ASECAP DAYS
MILANO 2024

A35 Brebemi

ALEATICA

POLITECNICO
MILANO 1863

UNIVERSITÀ
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THE FUTURE OF MOTOR FUELS: TRANSFORMING SAFETY, SUSTAINABILITY, AND TRAFFIC MANAGEMENT IN VEHICLES

ARENA DEL FUTURO PROJECT – WIRELESS POWER TRANSFER STUDY

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OVERVIEW

- The A35 Brebemi "Arena del Futuro" Partners
- The DWPT technology
- Design and technical specifications for the installation of ERS systems in the test track
- Experimental campaign
- Energy efficiency
- Measurement of magnetic field
- Compatibility with electromedical devices
- Asphalts - Laboratory Activity
- Asphalts - Characterization tests and parameter monitoring

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The A35 Brebemi "Arena del Futuro" Partners

The Italian pilot project "Arena del Futuro" coordinated by A35 Brebemi-Aleatica is the most advanced in DWPT technology.
Partner Companies, Institutions and Universities are reference points in each sector of competence.

Industrial Partners

A35 Brebemi ALEATICA

System ERS WPT	electreon
Development and integration of the WPT system	STELLANTIS, IVECO, IVECO BUS
Power supply and distribution	ABB, Prysmian Group, FIAMM
Asphalt	MAPEI
Construction	PIZZAROTTI
Communications V2I	TIM

Research centres

Power supply and charging	POLITECNICO MILANO 1863	**EQUIPMENT:** Study of power system, distributions, protections and electromagnetic fields.
Materials & Environment	UNIVERSITÀ DI PARMA	**INFRASTRUCTURE:** Electromagnetic fields and their interaction with asphalt mixes.
Environment	ROMA TRE	**ENVIRONMENT:** estimation of impacts and benefit

Security forces

Polizia di Stato, Vigili del Fuoco Corpo Nazionale

SAFETY: emergencies' management

This innovative system made by Electreon consists in many coils buried under the asphalt that transfer the energy directly to the vehicles during their journey.

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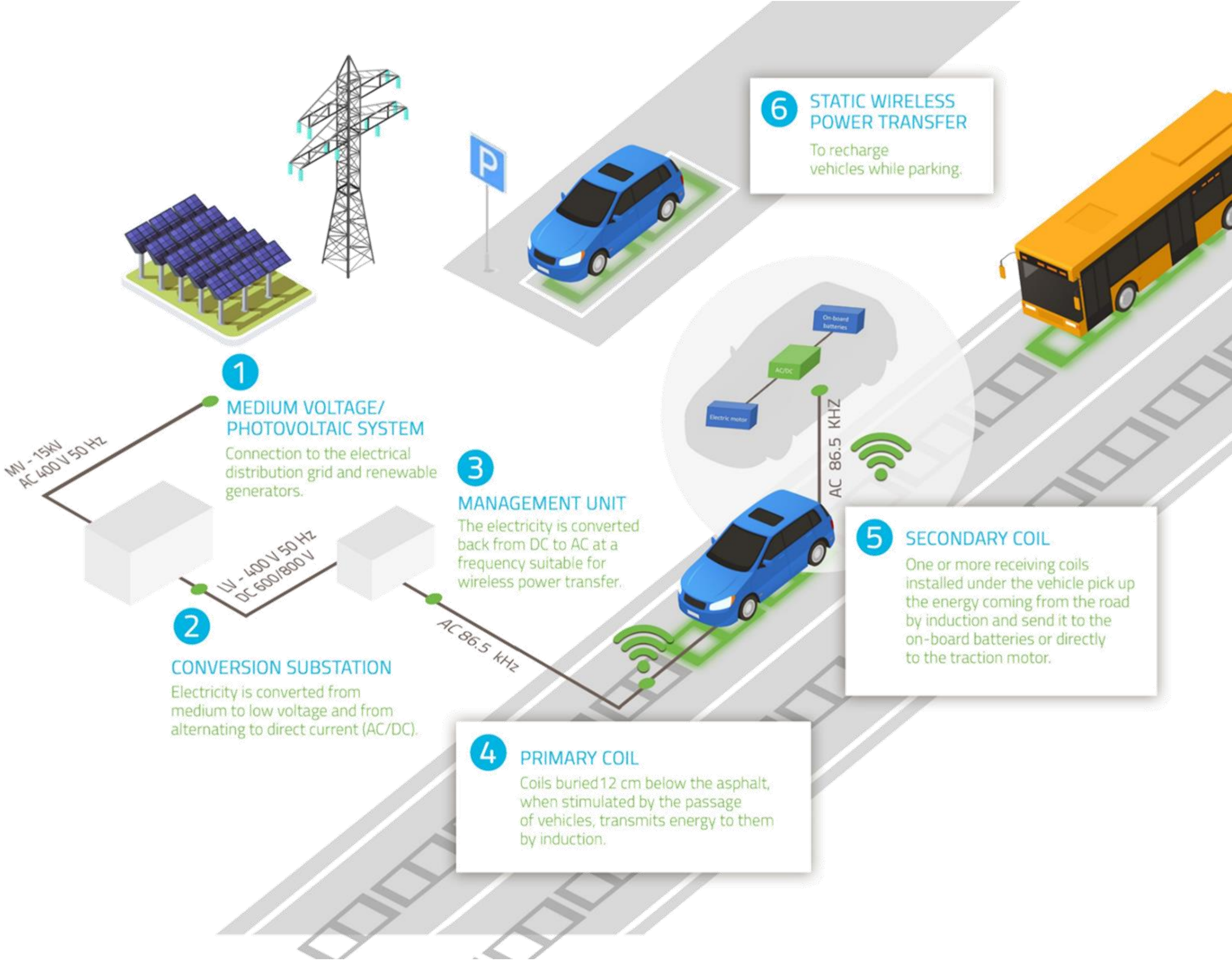
The WPT technology

