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Romania-Republic of Moldova
ENI-CROSS BORDER COOPERATION



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Project EMS-ENI, code 2SOFT/3.1/54

”Improving the cross-border public transportation using electric buses supplied with renewable energy (ELBUS)”

Activity A.3.6, Work visit at Technical University of Moldova, Chisinau

**Implimentation of scientific and research activities from
UTM**

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Chişinău, 25.02.2021



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Activities planned for implementation of scientific and research activities

GA3. Analysis of the electric bus optimal functionality

Activity 3.1. Analysis of the electric buses

D3.1.1 Technical report related to the using of the electric buses

Activity 3.2. Analysis of the auxiliary loads

D3.2.1 Automation system for auxiliary loads



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Activity 3.1. Analysis of the electric buses

D3.1.1 Technical report related to the using of the electric buses

Different types of electric vehicles (EV's) are put to the market:

- Fully Electric vehicle (FEV): a vehicle that drives using an electric driven engine.
- Hybrid electric vehicle (HEV): a vehicle that drives partly electric and partly on gas.
- Hydrogen vehicle (HV): a vehicle that drives using a hydrogen driven engine.

The main future trends and tasks are, related to electricity and public transport:

- ✓ Losing dependency on fossil fuels and increasing the amount of energy produced by renewable sources. Smoothing the peaks and valleys of the electricity demand and supply.
- ✓ Creating flexibility at both the demand and supply side of electricity.
- ✓ Increasing the amount of electric transport, and therefore the amount of EB's.
- ✓ Placing and using charging stations in a smart and conscious way, to avoid unnecessary costs.



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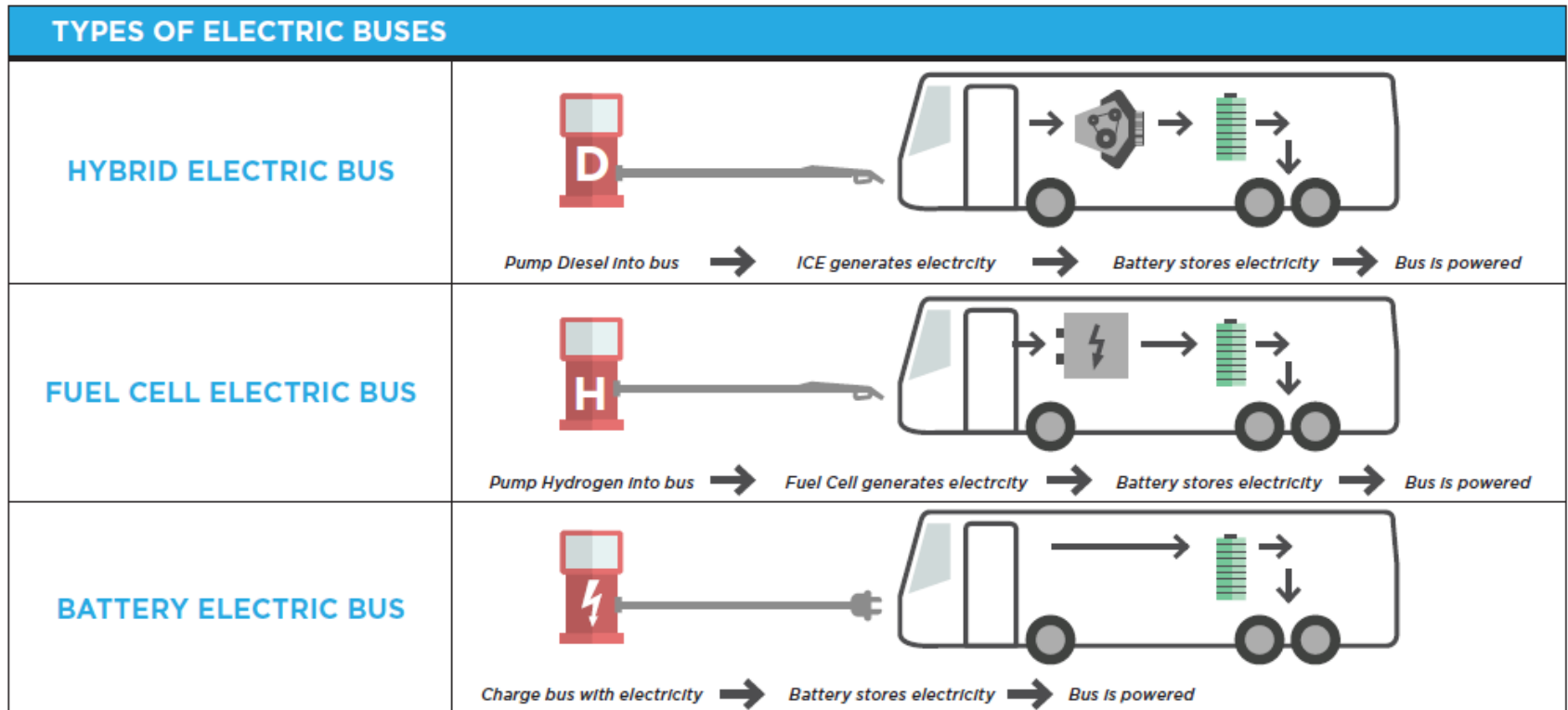
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Activity 3.1. Analysis of the electric buses

