Technical Sessions
PAVEMENT MANAGEMENT & PERFORMANCE

Dynamic electric charging on motorways

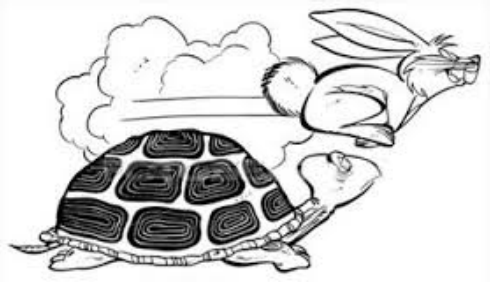
FABRIC

Guy Frémont, Head of Department Prospective and Transverse Projects - Sanef

Barcelona, 2017 May 23.

What role for the motorway operators ?

- Electric vehicle / motorway : a difficult association considering the autonomy of the vehicles (150-200 km vs > 700 km for fuel vehicles)
- Motorways are designed for fuel engine vehicles : service stations are built in coherence (every 30-50 km) with their long range autonomy
- Static charging means 30 mn stops every 150 km
  - Making travels very slow, in contradiction with the purpose of travelling on motorways
  - Dynamic charging would allow charging while travelling



- A new role for the motorway operators : enhance the development of the electric vehicles by supporting the implementation of charging systems

Different ways to charge a vehicle on motorways

Static charge

Conductive

State of the art

Operational

Slow or fast charge

Obstacle

Standard in progress : 3 plugs, 4 modes of charge

Wireless

State of the art

In Test

Designed for bus in South Korea
Promissing results :
> 95% efficiency

R&D

European project « Fast in charge »

Dynamic charge

Conductive

State of the art

In Test

Developped by Siemens and Scania in Sweden

Obstacle

Heavy visual impact

Wireless

State of the art

R&D

in South Korea and Germany

European R&D project FABRIC

FABRIC

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

FABRIC : Motivation & Solutions

Motivation & Solutions

Necessity

- Reduction of greenhouse air pollutants.
- Reduction of fossil fuel usage in transport.
- Electrification of transport.

Research Needs

- Longer EV range.
- Wireless dynamic EV charging feasibility analysis.
- A priori lifecycle impact & feasibility assessment of large scale electromobility deployment.

Project Solution

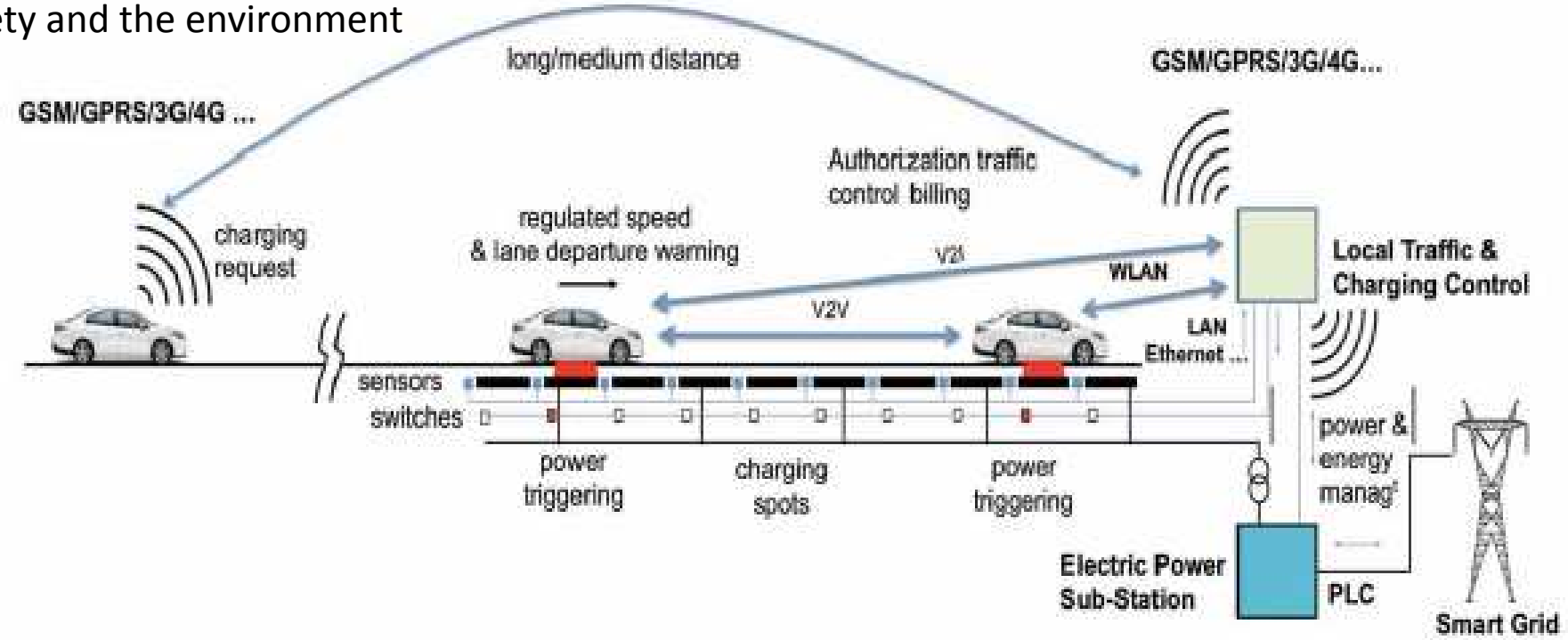
- Infrastructure adaptation.
- Prototypes testing.
- Feasibility studies.