Dynamic Wireless Power Transfer (DWPT), which is the power supply for dynamic charging of electric vehicles from the point of delivery in medium voltage to the Management Units (MU) that feed the coils placed under the road surface, is still the subject of research by the scientific community and in the industry.

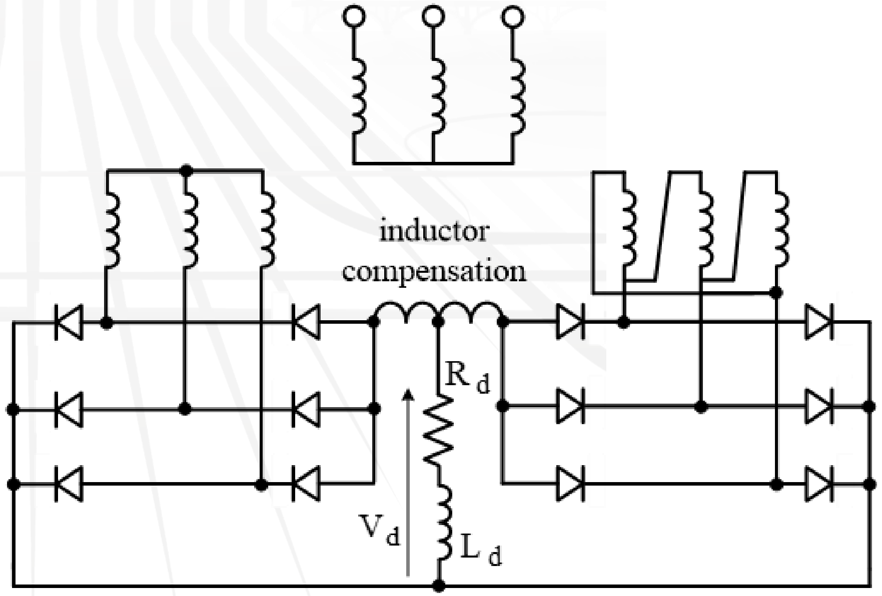
DWPT applied to e-Roads represents an important enabler of e-mobility. In fact, it allows to extend the mission coverage of Electric Vehicles (EV), reduce Total Costs of Ownership (TCO), and increase stowage space by reducing battery sized enabling contactless stationary charging. Moreover, all this applies to every product range from a small city-car to a heavy truck and both to Battery (BEV) and Fuel-Cell Electric Vehicles (FCEV).

