Hybrid-Trolleybus-System for Marburg







eBus:conference – Prague, 23 October 2024

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Institut für Bahntechnik GmbH

Consortium: ARGE BOB Marburg IFB-VI

Institut für Bahntechnik GmbH

VÖSSING INGENIEURE

Subcontractor

OMEXOM

Dr. Kübler GmbH Institut für Umweltplanung

Lohmeyer

EIBS

Owner: City of Marburg

MARBURG UNIVERSITÄTSSTADT

represented by municipal utilities Marburg

STADTWERKE MARBURG

Funding and support

(Federal level)

Bundesministerium für Digitales und Verkehr

NOW NOW-GMBH.DE

Participation

(State level, Regional Council Gießen)

HESSEN

HESSEN Regierungspräsidium Gießen

Project objectives

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- Providing approval and functional capability for the electrification of selected city bus lines in the university city of Marburg in the form of a hybrid trolleybus (battery / overhead line/ bus: BOB) system by means of in-depth preliminary planning.

- The planning and evaluation services of the project serve to successfully obtain a permit and to prepare a functional trolleybus system including a depot.

- Obtaining the right to build the infrastructure and legally securing its subsequent use in driving operations.

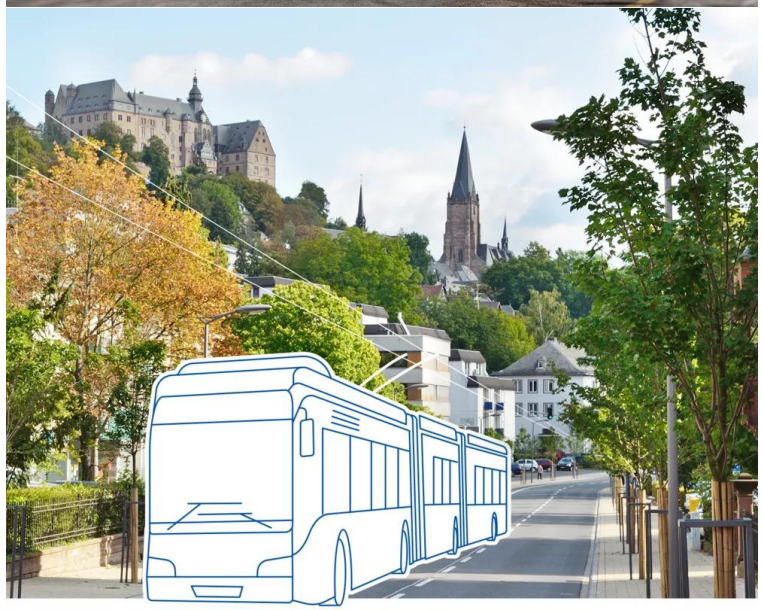
Premise: Operationally functioning system.

Tasks of the consortium

- Market research on the state-of-the-art technologies for IMC
- Technical design and rating using OpenPowerNet
  - Vehicle and drive technology, traction power supply (TPS) system
  - Rating of batteries
  - definition of technical parameters, power and energy demand
  - Bill of quantity for TPS system and vehicles
- CapEx and OpEx
- Representation of different scenario options and preferred scenario decision
- Preparation of planning documents and expert opinions
- Information events for public and political committees
- Application conference at Regional Council Gießen with participation of bearer of public interests (TöB)
- Initiation of the planning approval procedure for HTB Marburg
- *Plan approval decision is expected in December 2024*

