Promoting clean public transport

TROLLEY – WHAT WAS ACHIEVED BY BARNIM BUS GMBH

SZEGED, 01/2013

INTRODUCTION – EBERSWALDE

Trolley
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► Location

- in the German Federal State (Bundesland) of Brandenburg,
- about 50 km northeast of Berlin

► Population

- 40.745 inhabitants

Location of the town of Eberswalde within Barnim district [show]	
Coordinates	52°49′59″N 13°49′59″E
Administration	
Country	Germany
State	Brandenburg
District	Barnim
Town subdivisions	7 Ortsteile
Mayor	Friedhelm Boginski (FDP)
Basic statistics	
Area	58.17 km² (22.46 sq mi)
Elevation	25 m (82 ft)
Population	40,745 *(31 December 2011)*[1]
- Density	700 /km² (1,814 /sq mi)
Other information	
Time zone	CET/CEST (UTC+1/+2)
Licence plate	BAR (früher EW)
Postal codes	16225/16227
Area code	03334
Website	www.eberswalde.de

INTRODUCTION – COMPANY INFORMATION

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▶ General facts

- founded in 1992
- approx. 240 employees (incl. subsidiary)
- 110 vehicles (incl. 12 trolleybuses)
- 53 lines (incl. 2 trolleybus lines)
- 8 million passengers (p.a.)
- 6.5 million kilometers (p.a.)

▶ Trolleybuses in Eberswalde

- Germany's oldest trolleybus operator
- 2 trolleybus lines
- 12 trolleybuses
- 3.5 million passengers (per year)
  = 43.75% of all passengers (!)





1940 → 1945 → 1958 → 1985 → 1993 → 2010

REASONS FOR INTEREST – MAIN ACTIVITIES

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► REASONS FOR INTEREST IN PARTICIPATING IN TROLLEY

- share experiences & best practice examples
- common outputs
- new partners, contacts, network
- financial support

► MAIN ACTIVITIES

- **Optimised Energy Use:**
  Network-based energy storage systems

- **Increased Public Transport Efficiency:**
  Analysis on possible grid expansions

- **Improved Image and Patronage:**
  Production of a trolleybus short-movie.

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WP3: NETWORK-BASED ENERGY STORAGE SYSTEM

DESCRIPTION

- transnational manual on advanced energy storage
- pilot attempt of **testing of an energy storage system in a substation**

CENTRAL EUROPE COOPERATING FOR SUCCESS.
EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND
ebus the smart way

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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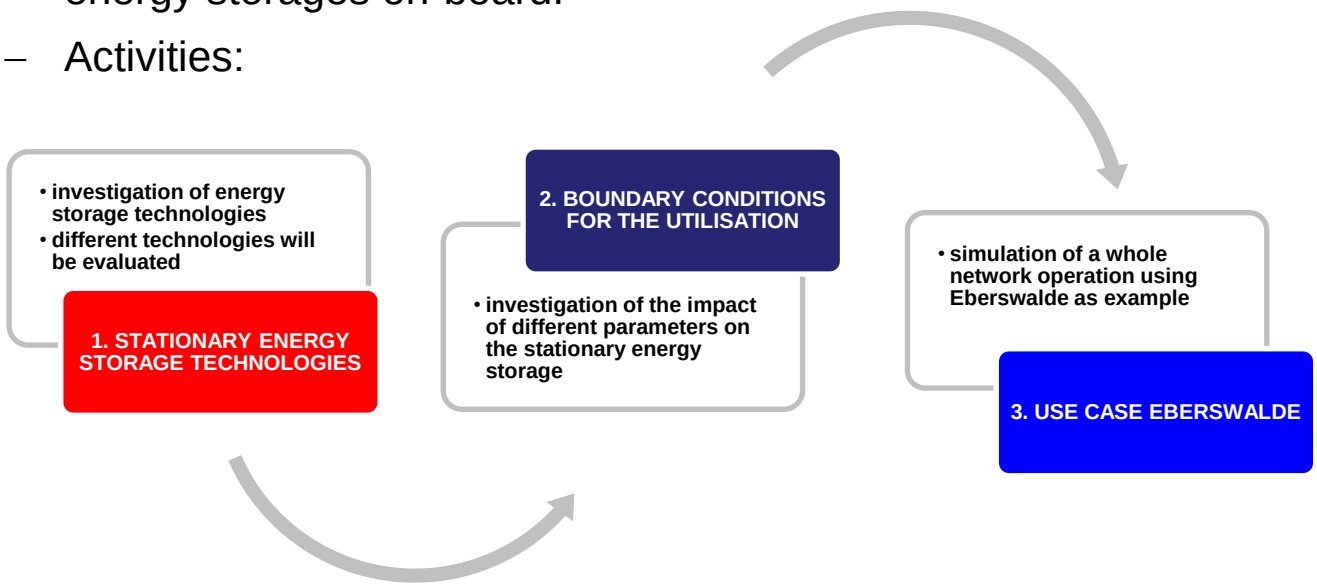
► FEASIBILITY STUDY (I)

- Fraunhofer Institute for Transportation and Infrastructure systems (IVI) was subcontracted.
- Data collection based on vehicles by MAN NGE 152 without energy storages on-board.
- Activities:



02/2010

12/2010 – 07/2011

11/2010

07/2011

04/2012

06/2012

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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02/2010