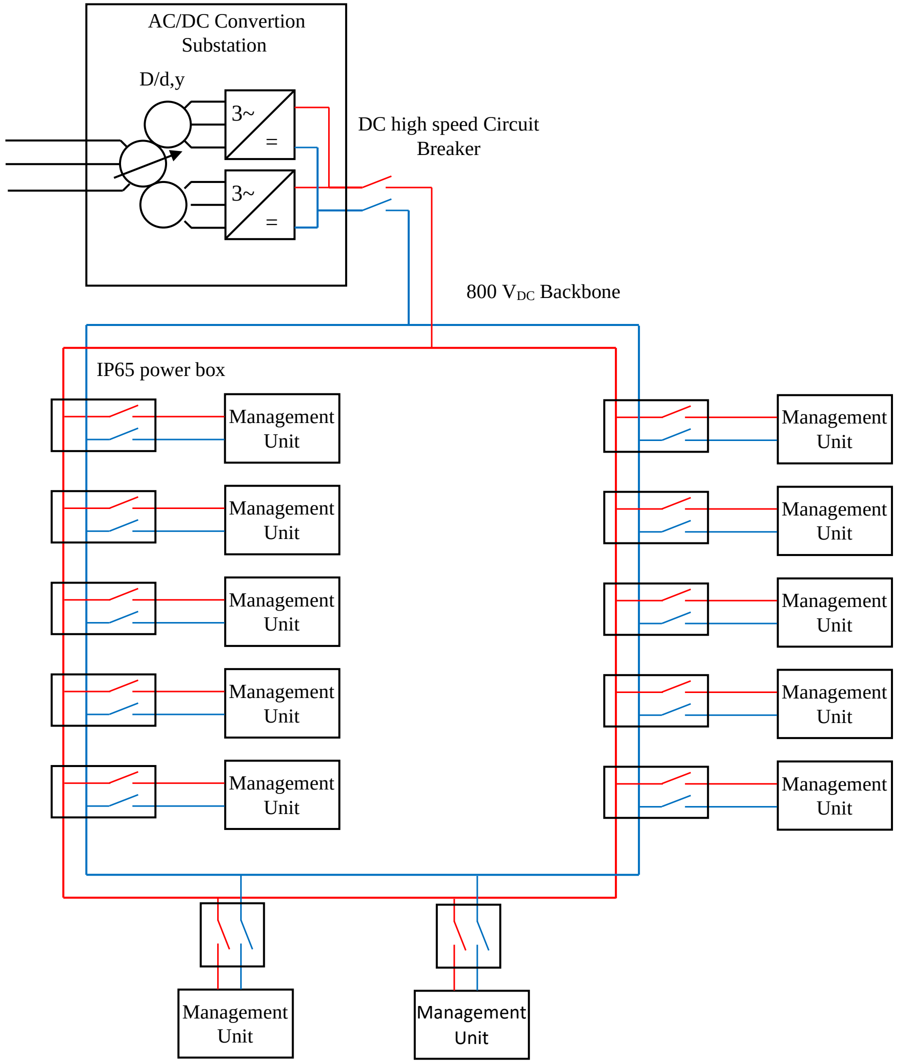


Design and technical specifications for the installation of ERS systems in the test track

The DC distribution has been chosen to supply the Management Units according to the loop distribution as here represented.

The AC/DC conversion is realized through a 12-pulse reaction diode bridge in order to maximize the energy efficiency of the system.





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Experimental campaign

POWER MEASUREMENT

The Brebemi test ring has been completed both from the point of view of civil and electric power system operations. To this aim the installation of measuring systems for the detection of electrical quantities (voltage, power, current. etc.) has already begun both in the conversion substation and in the field power boxes as shown in this figure.



ELECTROMAGNETIC FIELD MEASUREMENT

At the same time dynamic power transfer tests were launched between infrastructure and vehicles consisting of an IVECO electric bus and a Fiat 500e in order to assess energy efficiency and associated electromagnetic fields.

