



19/09/2018

Networking Breakfast & ASSURED-JIVE Talk #2

INNOTRANS 2018

9:30 – 12:00 @ UITP Stand



 @ASSURED_project
@Fuelcellbus



19/09/2018

ASSURED-JIVE Expert Talk #2

"Clean Bus Technologies: Insights into Battery Electric and Fuel Cell Buses for Urban Transport"

10:00 – 12:00 @ UITP Stand

INNOTRANS 2018



 @ASSURED_project
@Fuelcellbus

CLEAN BUS TECHNOLOGIES: BEB & FCB



➤ SPEAKERS

- Umberto GUIDA, Director Research & Innovation, UITP (moderator)
- Alex de JONG, Business Manager Public Transport, VDL Bus & Coach
- Geert VAN HECKE, Head of Public Transport, Van Hool
- Giorgio MANTOVANI, Alternative Traction Concept Manager, Iveco Altra
- Julen TROJAOLA, Project Manager, Irizar e-mobility
- Romuald WITKOWSKI, Regional Sales Manager, Solaris



AIMING FOR ZERO. MOVE. TOGETHER.

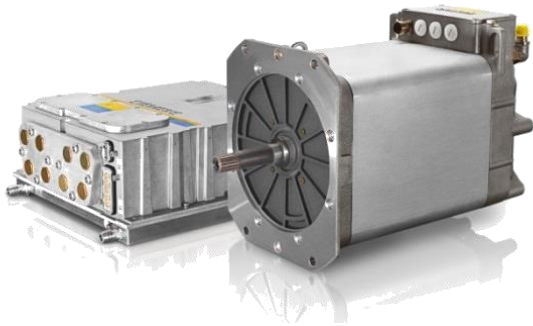


Market developments Public Transport



Vision VDL E-Mobility

- The driveline of the future will be electric! For the fuel cell bus as well
- Not only bus transport, but also other forms of heavy duty transport (trucks, vans, 'yellow goods')
- The sector public transport is the frontrunner in E-Mobility
- Knowledge of energy storage and software system integration is crucial for a successful integration
- Platform thinking needed to leverage developments and allow quick configuration / customization
- Creating job opportunities in Holland and Belgium is top priority for VDL Groep