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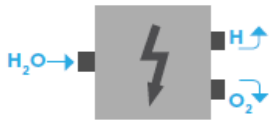

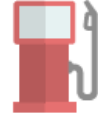
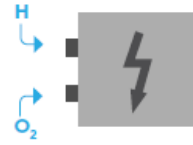







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Activity 3.1. Analysis of the electric buses

D3.1.1 Technical report related to the using of the electric buses

Environmental Impact from Operation of Electric Buses

	WELL-TO-TANK				TANK TO WHEEL	WELL-TO-WHEEL (g CO ₂ eq)
	EXTRACTION		TRANSPORTATION	DISTRIBUTION		
DIESEL	 Extract	 Refine	 Drive	 Pump	 Engine	1222
HYDROGEN	 Electrolysis		 Drive	 Pump	 Reverse Electrolysis	320
ELECTRICITY	 Hydro Power	 Wind Power	 Power Grid	 Charge	 Battery	173



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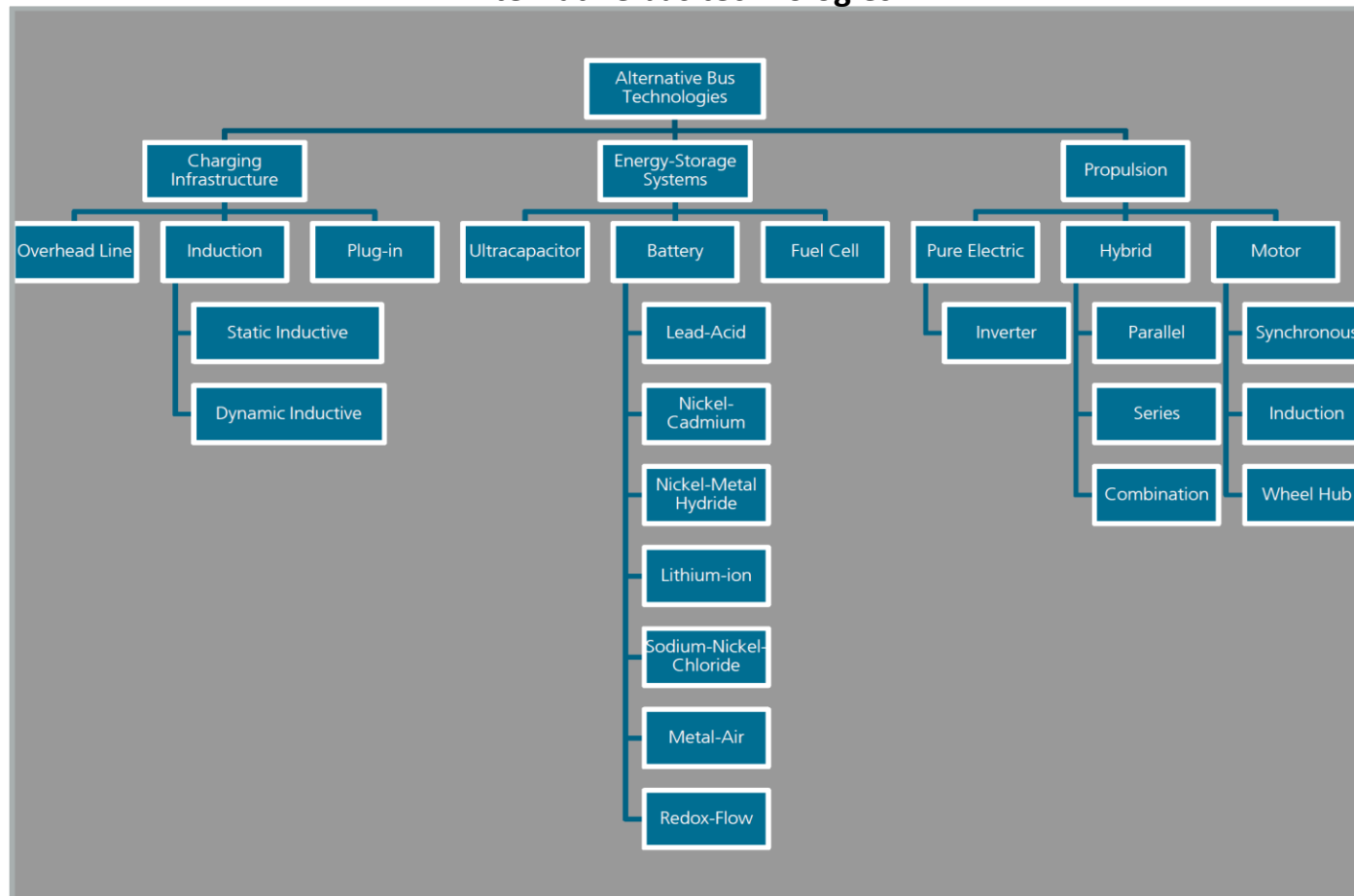