The measurement are carried out in different positions of the vehicle under different operating conditions (maximum speed, alignment, etc.).



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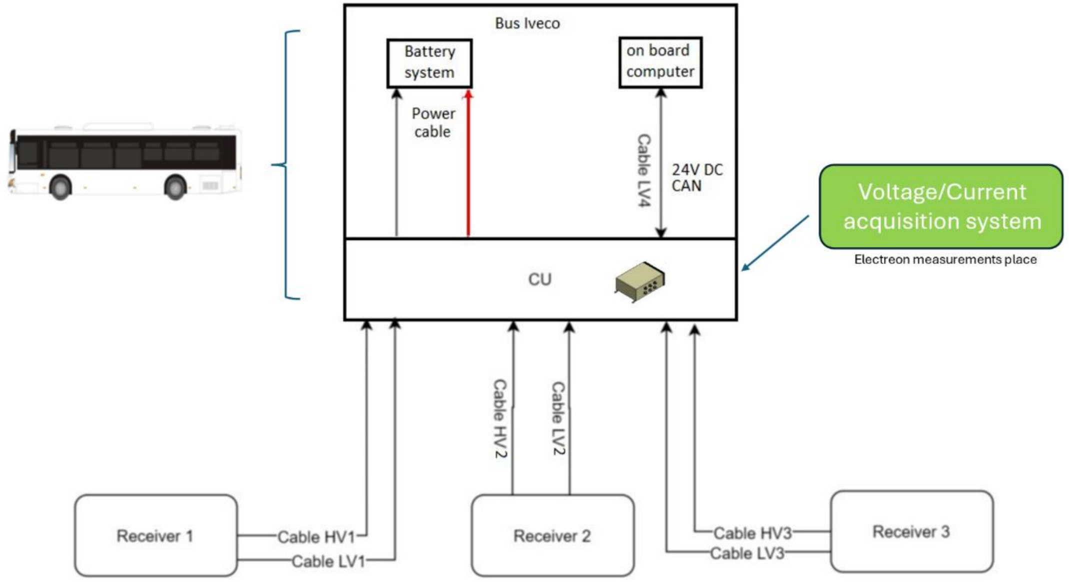
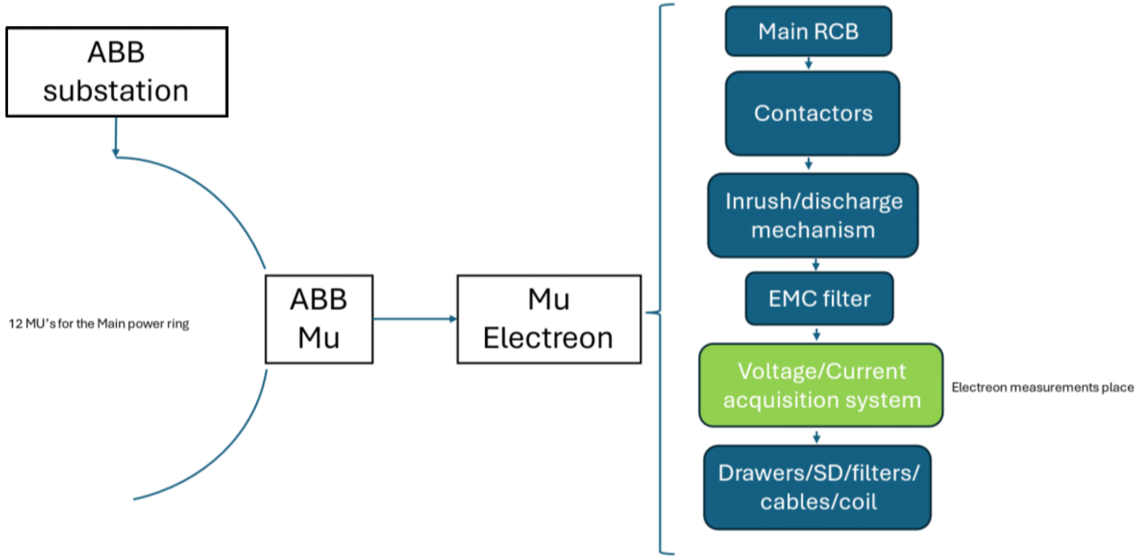
Energy Efficiency

