

A cutaway diagram of a bus showing its internal components. Labels include "Air-Conditioning" (two locations), "Battery", "Hydrogen Supply Module", "H₂ Refuelling Nozzle", "Fuel Cell Bus", "Electric Motor", "Hydrogen Fuel Cell", and "DC/DC Converter". The bus is shown on a road with yellow lane markings.

The GOLDiON Project: Zero-Emission Buses & Hydrogen Powered-Drone Development in Hungary

Dr. Naveed Akhtar
Founder & CEO, Hy-Hybrid Energy

Visit us: www.hy-hybrid.com
Email: info@hy-hybrid.com

Who Am I?

I am working on Hydrogen Energy/Fuel Cells since 2001 & hold some of the "**First**" titles in this field:

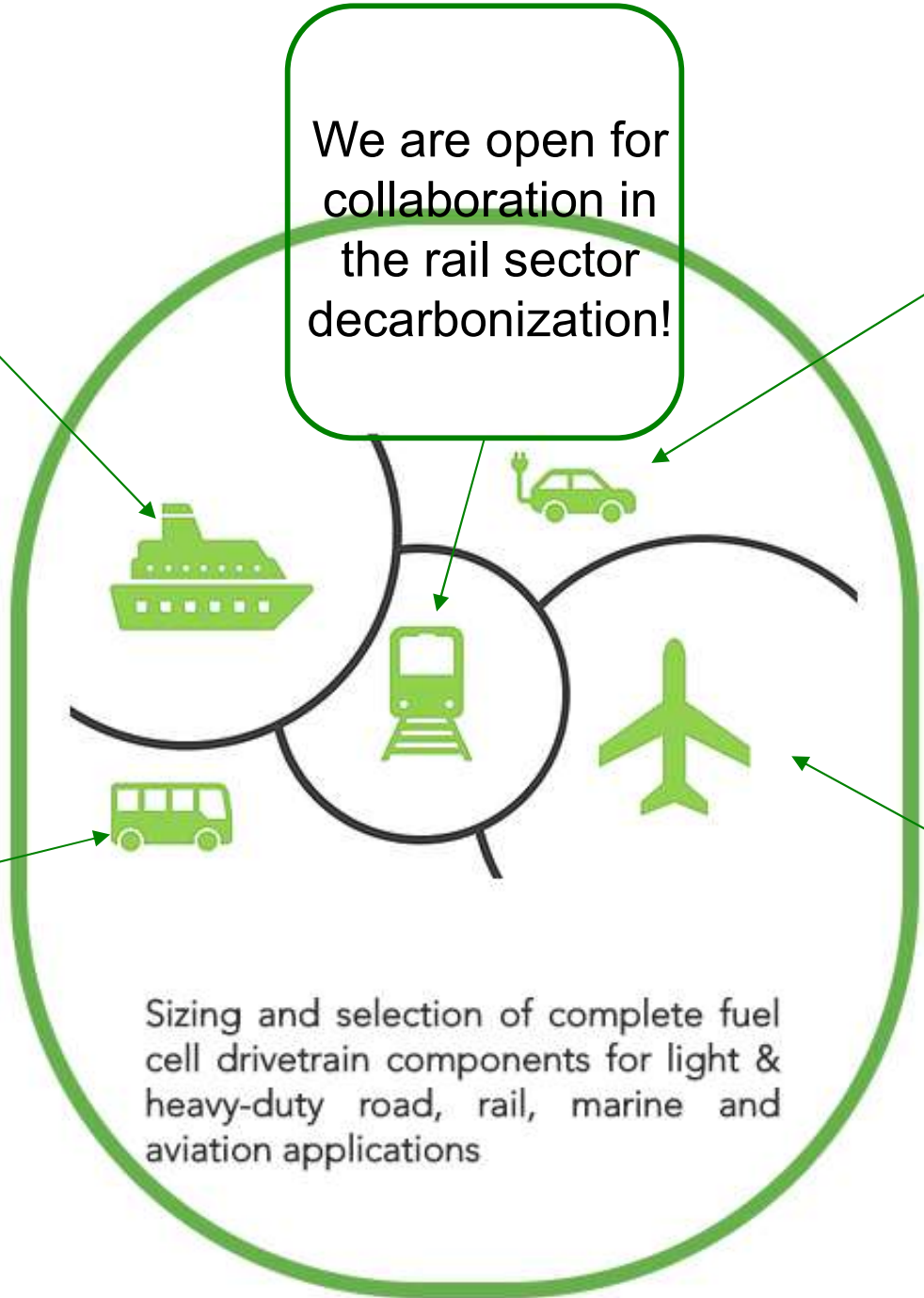
- ❑ Led **the first of its kind** in Pakistan- Metal Hydride, Hydrogen Storage Project (2001-2004)
- ❑ Executed **world's first** modelling and experimental study on mT-SC-SOFCs (2006-2009)
- ❑ Worked on **world's first largest** Stationary Alkaline Fuel Cell Power Plant (2011-2017)
- ❑ Leading the **first of its kind in Hungary**- the fuel cell bus project (2019-to date)
- ❑ Founder, **world's first** international hydrogen aviation conference (IHAC, 2020)
- ❑ Leading **the first of its kind** in Pakistan- 400 MW Green H2 Project (2021-to date)
- ❑ Signed **the first of its kind** in Hungary- Fuel Cell Systems Assembly Partnership under GOLDiON Project (08.06.2022)
- ❑ You never know what will be my next....."**First**".....?