12/2010 – 07/2011

11/2010

07/2011

04/2012

06/2012

► RESULTS FEASIBILITY STUDY (I)

use case MAN NGE 152 (without energy storages) – July 2011

ENERGY STORAGE TECHNOLOGY IN SUBSTATION:

- ~~Battery: low cycle stability~~
- ~~Flywheel mass storage: not available~~
- ***Supercapacitors***

USE CASE EBERSWALDE

dimensioning of wayside energy storage systems on the basis of supercapacitors

		Substation EAST	Substation CENTRAL	Substation WEST	Total
Mileage	[km]	204220	156437	297772	
Energy savings	[kWh/km]	0,755	0,929	0,653	
Savings	**[T€/year]**	**27.8**	**26.2**	**35.0**	**89**

- Procurement cost (each): 400.000 EUR (source: SIEMENS)
- Procurement cost (total): 1.200.000 EUR

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► NEW FLEET: Delivery 2010-2012

Solaris Trollino 18 (with on-board supercapacitors)

The supercapacitors used for the trolleybuses in Eberswalde are located on the roof.

- 02/2010
- 12/2010 – 07/2011
- 11/2010
- 07/2011
- 04/2012
- 06/2012

– 2010: 3 vehicles
– 2011: 6 vehicles
– 2012: 3 vehicles

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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02/2010

12/2010 – 07/2011

11/2010

07/2011

04/2012

06/2012

► RESULTS FEASIBILITY STUDY (I)

use case Solaris Trollino 18 – April 2012

USE CASE EBERSWALDE

dimensioning of wayside energy storage systems on the basis of supercapacitors

		Substation EAST	Substation CENTRAL	Substation WEST	Total
Mileage	[km]	204220	156437	297772	
Energy savings	[kWh/km]	0,524	0,595	0,460	
Savings	**[T€/year]**	**15.0**	**13.0**	**19.2**	**47.2**

*„However, the remaining **amount of energy** to be stored in wayside energy storages **is very low** and **does not suggest the installation** of such storages if the vehicles are already equipped with energy storages (cf. Table 18).“*

Quote: Calculation of the Electrical Network and Sketch Planning for the Energy-Efficient Operation of Trolley Buses of the Barnimer Busgesellschaft mbH, page 27

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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Europe's first Trolley-Battery-Hybrid-Bus operating in Eberswalde

- 02/2010
- 12/2010 – 07/2011
- 11/2010
- 07/2011
- 04/2012
- **06/2012**

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

Trolley
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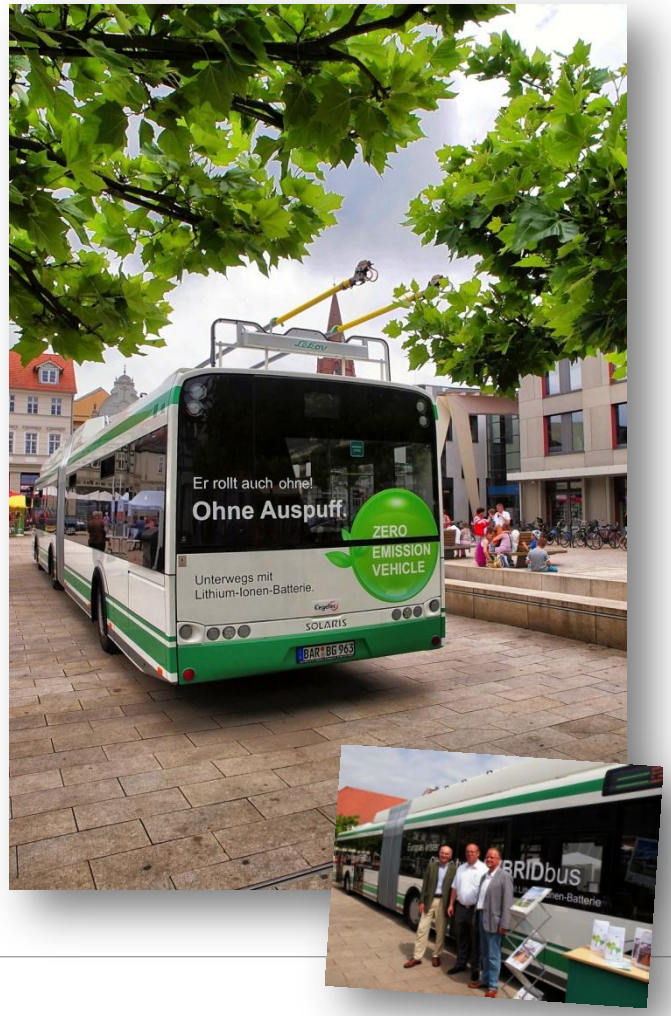

► TROLLEY-BATTERY-HYBRID-BUS:

- The auxiliary diesel engine has been replaced by a lithium-ion battery, the system is now featuring two fully electric drive systems.
- The bus can receive power either via the catenary or the lithium-ion battery.
- On short distances the bus can additionally run on supercapacitors – the third electric drive system.
- In test mode the new bus was able to run over a distance of 18 km – powered only by the battery.
- In daily operation, however, the bus will be able to cover a wireless distance of 5 km. Charging energy for this distance takes ca. 20 minutes.

- 100% emission-free
- Switching between the two systems happens unnoticed.

Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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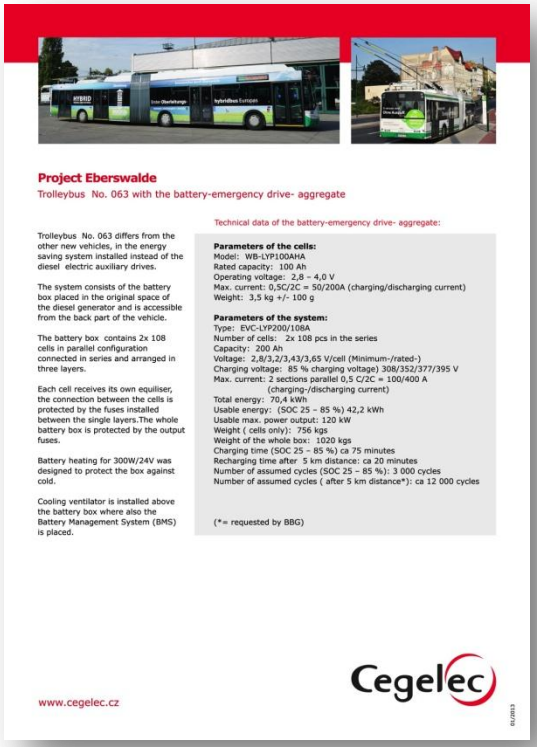
TECHNICAL DATA OF THE BATTERY-EMERGENCY DRIVE-AGGREGATE

Parameters of the cells:
Model: WB-LYP100AHA
Rated capacity: 100 Ah
Operating voltage: 2,8 - 4,0 V
Max. current: 0,5C/2C = 50/200A (charging/discharging current)
Weight: 3,5 kg +/- 100 g

Parameters of the system:
Type: EVC-LYP200/108A
Number of cells: 2x 108 pcs in the series
Capacity: 200 Ah
Voltage: 2,8/3,2/3,43/3,65 V/cell (Minimum-/rated-)
Charging voltage: 85 % charging voltage) 308/352/377/395 V
Max. current: 2 sections parallel 0,5 C/2C = 100/400 A (charging-/discharging current)
Total energy: 70,4 kWh
Usable energy: (SOC 25 - 85 %) 42,2 kWh
Usable max. power output: 120 kW
Weight (cells only): 756 kg
Weight of the whole box: 1020 kg
Charging time (SOC 25 - 85 %): ca. 75 minutes
Recharging time after 5 km distance: ca. 20 minutes
Number of assumed cycles (SOC 25 - 85 %): 3000 cycles
Number of assumed cycles (after 5 km distance*): ca. 12000 cycles

(*= requested by BBG)
www.cegelec.cz



Project Eberswalde
Trolleybus No. 063 with the battery-emergency drive- aggregate

Technical data of the battery-emergency drive- aggregate:

Trolleybus No. 063 differs from the other new vehicles, in the energy saving system installed instead of the diesel electric auxiliary drives.

The system consists of the battery box placed in the original space of the diesel generator and is accessible from the back part of the vehicle.

The battery box contains 2x 108 cells in parallel configuration connected in series and arranged in three layers.

Each cell receives its own equiliser, the connection between the cells is protected by the fuses installed between the single layers.The whole battery box is protected by the output fuses.

Battery heating for 300W/24V was designed to protect the box against cold.

Cooling ventilator is installed above the battery box where also the Battery Management System (BMS) is placed.

Parameters of the cells:
Model: WB-LYP100AHA
Rated capacity: 100 Ah
Operating voltage: 2,8 – 4,0 V
Max. current: 0,5C/2C = 50/200A (charging/discharging current)
Weight: 3,5 kg +/- 100 g

Parameters of the system:
Type: EVC-LYP200/108A
Number of cells: 2x 108 pcs in the series
Capacity: 200 Ah
Voltage: 2,8/3,2/3,43/3,65 V/cell (Minimum-/rated-)
Charging voltage: 85 % charging voltage) 308/352/377/395 V
Max. current: 2 sections parallel 0,5 C/2C = 100/400 A (charging-/discharging current)
Total energy: 70,4 kWh
Usable energy: (SOC 25 – 85 %) 42,2 kWh
Usable max. power output: 120 kW
Weight (cells only): 756 kgs
Weight of the whole box: 1020 kgs
Charging time (SOC 25 – 85 %) ca 75 minutes
Recharging time after 5 km distance: ca 20 minutes
Number of assumed cycles (SOC 25 – 85 %): 3 000 cycles
Number of assumed cycles (after 5 km distance*): ca 12 000 cycles

(*= requested by BBG)

www.cegelec.cz

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Pilot Action I – NETWORK-BASED ENERGY-STORAGE SYSTEM

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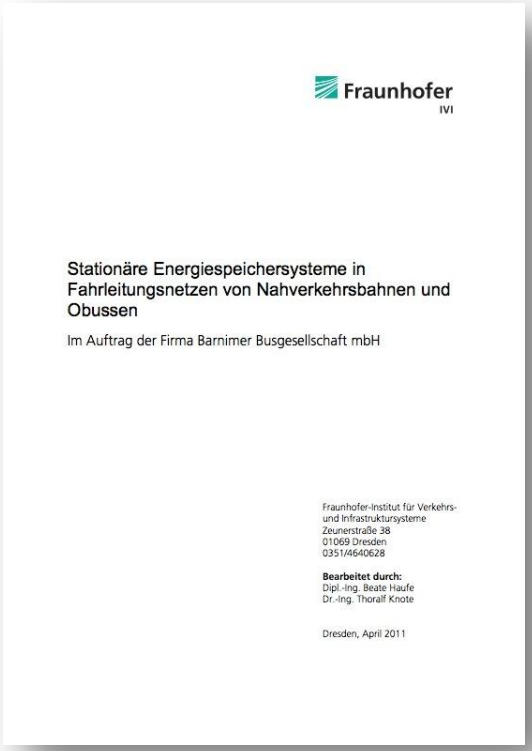
Outputs


