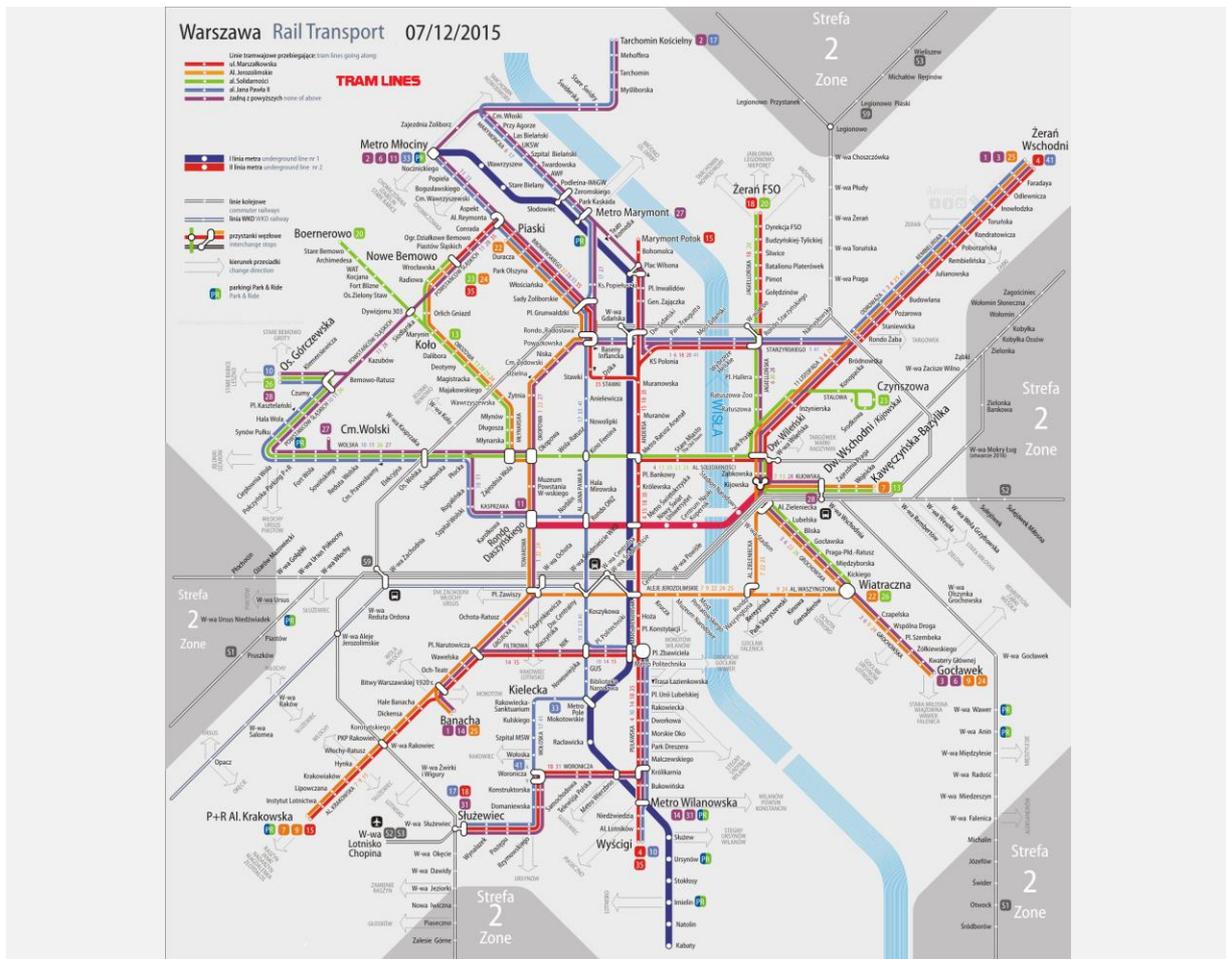
Miejskie Zakłady Autobusowe is Limited Liability Company owned by the City of Warsaw.