Our Projects

Green Hydrogen transport & shipping decarbonisation

We are open for collaboration in the rail sector decarbonization!

We have recently completed a project for fuel cell development in passenger cars!



We are leading the First Hungarian Fuel Cell Bus Development Project!

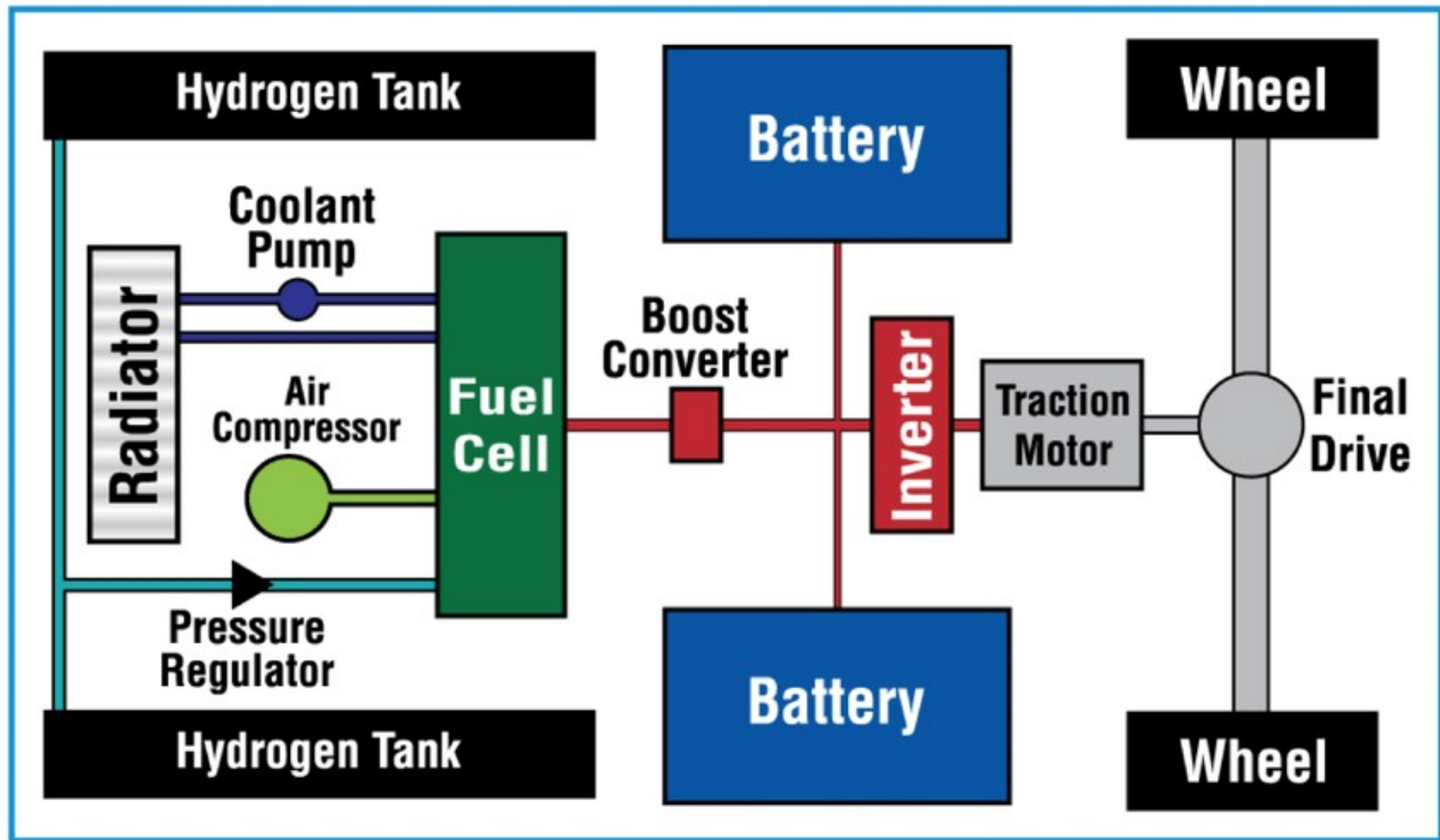
We are the organizer of the world's First Int'l Hydrogen Aviation Conference!

The GOLDiON Project (Aug 2019.....)

- ❑ We would like to work on exploring the EU market for zero-emission buses deployment with an aim to power the first articulated bus in Hungary under the project GOLDiON.
- ❑ We aim to achieve a long-term business goal in powering and selling zero-emission buses across Europe by executing:
 - a) **Phase-1:** Setup Zero-Emission Bus Family & Charging/Refuelling Infrastructure under the GOLDiON Project
 - b) **Phase-2:** Local Assembly of Fuel Cell Engines & Charging Stations
 - c) **Phase-3:** Local Assembly of drivetrains in Hungary with the goal of significantly reducing the cost of zero-emission buses to be deployed across the EU.