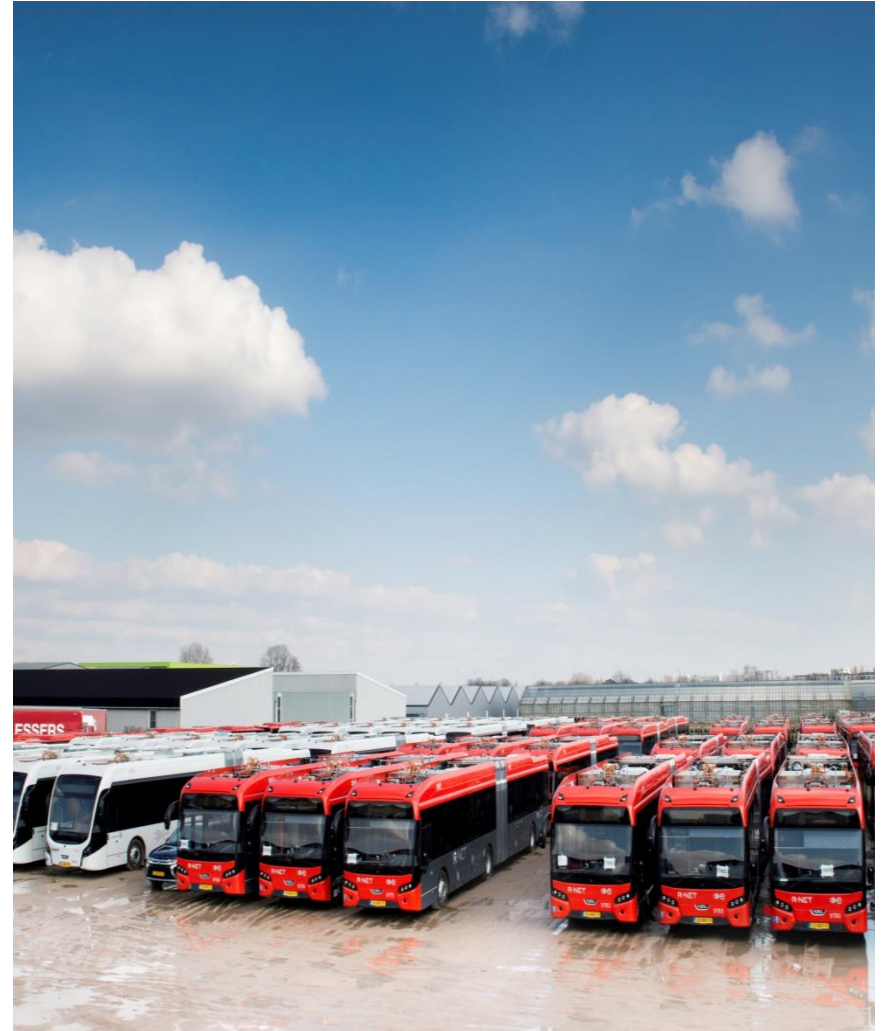


Advanced Charging Test Facility



Beliefs and learnings

- **Not pushing (bus) technology, but creating innovative, customized and flexible end-user focussed mobility solutions**
- **Extended partnerships with all relevant players in value chain**
- **Support customers by taking full system responsibility by professional project management**
- **Continuous improvement and optimization by team and fact based learning**
- **Shared roadmapping with all relevant key players**



AIMING FOR ZERO. MOVE. TOGETHER.





Heuliez 18 m articulated BEB

The main objective of Heuliez 18 m articulated BEB is to develop a battery electric urban bus for public transport with superfast charging (< 5 min) and daily electric driving range > 200 km and up to > 10 km between charging stations, with a power transfer capability > 400 kW superfast charge with top down pantograph.

The main technological objectives are:

1. To optimize the chemistry and sizing of the Energy Storage System basaccording operational requirements, batteries life-cycle and TCO
2. To allow Opportunity Charging Power up to 450 kW to minimize feeding time improving service availability and/or to improve full electric range

Contact person:

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Ludovic Balandreau (ludovic.balandreau@cnhind.com)



HEULIEZBUS



Heuliez target

Heuliez BEB operational and functional product target:

- A BEV articulated urban electric bus with super-fast charge developed for urban transportation.
- 16 hours ZEV range \geq 200 km with super-fast charge $>$ 400 kW at bus terminal/last stop.
- Up to 30 km electric range from 100% SOC
- OPPCharge type A top down pantograph infrastructure with a max power greater than 400kW
- Combo 2 CCS mode 4 for depot charging.
- Only ZEV operation
- charging time $<$ 5 min (for 10 km superfast charging)
- TCO not far from similar diesel bus by considering environmental cost according green public procurement directive, exemptions and institutional support
- Minimize impact on the power grid
- Standardized superfastcharge to guarantee interoperability
- Demonstration in real operation



Heuliez operational requirements

Customer's operational Requirements

Daily Range ≥ 200 Km

Number of Charging Stations ≤ 2 for each Line route

Time for Opportunity Charging
Best solution ≤ 5 min
Max 10 min

Time for Overnight Charging ≤ 6 hours

Charging System Main Overall Specs

Max Power ≈ 450 kW

Max Current ≈ 600 A

Max Voltage ≈ 800 V

Technical Constraints

Electric Range > 30 km

Required Usable Energy ≈ 90 kWh

Number of intermediate charging ≥ 16 times/day

Power of superfast Charging Station > 400 kW

Power of overnight Charging Station ≥ 50 kW

18 m Bus with A/C energy consumption ≈ 3 kWh /km



Heuliez product requirements

GX 437 E superfastcharge:

- i) BEB 18 m articulated urban bus with superfastcharge and specific battery,
- ii) ≥ 200 km 16 hours ZEV range with superfastcharge > 400 kW at bus terminal/last stop
- iii) Up to 30 km electric range from 100% SOC

Technical constraints:

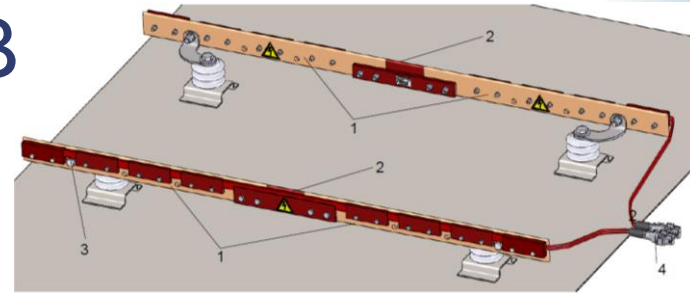
- RESS Usable Energy (no superfastcharge) 90 kWh
- Number of intermediate charging per daily cycle 16/d
- Power of the available superfast charging stations 450 kW
- Power of overnight charging stations ≥ 50 kW

