FABRIC

Feasibility analysis and development of on-road charging solutions for future electric vehicles

FABRIC Final Event

The story of the Italian test site

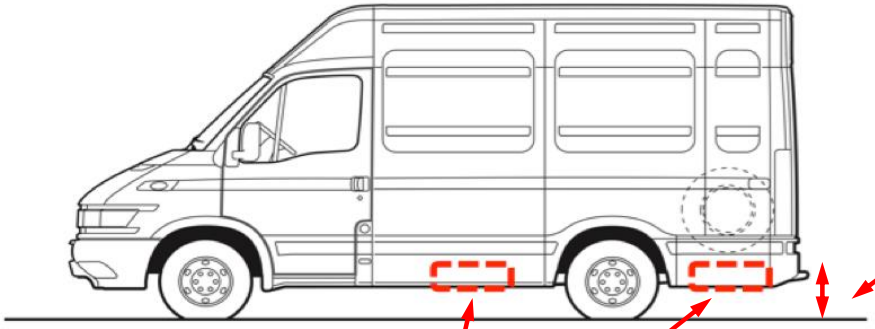
Paolo GUGLIELMI
POLITECNICO DI TORINO - DENERG
paolo.guglielmi@polito.it

TURIN, 21 June 2018

From eCo-FEV to FABRIC

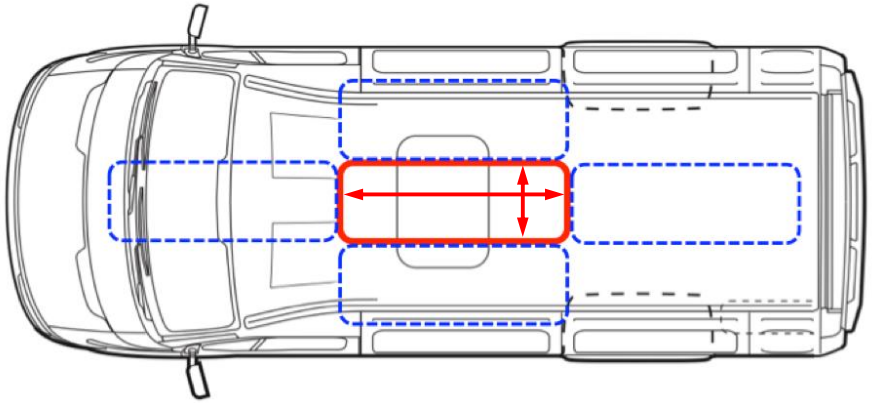
Development of the laboratory prototype
Electromagnetic design

A shape for the coils



Ground clearance
18 cm
(ISO/DPAS 19363)

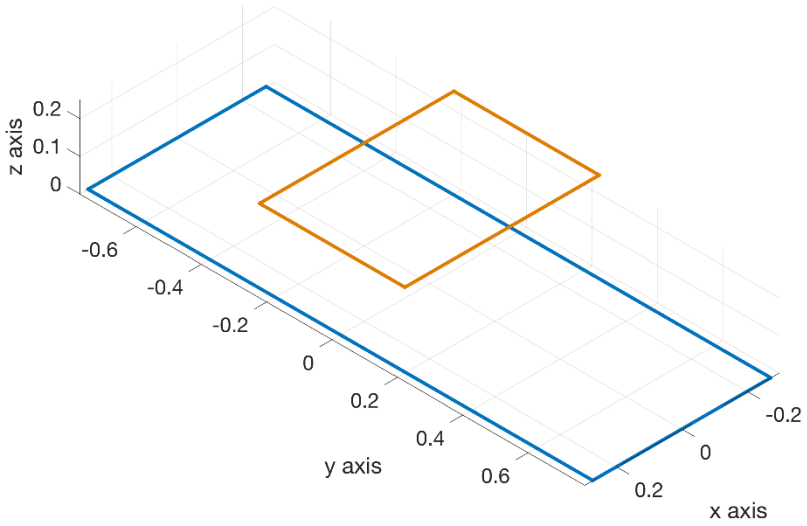
Two available mounting positions
(center and rear)
150 cm X 50 cm X 50 cm