Main objectives:

- Development and testing of advanced ICT and dynamic wireless charging solutions;
- Specifications for integration with road and grid infrastructures;
- Long-term socioeconomic impact and feasibility studies for large scale electromobility implementation.

FABRIC : Technical approach

- Assess the technological feasibility and long term viability of FEV wireless dynamic charging and the large scale deployment of electro mobility.
- Integrate adapted EVs, ICT and wireless power transfer solutions in road and grid infrastructure in 3 test sites
- Test and validate prototypes to feed feasibility analysis and impact assessment with respect to users, the society and the environment



FABRIC : Main achievements

Expected achievements

The FABRIC project expected achievements are :

- Road and grid infrastructure adaptations to support dynamic EV charging
- Development of prototypes for static, stationary and dynamic wireless EV charging
- Study of the Electromagnetic safety aspects
- Contribution to standards
- Feasibility study of the large scale deployment of dynamic charging solutions and economic sustainability study

Project Data

Coordinator

Angelos Amditis,
Institute of Communication & Computer Systems
a.amditis@iccs.gr

Duration: 48 Months
DGI: Unit Research and Innovation
Budget: 9 M€
Funding: 6.5 M€

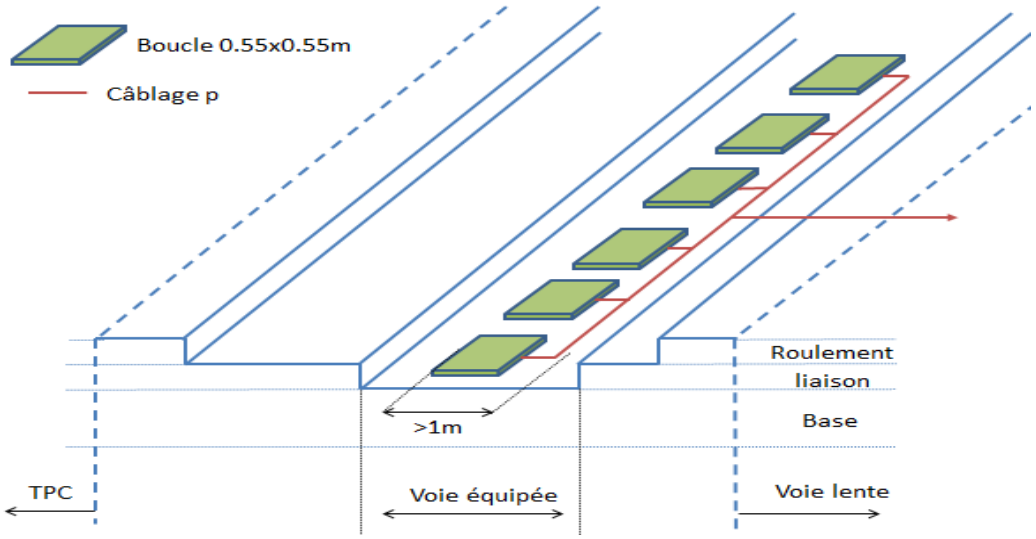
This project has received funding from the EU's FP7 for research, technological development & demonstration under GA no 605405

