



ELECTRIC BUS LINE FEATURES

Upscaling from the operator's point of view - different charging and battery approaches tested in one city

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Horizon 2020
Programme

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TEST B: SOLARIS PROJECT: 2 buses (7-23)

Opportunity charging on both terminals with pantograph.

Low Charging station in the depot: 50kW

Fast Charging station on the street: 400kW (500 kW)

Energy capacity: Batteries (125kWh) (150 kWh)

Partial operation: November 2016 (October 2018)



Features

- *Length: 2 x12.208 m*
- *Slope: Flat*
- *Bus stops: 40*
- *Time service: 17 h*
- *Interval: 7.6'*
- *Time Charging: 6.67'*
- *Commercial Speed: 10.9km/h*



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Features

- 1. Management of the line.***
- 2. New Infrastructure***
- 3. Standardization.***
- 4. Monitoring.***
- 5. Operation time***
- 6. Cost/financing***



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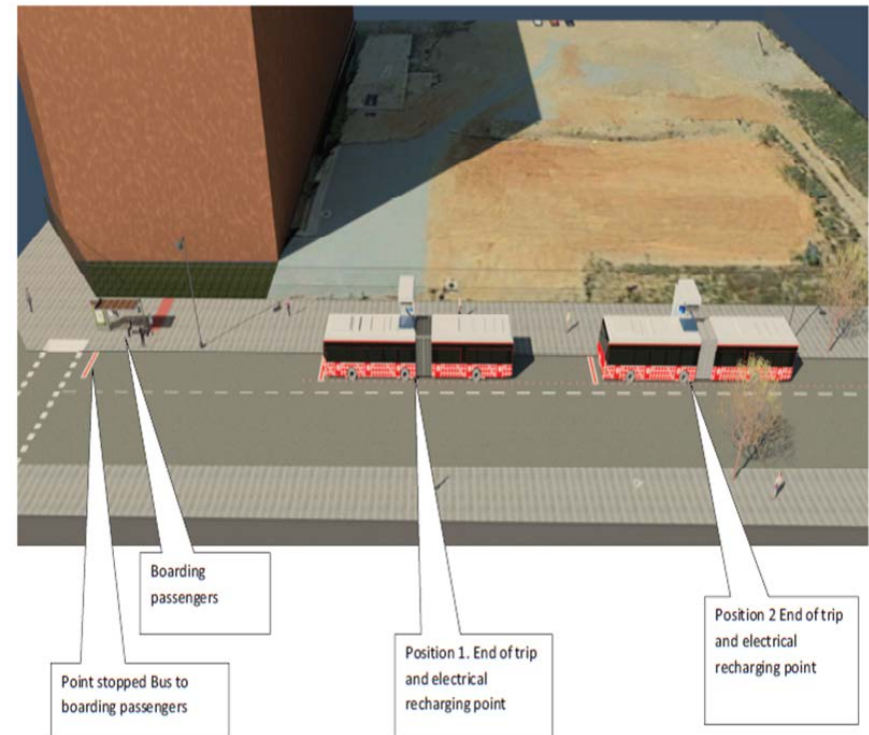
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View a stop at the end of the line. With two electric charging points: Position 1 and Position 2. And Point of passenger boarding...

1 FEATURE Management of the line

- **New management in the line.** One or two buses more, than a line with Diesel bus.
- **New bus management.** Control level of SOC and battery state.
- **Management charging process.** Supervision and control of fast charging and slow charging.
- **New Management infrastructure.** Control an supervision of Charging infrastructure (fast and slow charging)