Fixed (inner) transmitter dimensions: 0.5 m X 1.5 m

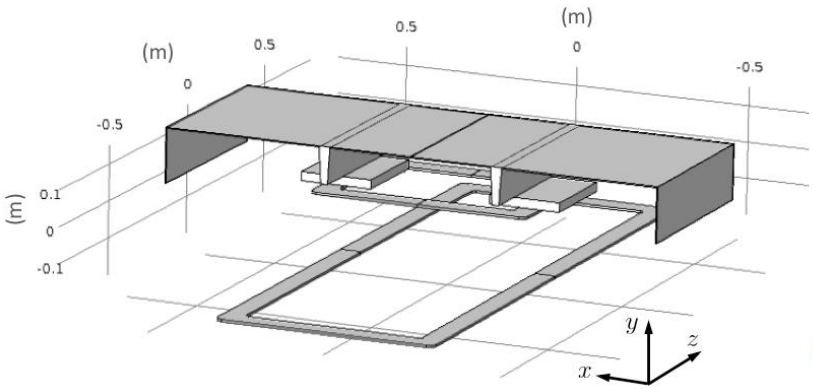
Development of the laboratory prototype
Electromagnetic design

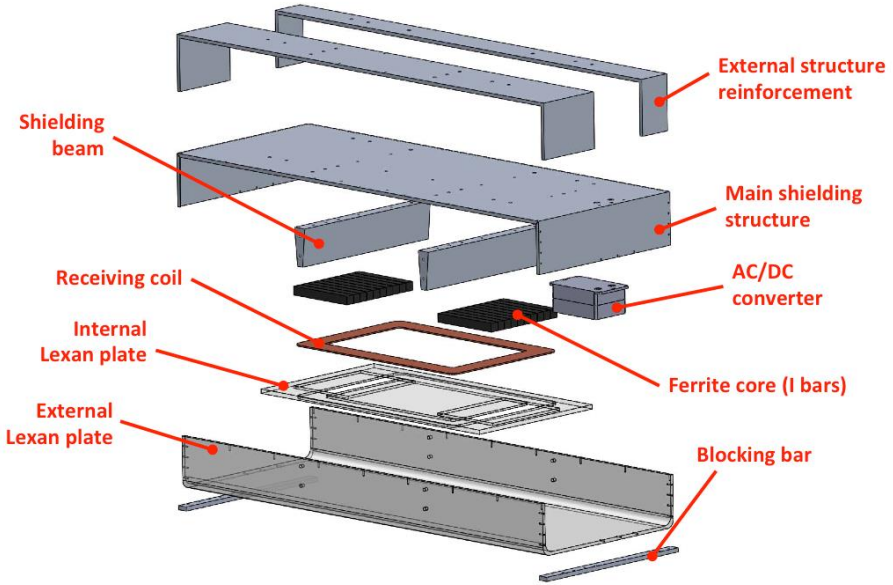
SIMPLE magnetic solution
Same physical dimensions meaning similar coupling factors



SAME adopted RECEIVER but different solutions implemented on the transmitting side
In both solutions
NO ferrite on ground
NO shielding on ground

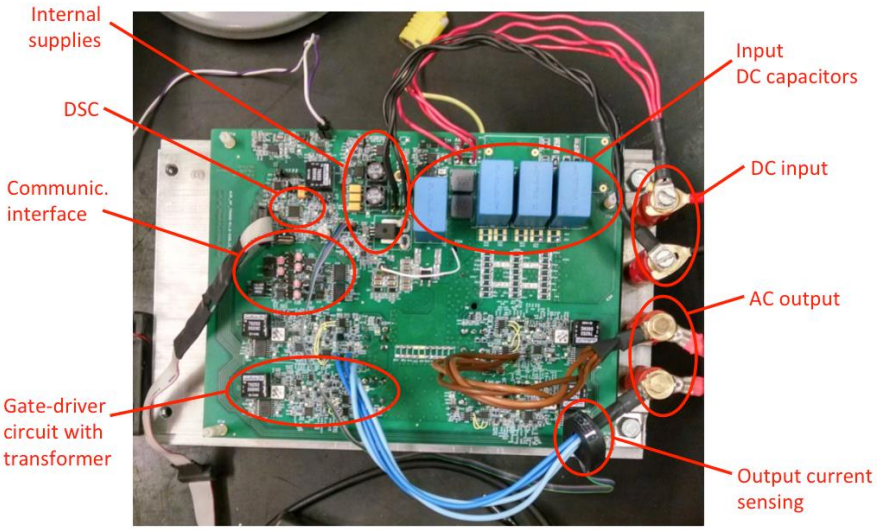
Development of the laboratory prototype
Electromagnetic design