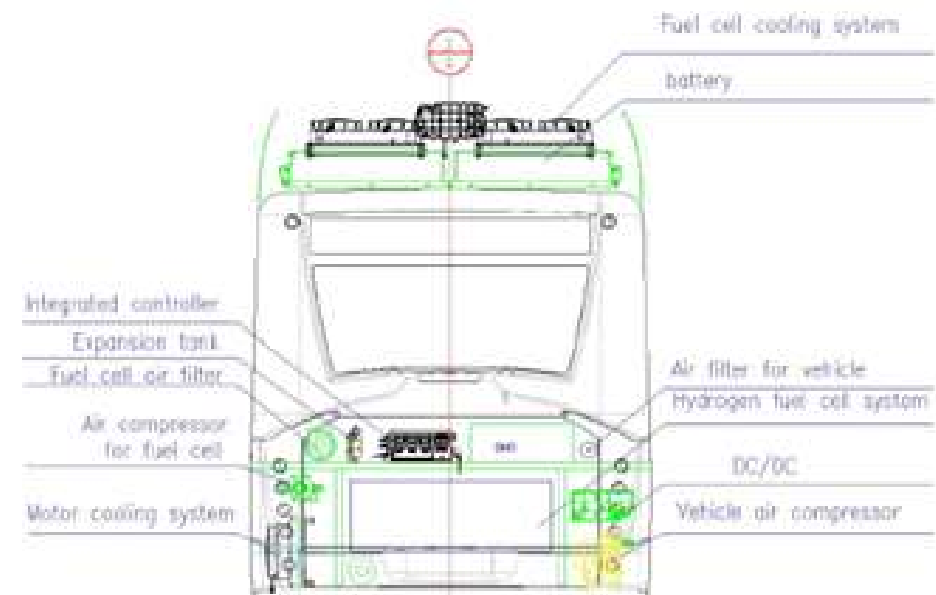
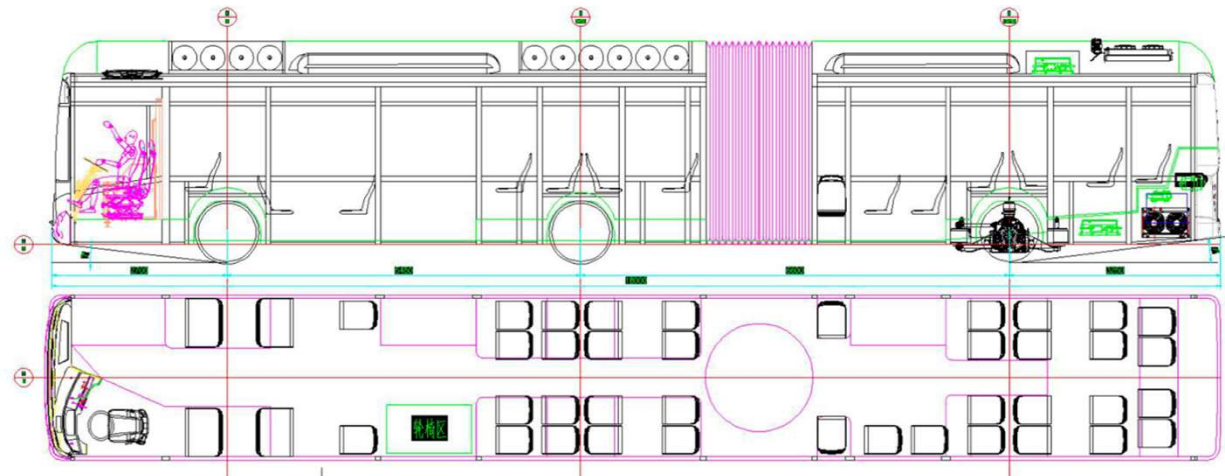
Hydrogen powered drone was later added to the GOLDiON Project

The Electric Drivetrain



Zero Emission Bus Family: GOLDiON

- GOLDiON H12: 12 m fuel cell electric bus (FCEB)
- GOLDiON H18: 18 m fuel cell electric bus (FCEB)
- GOLDiON E12: 12 m battery electric bus (BEB)
- GOLDiON E9: 8.5 m battery electric bus (BEB)