Consortium

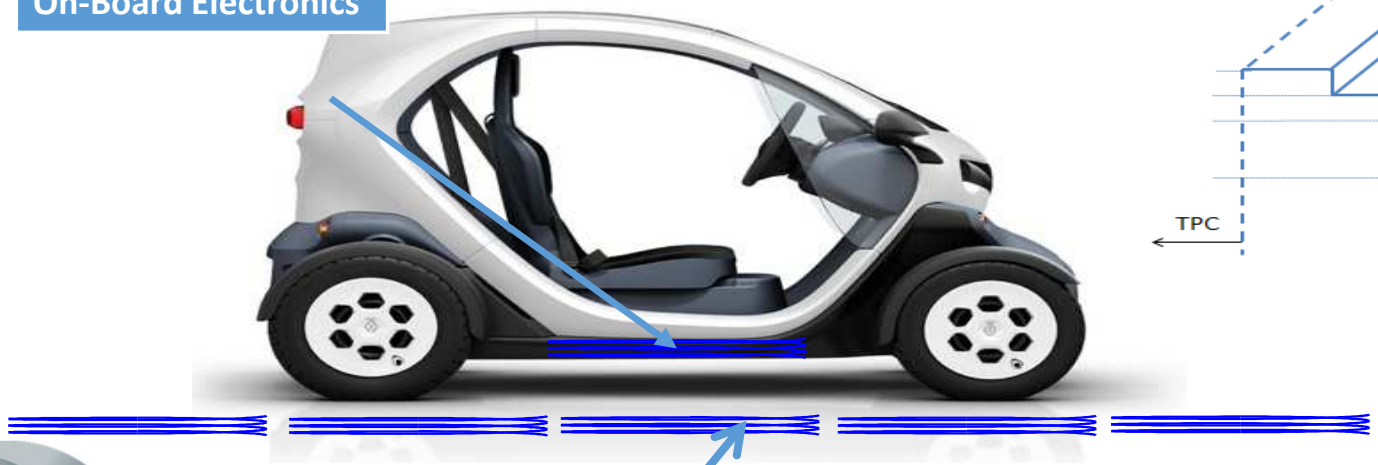
25 partners from 9 European countries: ICCS, CRF, ERTICO, TRL, KTH, VOLVO, SCANIA, TNO, VeDeCom, CIRCE, QIE, IREN, FKA, TECNOSITAF, ENIDE, POLITO, UNIGE-DITEN, SAET, SaNeF, CEA, ATA, AMET, MECT, HITACHI Europe Ltd, TU Berlin