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Alternative bus technologies





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OVERVIEW OF CURRENT CHARGING STRATEGIES AND TECHNOLOGIES



- Low power charging through cable and plugin (overnight)



- High power charging through conductive charging with physical connections



- Fast charging through inductive charging with a transfer of energy through a magnetic field for fast charging





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Activity 3.2. Analysis of the auxiliary loads.

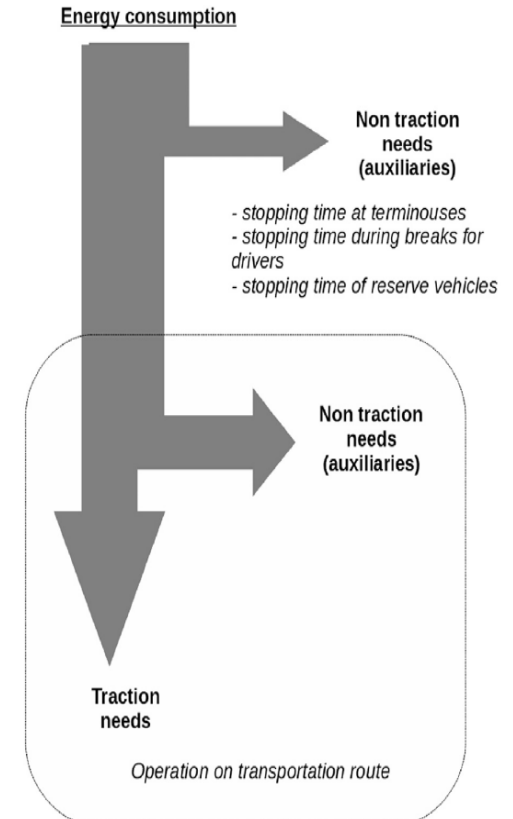
D3.2.1 Automation system for auxiliary loads

The following elements can be included in auxiliary systems:

- *compressor and hydraulic pump motors*
- *supply of low voltage equipment*
- *air conditioning*
- *heating*

System	Nominal power
Lightning	1-2 kW
Passenger information systems, ticket vending machine	1-3 kW
Charging of 24 V board batteries	0,5 - 2 kW
Air compressor	3-6 kW
Hydraulic pump	2-4 kW
Air condition	10-16 kW
Heating	5-25 kW