Articulated Fuel Cell Powered Bus

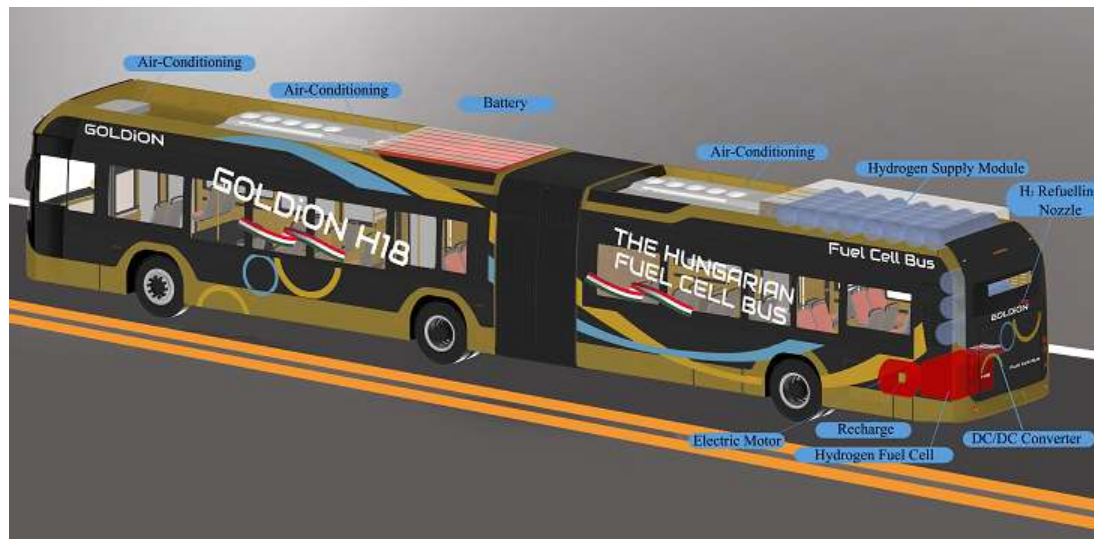
GOLDiON Zero-Emission Bus Family



GOLDiON H12



GOLDiON E9 & E12



GOLDiON H18

GOLDiON Electric Chargers

- 3 Phase, 400 VAC
- 120 kW (60 kW + 60 kW)
- 500-750 VDC
- CCS1 + CCS2
- CE/IEC 61851



- 3 Phase, 305-520 VAC
- 150 kW (75 kW + 75 kW)
- 150-1000 VDC
- CCS1 + CHAdeMO
- CE/IEC 61851

Hydrogen Refuelling Station (Cooperation Under Discussion)

- Suction Pressure: 5 – 20 MPa
- Max. Discharge Pr.: 45/87.5 MPa
- Refuelling Pr.: 35/70 MPa
- Ambient Temp: -40° to +50° C
- Refuelling Capacity: ~200 kg/day
- ISO 19880, SAE J2601-2, ATEX, PED



Articulated Fuel Cell Electric Bus- GOLDiON H18

- Fuel cell plug-in hybrid electric bus (FC-PHEB) which runs on hydrogen as well as also powered by electricity
- GOLDiON-H18 is an M3 category, low floor city bus with full homologation under Whole Vehicle Type-Approval System (WVTA) for EU use
- The bus is equipped with a 100-kW fuel cell system, high-voltage battery, 250 kW rated/350 kW peak power electric motor, 12 hydrogen cylinders with 350 bar onboard storage capacity, CCS2 type European standard DC charging socket

GOLDiON		
Main parameters	Vehicle category	M3
	Design	Low floor city bus
	Dimension (mm)	18711x2550x3380
	Homologation	EU(WVTA)
	Fuel type	Plug-in, Hydrogen fuel-cell vehicle
	Design	GOLDiON
	G.V.W (kg)	28000
	Max. Speed	80km/h, limited: 70km/h
	Interior height (mm)	F: 2450, R: 2250
	Min turning diameter(m)	≤25
	Ground height (mm)	≤340 mm (EU standard)
	Max passenger capacity	≤140 passenger
	Seats	49+4+1
	Altitude (m)	0-2000
	Min ground clearance (mm)	≥130
	Axle (kg)	E: 6500/K: 10000/H: 11500
	Climate	-20°C +45°C
Gradeability(%)	≥15%	
Power system	Electric motor	Rated: 250kW, Peak 350 kW
	Driving mode	Direct driving
	Power battery system	618.24V, Water cooling
	Fuel Cell System	100 kW FCS
	Hydrogen Supply System	12 Hydrogen Cylinders Onboard
	VCU	CVCT
	Charger	European standard DC charging socket, CCS2
	Auxiliary braking system	Auxiliary braking of driving motor
	Middle axle	ZF AVN132
	Front axle	ZF RL82A
	Rear axle	ZF AV133
	Hinged plate	Hubner hinged plate with connecting shed, with ACU3.0
	Braking system	Spring energy storage parking brake, disc brake, pneumatic dual-circuit braking system
	Suspension type	ZF, air suspension, shock absorber
	Tyre	Michelin, 275/70R22.5 18J
	Rims	8.25*22.5
	Steering gear	BOSCH 8098
	Electric steering pump	Quanxing brand
	Electric air compressor	Ingersoll Rand, 4kW
	ABS	WABCO
Brake valve	Comet brake master cylinder and valves, two front wheels	
Centralized lubrication	With	

Articulated Fuel Cell Electric Bus- GOLDiON H18

- ✓ Layout design and drawing frozen
- ✓ Chassis and body structure design finish
- ✓ Key component purchasing start
- ✓ Chassis and Mechanical part arrival
- ✓ Chassis structure done
- ✓ Body sub-assembly completed
- ✓ Chassis assembly completed
- ✓ Welding production completed
- ✓ Paint coating done
- Final assembly & commissioning
- Inspection & Debugging (including calibration of EBS & ECAS)
- EU Homologation