Inductive charging : principles of functioning

FABRIC



On-Board Electronics



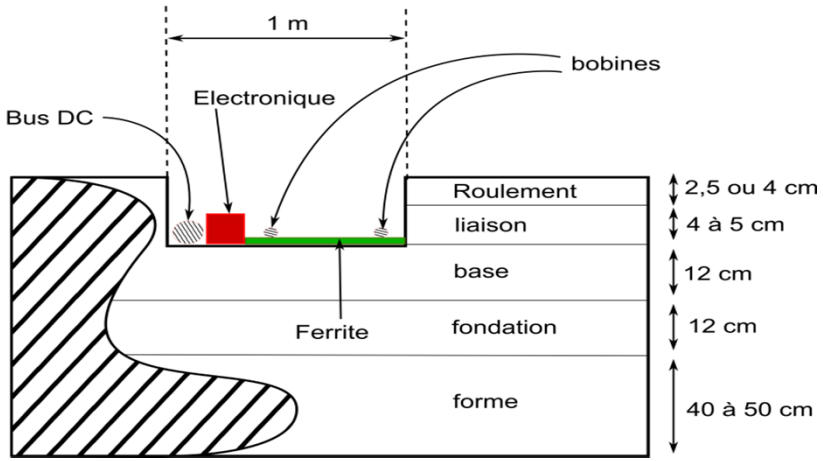
Inductive coils

ertis

FABRIC project : issues for highway operators

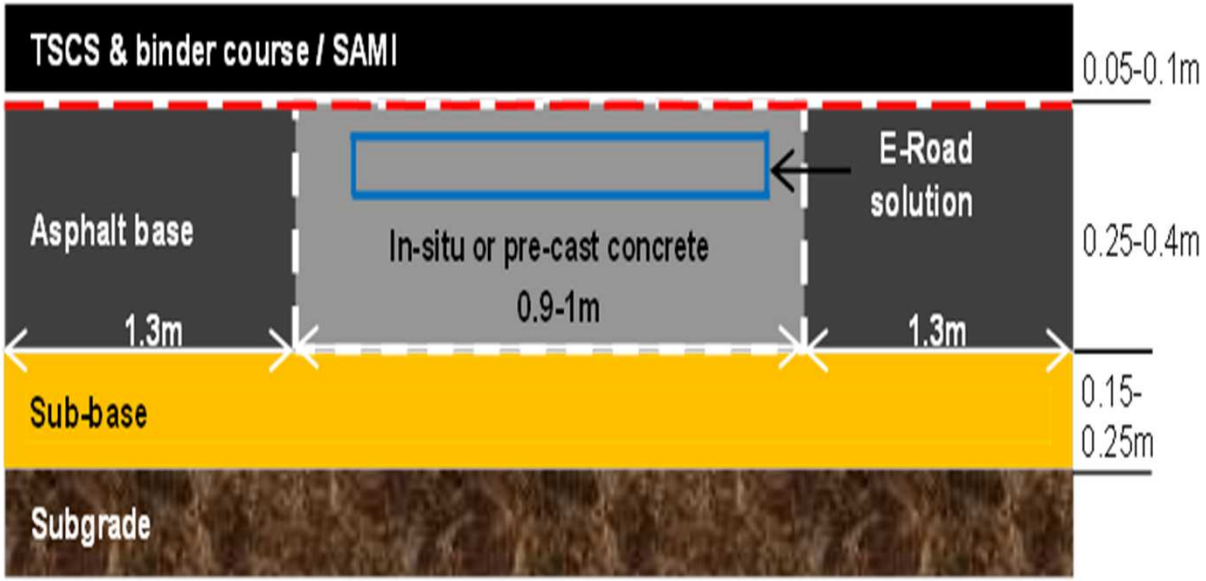
- Impact of inductive systems on the infrastructure (cracking, road surface quality)
- Ability of the system to cope with roadwork conditions (temperature of mixture, pressure of compactor)
- Ability of the system to cope with « normal » traffic conditions (90-130 km/h, mix of cars and heavy goods vehicles)
- Impact of the inductive system with bad weather conditions (rain, ice…)
- Organisation of the operation of the system (share of responsibilities between highway operator, charging infrastructure operator, grid operator, electric vehicle backend operator)
- Business model !
- …