→ see: www.BOB-Marburg.de



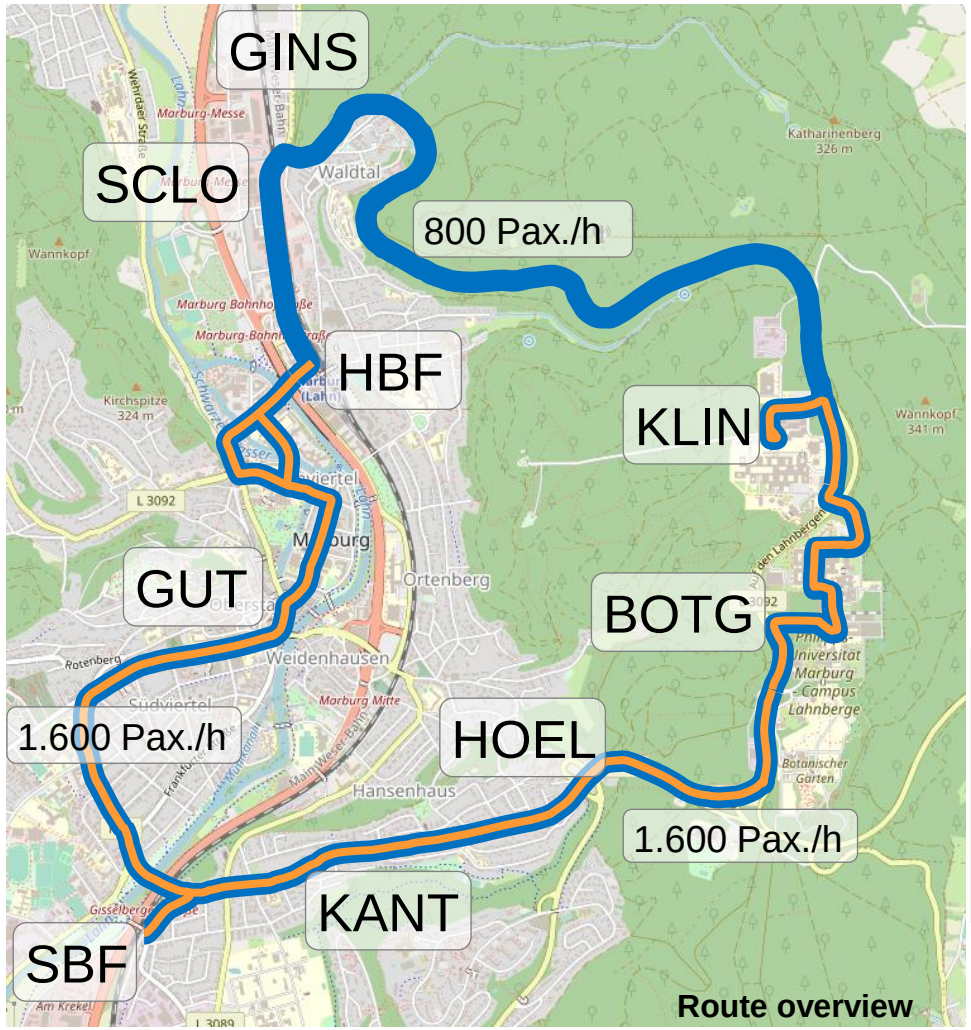


Operation overview

Abbreviation	Name
SBF	Südbahnhof
HBF	Hauptbahnhof
KANT	Kantstraße
HOEL	Hölderlinstraße
GUT	Gutenbergstraße
GINS	Ginseldorfer Weg
KLIN	Klinikum
BOTG	Botanischer Garten
SCLO	Schlosserstraße

Line 27
HBF – SBF – KLIN – GINS

Line 7
HBF – SBF – KLIN and return



Route overview

Both lines should operate in a **30-min-Headway** with Biarticulated Trolleybuses

capacity per vehicle: **400** Pax per hour and direction each

Mileage per vehicle:
ca. 330 km per day

Challenging topography



Heightprofile L7: 200m Heightdifference

Evaluation of options

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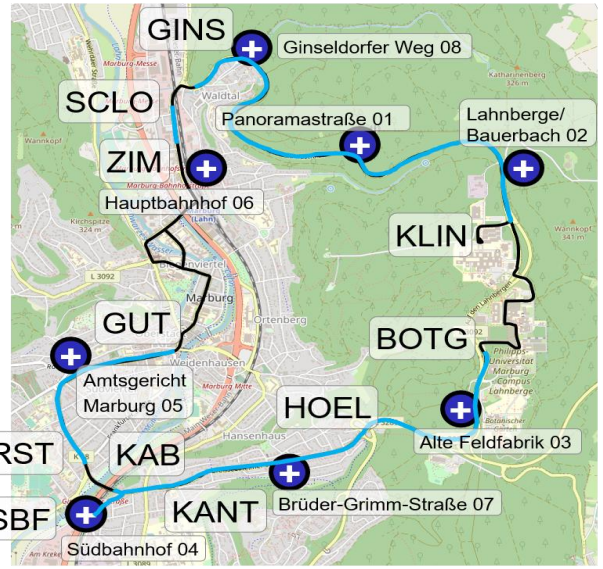
Option 1