Fraunhofer IVI

Stationäre Energiespeichersysteme in Fahrleitungsnetzen von Nahverkehrsbahnen und Obussen

Im Auftrag der Firma Barnimer Busgesellschaft mbH

Fraunhofer-Institut für Verkehrs- und Infrastruktursysteme
Zeunerstraße 38
01069 Dresden
0351/4640628

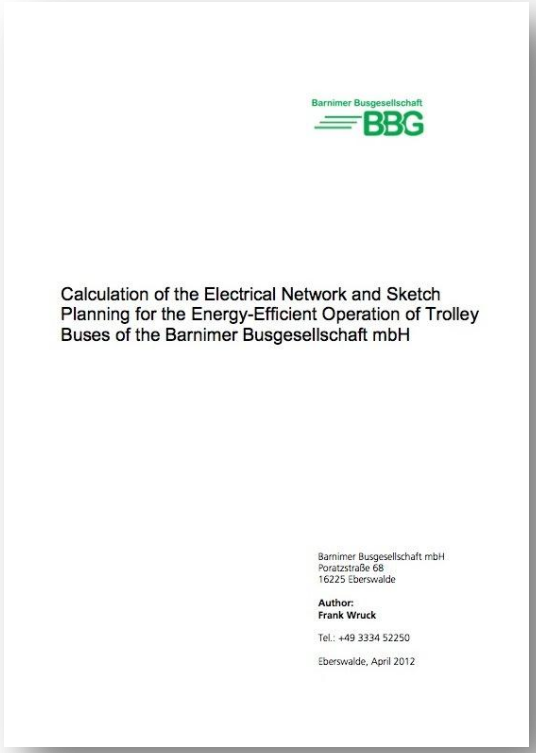
Bearbeitet durch:
Dipl.-Ing. Beate Haufe
Dr.-Ing. Thoralf Knote

Dresden, April 2011

Stationäre Energiespeichersysteme in Fahrleitungsnetzen von Nahverkehrsbahnen und Obussen

Netzberechnung und Entwurfsplanung für energieeffizienten O-Busbetrieb der Barnimer Busgesellschaft

Ergänzende Untersuchung über die Auswahl und den Einsatz eines Energiespeichers im Fahrleitungsnetz von O-Bussen


Barnimer Busgesellschaft BBG

Calculation of the Electrical Network and Sketch Planning for the Energy-Efficient Operation of Trolley Buses of the Barnimer Busgesellschaft mbH

Barnimer Busgesellschaft mbH
Poratzstraße 68
16225 Eberswalde

Author:
Frank Wruck

Tel.: +49 3334 52250

Eberswalde, April 2012

Calculation of the Electrical Network and Sketch Planning for the Energy-Efficient Operation of Trolley Buses of the Barnimer Busgesellschaft mbH

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WP4:
ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

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the smart way

Pilot Action II –
ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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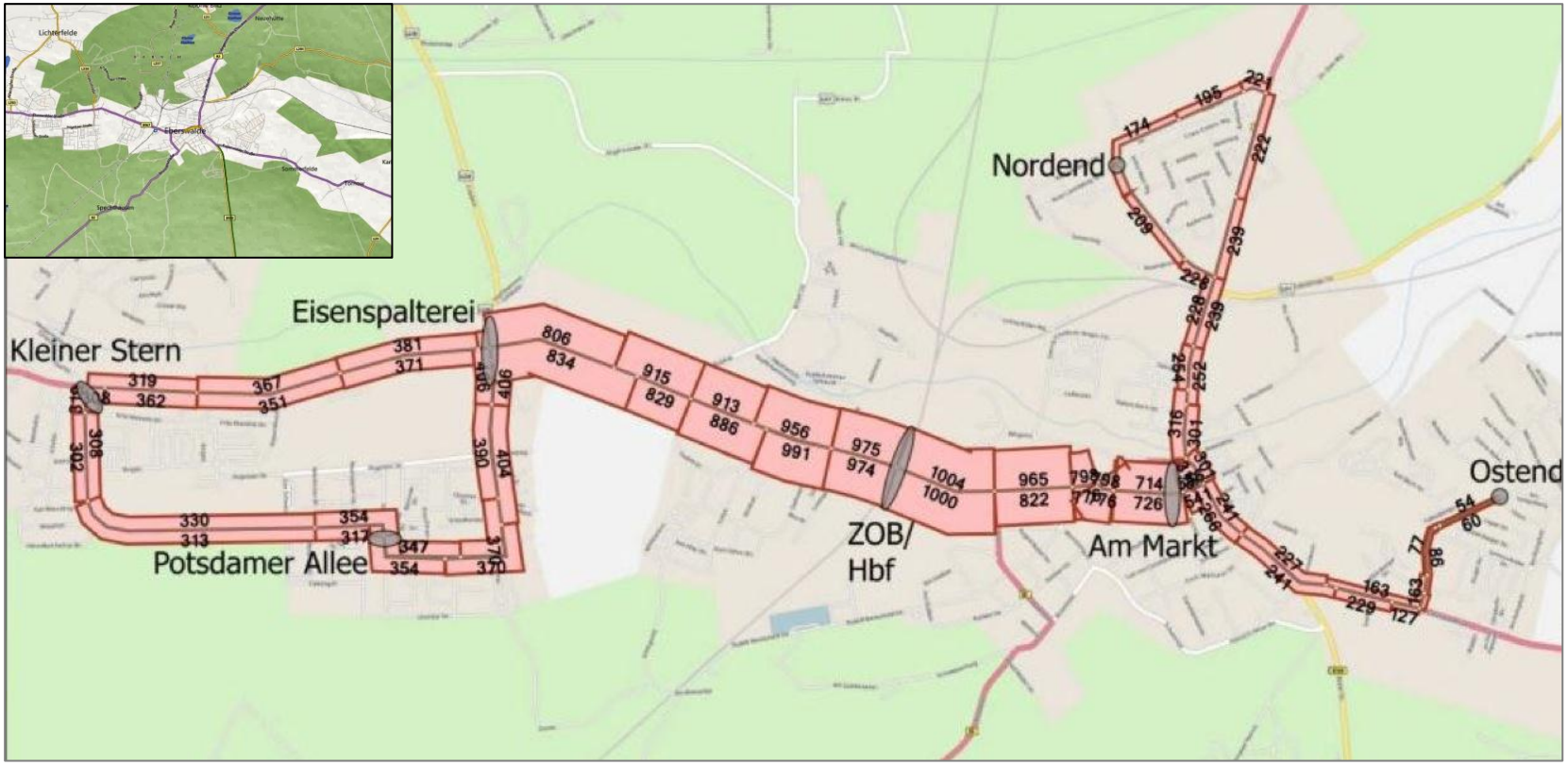
► TRAVEL DEMAND