The distribution of electric energy consumed by vehicles





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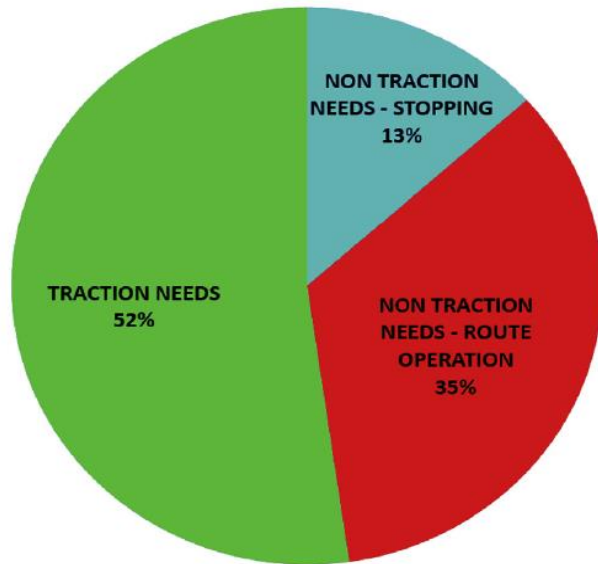


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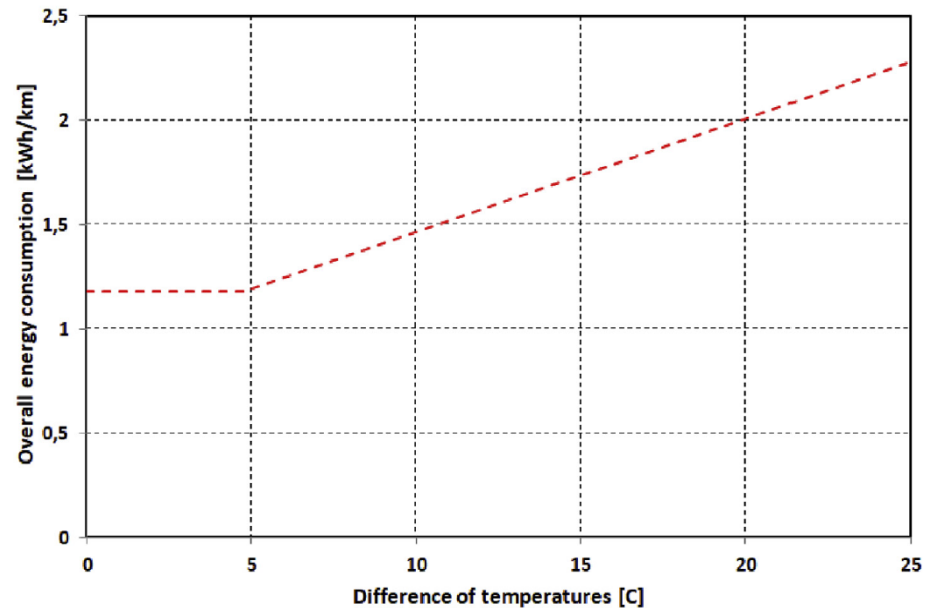
Activity 3.2. Analysis of the auxiliary loads.

D3.2.1 Automation system for auxiliary loads

The overall annual structure of energy consumption.



Overall vehicle power consumption in function of difference between ambient and internal temperature