MZA Warsaw, is the largest bus PTO in Poland employing over 4 300 specialised workers, with abt. 1 300 buses in inventory, owning 5 highly specialised bus depots located in key locations over the municipal area and with yearly turnover exceeding € 200 million.

MZA Warsaw carries passengers throughout the Capital City of Warsaw Metropolitan Area with population exceeding over 2'000'000 people.

Every day over 1100 buses maintaining more than 180 lines carry about 1'150'000 passengers. Yearly busses of MZA Warsaw are passing approx. 88 000 000 km. MZA Warsaw is also an experienced technological leader. Through the purchases of up to 100 buses each year our company raised to be one of the largest buyers of the Polish market. The company's agenda lays an emphasis on constant pursuit for the highest standards and improving quality of service e.g. through constant development of the infrastructure and purchases of vehicles representing state of the art in terms of technological innovation and green solutions. Our goal is to allow our passengers to commute comfortably and to decrease the level of pollution within the urban metropolitan area. This makes MZA Warsaw influential partner for the whole urban transport society in Poland.

Operating the e-buses, on the regular passenger lines within the City of Warsaw, due to the diverse traffic (from light to heavy) will allow to properly assess the suitability of the proposed solution for passengers.



The above diagram shows the network of trams and thus the possibility of using the tram catenary to power EV charging stations.

3.3. Information about the Use Case

The ELIPTIC use case for the Capital City of Warsaw coincides with the long-term development strategy of Miejskie Zakłady Autobusowe Sp. z o. o. (MZA Warsaw) for the years 2014 – 2024, which involves major investments focused on development and exploitation of environmental friendly vehicles. MZA Warsaw intends to undertake a feasibility study and analyse the possibility to use the municipal power grid (city owned), supplying catenary infrastructure (municipal tram company) as an energy

source for the chargers of e-buses. The study is intended to explore existing possibilities for (re)charging of e-buses using tram infrastructure within multimodal terminus– shared by the buses and trams at the intersecting points of existing infrastructure. For a feasibility study of such a solution, MZA Warsaw intends to use their e-bus to demonstrate the use case by modification and adaptation of the e-bus to be powered by the tram catenary power grid.

For testing and demonstration MZA Warsaw must complete the following tasks:

- 1) Design and construct proper hardware: charger with adaptive voltage module adjusting the voltage out of the catenary of TW (municipal tram company) to the e-bus parameters of charging system parameters;
- 2) Design and construction of the necessary technical infrastructure for the project taking into account the consistent and / or conflicting interests of the parties - including:
 - a) Negotiations and agreements, permits, land acquisition and settlement of land ownership issues around a designated space for infrastructure;
 - b) Creating a common (for TW and MZA Warsaw) network of emergency power supply from points of existing infrastructure, enabling the repair of charging stations, fixing of malfunctions without switching off the buses from passenger service;
 - c) Identify and determine the location of charging stations for e-buses at the end of the dedicated route.

4. Objectives

4.1. Objectives of the Use Case

Short term:

- 1) Obtaining the consent of the National Energy Regulation Office (URE) to use the tram network for the supply of opportunity chargers;
- 2) Work out a concept for the use of the tram network in accordance with the selected type of charging solution.

Long term:

- 1) Savings from implemented technology (lower cost per 1vkm (vehicle kilometer) compared to Diesel powered);
- 2) Decreased direct emission of pollutants – mainly reduction of the CO₂ emission and noise pollution in densely populated urban area, with a key factor which is general reduction of emissions of pollutants – in conformity with the “Clean Vehicles Directive” 2009/33/EC – which impacts the environment by increasing the quality of air and general health through improving living conditions;
- 3) Service rating, reception by the passengers and overall higher quality of service satisfaction.

4.2. Expected impacts

We are convinced that Warsaw will become a good example for others cities that through the introduction of electric public transport will help to protect the environment and to reduce operating costs.

Main identified impacts:

- Faster delivery of electrification across Warsaw bus network – improving sustainability by deploying and promoting an electric environment (more charging possibilities)
- Possibility of reducing the energy costs
- Possibility of increasing the operational time of e-buses.