Development of the laboratory prototype
PE design – Transmitter DC/HF

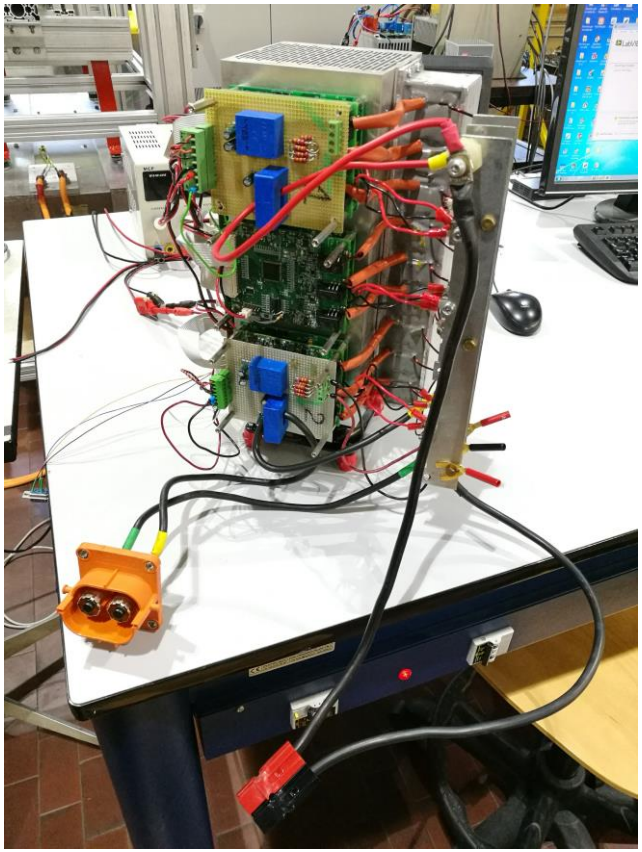
First POLITO prototype

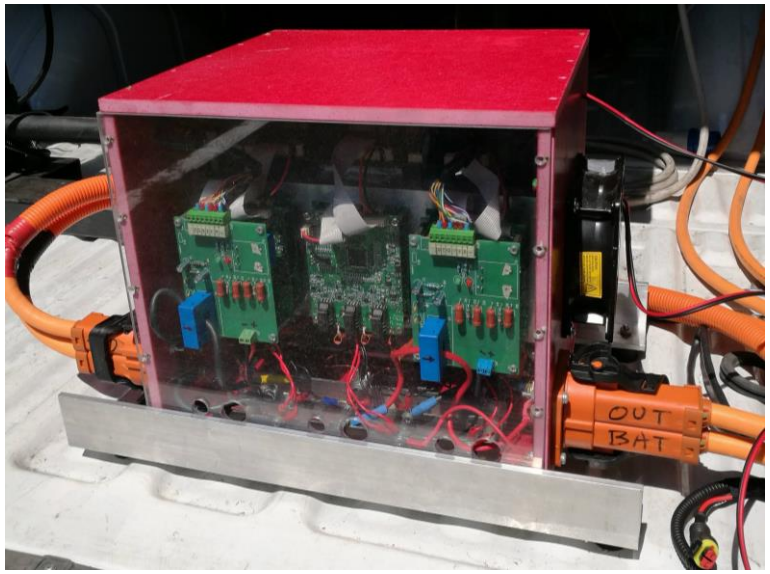


SAET Peculiarity

SAET prototype

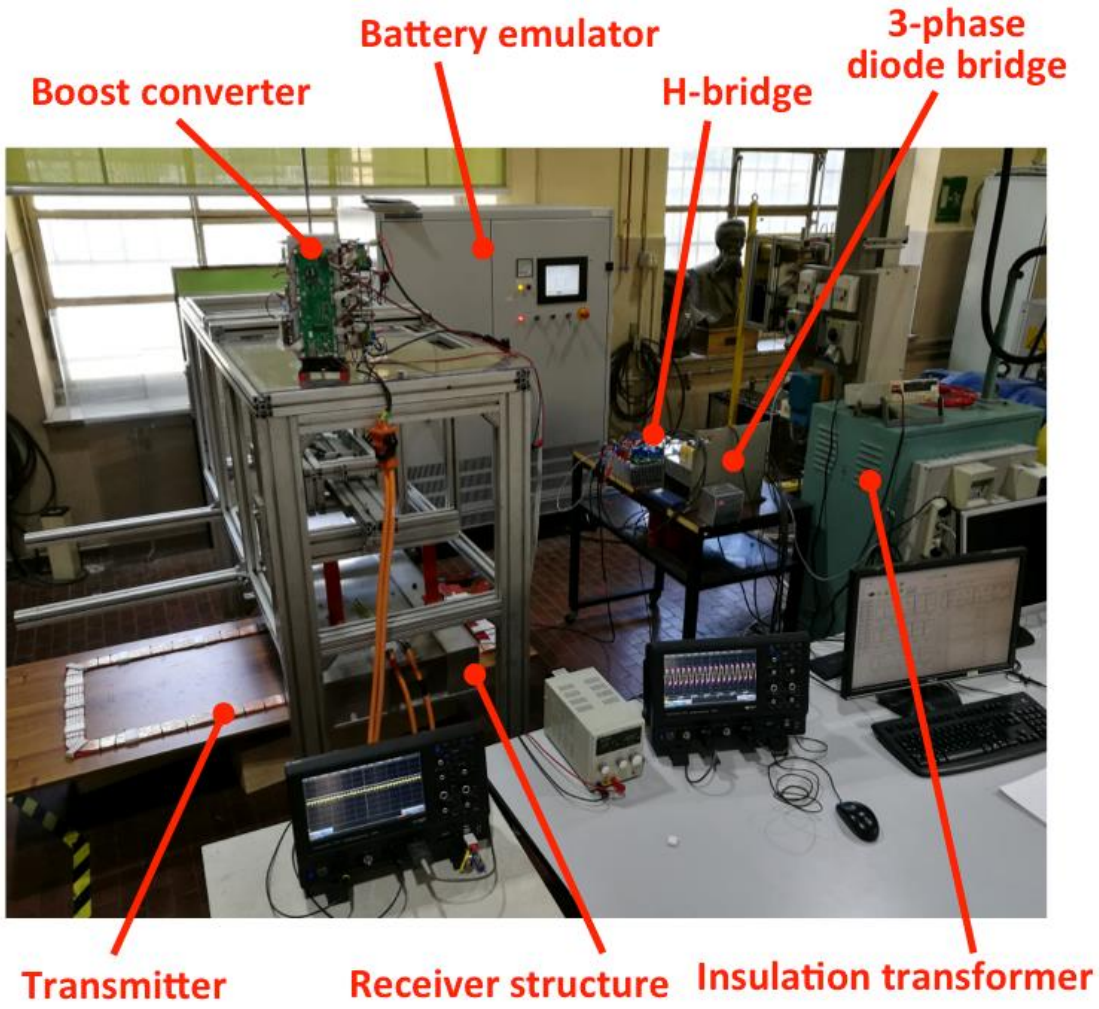
Development of the laboratory prototype
PE design – Receiver DC/DC



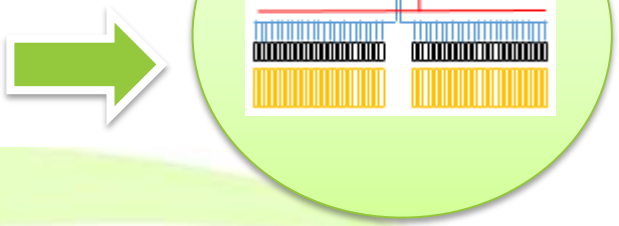


Development of the laboratory prototype

The ensemble



Extension towards the on-road system
Goals and challenges



1. An interoperable test site

- DIPT capability up to 100m & 100kW total
  - Each coil designed to operate between 0 and 20kW
- Flexibility
  - Each coil can individually limit the transmittable power