Customer's and product requirements:

- Maximum/Minimum/Average daily range ≥ 200 km
- Number of available charging stations per route 1
- Time that can spend for 10 km opportunity charging nice to have 5', $< 10'$
- Time of overnight charging in depot < 4 h
- 4 poles infrastructure mounted pantograph type A up to 450 kW
- Max range(without superfastcharge from 100% SOC) at least 30 km
- Overnight charging Mode 4 Combo CCS.



Heuliez 18 m articulated BEB



1	contact rails, four poles	2	Insulating between two poles
3	Heating	4	Connector of Heating





Heuliez 18 m articulated BEB

GX 437 E with opportunity charge	Value
Length / width / height [mm]	17,97 m
Empty weight [kg]	≈ 19.000 kg
Total passenger capacity / maximum load [kg]	154
Total weight [kg]	< 30.000 kg
Maximum lifetime as expected [years]	15 y
Motor continuous power [kW]	160 kW
Motor peak power [kW]	200 kW
Maximum Torque [Nm]	5100 Nm
Battery type (LiFeS2, LiMnO2, etc.)	LTO
Nominal capacity [Ah]	160 Ah
Storable energy [kWh]	106 kWh
Maximum charge current [A]	600 A
Maximum continuous discharge current [A]	300 A
Working voltage range (min/max) [V]	520 – 780 V
Number of maximum fully charge cycles	NA
Maximum lifetime as expected [years] (with limited DoD)	15 y
Effective electric driving energy of the vehicle [kWh]	90 kWh max
Maximum electric driving range fully charged [km @ km/h @ 90 kWh usable]	30 km
Possible daily fully electric operation time [h]	16h
Duration of fully overnight charging in depot [h]	1h
Nominal charging current [A]	<200 A
Nominal charging voltage [V]	< 800 V
Contact type (CHAdeMO, CCS, Type 2, etc.)	CCS
Charging power range (min/max) [kW]	Mode 4
Nominal charging power [kW]	Mode 4
Charging current range (min/max) [A]	0 – 200 A
Nominal charging current [A]	Mode 4
DC-Voltage range (min/max) [V]	520 – 780 V
Nominal charging Voltage [V]	Mode 4
Pantograph connection On-board Bottom-up (type/manufacturer)	NA
Pantograph connection Off-board Top-down (type/manufacturer)	Type A ABB



HEULIEZBUS

Irizar Group
One Group, seven brands



Irizar Group



First european electromobility plant

Investment: 75 M euros
37.000m2 Area
18.000m2 Area
Production capacity of **1000 vehicles a year**