Implantation dans la chaussée



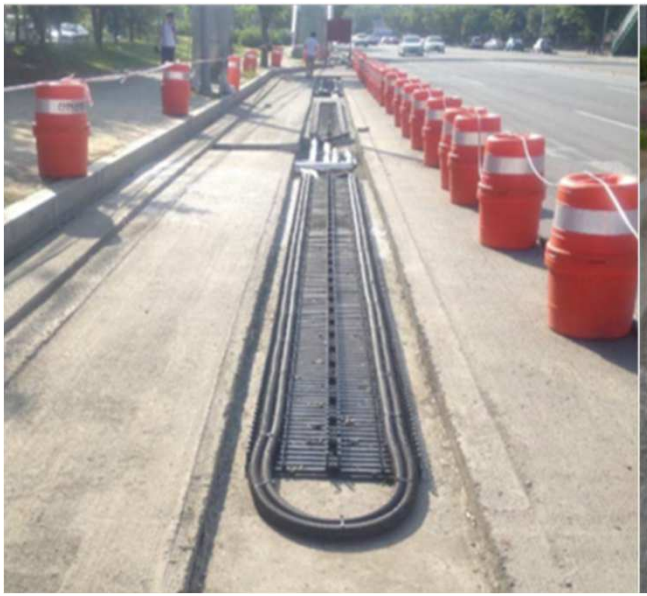
E-Road installation concepts

- Trench-based construction (sub-surface layer or surface-flush)
- Full lane-width construction (sub-surface layer or surface-flush)
- Pre-fabricated full lane-width construction (sub-surface layer or surface-flush)



E-Road : construction methods

Trench-based construction of E-road solution (*photographs courtesy of Dongwon OLEV*)



