

Zero Emission Bus Certificate

Customer: Wrightbus				DYNAMOMETER SETTINGS		
Customer Address:	201 Galgorm Road, Ballymena, County Antrim, BT42 1SA	Telematics Capability	Yes	Test Weight	15500	kg
Test Purpose:	Zero Emission Bus Testing	Maximum Speed (km/h)	80 km/h	F°	-394.24	N
Vehicle Manufacturer:	Wrightbus	Seated Capacity	60	F¹	0.981	N/kmh
Vehicle Model Name:	Electroliner Double Deck	Passenger Capacity	87	F²	0.098	N/kmh ²
Powertrain Technology:	Battery Electric	Declared Unladen Weight (kg)	13385	Equivalent test passengers	30	passengers
Powertrain Configuration:	Direct Drive	Gross Weight (kg)	19500	Measured Unladen Weight	13149	kg
Zero Emission Heating:	Heat Pump	GVW Check	OK	Number of consecutive tests completed	5	Tests
Battery Specification		Charging and Refuelling Capability		Hydrogen Specification		
Battery Manufacturer	Forsee Power	Plug Type	CCS2 / Oppcharge	Fuel Cell Manufacturer	N/A	
Battery Chemistry	NMC	Max Charge Capability (kW)	Up to 150kW / 360kW	Fuel Cell Power Rating (kW)	N/A	
Battery Installed Capacity (kWh)	454	Charger Compatibility	DC	Hydrogen Storage Capacity (kg)	N/A	
Battery Usable Capacity (kWh)*	363	Charge time from 20-80% SOC**	1-6 hours	Hydrogen Storage Pressure (bar)	N/A	

* Recommended manufacturer guideline, subject to warranty

** Based on manufacturer estimate

Declared fuel, properties and source plus carbon conversion factors

Well-to-Tank Factor:	Electricity	80.92	g CO ₂ e / MJ	Fuel Provider	UK market standard	WTT evidence	DBEIS Conversion 2021
Well-to-Tank Factor:	Hydrogen	N/A	g CO ₂ e / MJ	Capacity of Tanker (kg)	N/A	Fuel Type / Pathway	UK Grid Electricity
Energy Density	Hydrogen	120	MJ / kg	Transport Distance of Hydrogen (km)	N/A	Energy Source	Renewable

Emissions and Energy consumption results from approved test facility - Average 4 tests

Test Phase	HC (g/km)	CO (g/km)	NOx (g/km)	PM (g/km)	CO ₂ (g/km)	CH ₄ (g/km)*	N ₂ O (g/km)*	Total Energy Consumption (kWh)	Vehicle Energy Consumption (kWh/km)	Grid Electrical Energy Consumption (kWh/ 100km)
Outer Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.07	0.78	90.99
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.65	1.05	122.49
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.69	0.63	73.50
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.72	0.86	100.33
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.41	0.75	81.07

Zero Emissions (Z.E.) Range: Energy consumption and charging efficiency

Test Charger Used	40kW	Total measured energy consumed on vehicle (kWh)¹	62.00	Max ZE Range at 100% SOC (km)	484
Hydrogen Energy Over Test (kWh)	N/A	Measured grid energy during charging (kWh)	67.00	Max ZE Range at 80% SOC (km)	387
Hydrogen Delivered to Vehicle (kg)	N/A	Grid-to-Wheel efficiency (%)²	86%	Test Distance Travelled (km)	82

¹ Total measured energy may include energy used during the 23 minute warmup, this is needed for charge efficiency calculation.

² Grid to Wheel efficiency represents the total energy losses between the grid and the wheels of the bus.

Calculated total Well-to-Wheel GHG CO₂ equivalent emissions over test

Test Phase	Fuel Energy (MJ / km)	Fuel WTT*GHG Emissions (g CO ₂ e / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO ₂ e / km)	Data Generated by (On behalf of Test facility):	Date:
Outer Urban	N/A	N/A	3.28	265.08	Data Approved by:	Date:
Inner Urban	N/A	N/A	4.41	356.83		
Rural	N/A	N/A	2.65	214.10		
LBC Average	N/A	N/A	3.61	292.26		
UK BUS Average	N/A	N/A	2.92	236.17		

Zero Emission Bus Certificate Summary

Test Vehicle		Average Euro VI Diesel Equivalent	
Greenhouse Gas Emissions: Well-to-Wheel	236.2 g CO ₂ e / km	Average Diesel GHG Emissions Equivalent	1300 g CO ₂ e / km
WTW CO₂ per passenger km (@ Max Pass Capacity)	2.7 g CO ₂ e/pass km	WTW CO₂ per passenger km (@ Max Pass Capacity)	14.9 g CO ₂ e/pass km
Overall Zero Emission Bus Performance			
WTW GHG saving	1063.4 g CO ₂ e / km	Maximum Theoretical Zero Emission Range (km)	484.3
% WTW GHG saving	82% g CO ₂ e / km	Vehicle Energy Consumption (kWh/ km)	0.75
Approved as Zero Emission Bus? (50% GHG saving or more)		YES	

* WTT : Well-to-Tank

** TTW : Tank-to-Wheel

*** WTW : Well-to Wheel

COMMENTS: Emission results marked in red are below detection levels. LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only.

Heating Requirement	Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	10	17	17
Average Temperatures across testing (°C)	10.12	18.29	16.39

Test Numbers: 20220412_1038_2xUKBC, 20220412_1247_UKBC, 20220412_1406_2xUKBC

 Certificate approved by: Brian Maybin
 On behalf of Bus manufacturer: Brian Maybin (Aug 5, 2022 11:11 GMT+1)

Aug 5, 2022

 Certificate Approved by: Dan Hayes
 On behalf of DfT / Zemo Partnership: Daniel Hayes 04.08.22

ZEB_Certificate_Wrightbus_Electroliner_454kWh_15500kg_Electric_August_22

Final Audit Report

2022-08-05

Created:	2022-08-04
By:	Zemo Partnership (admin@zemo.org.uk)
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"ZEB_Certificate_Wrightbus_Electroliner_454kWh_15500kg_Electric_August_22" History

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