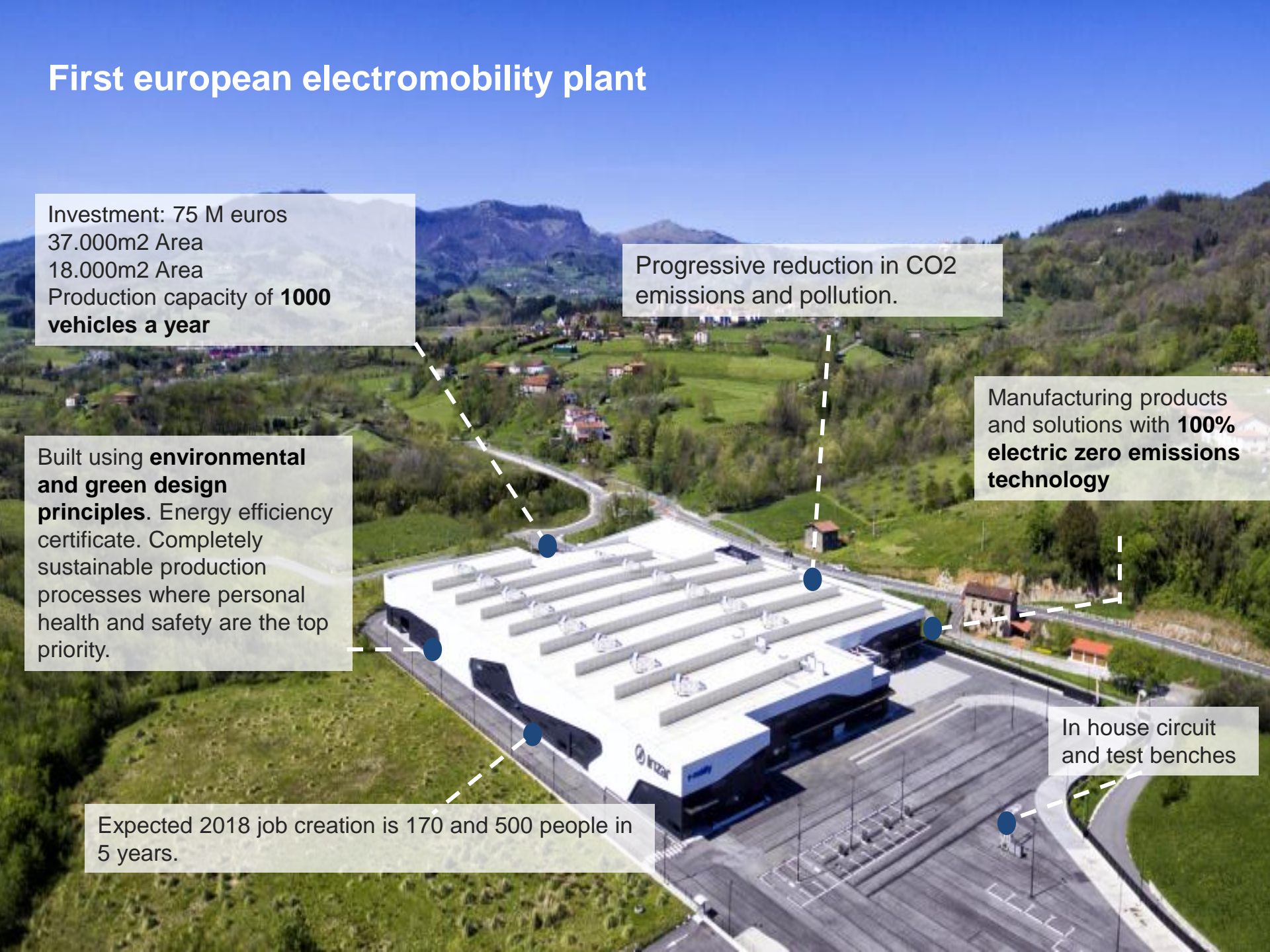
Progressive reduction in CO2 emissions and pollution.

Manufacturing products and solutions with **100% electric zero emissions technology**

Built using **environmental and green design principles**. Energy efficiency certificate. Completely sustainable production processes where personal health and safety are the top priority.

In house circuit and test benches

Expected 2018 job creation is 170 and 500 people in 5 years.



Irizar ie bus

Irizar ie tram

Irizar ie truck



Turnkey electromobility solutions



Analysis



Calculation



Implementation



Test period



Daily operation



It's already a reality



EMT – MADRID

- ✓ 15 Irizar ie bus 12 m
- ✓ Slow charging station



AMIENS METROPOLE - AMIENS

- ✓ 43 Irizar ie tram 18m
- ✓ 6 fast charging stations + pantograph
- ✓ 43 slow charging stations
- ✓ 15 years maintenance
- ✓ Delivery: April 2019



VOYAGES ECKER – LUXEMBOURG

- ✓ 6 Irizar ie bus 12 m
- ✓ 4 Irizar ie bus 18 m
- ✓ Delivery: June 2018
- ✓ Slow charging station



AGGLOMÉRATION CÔTE BASQUE ADOUR - BAYONNE

- ✓ 18 Irizar ie tram 18m
- ✓ 5 fast charging stations + pantograph
- ✓ 18 slow charging stations
- ✓ 15 years maintenance
- ✓ Delivery: February 2019

Irizar Charging systems

Pantograph charging

Recommended when the vehicle does not have sufficient range to complete the journey. The operator can choose from automatic mode or manual mode.

Pantograph in depot

Possibility of complete automation of the slow load in garages. The automation of the contact between the vault and the pantograph of the parked bus allows instant charging.