- Two different distributions and IPT configurations on ground
- The vehicle will chose how much power receive
- MINIMUM COST

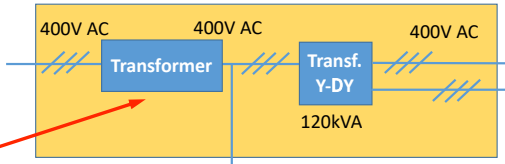
2. All ICT and communication issues

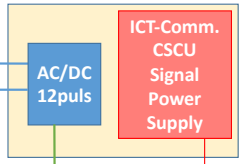
- Authorization Accounting and Metering

3. Human exposure to EMF assessment

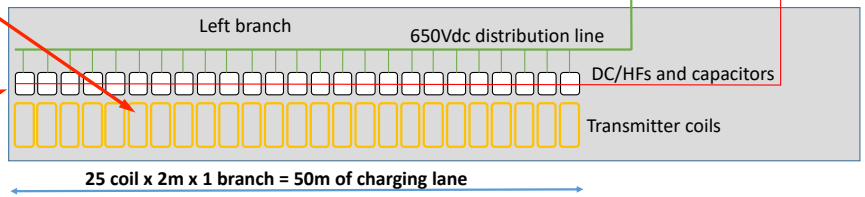
Extension towards the on-road system
The test site electric plant

SAET architecture



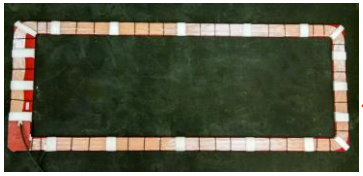


SAET SYSTEM SETUP



Extension towards the on-road system
The test site electric plant

POLITO architecture



Extension towards the on-road system
First crucial issue: the compensation capacitors