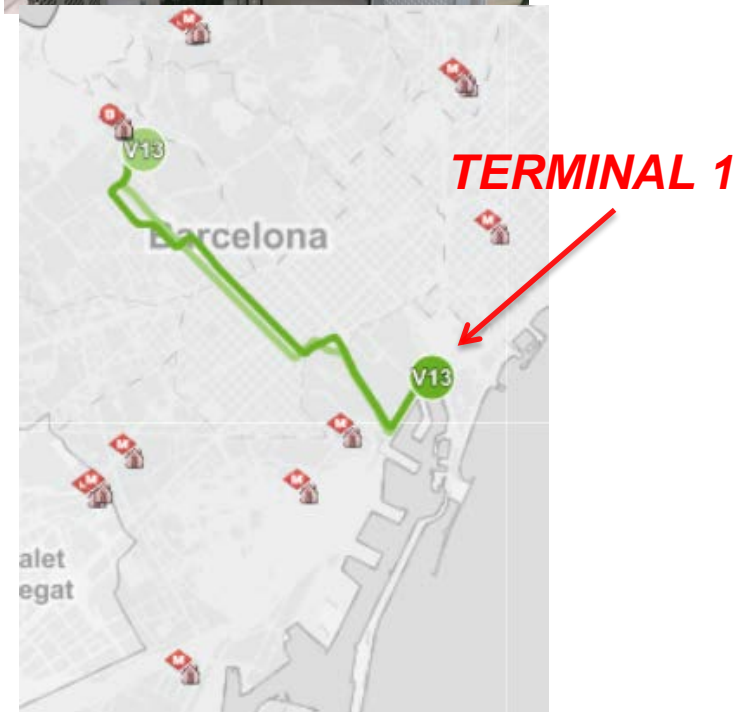
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2 FEATURE New Infrastructure.

- **Fast charging infrastructure.** In our case in the street . Very slow Administrative process.
- **Electric power supply.** Possibilities of having two different energy suppliers, both with fast and slow chargers. (ENDESA or METRO)
- **Design and construction of infrastructures, according to the technical specifications for their use.** Such as those required by urban planning and environment of the city, in addition to the adaptation to depot. New technologies in chargers.
- **Design of line with Two Charging stations or only one.** As is the case of line H16 with two electric charging stations, one at each end of the line, or as it is the case of line V-13 (the next line to be projected) with a only one charging station at one end.



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3 FEATURE Standardization.

- **Agreements for standardization of communication interfaces between infrastructure and heavy duty vehicles.** Now the prototype IEC 61851-23 ISO 15118/ DIN 70121 CSS and with the OCPP version 1.5 is in operation. We'll work next year for the OCPP version 1.6. In June 2018, we'll have developed the interoperability between different manufacturers of electric chargers and e-buses: IRIZAR, SOLARIS, EKOENERGETIKA and CIRCONTROL.
- **Standardization of the conductive connection with pantograph with 4 poles. Pantograph arrangement in the bus on the front axle.**
- **Standardization equipment and installation Electric Substation and Transformer Center like the Railway standard. RAMS: Reliability, Availability, Maintainability and Safety EN 501126-1**



IEC 61851-23

Edition 1.0 2014-03

INTERNATIONAL
STANDARD

NORME
INTERNATIONALE



Electric vehicle conductive charging system –
Part 23: DC electric vehicle charging station

Système de charge conductive pour véhicules électriques –
Partie 23: Borne de charge en courant continu pour véhicules électriques



ADVANCING
PUBLIC
TRANSPORT
schaufenster
elektromobilität

VDV Die Verkehrs-
unternehmen

May 5, 2016

Working group on standardisation of battery electric buses – use cases¹⁾ & requirements

Charging in depots (manual plug²⁾) – Use cases of the charging system for the charging in the depot

To standardise the interfaces of the charging infrastructure for buses (utility vehicles), the interfaces of the charging system and the resulting requirements that are described in the form of use cases concerning the charging of buses in depots.

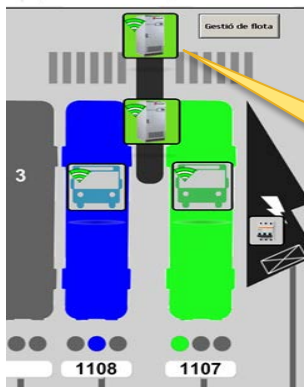
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4 FEATURE Monitoring.