In- depot charging

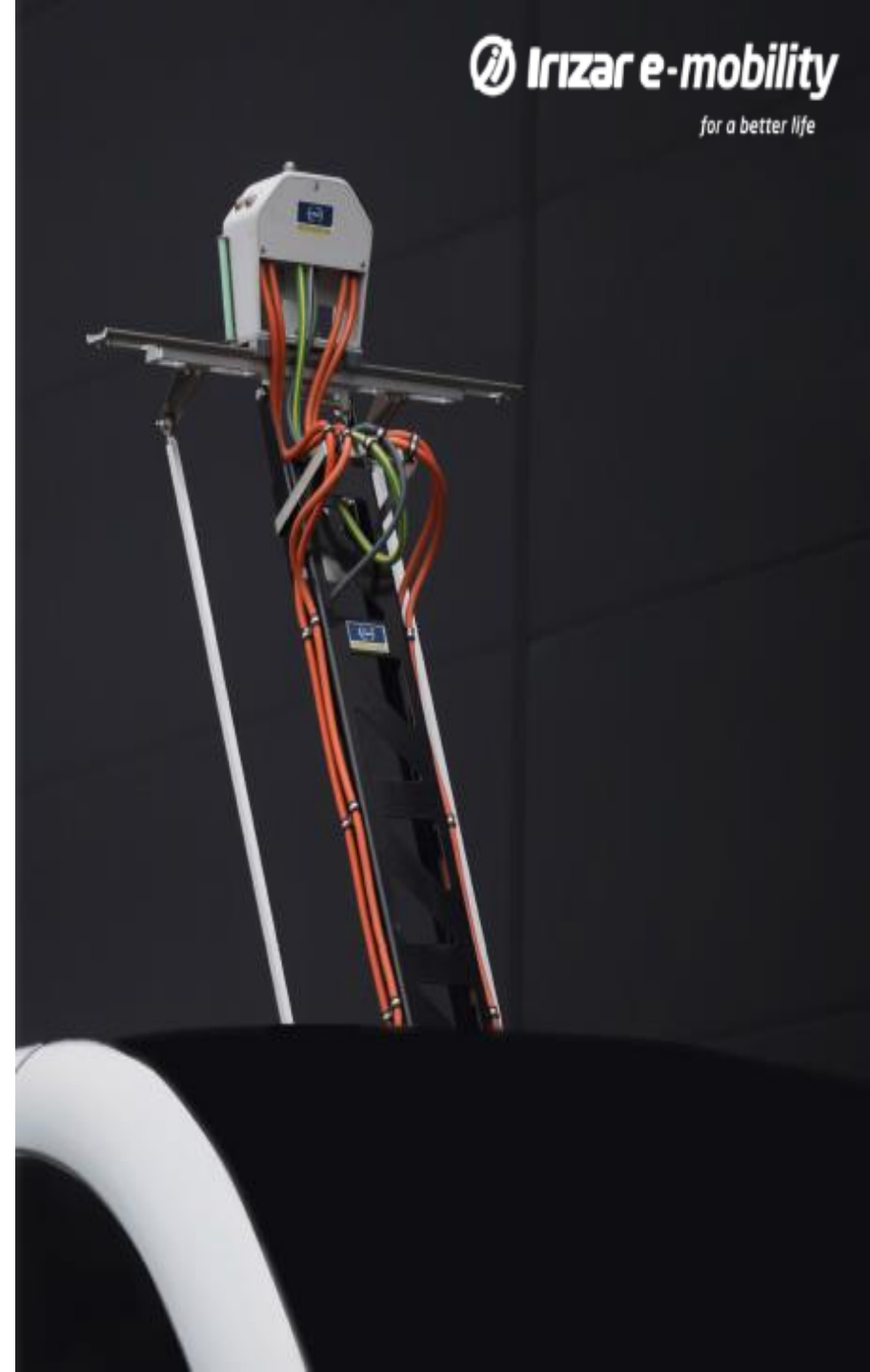
The easiest and most traditional way of charging. Available for use out doors as well as indoors.

Smart charging

This is a control centre that efficiently manages all charging conditions/ restrictions in the depot.