For transmitted power of decades of watts the voltage stress over the compensation capacitors is in the order of ten kilovolts
=> A huge voltage stress tolerant capacitor is mandatory

Any variation of the capacitance leads to a strong variation of the equivalent coils behavior
=> A strong precision is mandatory

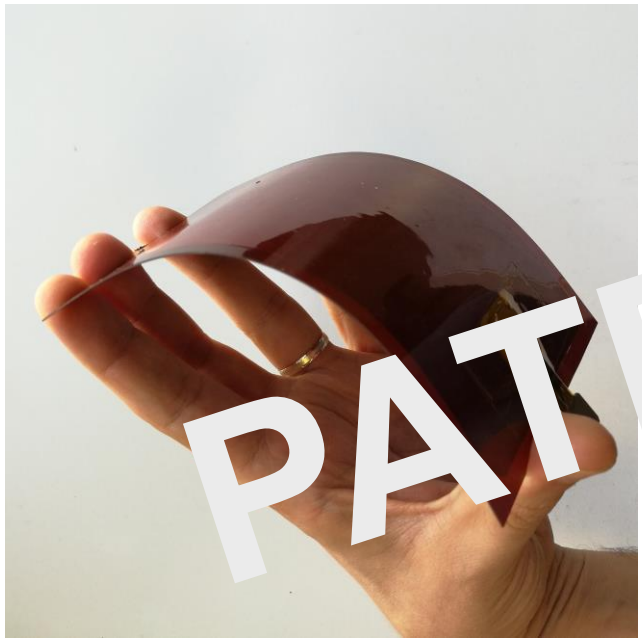
Each coil needs is own compensation capacitor
=> A reduced cost is mandatory

Only few and really expensive capacitors fit these characteristics so…

Extension towards the on-road system
First crucial issue: the compensation capacitors

We invented and constructed OUR own capacitor

The RES power CAP



Extension towards the on-road system
PEs adaptation for widespread external installations

- Daisy chain connections for power and communication
- IP68
- Same communication protocol through CAN network
- Minimum cost

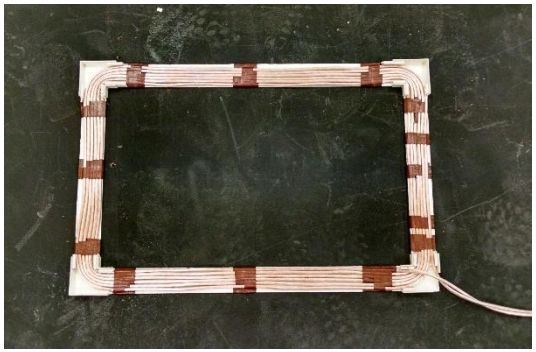
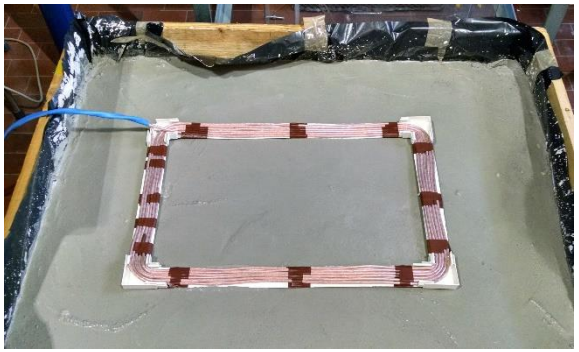
Extension towards the on-road system
Second crucial issue: transmitter coils embedment

First embedding trial

The test showed that the coil were no longer behaving as inductors!!!

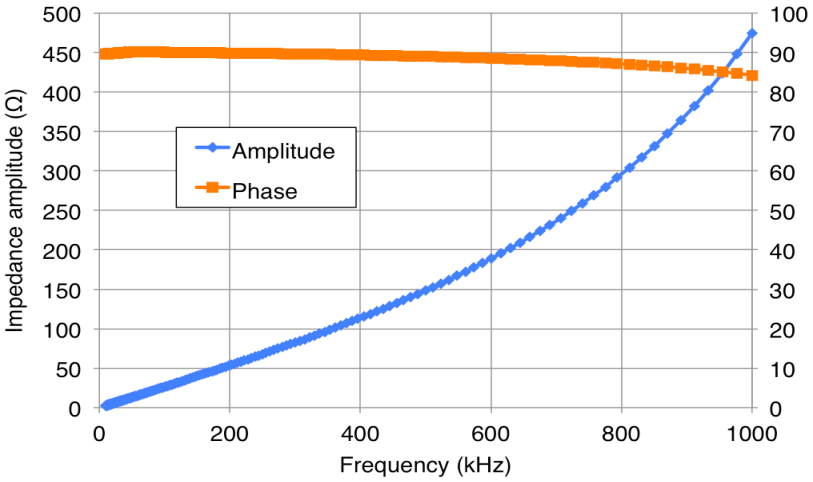
Extension towards the on-road system
Second crucial issue: transmitter coils embedment