- **Monitoring infrastructure charging process.** Slow chargers, in depot. Fast Charger in street
- **Reporting process charging and control maintenance.** In depot in Street.
- **Control and management Power Supply and control quality electric.** in depot and in street.
- **Control safety .** Fire protection and security.



Control and monitoring in Electric charging in fast electric charging

BCNCGDEVRS_EKOBARCA001
Carregador Cissell 01

Controlador: Endesa
Carregador: EKOBARCA001
Connector: 1

Calca Autobús: 1110
Estat de càrrega: 75.0 %

Estat

- Disponible
- Ocupat
- Reservat
- No disponible
- Error
- Manteniment
- Manteniment Dispositiu
- Manteniment Forçat
- Connectat
- Carregant
- Carregat
- EOC
- Lastrido OK
- Càrrega Denegada

Alarmes Carregador

▲ Carregador: OK

Alarmes Vehicle

▲ Bateria

Ordres

Activar, Alliberar, Normal, Manteniment, Autorització, Forçar, Desactivar, Continuar, Càrrega, Parar, Disponible, Disponibilitat, No disponible

Dades

Identificador VIN	SUU34121EFB015055	Tensió DC nominal	679.0 v	Temps fi Càrrega	00:00:00
Estat de càrrega (SOC)	75.0 %	Intensitat DC nominal	296.0 A	Inici de Càrrega	05:46:22
		Potència DC càrrega	221.0 kw	Temps en Càrrega	00:16:26
		Energia AC consumida	57.0 kWh		

Control and monitoring in Electric charging in Depot

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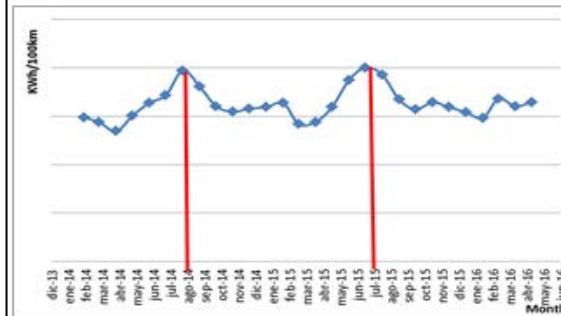
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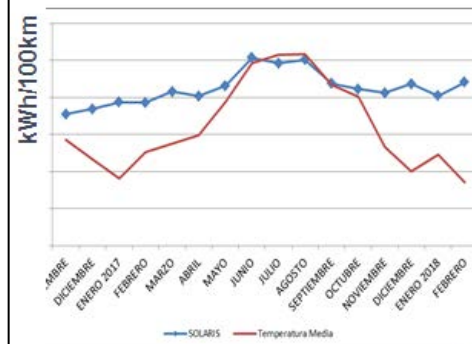
5 FEATURE Operation time

- **The operation time and Consumption bus.** The operating time in electric buses is conditioned by the capacity of batteries and the power demand of line. We have been verified, that during tests, the use of climate equipment is a determining in the increase of consumption. **Our conclusion, with an operation time of 16 hours, the best solution is the opportunity charging, specially in 18 m buses.**

Curve of the average consumption linked to the temperature (12m buses)



Curve of the average consumption linked to the temperature (18m)buses



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6. Feature Cost/financing

TMB Bus fleet renewal arrangements

1075 bus fleet average.

12 year depreciation.

90 buses a year renewal average.

332,000 € purchase price average.

30,000,000 € yearly *financial need* for the following years.

A bid following UITP/UE procurement procedures is done almost every year. Nowadays **Spanish Banks** offer to TMB a **12 year financial leasing** scheme.

Projection for 2018-2021 and beyond:

If we transform the **diesel** bus fleet into a **clean** bus fleet with *only* hybrid & electric –*maintaining* the size of the Natural Gas fleet– **there is an over cost of 85% weighted.**

WITHOUT CHARGING STATION

THANK YOU VERY MUCH

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