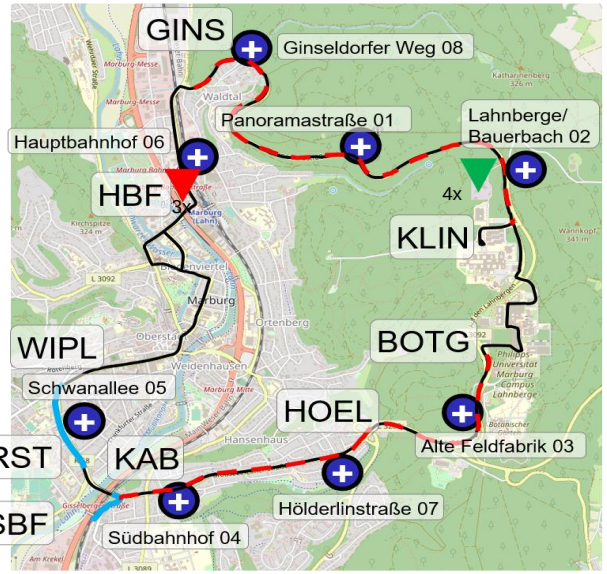
- 8 Substations
- ~ 68 % covered by catenary
- 6 Vehicles

Option 3



- 8 Substations,
  2 Opportunity charging stations
- ~ 55 % covered by catenary
- 9 Vehicles

Option 4



- 8 Substations,
  2 Opportunity charging stations
- ~ 35 % covered by catenary
- 12 Vehicles

Catenary both lanes

Catenary single lane, uphill

Substation

3x Opportunity charging station at HBF

3x Opportunity charging station (Reserve), 3 or 4 slots

Vehicle and Traction Power Supply System Configuration

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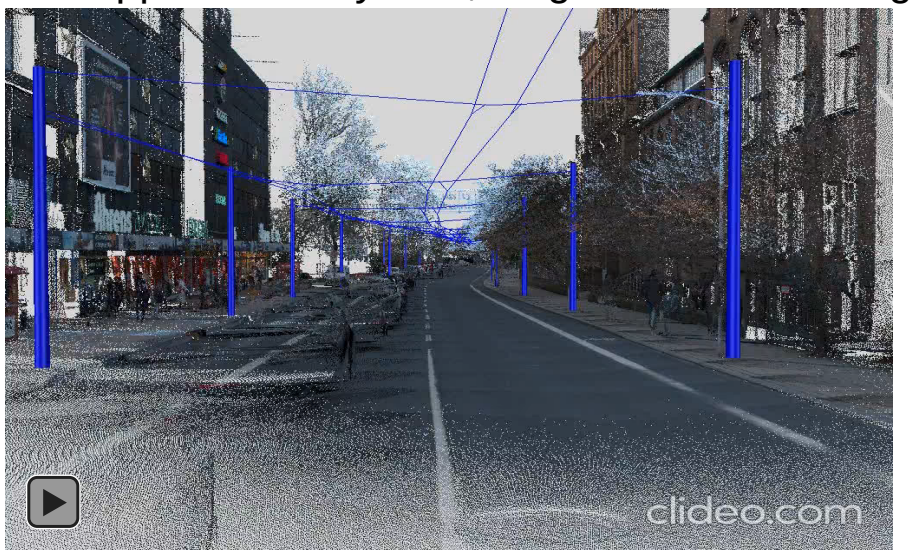
Parameter	Biarticulated HTB
Length [m]	25
Weight, empty [t]	24
Permissible Maximum Weight [t]	39
Seats | Standing Passengers 4P/m²	55|145
Mech. Traction Power [kW]	320
AUX max. [kW]	63
Regenerative	yes
Battery Type (chemicals)	LTO
Capacity of the Battery [kWh]	ca. 90
Mean State of Charge ± Rate [%]	50 ± 40
End of Life (capacity in [%] or R_I)	80%
Current [A] (Charge | Discharge)	185 | 343



Biarticulated Trolleybus Solaris Trollino

Traction Power Supply System

- Design & rating for normal and (n-1) outage operation, short circuit detection
- U_{Nom}: DC 750 V, two-pole single catenary
- Infeeds from 8 DC-substations
- Catenary configuration: angular pendulum suspension or single catenary with messenger wire, BRi 120 mm² copper catenary wire, height 5.50 m above ground