The embedment conditions have been repeated in lab

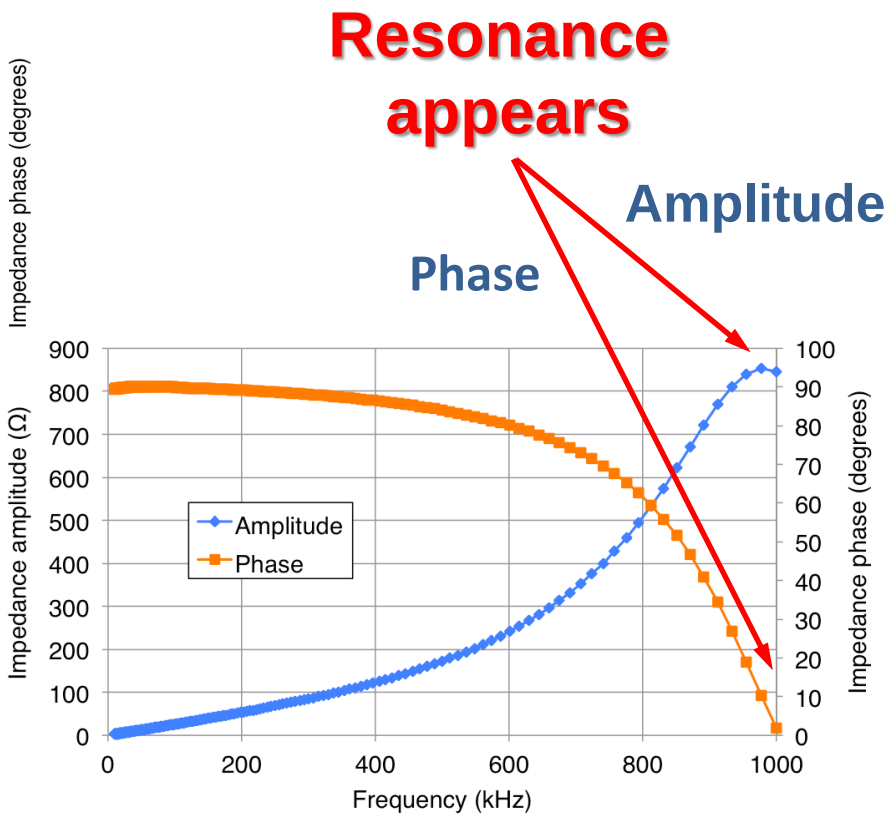




Replicated embedding conditions in laboratory

Extension towards the on-road system
Second crucial issue: transmitter coils embedment