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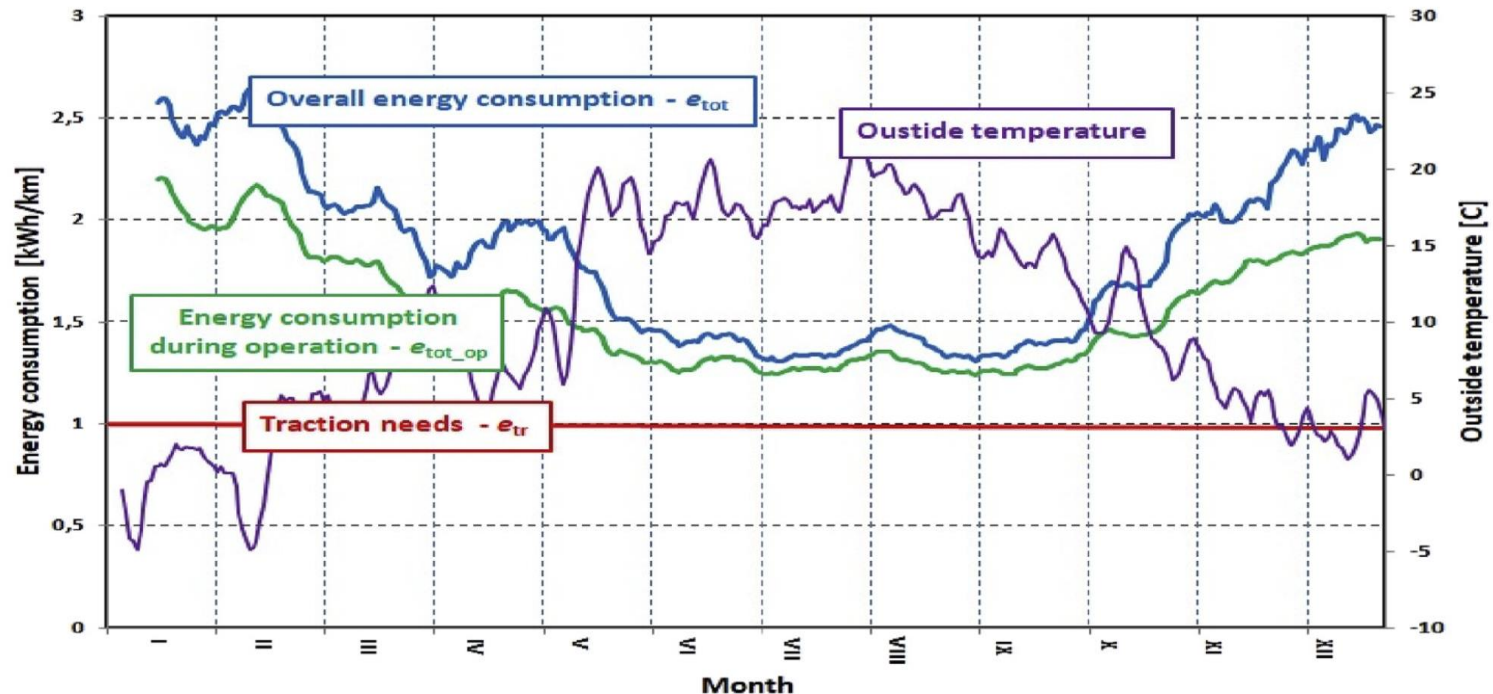


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Activity 3.2. Analysis of the auxiliary loads.

D3.2.1 Automation system for auxiliary loads

The values of average energy consumption and daily average outside temperature in annual scale