Animation Universitätsstraße

Preparation of plan approval documents

Explanatory report with planning documents and expert opinions

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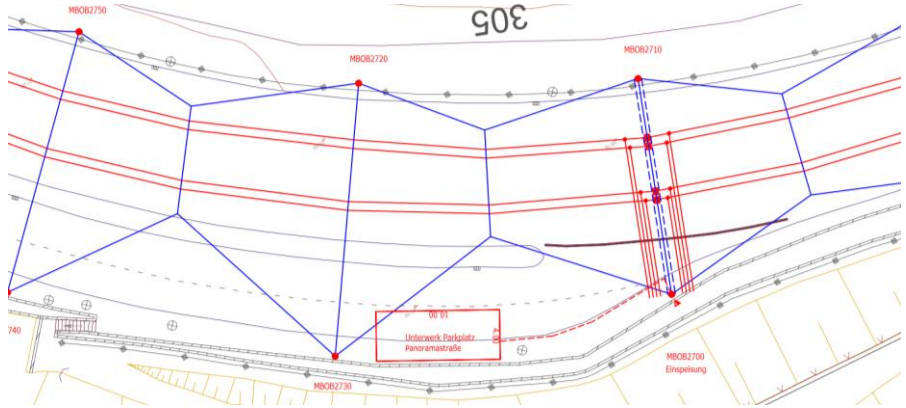
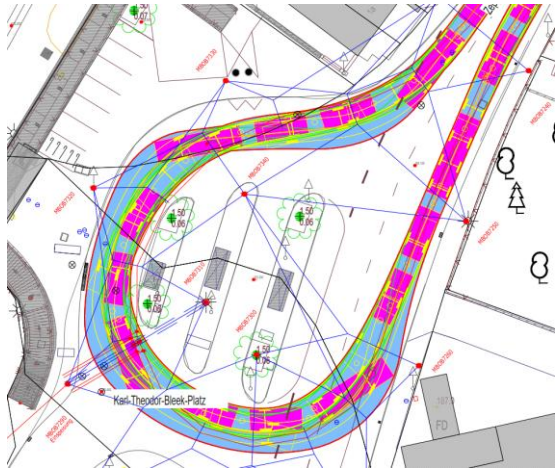
1. Preliminary Assessment for Environmental Impacts
    1. Registration of flora and fauna
    2. Interventions in the environment (impact compensation plan)
2. Assessment of species protection potential
3. Landscape conservation plan
4. Expert report on species protection
5. Fauna-flora habitat preliminary assessment
6. Consideration of protected assets: soil, water (groundwater and surface water) and land consumption
7. Cultural heritage
8. Experts opinions on electric and magnetic fields
8. Air pollution report
9. Noise protection / acoustic studies
10. Interference from the rectifier substations on the medium-voltage grid
11. Technical fire protection statement



Example of the catenary planning with substation / feeder



Minimum turning curve analysis

Preliminary Assessment for Environmental Impacts

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- Preliminary assessment of the individual case in accordance with § 7 of the Environmental Impact Assessment Act

- **Results of the preliminary assessment**
  - The HTB Marburg project is expected to have **no significant environmental impact**.
  - Significant adverse effects on *Natura 2000* sites are **excluded**.
  - Ecosystem impairments (interactions between protected assets) or other significant cumulative effects are **not to be expected** as a result of the planned overhead lines.
  - In principle, §39 BNatSchG (federal nature conservation act → responsibility of care during construction work) applies.

Therefore, there is no obligation to carry out an environmental impact assessment.

Process of the Planning Approval Procedure

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Planning Approval vs. Building Permit

Planning approval for transportation with trolleybuses (tram) is clarified by public transport act (PBefG §41)