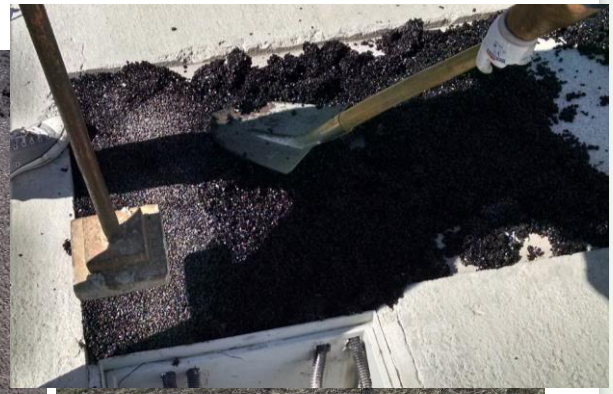
Before embedding



After embedding

Extension towards the on-road system

Second crucial issue: transmitter coils embedment

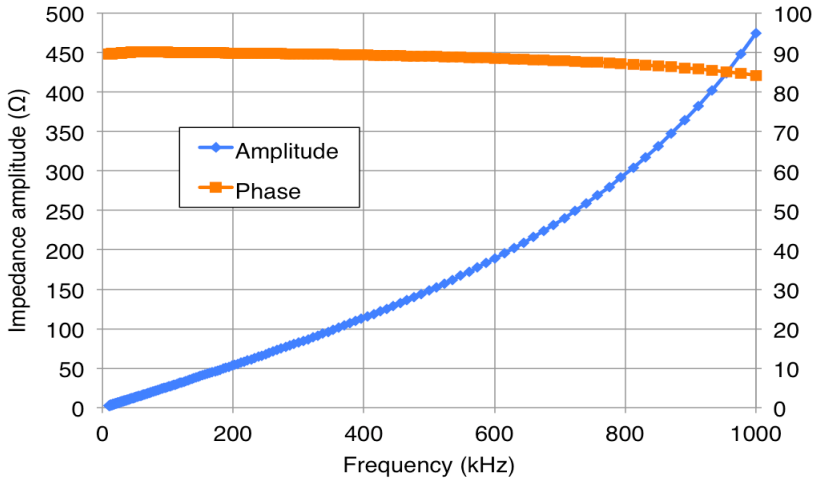


After about six months of tests…

Extension towards the on-road system

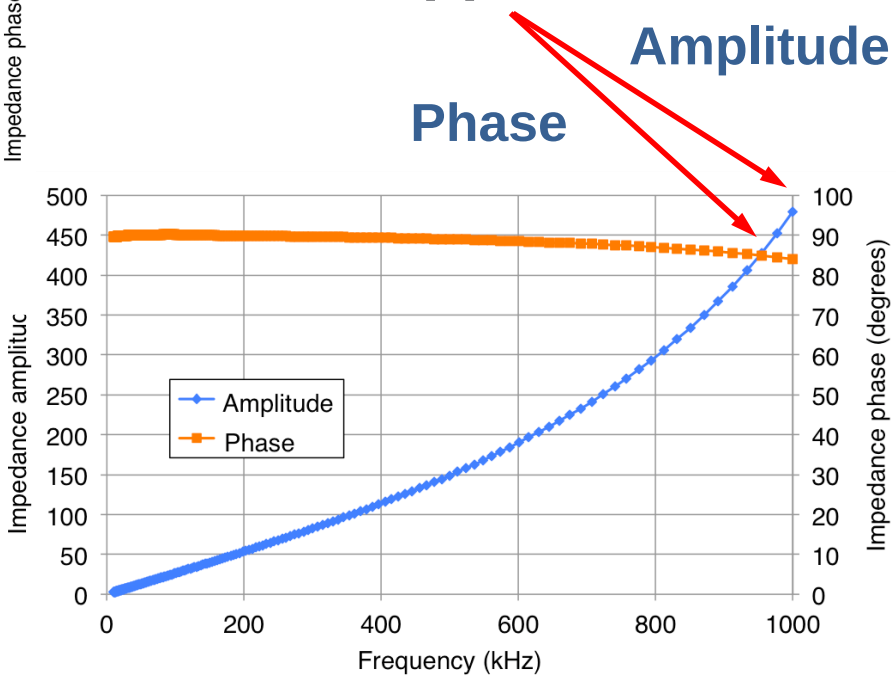
Second crucial issue: transmitter coils embedment

Our solution under patenting



Before embedding

Resonance disappears!



After embedding with our material

Extension towards the on-road system
Second crucial issue: transmitter coils embedment