4.3. Use Case KPIs

The aim of MZA Warsaw in ELIPTIC project is based on the feasibility study of the use of tram infrastructure for recharging e-buses.

MZA Warsaw proposes the following KPIs that in our opinion best reflect the nature of the MZA Warsaw use case:

- 1) **An indicator of reduction in energy purchase costs [expressed as: PLN/kWh]**
- we expect that the tariff of TW is lower than what MZA Warsaw can obtain and therefore the cost of 1 kWh taken by the e-bus charger will also be lower;
- 2) **An indicator of longer e-bus working hours [expressed as: hrs and km of service]** - we expect that opportunity charging will shorten the charging time of e-bus, increase (as needed) frequency of recharging and therefore extend the effective working time which may also result with higher mileage;
- 3) **An indicator of efficient use of drivers [expressed as: working (as a driver) hrs vs total daily amount of hrs]** - we expect that the excluding of day time charging at the depot, which takes at least a few hours, would allow not only the extension of the e-bus operational time but also more efficient fleet managing and planning of the driver schedule;
- 4) **An indicator of reduction of costs for “kilometers unpaid” [expressed as: service km vs total daily mileage]** – During the day the EV won’t need to drive back to the depot to recharge its batteries. “Technical transfer” to the depot is at the expense of the PTO and not PTA.

5. Risks

Crucial point in our Use Case is to obtain an official permit to access TW catenary power grid. TW can grant us an access (based on commercial use only after a positive decision from the Authorities – National Energy Regulatory Office – URE (tariffs). With URE acceptance we can elaborate together (PTA+TW) a location for placing the recharging infrastructure. We can start the process of developing the technical project for power grid connection and finally after obtaining the approval from ZUDE (National Office for Energy Projects) we can proceed with the selection, purchase (or execution upon request) and then construction on the chosen charger location.

After the functional acceptance (by the authorities), the charger can be put into operation.

All of these official permits are time consuming efforts and generating additional risks and problems, especially in the process of land acquisition for of the recharging infrastructure.

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

Step 1 - Approvals

Approval from National Energy Regulatory Office (URE) means:

- a) Consent to using of the tram network (power grid) to recharge e-buses;
- b) Determination of network usage and tariff conditions for the resale of energy.

Step 2 – Concept

Crucial point in our Use Case is to obtain official permit to access TW catenary power grid. TW can grant us an access (based on commercial use only after positive decision from the Authorities – National Energy Regulatory Office – URE (tariffs). We know that procedures are time-consuming. With URE acceptance we can elaborate together (PTA+TW) one location for placing recharging infrastructure. We can start the process of developing the technical project for power grid connection and finally after obtaining approval from ZUDE (National Office for Energy Projects) we can proceed with the selection, purchase (or execution upon request) and then construction on the spot chosen charger.

- a) With the above documents, we can chose (together with PTA, TW as energy provider) location of charger as the best place lying on the bus routes network.
- b) Together with PIMOT, MZA Warsaw will evaluate existing on market, type of charging equipment suitable for our e-vehicles.
- c) With selected technological solution we shall proceed with the selection process of manufacturer of charging device, in accordance to technical assumption as per letter b) in step 1 above.

Step 3 - Tender

- a) MZA Warsaw shall announce a Price Call for Proposals for the best technological solution used to wire the energy out from the TW power grid directly to the charger.

- b) The winning company (most probably one of the Energy Project Design Offices) is to prepare the technical documentation of electrical connection including all necessary acceptances, permits and technical reconciliation.
- c) MZA Warsaw can announce a contest for offers to engineers and manufacturers of such chargers in accordance with the technical assumption given by the MZA Warsaw and PIMOT. The winner is obliged to prepare the technical documentation of the charger, production and construction at the chosen location.

Step 4 – Documentation

Above mentioned documentation must be additionally approved by the ZUDE (National Office for Energy Projects) b) This set of documentation consist of different permits, among them:

- Environmental permit,
- Real property ownership,
- Construction permit.