Energy Efficiency was assessed as the ratio of the energy supplied on board the vehicle measured at the DC-link, thus also including the performance of the on-board electronics, to the energy absorbed by the Management Unit

Charging typology	Energy received by the vehicle [kWh]	Energy absorbed by the MU [kWh]	Energy efficiency [%]
Static	0.642	0.77	92.1
Static	4.298	4.93	92.0
Static	5.143	5.94	90.7
Dynamic	0.602	0.698	86.2
Dynamic	0.508	0.606	83.8
Dynamic	0.518	0.621	83.4
Dynamic	0.504	0.608	82.9
Dynamic	0.367	0.419	87.6
Dynamic	0.377	0.432	87.3
Dynamic	0.382	0.439	87.0
Dynamic	0.377	0.434	86.9





Measurement of magnetic field 1/2

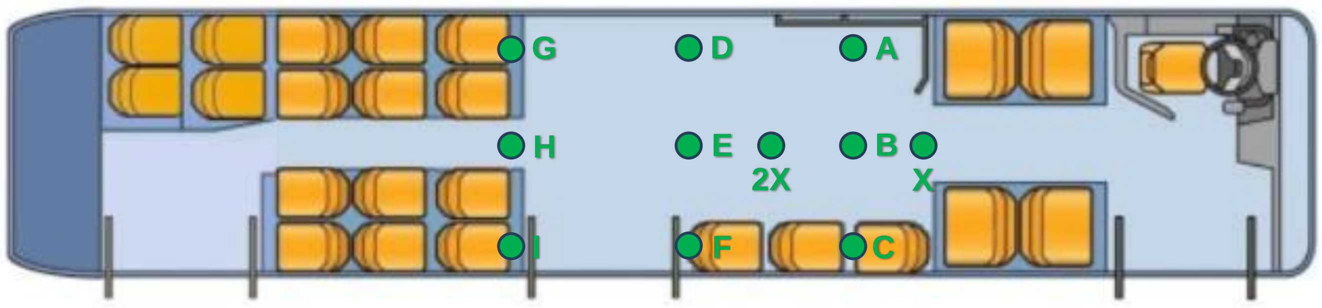
The DWPT system operates through a magnetic coupling between the transmitting coils under the road and the receiving coils on the vehicle. Since it operates at a constant frequency of 86 kHz, the level considered as the reference value for the flux of the magnetic field is 6.25 μT as indicated in table 2 of Annex 3 of the ICNIRP Guidelines.

The instrument used for the measurement is the Wavecontrol SMP2-5G equipped with a WP400 probe.

The magnetic field was measured in 9 different points on board of an electric bus at 3 different speeds.

For each point the measures were taken at 3 different heights:

1. At the floor level
2. At 95 cm from the floor (heart level of an adult)
3. At 170 cm from the floor (head level of an adult)



A: on the right of the 1st receiving coil (disabled area)