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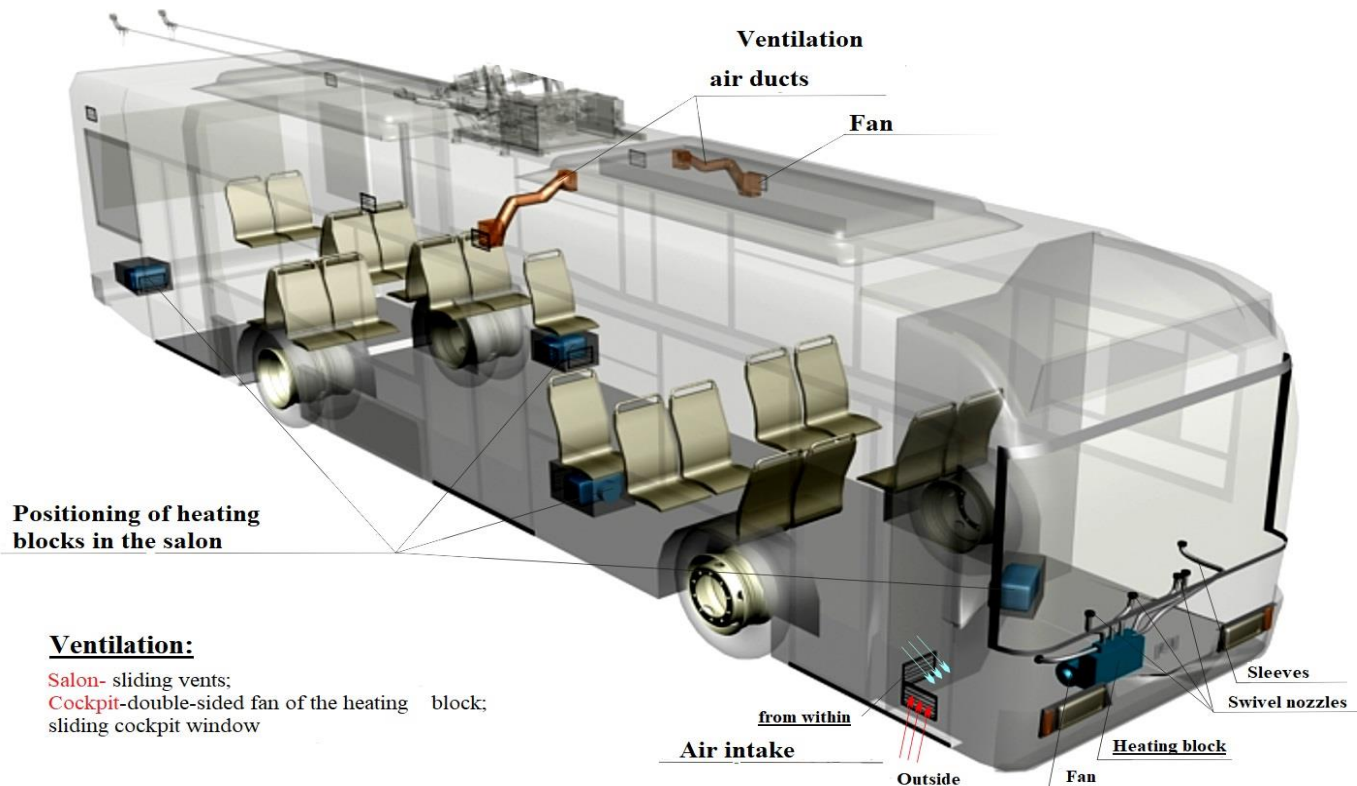


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D3.2.1 Automation system for auxiliary loads

The E321 BUS heating and ventilation system





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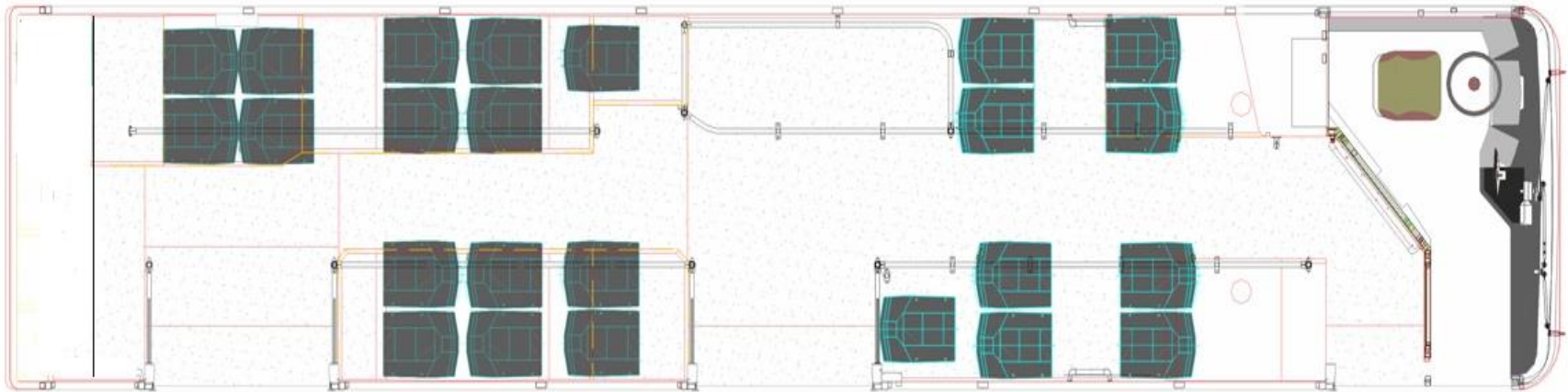


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Activity 3.2. Analysis of the auxiliary loads.