Step 5 – Implementation

Implementation of the project - will be carried out in the end of the process mentioned above in step 3. After the functional acceptance (by the authorities) can be put into operation.

6.2. Use Case constraints

Impact on overall battery output and vehicle range related to battery power and constraints, which are most likely related to various factors with impact on overall efficiency of given solution which includes i.e.: uneven ground, declines, heights, heat during summer and freezing in the winter season, decreasing overall lifetime battery output, various malfunctions of electric and electronic devices used for powering and propelling the vehicle, number of the bus stops and distance between the stops, route characteristics, charging infrastructure and number of devices and total time for charging, energy recuperation, traffic density in terms of traffic fluency or jams, availability and access to latest technological solutions and achievements in the field of electric batteries and chargers.

6.3. Use Case monitoring criteria

The task will be monitored by MZA Warsaw and PIMOT representatives according to the internal procedures.

Monitoring is based on ongoing review of projected timetable, taking action in case of disruption of its implementation.

Number of consecutive steps, which are spread over time, it is not big enough for us, to not be able to reign over their implementation.

7. Use case work plan

7.1. Use Case development logic

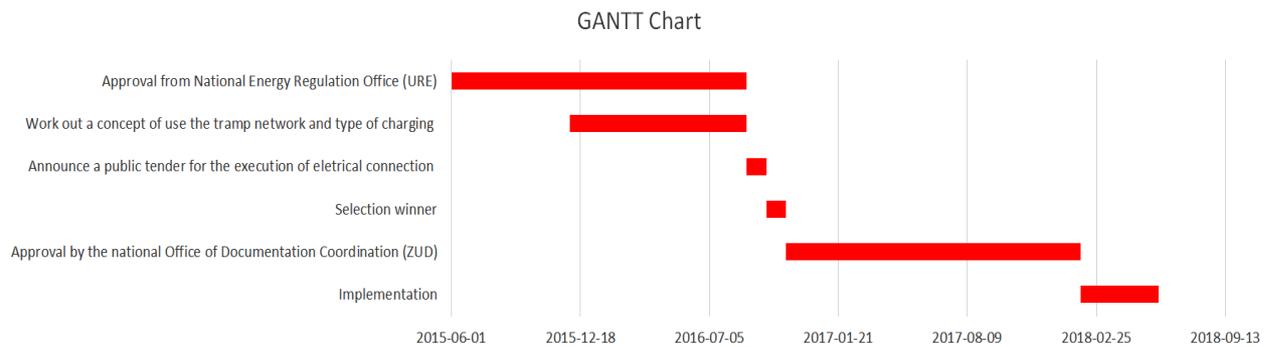
- 1) Approval from National Energy Regulation Office (URE) - essential information, without which further steps are impossible
- 2) Development of concept for the use of tram catenary and application of feasible charging solution – development of the concept and assumptions allows to prepare the records for the tender specification
- 3) Tender announcement for implementation of electrical connection of charger tram network – selecting the winner can continue the process
- 4) Tender conclusion – we can outsource the documentation / project
- 5) Approval of National Office for Energy Projects (ZUD) - essential information, without such approval implementation is not possible
- 6) Implementation of chosen solution

7.2. Work plan

Number	Action	Total person months	MZA Warsaw	PIMOT	Start-month	End-month
1	Approval from National Energy Regulation Office (URE)	3	3		1	15
2	Work out a concept of use the tram network and type of charging	4	2	2	6	15
3	Announce a public tender for the execution of electrical connection	0,5	0,5		15	16
4	Selection of winner	0,5	0,5		16	17

5	Approval by the National Office for Energy Projects (ZUDE)	2	2		17	32
6	Implementation	2	1,5	0,5	32	36

7.3. Detailed timeline



8. Expected results

Our experiences are going to be highly valuable for the majority of public transport operators in the pursuit of an opportunity to benefit from the TW power grid to charge e-buses. Municipal infrastructure (trams, metro, etc.) can provide more than sufficient basis for creation and further development of a network of charging stations for electric buses used by the operators of municipal public transport.