Zemo Partnership | **Zero Emission Bus Certification ID:** | **ZEB-CAETANO-ECITYGOLD-2023** | Approved Test facility | UTAC

Zero Emission Bus Certificate

Customer:	**CaetanoBus, S.A.**			**DYNAMOMETER SETTINGS**		
Customer Address:	**4431-901 Vila Nova de Gaia**	*Telematics Capability*	Yes	Test Weight	14375	kg
Test Purpose:	**Zero Emission Bus Testing**	*Maximum Speed (km/h)*	80 km/h	F°	346.64	N
Vehicle Manufacturer:	**CaetanoBus**	*Seated Capacity*	31	F¹	-10.2804	N/kmh
Vehicle Model Name:	**e.CityGold**	*Passenger Capacity*	65	F²	0.52	N/kmh ²
Powertrain Technology	**Battery Electric**	*Declared Unladen Weight (kg)*	13530	*Equivalent test passengers*	16	passengers
Powetrain Configuration	**Elbe Direct Drive**	*Gross Weight (kg)*	17950	*Measured Unladen Weight*	13195	kg
Zero Emission Heating	**Heat Pump**	*GVW Check*	**OK**	Number of conseuitve tests completed	4	Tests

Battery Specification		**Charging and Refuelling Capability**		**Hydrogen Specification**	
Battery Manufacturer	**Forsee Power**	**Plug Type**	**DC CCS2**	**Fuel Cell Manufacturer**	**N/A**
Battery Chemistry	**NMC**	**Max Charge Capability (kW)**	**Up to 150kW**	**Fuel Cell Power Rating (kW)**	**N/A**
Battery Installed Capacity (kWh)	**385**	**Charger Compatibility**	**DC**	**Hydrogen Storage Capacity (kg)**	**N/A**
Battery Usable Capacity (kWh)*	**308**	**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***	**72.65**	**g CO2e / MJ**	*Fuel Provider*	**UK market standard**	*WTT evidence*	**DBEIS Conversion 2022**
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/
Outer Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.53	1.02	133.86
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.98	1.20	157.88
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.64	0.76	100.25
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.51	1.07	141.57
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.15	0.93	**122.27**

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

Test Charger Used	**22 kW**	**Total measured energy consumed on vehicle (kWh)[1]**	**90.90**	**Max ZE Range at 100% SOC (km)**	**331**
Hydrogen Energy Over Test (kWh)	**N/A**	**Measured grid energy during charging (kWh)**	**119.40**	**Max ZE Range at 80% SOC (km)**	**265**
Hydrogen Delivered to Vehicle (kg)	**N/A**	**Grid-to-Wheel efficiency (%)[2]**	**76%**	**Test Distance Travelled (km)**	**65**

[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	4.82	350.10
Inner Urban	N/A	N/A	5.68	412.92
Rural	N/A	N/A	3.61	262.19
LBC Average	N/A	N/A	5.10	409.48
UK BUS Average	N/A	N/A	4.40	319.78

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	**319.8**	**g CO2e / km**	**Average Diesel GHG Emissions Equivalent**	**1092**	**g CO2e / km**
WTW CO2 per passenger km (@ Max Pass Capacity)	**4.9**	**g CO2e/pass km**	**WTW CO2 per passenger km (@ Max Pass Capacity)**	**16.8**	**g CO2e/pass km**

Overall Zero Emission Bus Performance

WTW GHG saving	**772.5**	**g CO2e / km**	**Maximum Theoretical Zero Emission Range (km)**	**331.2**
% WTW GHG saving	**71%**	**g CO2e / km**	**Vehicle Energy Consumption (kWh/ km)**	**0.93**
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)	9.40	18.58	N/A

Test Numbers: ML02019187 (24-June-20), ML02019188 (24-Jun-20), ML02019189 (24-Jun-20), ML02019189 (24-Jun-20)

Certificate approved by: Tony Tomsett
On behalf of Bus manufacturer 26.04.23

Certificate Approved by: Tim Griffen
On behalf of DfT / Zemo Partnership 21.03.2023