ill. 3: Travel demand city traffic Eberswalde p.a.

Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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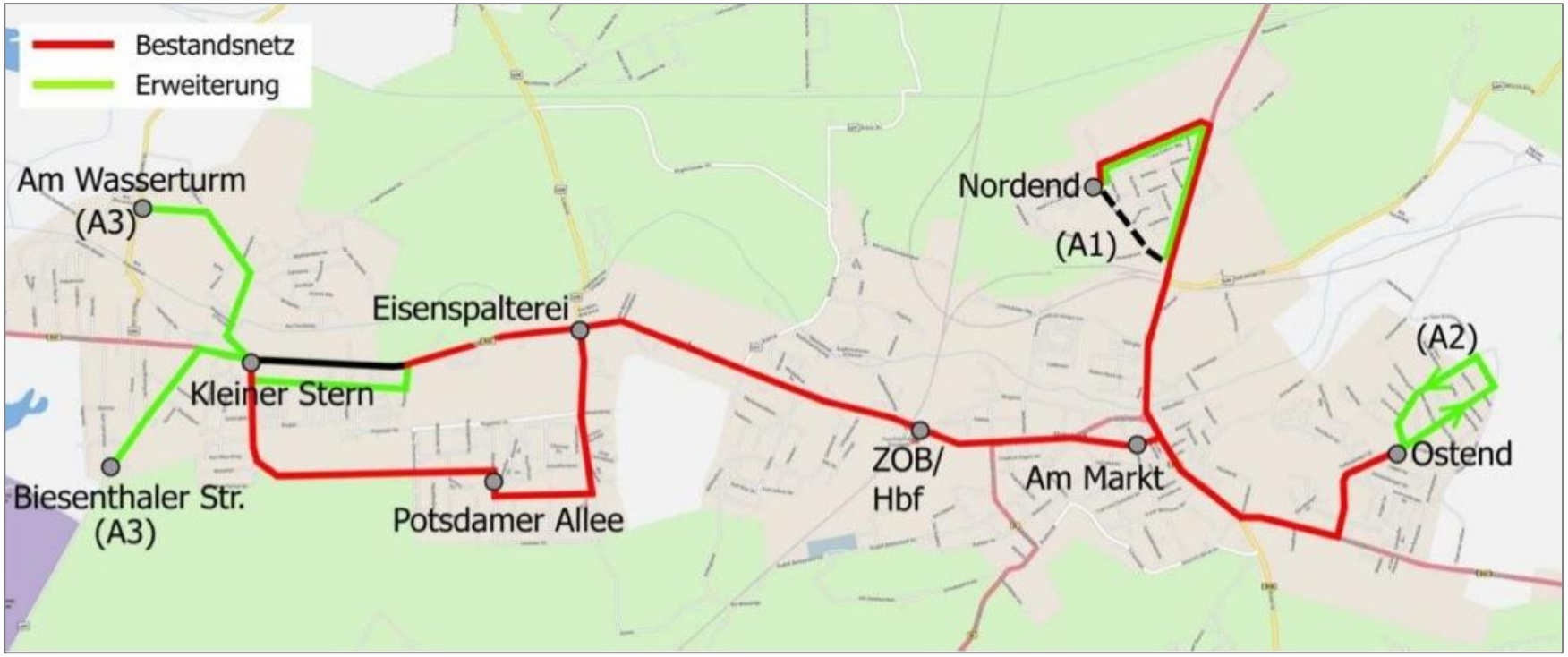
► OPTIONS FOR GRID EXPANSION EBERSWALDE



Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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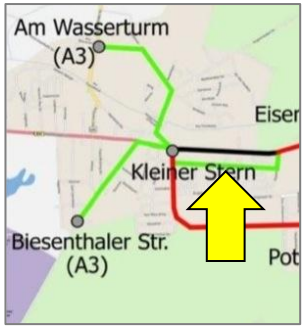
Nordend (A1)	Nordend – Britz (A2)	Fritz-Weineck-Str. – Biesenthaler Str. – Am Wasserturm (A3)
• Investment cost: – **approx. 500.000 €** (Prospect: Contact wire poles exist)	• Investment cost: – Contact wire: approx. **680.000 €** (80 % double wire circuit) – vehicle: **680.000 €**	• Investment cost: – Overhead contact wire: 550.000 €,
• Operating costs: – no modification	• Operating cost per year (additional): – Energy: 12.000 € – Staff: 37.000 € – Repair/maintenance: 16.000 € – Vehicle insurance: 4.000 € – Operating cost total/year: + 69.000 €	• Operating cost per year: – constant
• Estimated additional demand p.a.: 81.000 trips.	• Estimated additional demand p.a.: 62.000 trips.	• Estimated additional demand p.a.: 44.000 trips.
		

Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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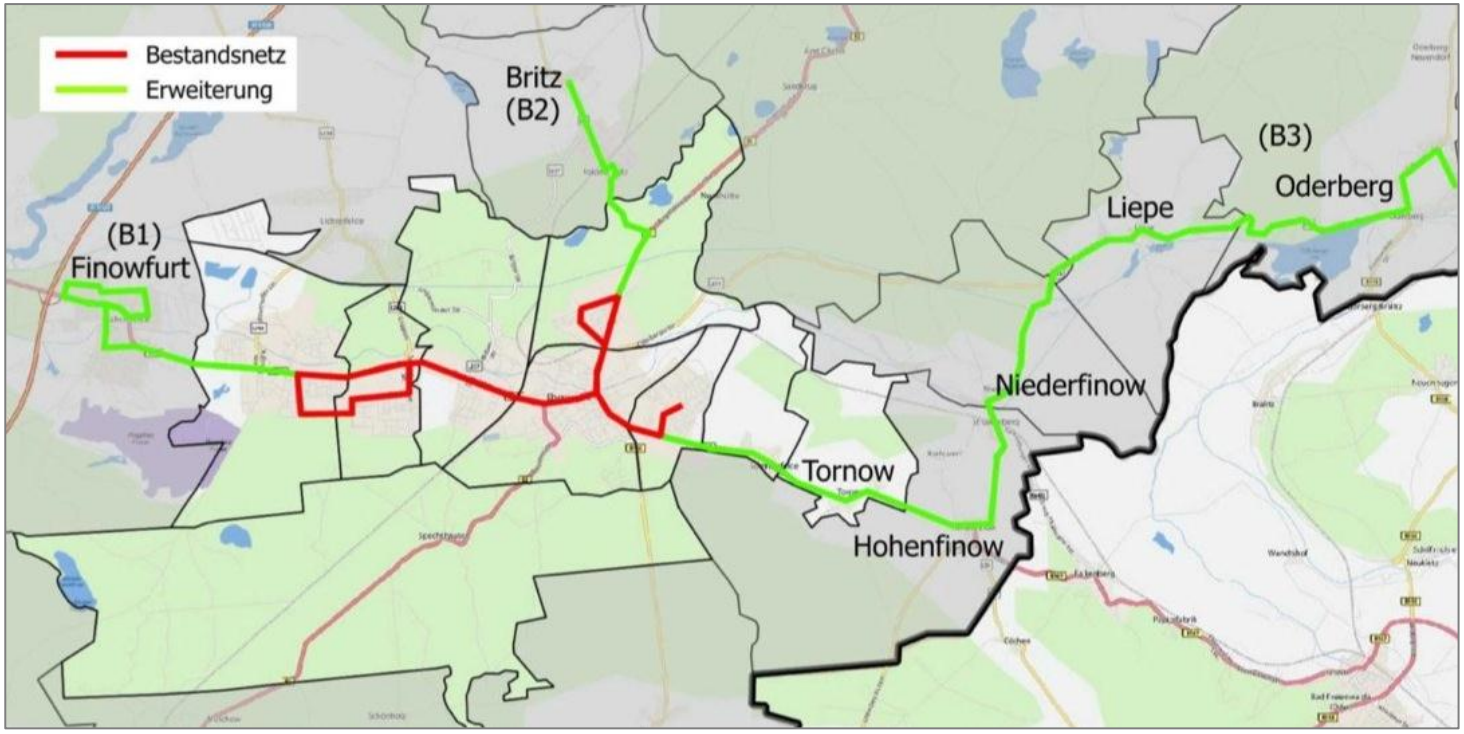
► OPTIONS FOR GRID EXPANSION INTO NEARBY TOWNS



Option B1: Extension West: Kleiner Stern – Finowfurt (8.6 km)
Option B2: Extension North: Nordend – Britz (5 km)
Option B3: Extension East: Ostend – Niederfinow – Oderberg (22 km)

Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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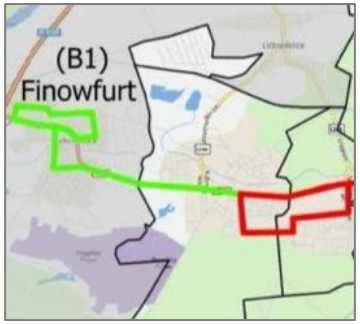
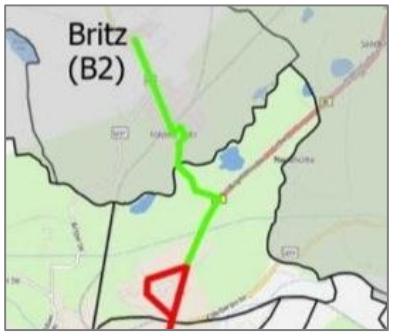
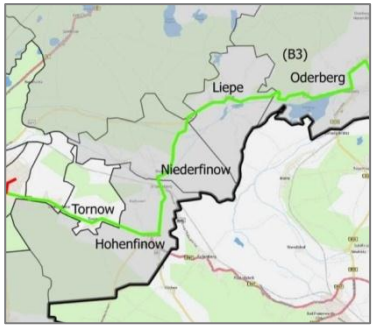
Kleiner Stern – Finowfurt (B1; 8.6 km)	Nordend – Britz (B2; 5 km)	Ostend – Niederfinow – Oderberg (B3; 22 km)
• Investment cost: – Overhead contact wire: 3.900.000€ (4,6 km double wire circuit - and 4,0 km single contact wire) – Vehicle: 1.360.000 €, – Traction substation: 1 (1,3 Mio. €)	• Investment cost: – Overhead contact wire 2.500.000 €, – Vehicle: 680.000 €, – Traction substation: 1 (1,3 Mio. €)	• Investment cost: – Overhead contact wire: 11.000.000 €, – Vehicle: 1.360.000 €, – Traction substation: 2 (2,6 Mio. €)
• Operating cost per year: – Energy: 59.000 €, – Staff: 74.000 € (Longer working hours), – Repair/ maintenance: 78.000 €, – Insurance vehicle: 8.000 €, – Operating cost total/year: 219.000 €	• Operating cost per year: – Energy: 23.000 €, – Staff: 37.000 € (Longer working hours), – Repair/ maintenance: 30.000 €, – Insurance vehicle: 4.000 €, – Operating cost total/year: 94.000 €	• Operating cost per year: – Energy: 98.000 €, – Staff: 73.000 € (Longer working hours), – Repair/maintenance: 129.000 €, – Insurance vehicles: 8.000 €, – Operating cost total/year: 308.000 €
• Estimated additional demand p.a.: 168.000 trips.	• Estimated additional demand p.a.: 80.000 trips.	• Estimated additional demand p.a.: 307.000 trips.
		

Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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Checklist

The following questions and aspects should be examined and considered in the initial planning:

Activity	Conceptual Requirements	Travel Demand	Operational Requirements	Infrastructural Needs	Tariff and Returns	Total Assessments
Criteria	• Which extensions should be included in the considerations? • Where will the extension join the existing grid? • How could a potential route look like? • Which Diesel bus lines already operate in or near the planned vicinity? • Is it possible to replace those or to relocate them? • Which other aspects should be considered? • Would the project offer any economical advantages?	• What is the current travel demand in the area under investigation for the Diesel bus? • Can the Trolley bus provide a better accessibility for the existing settlements? • Can additional potential demand be developed for public transport?	• Which lines or which particular line shall operate in the expansion area? • In what intervals are the buses planned to operate? • What is the demand for staff and vehicles? • What costs incure from that? • What distance and how many kilometers will the service cover? • Can capacities be saved in the conventional Diesel bus system?	• Which infrastructural adjustments have to be made? • What costs incur for: – Contact wire? – Traction substation? – Bus stops? – Other parameters (e.g. new terminal loop)?	• Do negotiated conditions have to be considered? • What returns can be expected?	**Overall decision of the value** derived from the parameters • Achievable travel demand and return situation • Estimated operational costs • Estimated investment cost.
Aim	**Classification of the project and identification of significant requirements**	**Evaluation of potential demand**	**Outline of the expected operational performance parameters and of the connected cost for vehicles, staff and the company**	**Assessment of the to expected Investment needs**	**Overview over expected revenue**	