In-situ construction

Pre-fabricated system

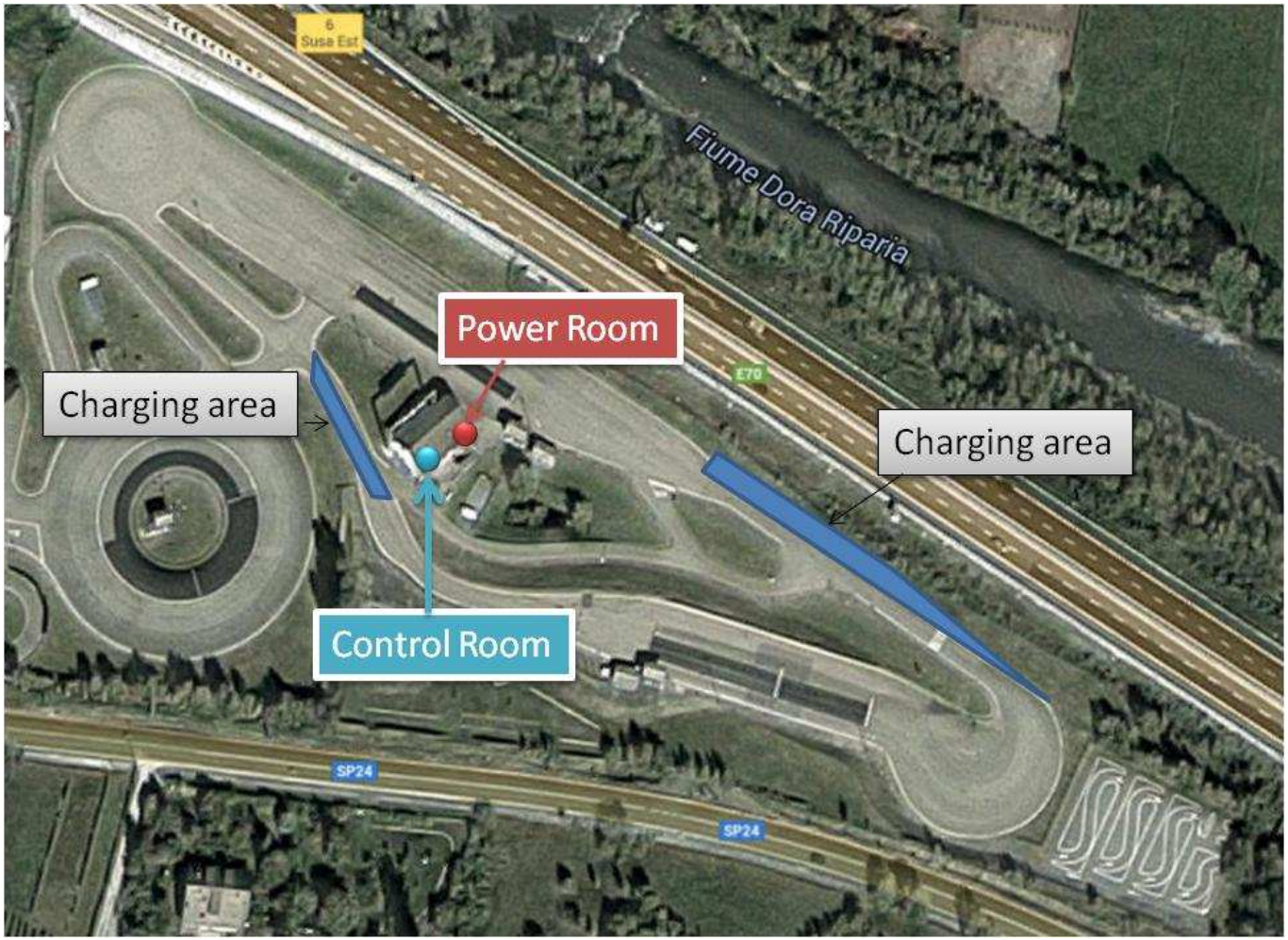
E-Road : construction methods

Full lane reconstruction using static E-road system (*images courtesy of Bombardier*)

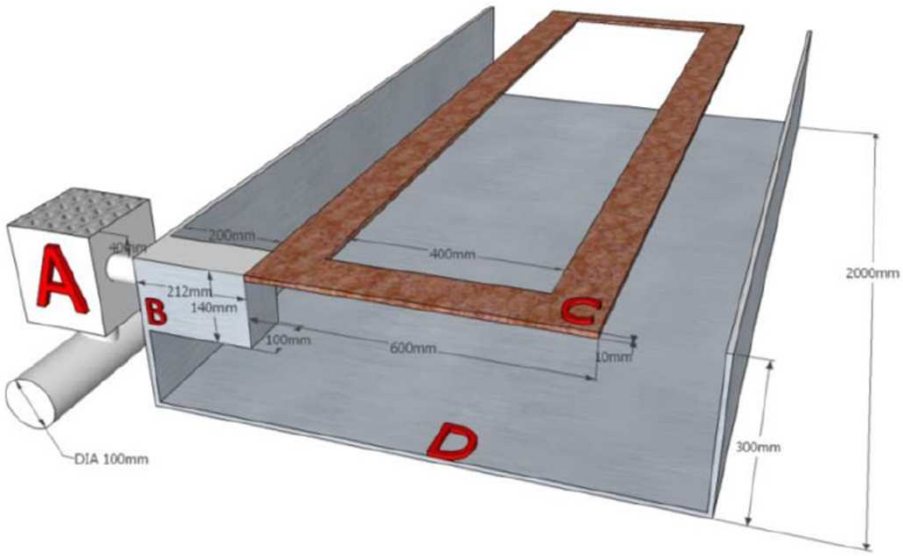
Installation

Bus stop solution

FABRIC test site in Italy (rest area, near Turin)