B: in correspondence of the axis of the 1st receiving coil

C: on the left of the 1st receiving coil

D: on the right of the 2nd receiving coil

E: in correspondence of the axis of the 2nd receiving coil

F: on the left of the 2nd receiving coil

G: on the right of the 3rd receiving coil

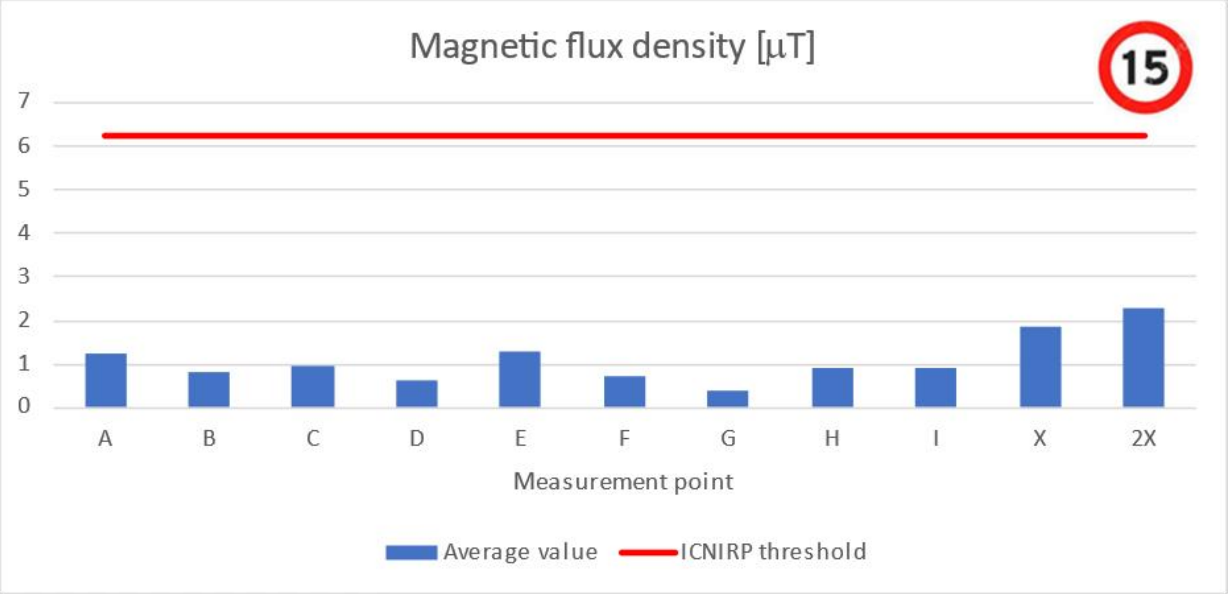
H: in correspondence of the axis of the 3rd receiving coil

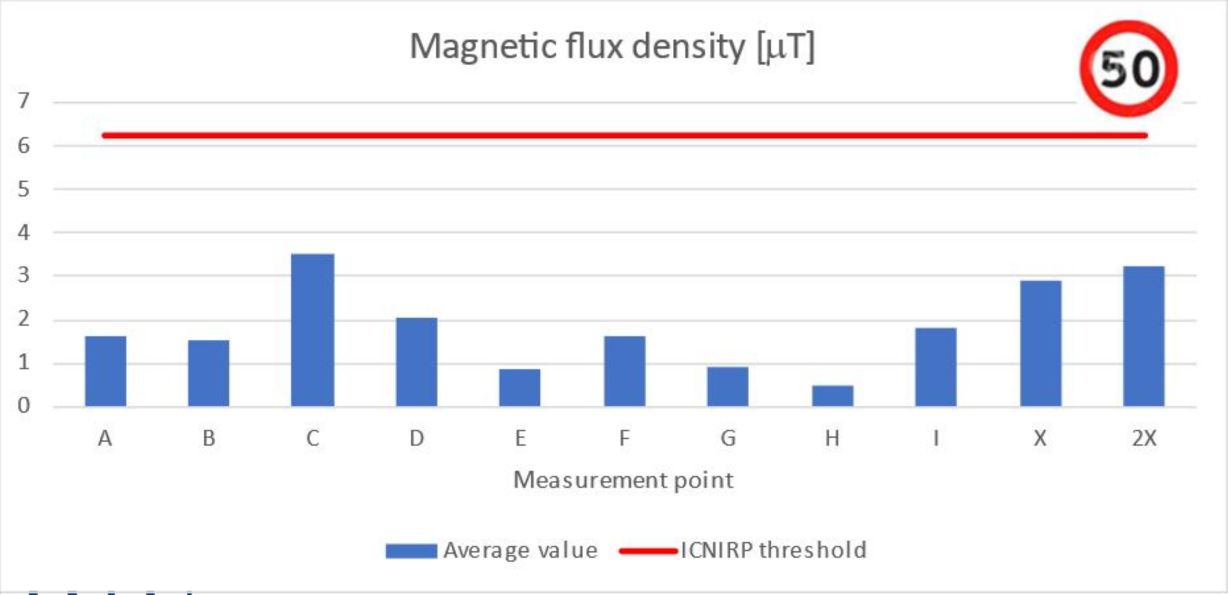
I: on the left of the 3rd receiving coil