Pilot Action II – ANALYSIS REGARDING THE POSSIBLE GRID EXPANSION

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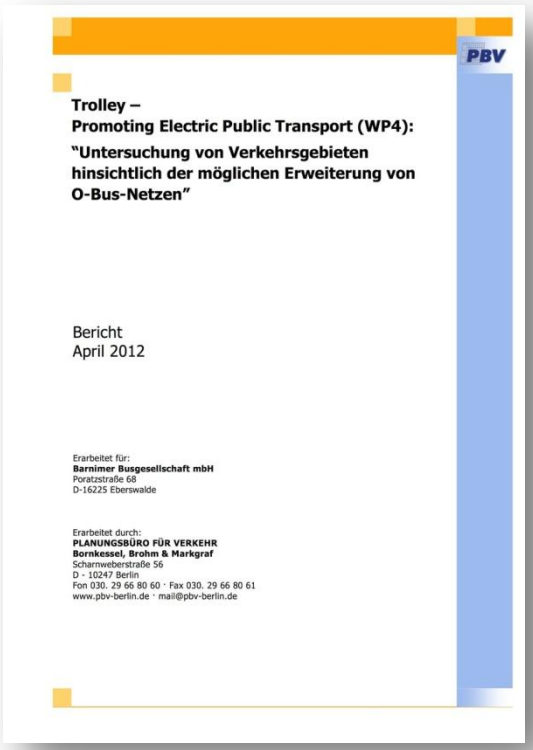
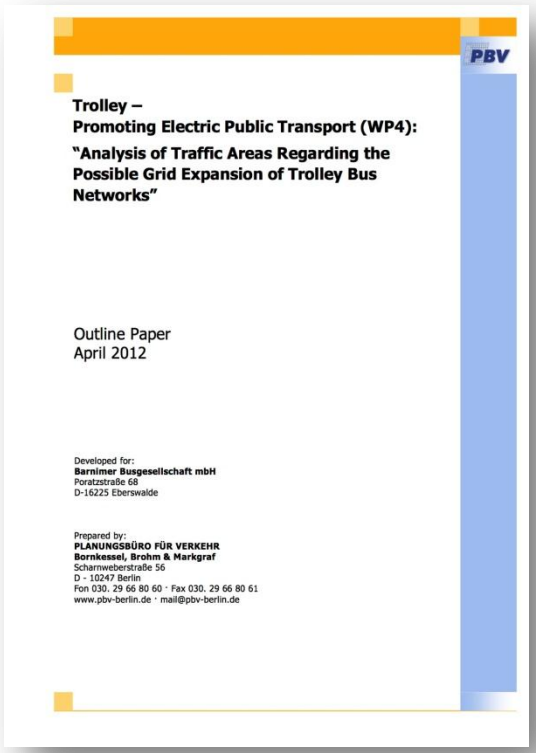
Outputs



Untersuchung von Verkehrsgebieten hinsichtlich der möglichen Erweiterung von O-Bus-Netzen



Analysis of Traffic Areas Regarding the Possible Grid Expansion of Trolley Bus Networks

Trolley

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WP5: MARKETING ACTIVITIES

Pilot Action III –
MARKETING ACTIVITIES

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► eBus-campaign/European Trolleybus Day

Pilot Action III –
MARKETING ACTIVITIES

Trolley
Promoting electric public transport

Presentation
Trolley-Battery-Hybrid-Bus

Special Exhibition

European Trolleybus Day

Pilot Action III – MARKETING ACTIVITIES

► Promotion Video

available on:

YouTube

vimeo

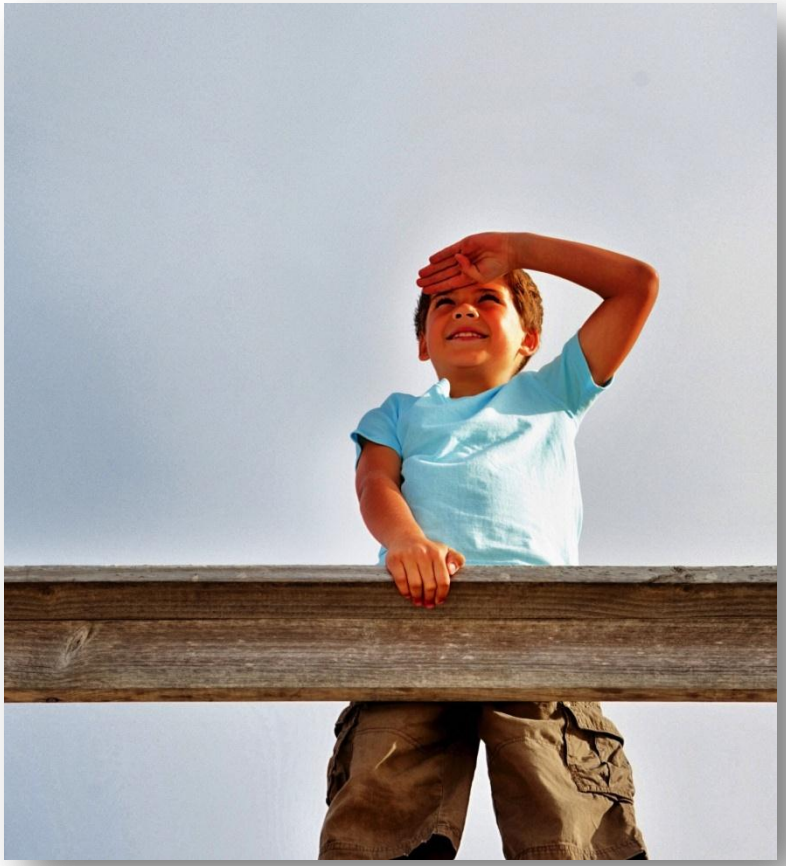
What is the way forward after TROLLEY in …

Trolley
Promoting electric public transport

► FOLLOW-UP ACTIVITIES

– grid expansion in Fritz-Weineck-Straße?

– replace other auxiliary diesel engines?



What has changed in Eberswalde through TROLLEY

- Europe’s first Trolley-Battery-Hybrid-Bus
- Emission-free vehicle/s
- Events increased awareness and refreshed image of trolleybuses in Eberswalde
- Quote by Mayor Friedhelm Boginski at New Year‘s reception: ***„trolleybus in Eberswalde is no longer questioned“***

New Year‘s reception in Eberswalde, 2013

THANK YOU TROLLEY!

Thanks to: Central Europe, JTS, Salzburg AG, City of Brno, TEP S.p.A., LVB, City of Gdynia, University of Gdansk, SZKT, TrolleyMotion, & Rupprecht Consult

Mandy Kutzner
(Marketing)
Barnimer Busgesellschaft
Poratzstraße 68
16225 Eberswalde
Germany
Mandy.Kutzner@bbg-eberswalde.de