Zemo Partnership

Zero Emission Bus Certification ID: **ZEB-ADL-Enviro400EV-472kWh-2022**

Approved Test facility UTAC

Simulated Zero Emission Bus Certificate

				DYNAMOMETER SETTINGS		
Customer:	**Alexander Dennis**					
Customer Address:	**Cameron House, Priorswood Pl, Skelmersdale, Lancs**	*Telematics Capability*	Yes	Test Weight	16433	kg
Test Purpose:	**Zero Emission Bus Testing**	*Maximum Speed (km/h)*	92 km/h	F°	N/A	N
Vehicle Manufacturer:	**Alexander Dennis**	*Seated Capacity*	80	F¹	N/A	N/kmh
Vehicle Model Name:	**Enviro400EV**	*Passenger Capacity*	85	F²	N/A	N/kmh ²
Powertrain Technology	**Battery Electric**	*Declared Unladen Weight (kg)*	13638	*Equivalent test passengers*	40	passengers
Powetrain Configuration	**Direct Drive**	*Gross Weight (kg)*	19500	*Measured Unladen Weight*	N/A	kg
Zero Emission Heating	**Heat Pump**	*GVW Check*	**OK**	Number of conseuitve tests completed	N/A	Tests

Battery Specification		Charging and Refuelling Capability		Hydrogen Specification	
Battery Manufacturer	**Impact Clean Power Technology**	**Plug Type**	**CCS2 & OppCharge**	**Fuel Cell Manufacturer**	**N/A**
Battery Chemistry	**NMC**	**Max Charge Capability (kW)**	**Up to 150kW/300 kW**	**Fuel Cell Power Rating (kW)**	**N/A**
Battery Installed Capacity (kWh)	**472**	**Charger Compatibility**	**DC**	**Hydrogen Storage Capacity (kg)**	**N/A**
Battery Usable Capacity (kWh)*	**415**	**Charge time from 20-80% SOC****	**2-4 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 CO2e / MJ**	*Fuel Provider*	**UK market standard**	*WTT evidence*	**DBEIS Conversion 2021**
Well-to-Tank Factor:	***Hydrogen***	**N/A**	**g CO2e / 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*	**UK Grid**

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_2O (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	6.00	0.92	115.00
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.10	1.24	155.00
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.80	0.78	97.50
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.10	1.01	126.25
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.90	0.91	**113.75**

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

Test Charger Used	**22 kW**	**Total measured energy consumed on vehicle (kWh)[1]**	**N/A**	**Max ZE Range at 100% SOC (km)**	**456**
Hydrogen Energy Over Test (kWh)	**N/A**	**Measured grid energy during charging (kWh)**	**N/A**	**Max ZE Range at 80% SOC (km)**	**365**
Hydrogen Delivered to Vehicle (kg)	**N/A**	**Grid-to-Wheel efficiency (%)[2]**	**80%**	**Test Distance Travelled (km)**	**N/A**

[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 CO_2 equvialent emissions over test

Test Phase	Fuel Energy (MJ /km)	Fuel WTT*GHG Emissions ($g\ CO_2e$ / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions ($g\ CO_2e$ / km)
Outer Urban	N/A	N/A	4.14	335.01
Inner Urban	N/A	N/A	5.58	451.53
Rural	N/A	N/A	3.51	284.03
LBC Average	N/A	N/A	4.55	367.78
UK BUS Average	N/A	N/A	4.10	331.37

Data Generated by (On behalf of Test facility): *Date:*

Data Approved by: *Date:*

Zero Emission Bus Certificate Summary

Test Vehicle			Average Euro VI Diesel Equivalent		
Greenhouse Gas Emissions: Well-to-Wheel	**331.4**	**g CO2e / km**	**Average Diesel GHG Emissions Equivalent**	**1281**	**g CO2e / km**
WTW CO2 per passenger km (@ Max Pass Capacity)	**3.9**	**g CO2e/pass km**	**WTW CO2 per passenger km (@ Max Pass Capacity)**	**15.1**	**g CO2e/pass km**

Overall Zero Emission Bus Performance

WTW GHG saving	**949.3**	**g CO2e / km**	**Maximum Theoretical Zero Emission Range (km)**	**456.4**
% WTW GHG saving	**74%**	**g CO2e / km**	**Vehicle Energy Consumption (kWh/ km)**	**0.91**
Approved as Zero Emission Bus? (50% GHG saving or more)			***YES***	

**** WTT : Well-to-Tank*** ***** TTW : Tank-to-Wheel*** ****** WTW : Well-to Wheel***

COMMENTS: LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only. Certificate generated using simulated data from AVL Cruise M multi-physics simulation tool. Simulated certificate valid until 31/12/23 - following receipt of purchase order number for physical chassis dynamometer test. Results to be replaced from valid UKBC tests. Certificate will become invalid. Charger efficiency based on existing certified ADL E400EV and E200EV.

Heating Requirement	Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	**10**	**17**	**17**
Average Temperatures across testing (°C)	N/A	N/A	N/A

Test Numbers:

Certificate approved by:
On behalf of Bus manufacturer

Certificate Approved by:
On behalf of DfT / Zemo Partnership Dan Hayes Daniel Hayes 23.01.23

ZEB_Simulated_Certificate_ADL_E400_EV_472 kWh_November_22_V2

Final Audit Report 2023-01-23

Created:	2023-01-23
By:	Zemo Partnership (admin@zemo.org.uk)
Status:	Signed
Transaction ID:	CBJCHBCAABAAhtjzBjHaLdIiNzXUc2CKsHwD1sLEaNJC

"ZEB_Simulated_Certificate_ADL_E400_EV_472kWh_November_22_V2" History

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