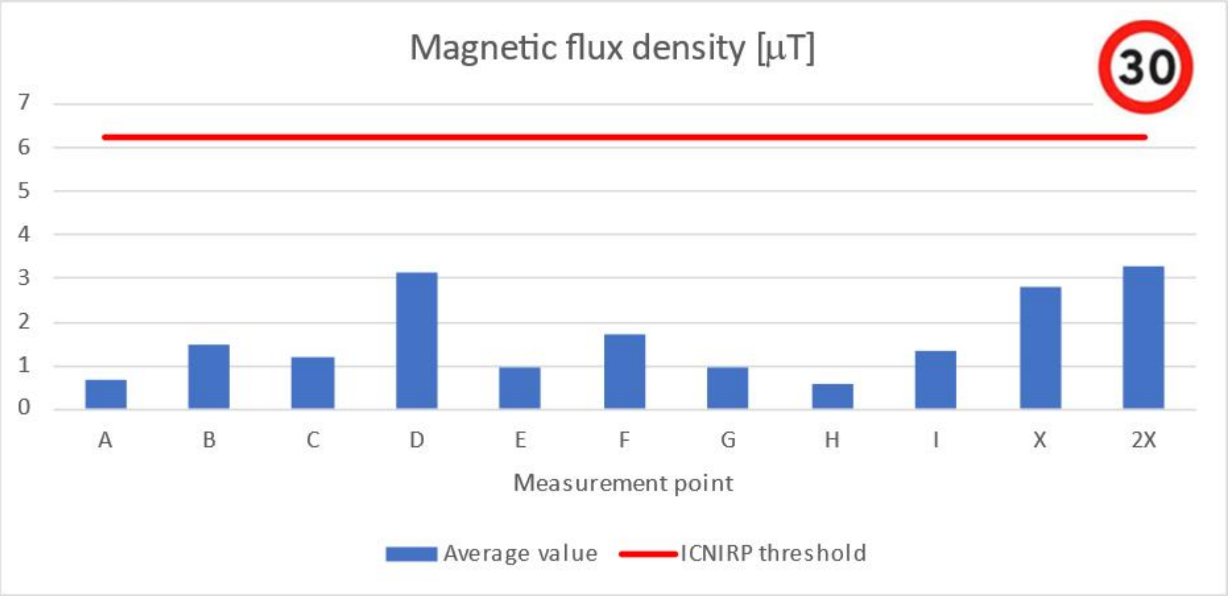
Measurement of magnetic field 2/2

Comparison of the measurements between 15 km/h, 30 km/h and 50 km/h

All the measured fields are below the allowed threshold.







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Compatibility with electromedical devices

For testing electromagnetic compatibility between the track facility and electromedical devices such as pacemakers and electrostimulators many tests were conducted under different speed conditions of the vehicle and position of the device including a person lying down on the floor. To reproduce real conditions the device inside the human body was embedded in an appropriate physiological solution.

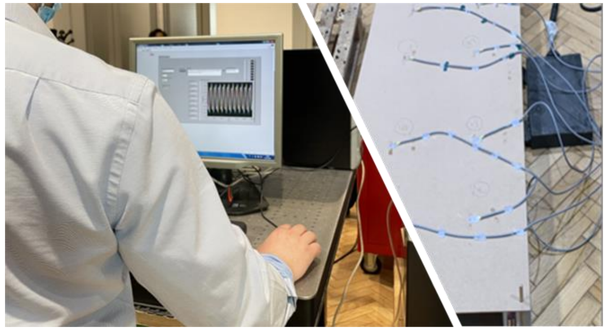
During the execution of the tests, through the use of sophisticated instrumentation, monitoring of the equipment was carried out.