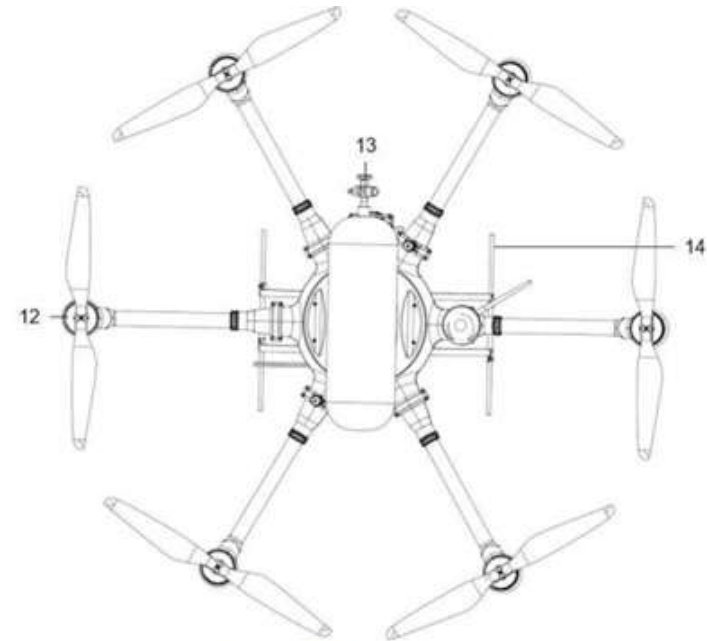
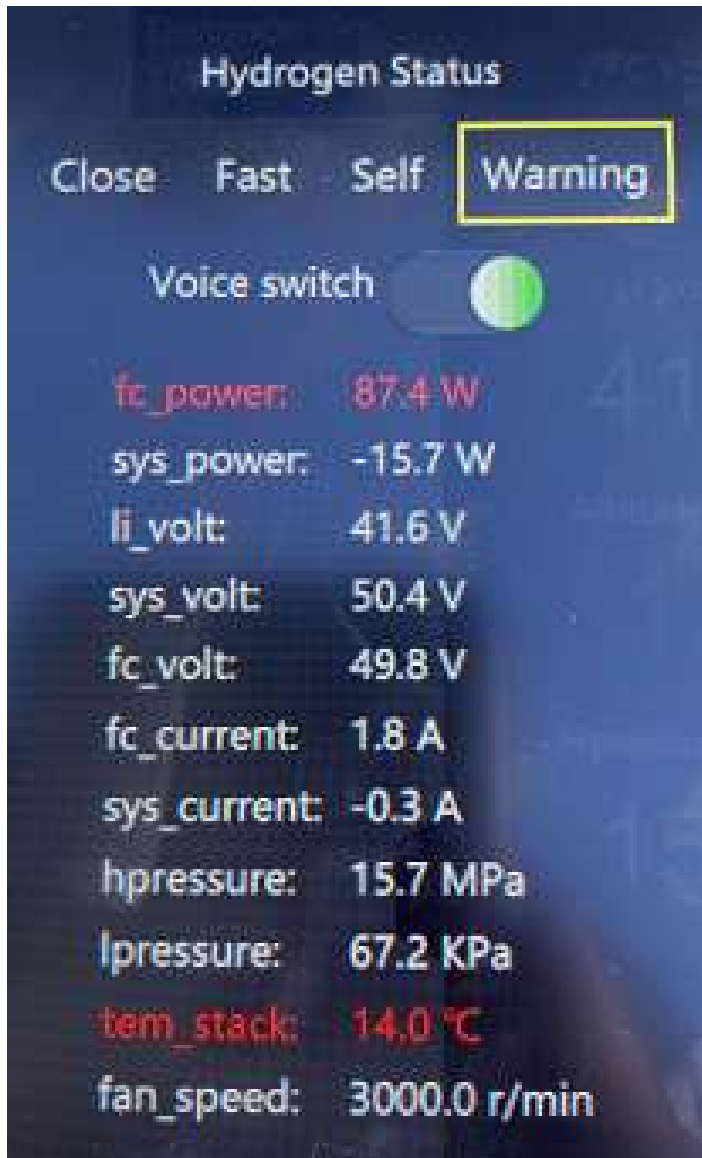


Hydrogen Powered Drone

Basic Data	Type	Hexa copter
	wheelbase	1550mm
	height	654mm
	Body weight	14kg (includes 12L fuel tank and reactor)
	Packing dimension	400*730*930 (includes wheels 70) mm
Performance	Power	1800W fuel cell
	Max. endurance without load	9L/150min, 12L/190min, 20L/253min
	Max. payload	5kg
	Max. take off weight	19kg
	Cruising speed	0~15m/s
	Sea level climb rate	0~3m/s
	Ceiling	5km
	Communication distance	10km
	Datalink communication distance	2km (RC) / 10km (standard radio)
	Environment	Max. wind resistance
Operation temperature		0°C-40°C
Operation humidity		10%-90% No condensation
IP rate		IP54
electromagnetic interference		100A/m (Power frequency magnetic field)