Interoperability

ISO 15118, DIN70121, OCPP 1.6
CE mark, EMC 61000-6-2, 61000-6-4, IEC 61851,
IEC 61000



**Thanks for
your
attention!!**

Irizar

electric



SOLARIS

COMMON
DIRECTION >

Changing the image of public transport

www.solarisbus.com



Clean Bus Technologies:
Insights into BEB and FCB for Urban Transport

**Romuald
Witkowski**

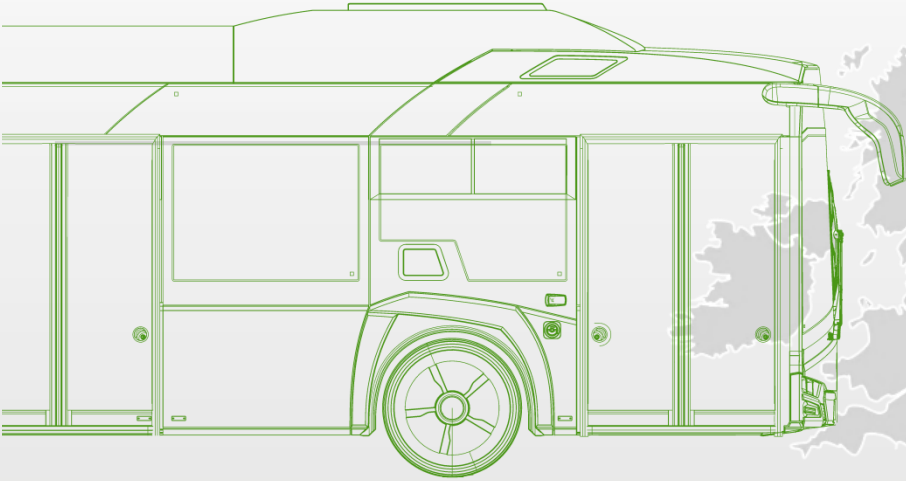


**COMMON
DIRECTION >**



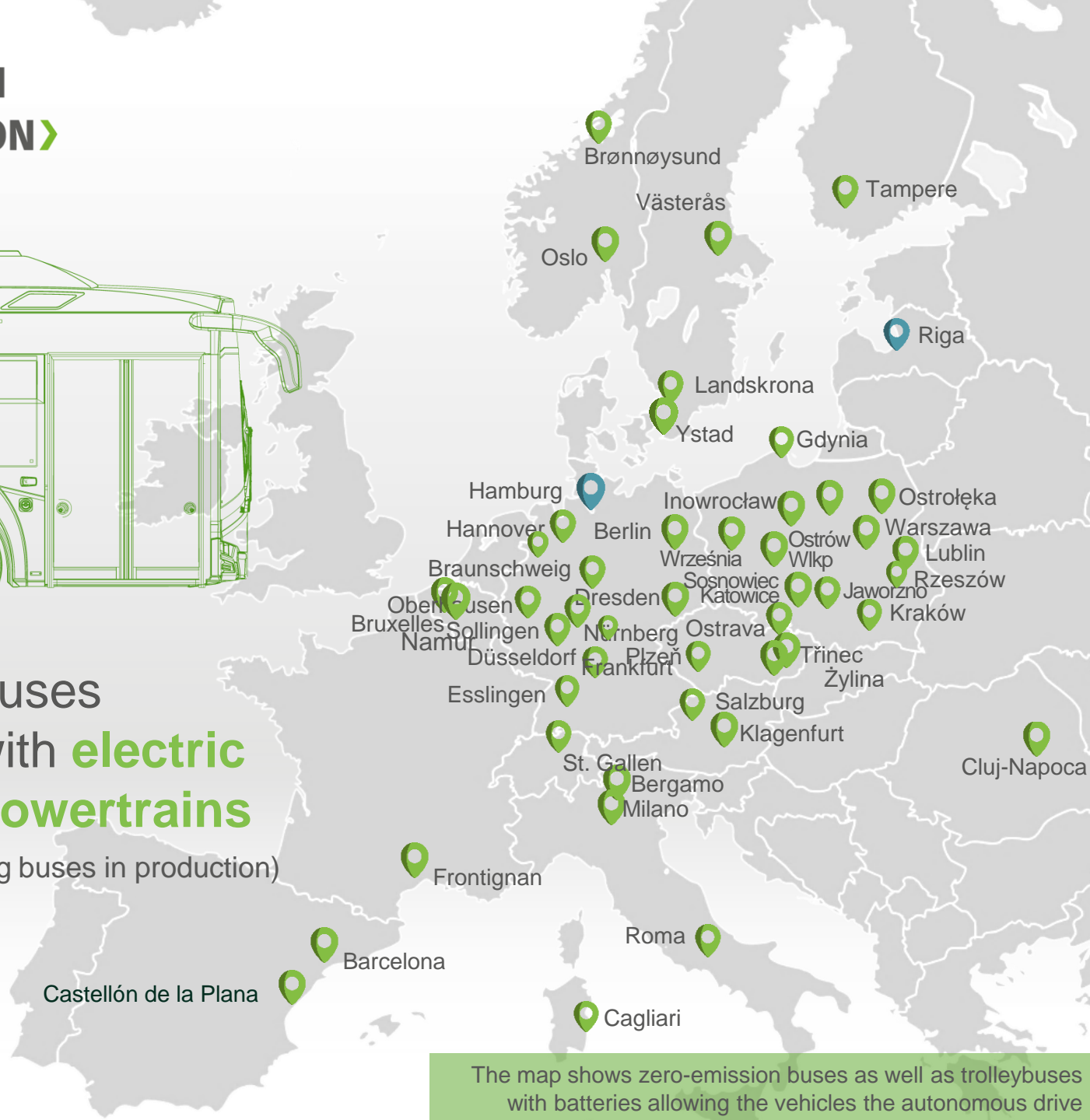


**COMMON
DIRECTION >**



2500 buses
with **electric
powertrains**

(including buses in production)



The map shows zero-emission buses as well as trolleybuses with batteries allowing the vehicles the autonomous drive

› **By mid-century, GHG emissions** from transport will need to be **at least 60% lower** than in 1990 and be firmly on the path towards **zero concerning both GHG and pollutant emissions** in order to meet the EU's emissions targets.