Dedicated embedment method

Extension towards the on-road system
On-road infrastructure

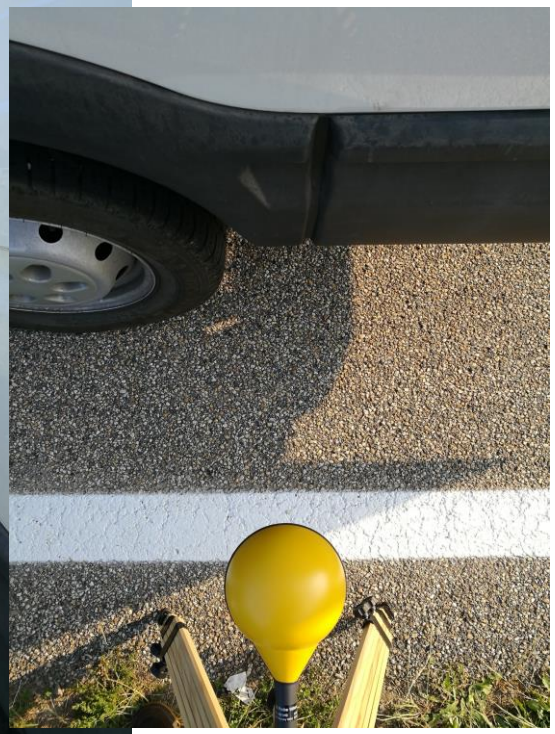
Charging lane construction

Extension towards the on-road system

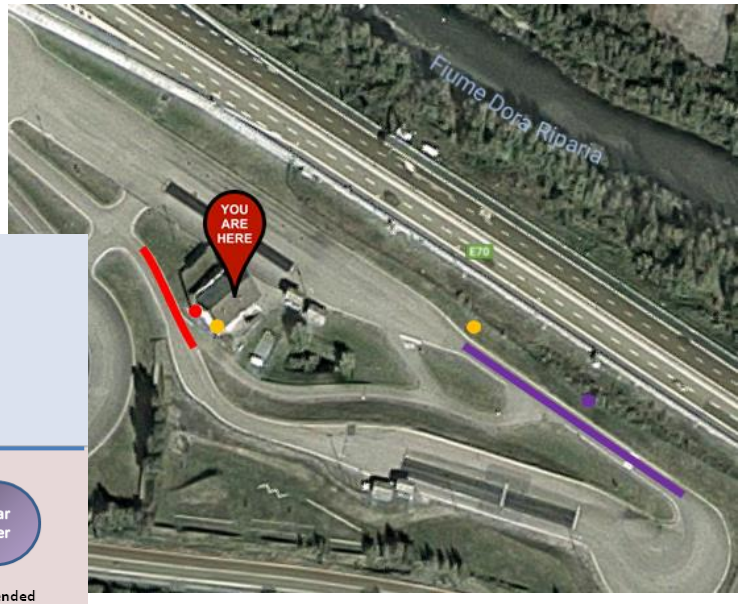
On-road infrastructure

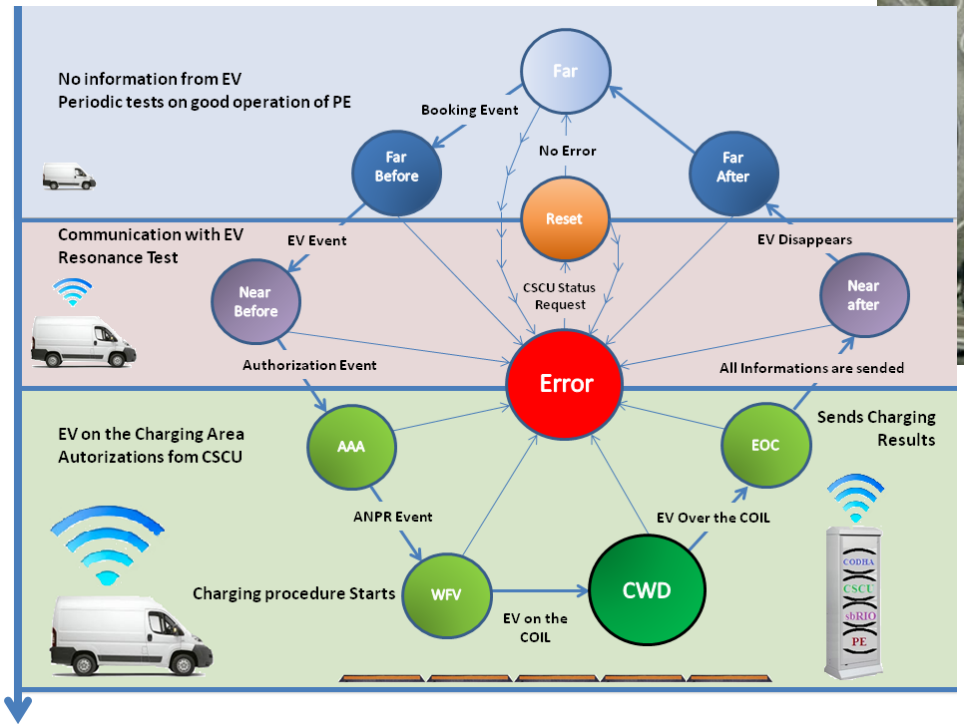
Extension towards the on-road system
Installation on vehicle board

Extension towards the on-road system
Installation on vehicle board: EMF exposure



The POLITO Charge While Driving
Management of the charging process





The POLITO Charge While Driving
Achieved results

POLITO

- Maximum transferred power = 6.5 kW
- Maximum efficiency = 81%
- Maximum test speed = 50 km/h
- Maximum manageable misalignment = 30 cm
- Compliance with actual standard for EMF exposure verified for passengers and people in proximity of the vehicle

SAET

- Maximum transferred power = 9 kW
- Maximum efficiency = 66%
- Maximum test speed = 30 km/h
- Maximum manageable misalignment = 30 cm
- Compliance with actual standard for EMF exposure verified for passengers and people in proximity of the vehicle

FABRIC

Feasibility analysis and development of on-road charging solutions for future electric vehicles

Thank you!

Paolo GUGLIELMI

Associate Professor,

Politecnico di Torino – DENERG
Italy

paolo.guglieilmi@polito.it