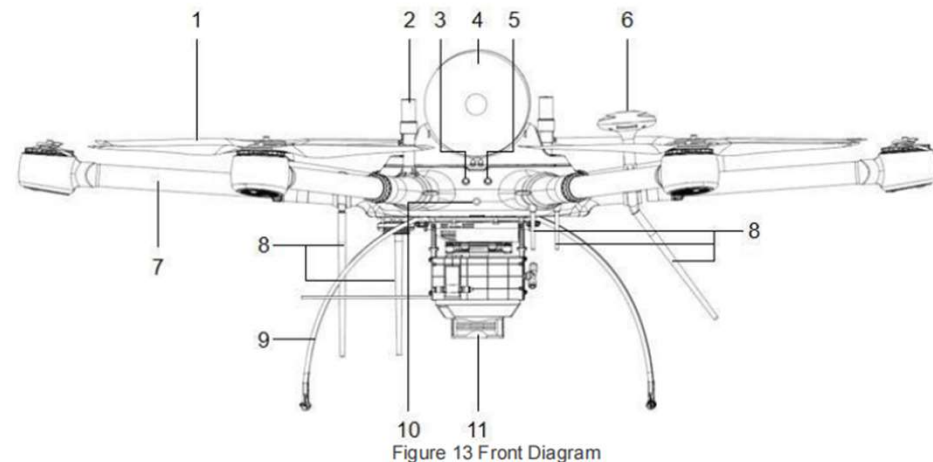
Hydrogen Powered Drone



12, Motor

13, Air valve

14, Landing Gea



1, Propeller
5, Safety switch
9, Landing Gear

2, RTK Antenna*
6, GPS
10, LED taillight

3, Power Switch
7, Arm
11, fuel cell

4, Gas cylinder
8, Image/Data Antenna

Hungary could get Green Hydrogen via our 400 MW Project



- Annual green hydrogen output capacity to be 54,750 tons on completion
- The purity of produced hydrogen planned to be 99.999%, making it viable for multiple purposes




2nd International Hydrogen Aviation Conference (IHAC 2021)

2nd September 2021, Virtual



Rinaldo Brutoco	Salman Rehman (IHAC Team)	Barry Prentice	Paul Perera	James Ferguson
Marek Alliksoo	Jonas Schroeter	Thibaud Millotte	Huw Edwards	Greg Cipollone
Ben Mclean	Philippe Collin	Ramy Ali	Jimmy Royer	Erica Trevisin
Jean-FrancoisBoissin	James Nicol (IHAC Team)	Lara Fleischhauer	Naveed Akhtar	2nd International Hydrogen Aviation ...
MD Vazquez-N...	Laima Klemas	Arslan Zia		
MD Vazquez-Navarro	Laima Klemas	Arslan Zia		

Summary

- Phase-1 (Setup Zero-Emission Bus Family & Charging/Refuelling Infrastructure) is near completion. E9, E12 Prototypes ready, H12 undergoing EU homologation & H18 in final stages of assembly & commissioning
 - Phase-2 (Local Assembly of Fuel Cell Engines & Charging Stations) has begun. We are currently finalizing the joint-assembly plan with our partners for fuel cell systems assembly & charging stations
 - Hydrogen powered drone has been demo tested in Hungary. The next stage is to achieve local/EU certifications
 - In discussions with H2 refuelling suppliers & Green Hydrogen delivery
 - Exploring potential partnerships with supply chain partners, i.e., battery, electric motors, VCU, H2 tank suppliers etc. for planning towards Phase-3
- 

**3rd International
Hydrogen Aviation
Conference
IHAC 2022**

"Hydrogen: makes you fly in the sky!"