Source: A European Strategy for low-emission mobility

➤ The next ten years will see the electric bus market **expanding fivefold**. Now, it is growing at a compound annual **growth rate of 20%** in terms of unit sales.



Source: IDTEchEX Research of Cambridge, 2016

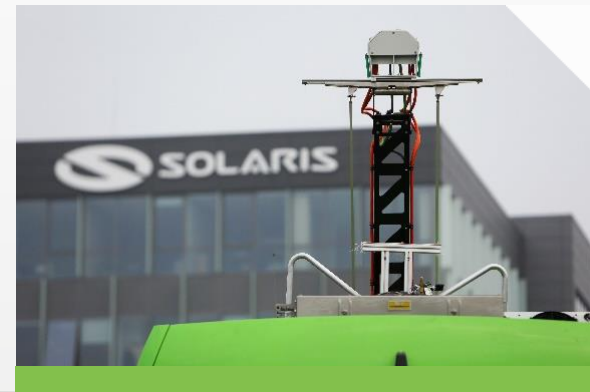
Charging solutions

Plug-in >



- > Up to 200A DC
- > Manual operation
- > Low costs
- > Contact charging

Pantograph >



- > Up to 800A (8 minutes)
- > Automatic operation
- > Relatively low costs
- > Contact charging



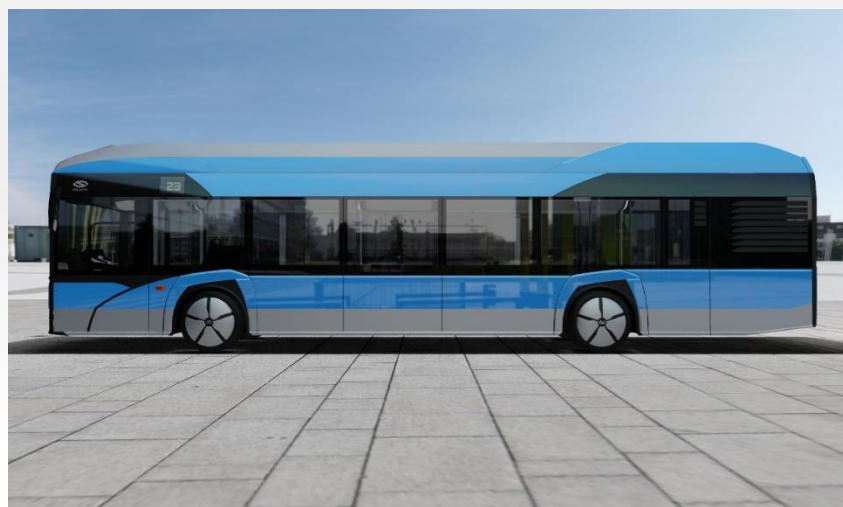


COMMON
DIRECTION

› Solaris Urbino 12 hydrogen

Technical info

- › 12m Low Floor chassis
- › 29 kWh High Power batteries
- › 34 kg hydrogen storage
- › 60 kW Ballard fuel cell
- › ZF electric drive axle
- › AC unit with heat pump