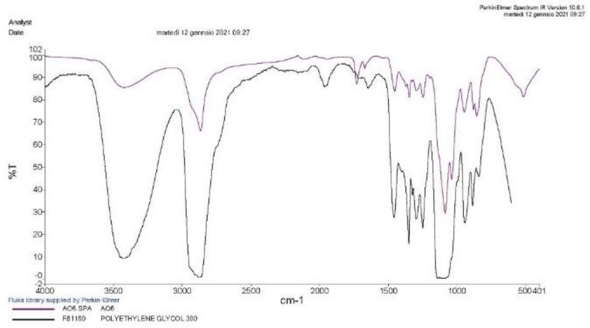
No interference with the electromedical device was detected.

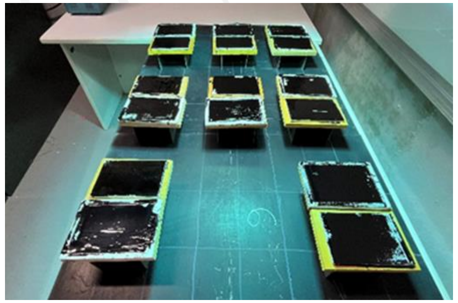
Asphalts - Laboratory Activity

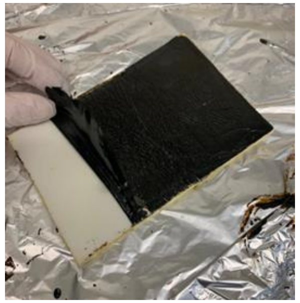
- BEFORE ACTIVITY COSTRUCTION

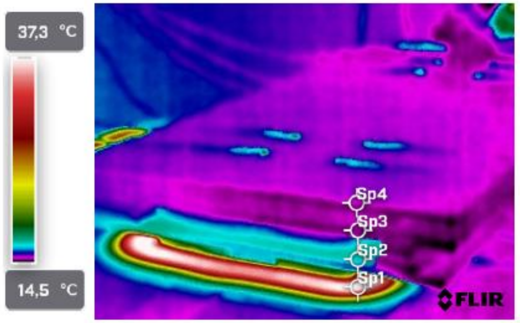
CHEMICAL CHARACTERIZATION OF BITUMENS WITH ADDITIVES → RHEOLOGICAL PROPERTIES OF BITUMENS WITH ADDITIVES → SIMULATION PROTOCOLS TO EVALUATE MATERIAL PERFORMANCES → LABORATORY SCALE PROTOTYPES TO SIMULTANEOUSLY ANALYZE ALL VARIABLES









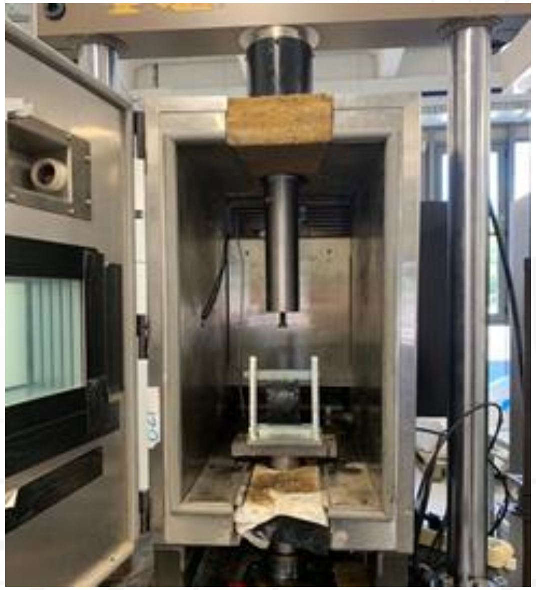


Coil and plasterboard structure

Asphalts - Characterization tests and parameter monitoring

- BITUMINOUS CONGLOMERATE CORES EXTRACTION EVERY 4 MONTHS

DURING ON SITE EXPERIMENTATION



Mechanical Characterization of mix designs in laboratory

- Tensile Strength
- Resilient Modulus/Creep Compliance
- Complex Modulus

DESTRUCTIVE TESTS | **NON DESTRUCTIVE TESTS**

FWD Falling Weight Deflectometer

Monitoring of:

- Deformations under load
- Mechanical parameters of materials
- Alteration of the thicknesses of the asphalt pavement layers

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THANK YOU

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