Website: <https://www.hy-hybrid.com/i hac-2022>

1st September 2022, Glasgow



**Thank you for your kind attention!
Any questions?**

Visit us: www.hy-hybrid.com
Email: info@hy-hybrid.com

Additional Slides



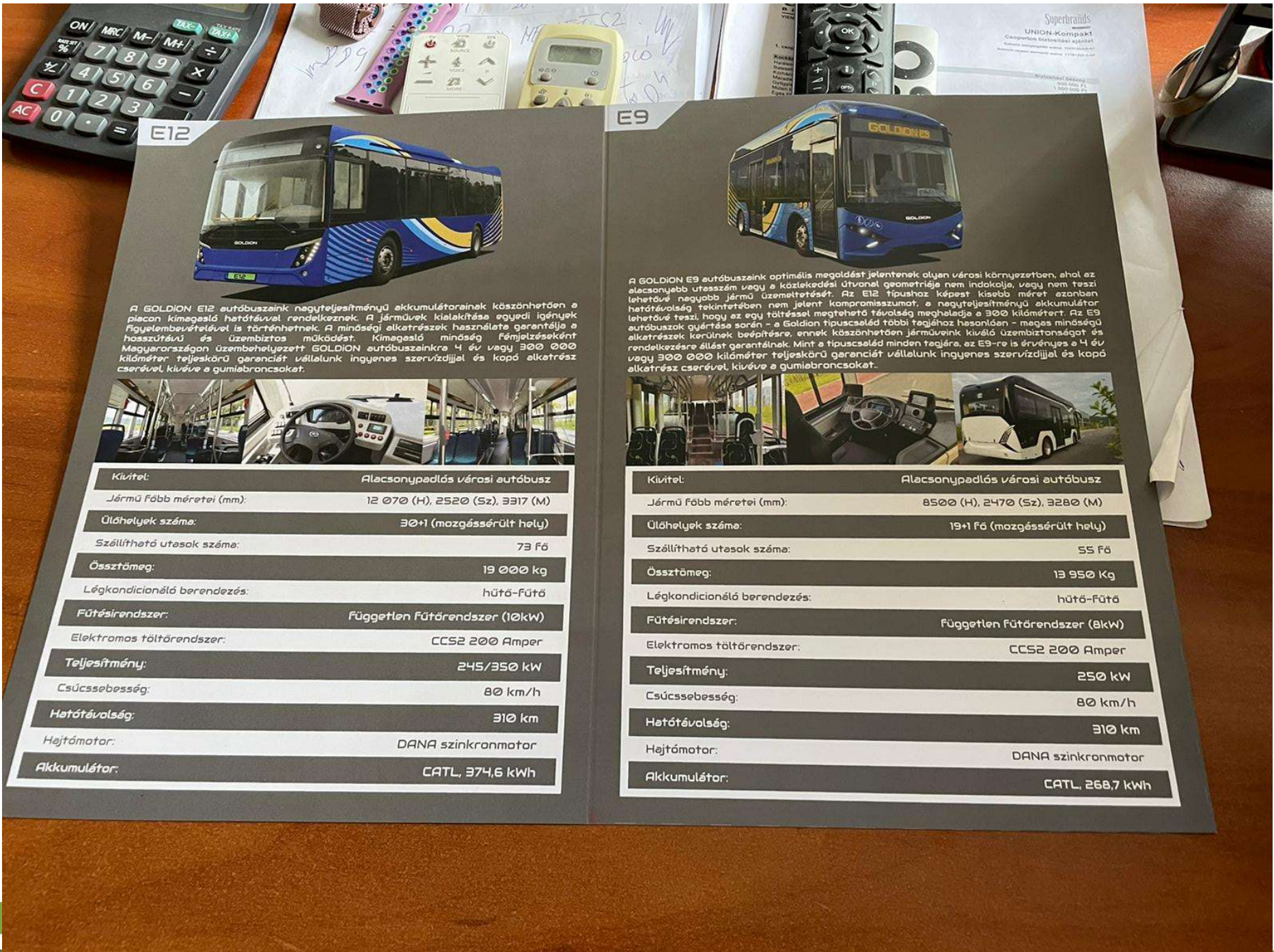
120 kW Electric Charger

150 kW Electric Charger

 Váltóáramú bemenet	Névleges feszültség	3 fázis 400 VAC
	Fázisok száma	3 + N + PE
	Névleges frekvencia	50 vagy 60 Hz
	Bemeneti teljesítménytényező	0.99
	Bemeneti teljesítmény	60 kW + 60 kW + 10%
	Áram-védőkapcsoló küszöbérték	30 mA
 Egyenáramú kimenet	Névleges kimeneti teljesítmény	2 x 60 kW
	Kimeneti feszültségtartomány	50 – 750VDC
	Kimeneti áram	100 ADC
	Aktuális változótartomány	0 – 100A
	Hatásfok	legalább 96%
	Kimeneti áram hullámossága:	Legfeljebb 6.0 Ap-p
 Mechanikai adatok	Por és víz bejutása elleni védelmi osztály (IP)	Ip54
	Működési környezeti hőmérséklet tartomány	-20 °C ~ 50 °C
	Tárolási hőmérséklet tartomány	-30 °C ~ 70 °C
	Befoglaló méretek Mag x Sz x Mé	1650 x 1193 x 710mm
	Tömeg	490 kg
 További adatok	Tanúsítás	CE/IEC 61851
	Biztonság	Vészleállító gomb
	Járműcsatlakozó	CCS2 + CCS2
	Akkumulátor kommunikációs protokoll	CAN 2.0 / PLC
	Irányítási rendszer	OCPP 1,6
	Hálózati kommunikáció	4G, Ethernet, WIFI
Hűtés típusa	Léghűtés	

AC Nominal Input	Phase/Lines	3 phase+neutral+PE
	Voltage	305-520 VAC
	Frequency	40-65HZ(±10%)
DC Nominal Output	Voltage	150-1000 VAC
	Power	30KW-210KW (constant power)
Electrical Parameter	Power Factor	≥0.99
	Unequal Current Ratio	≤ 5%
	Stable voltage accuracy	≤ ±0.5%
	Stable Current Accuracy	≤ ±1%
	Efficiency	≥95% max
	Soft Start Time	3-8s
	Auxiliary Power	12V
	Installation Method	Ground mount
Structure Design	Charging Outlet	CCS2\CHAdEMO
	Cable Length	5 m (standard)
	LED Indicator	3 indicators
	LCD screen	10 inch/15 inch Daylight readable touchscreen
	Emergency Stop Button	Yes
	Startup Mode	Plug-and-play/RFID card
	RFID	Yes
	EN-GATE v.s.Charger	CAN 2.0 (CHAdEMO)BLC (CCS)
Communication	EN-GATE v.s.Backend	Ethernet/3G/4G/WIFI
	Communication Protocol	OCPP 1.5/OCPP 1.6 (JSON)
Environmental Index	Operation Temperature	-30 °C +65 °C
	Working Humidity	5%-95% without condensation
	Working Altitude	<2000m
	Protection Grade	IP54
	Application Site	Indoor/Outdoor
	Cooling Method	Fan cooling (Liquid cooling for option)
Security Protection	Multiple Protection	Over/Under voltage protection, overload protection, short circuit protection, over/under temperature protection, Surge protection, Communication failure

GOLDION E9 & E12



E12



A GOLDION E12 autóbuszaink nagyteljesítményű akkumulátoreinek köszönhetően a piacon kimagasló hatótávval rendelkeznek. A járművek kialakítása egyedül igények figyelembevételével is történhetnek. A minőségi alkatrészek használata garantiálja a hosszútávú és üzembiztos működést. Kimagasló minőség fémjelzősoként Magyarországon üzembehelyezett GOLDION autóbuszainkra 4 év vagy 300 000 kilométer teljeskörű garanciát vállalunk ingyenes szervízdíjjal és kopó alkatrész cserével, kivéve a gumibroncsokat.