D3.2.1 Automation system for auxiliary loads

Location of the seats



Power of heating system

Nr .	Equipment destination	Rated power, kW	Nr. unit	Total power, kW
1	Cabin heating	9	1	9
2	Saloon heating	6	4	24



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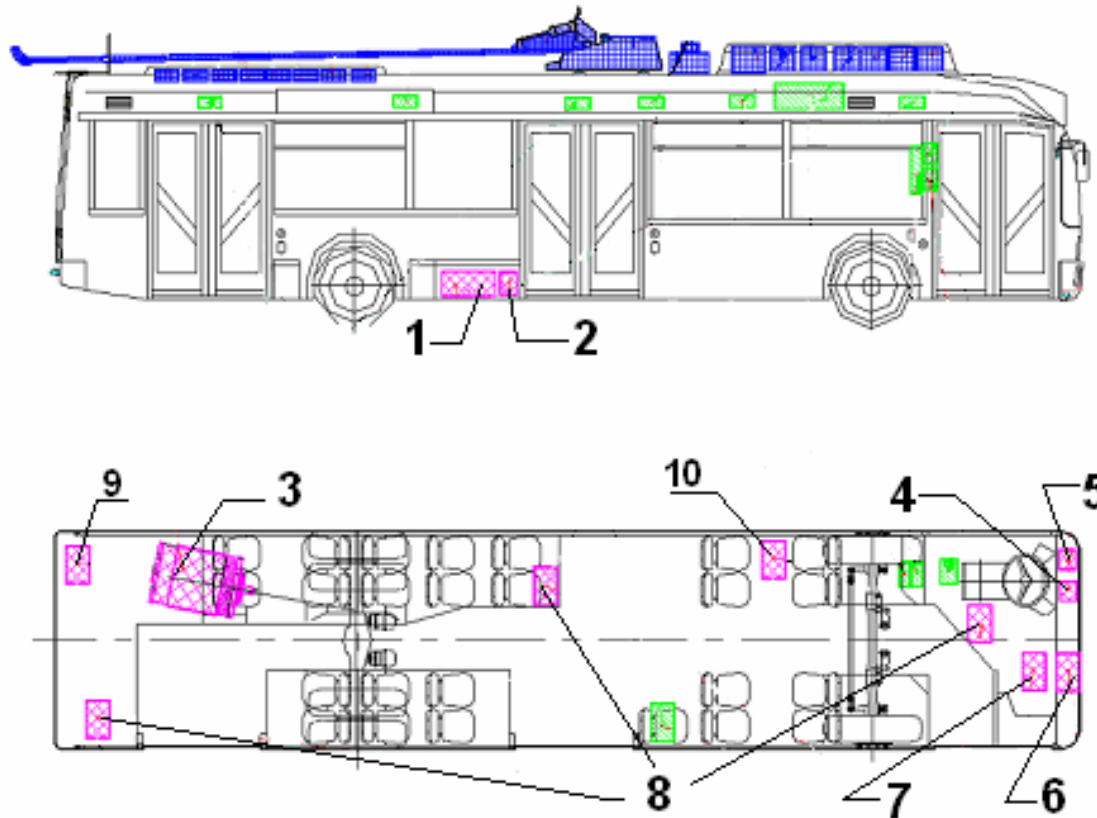


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Activity 3.2. Analysis of the auxiliary loads.