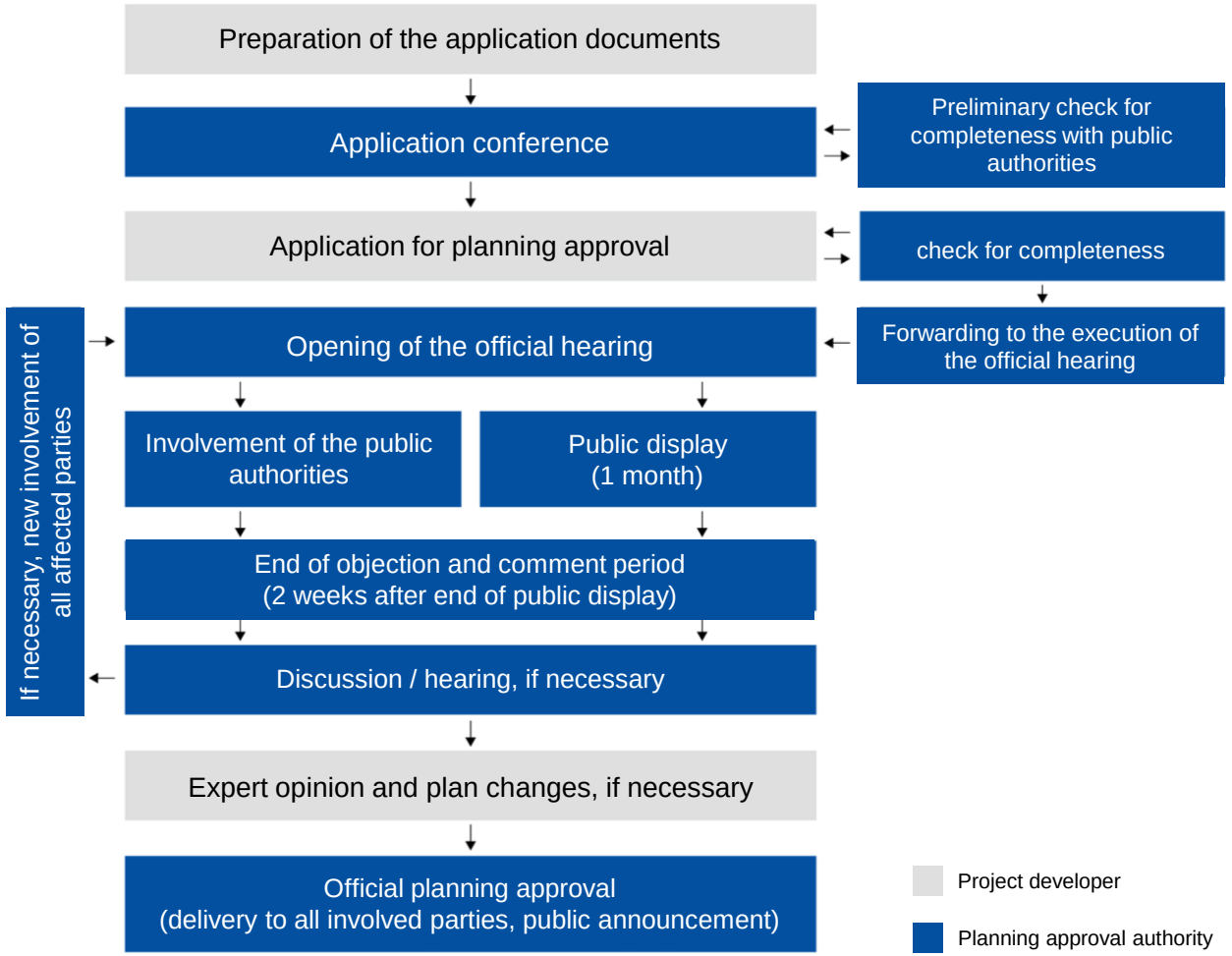
→ Request for planning approval according to public transport act (PBefG §28) and Hessian administrative procedures act (Verwaltungsverfahrensgesetz)

Technical rules: BOStrab *(tram)* **vs. BOKraft** *(bus)*

According to §1 section 1 of BOKraft, this rule applies to companies, that transport passengers with trolleybuses.

Coordination with 42 bearer of public interests

→ enormous effort in administration und coordination



One of the keys to success: Public relations

As part of the project, there were various opportunities for public participation:

- Project homepage
- Information market
- Digital dialogue board: MARBURGMACHTMIT
- Information events
- Target group-oriented presentations (specialist conferences, building committee, regional council and technical supervisory authority)
- General press relations



www.bob-marburg.de



Information market to general topics of the project



Handover of the plan approval documents



Information event about the planning approval procedure

Conclusion

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- **HTB for the university city of Marburg is technically feasible.**
- HTB has advantages due to the high transport capacity and the demanding topology
  → **Lines 7 and 27 are a predestined area of operation**
- HTB combines tried-and-tested, reliable technology from conventional trolleybuses with modern battery storage technology → enables **efficient and reliable operation**
- The use of an on-board energy storage system opens up **a range for an urban-friendly and technically flexible design** of the electrical grid infrastructure
- Considering the funding quotas (pro rata additional costs for vehicles and up to 90% for infrastructure), this results in a specific **own contribution for investments** of EUR 8.6 million for plan variant 1
- **Planning approval decision** expected by the end of Q4/2024

Let‘s work together for the realisation of eBus-Systems

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