Kivétel:	Alacsonypadlós városi autóbusz
Jármű főbb méretei (mm):	12 070 (H), 2520 (Sz), 3317 (M)
Ülőhelyek száma:	30+1 (mozgássérült hely)
Szállítható utasok száma:	73 fő
Össztömeg:	19 000 kg
Légkondicionáló berendezés:	hűtő-fűtő
Fűtésrendszer:	Független Fűtőrendszer (10kW)
Elektromos töltőrendszer:	CCS2 200 Amper
Teljesítmény:	245/350 kW
Csúcssebesség:	80 km/h
Hatótávolság:	310 km
Hajtómotor:	DANA szinkronmotor
Akkumulátor:	CATL, 374,6 kWh

E9



A GOLDION E9 autóbuszaink optimális megoldást jelentenek olyan városi környezetben, ahol az alacsonyabb utasszám vagy a közlekedési útvonal geometriája nem indokolja, vagy nem teszi lehetővé nagyobb jármű üzemeltetését. Az E12 típushoz képest kisebb méret azonban lehetővé teszi, hogy az egy töltéssel megtehető távolság meghaladja a 300 kilométert. Az E9 autóbuszok gyártása során - a Goldion típuscsalád többi tagjához hasonlóan - magas minőségű alkatrészek kerülnek beépítésre, ennek köszönhetően járműveink kiváló üzembiztonságot és rendelkezésre állást garantálnak. Mint a típuscsalád minden tagjára, az E9-re is érvényes a 4 év vagy 300 000 kilométer teljeskörű garanciát vállalunk ingyenes szervízdíjjal és kopó alkatrész cserével, kivéve a gumibroncsokat.



Kivétel:	Alacsonypadlós városi autóbusz
Jármű főbb méretei (mm):	8500 (H), 2470 (Sz), 3280 (M)
Ülőhelyek száma:	19+1 fő (mozgássérült hely)
Szállítható utasok száma:	55 fő
Össztömeg:	13 950 Kg
Légkondicionáló berendezés:	hűtő-fűtő
Fűtésrendszer:	Független Fűtőrendszer (8kW)
Elektromos töltőrendszer:	CCS2 200 Amper
Teljesítmény:	250 kW
Csúcssebesség:	80 km/h
Hatótávolság:	310 km
Hajtómotor:	DANA szinkronmotor
Akkumulátor:	CATL, 268,7 kWh

GOLDION H18

H18 Fuel cell Bus

H18 Fuel cell Bus					
Chassis	Body frame and panel	Aluminum	Electrical equipment	Air conditioner	Valeo 2x30kw, single cooling air conditioner, with battery water cooling, independent control, Driver area: Webasto, 1,6kw
	Dashboard	Forming instrument panel		Defroster	With
	Driver seat	Manufacturer: Grammer Type: MSG 90 6PG		Heating system	Valeo, water heating system, Total heating power 40kW
	Driver cabin	The driver cabin fully inclosed with door		Combination instrument	ACTIA
	Seats	EU standard, upholstered seats		Audio visual system	Radio with 8 speakers
	Wheelchair area	with		Guidepost	Reserved wire harness
	Top interior panel	Aluminum		Interior display screen	Reserved wire harness
	Side interior panel	Aluminum plastic plate, flame retardant		Coin box	Reserved wire harness
	Side window decorate	PVC Silver gray PVC extruded parts		CCTV system	Interior and reversing monitor, 7" LCD screen
	Armrest, Handrail, ring, Cold proof sleeve	φ35 stainless steel wire drawing		Tachograph unit	Tachograph with EU standard, DRCO 4.0
	Floor	15mm, Finnish wood floor		Microphone	Reserved wire harness
	Step for disable	With		Bus door bell	Touch with dots for the blind
	Window curtain	Front electric retractable sun blind, half width, no guide rail; manual sliding rod type sun blind for driver's window, with guide rail		Automatic fire extinguishing device in battery box	W/O
	Side window curtain	W/O		Lighting lamps on board	LED strip lamp, two stage lighting
	Safety hammers	With		Step lamp	W/O
	Glass	Front windshield integral white laminated glass, rear windshield white toughened glass, front fixed rear built-in push-pull driver's window,		Auxiliary battery	2 x 120 Ah (2 x 12V), maintenance-free battery
	External rear mirror	Electric heating, main mirror and auxiliary mirror can be lectrically adjusted		Intelligent bus system	Reserved wire harness
	Passenger door	Front, middle, rear, 2-2-2 inner swinging passenger doors, pneumatic, ≥1100mm		ECAS	WABCO ECAS with kneeling function
	Side compartmet door	Lift up aluminum alloy cabin door		Other request:	width of passenger corridor≥550mm
	Wiper	Partograph windscreen wipers, Equipped with at least 14L wiper kettle with liquid level sensor			Emergency button in driver area
	Fire extinguishers on board	With			With front tow coupler
	Paint	According to individual needs with EU standards colors			Reserved IBIS wiring
					USB-A X2