SOLARIS

THANK YOU FOR
YOUR ATTENTION

Company presentation

www.solarisbus.com



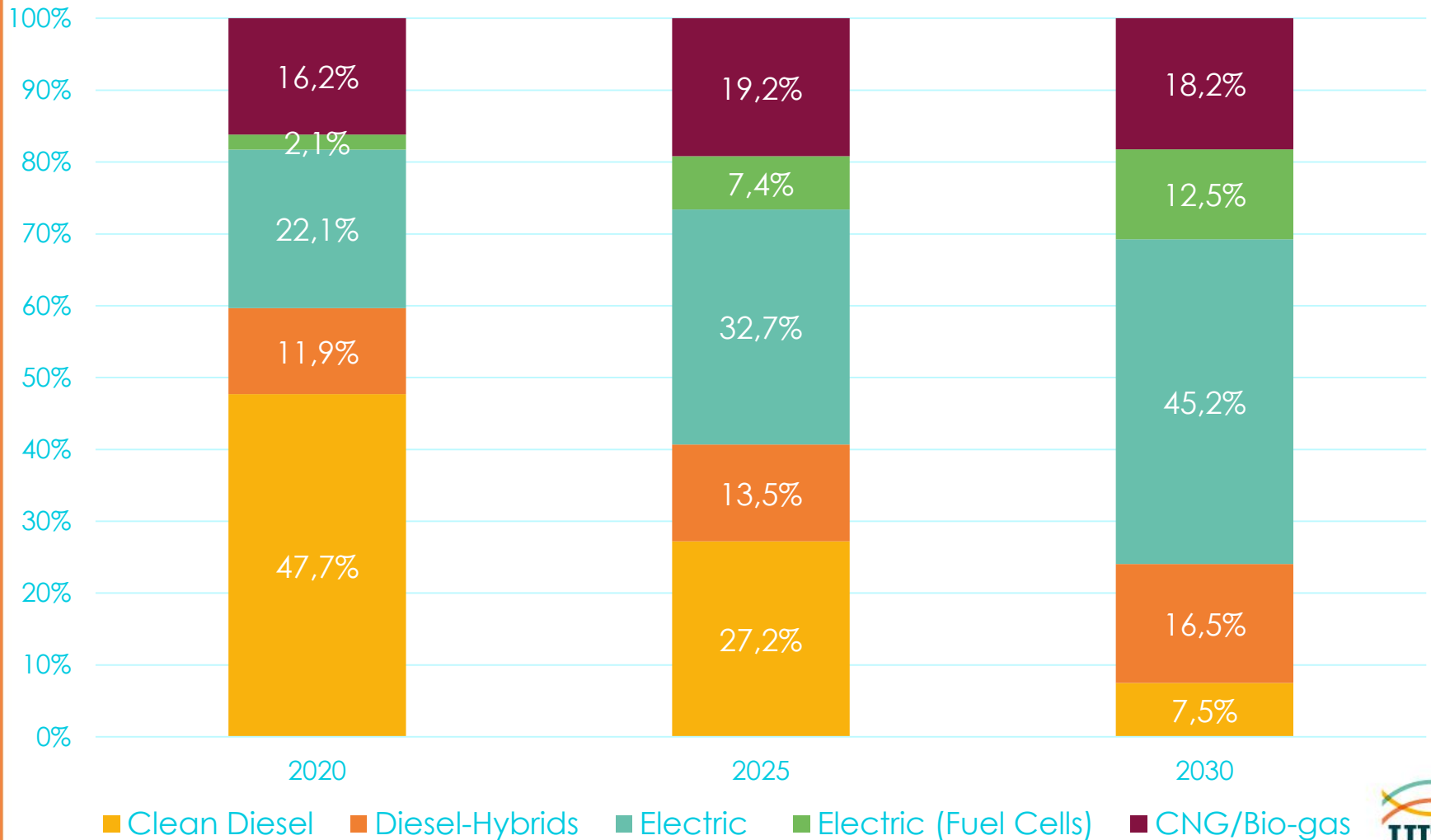
> PANEL DISCUSSION

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INDUSTRY VIEW: MARKET SHARE PROJECTIONS



Source: www.zeeus.eu and UITP VEI Committee





QUESTIONS?



THANK YOU!



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