D3.2.1 Automation system for auxiliary loads

Electrical equipment under the ebus floor





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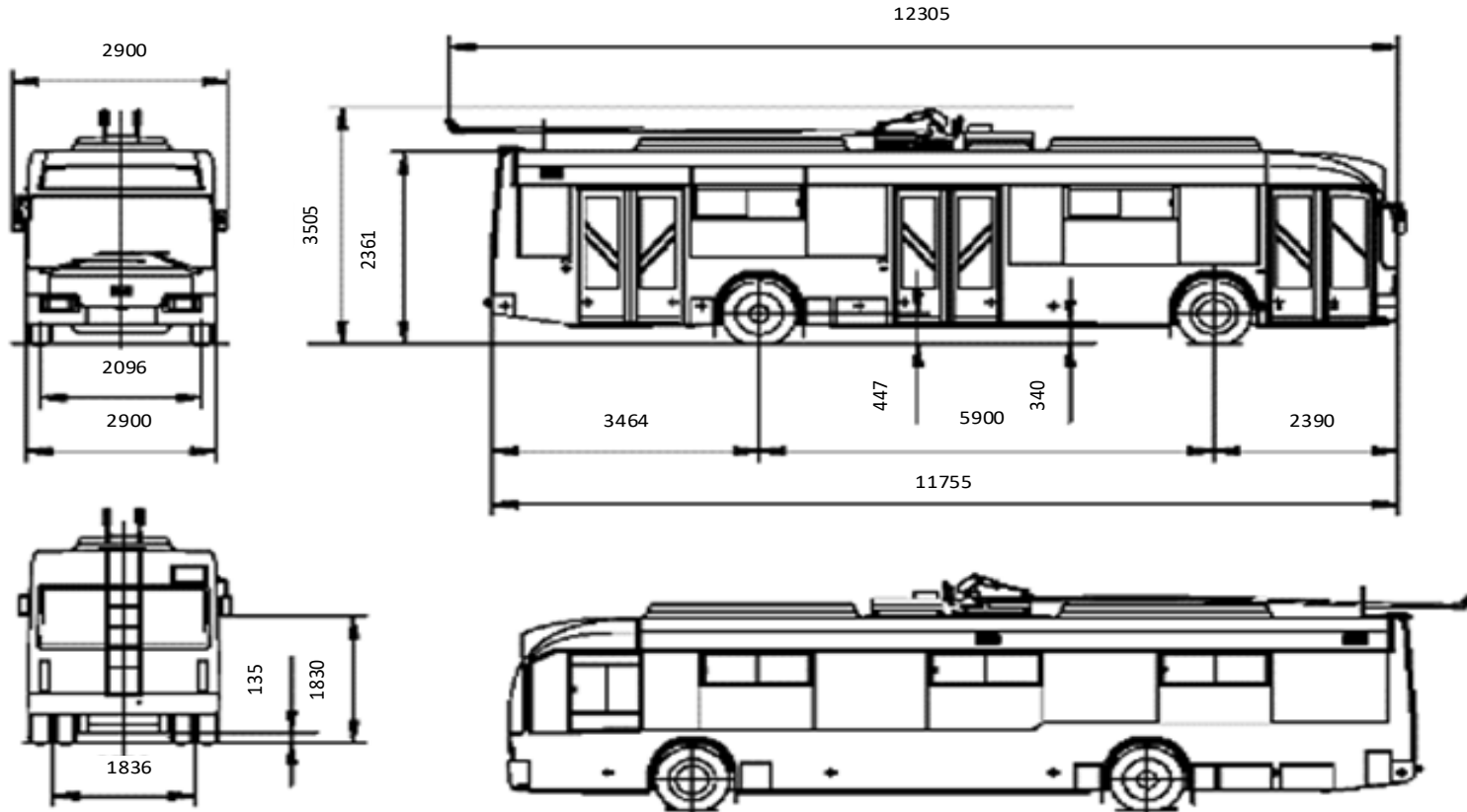


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Activity 3.2. Analysis of the auxiliary loads.

D3.2.1 Automation system for auxiliary loads

The main dimensions of the ebus





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Conclusions

- Energy consumption for auxiliaries accounts for almost half of total energy consumption, and in the winter it reaches 70% in daily scale.
- Optimization of non-traction needs consumption allows to reduce the capacity of traction batteries by 20-50%. This brings with it a reduction in the vehicle price and an increase in passenger capacity.
- An important issue is also increasing the smooth flow of public transport traffic. This can be done by giving priority to buses, the use of dedicated lanes for public transport and the use of intelligent traffic control systems (ITS).
- In cities with a very cold climate, an alternative can also be dynamic charging, in which it is possible to increase the heating power on sections equipped with traction catenary (or another linear charging system) and its limitation on sections without the catenary. In other words, dynamic charging of electric buses is a method of reducing the capacity of traction batteries.