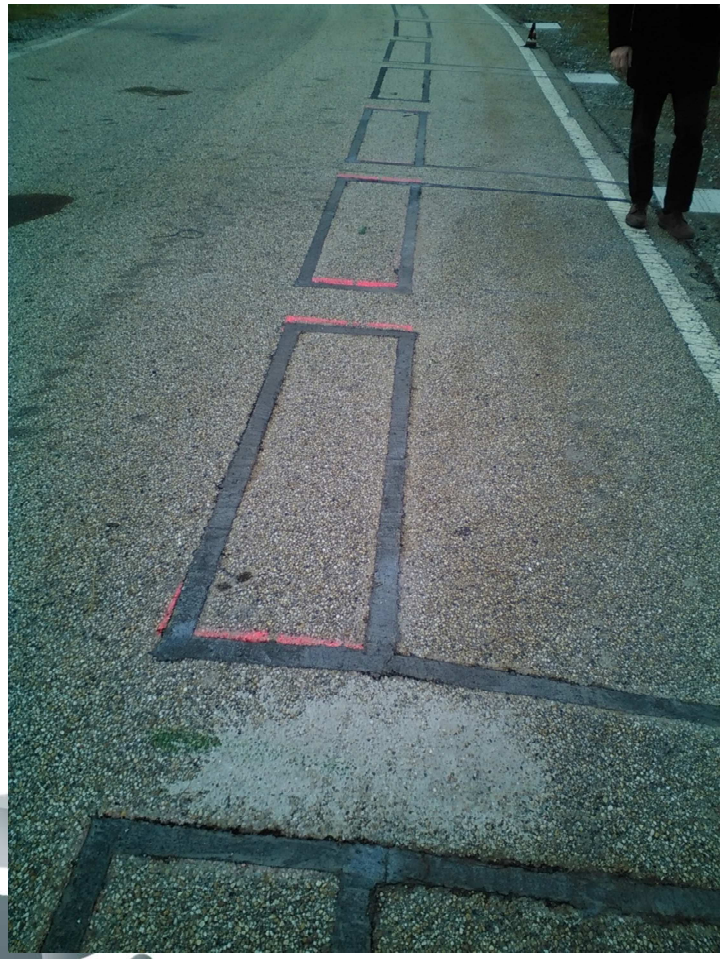


Italian test site – system design

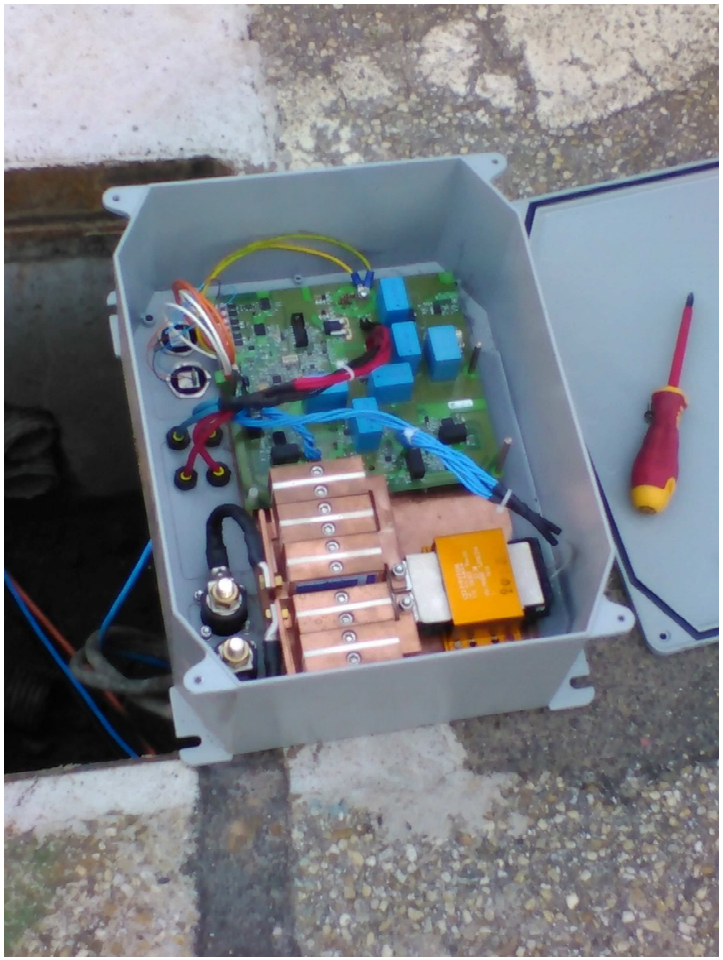


- 2 different designs by SAET and Politecnico di Torino
- Coils have been embedded by sawing the asphalt
- Several issues with the embedding of the coils in the road (find the right material to cover the coils)
- The electronics is located in a box placed in a hole nearby in the hard shoulder

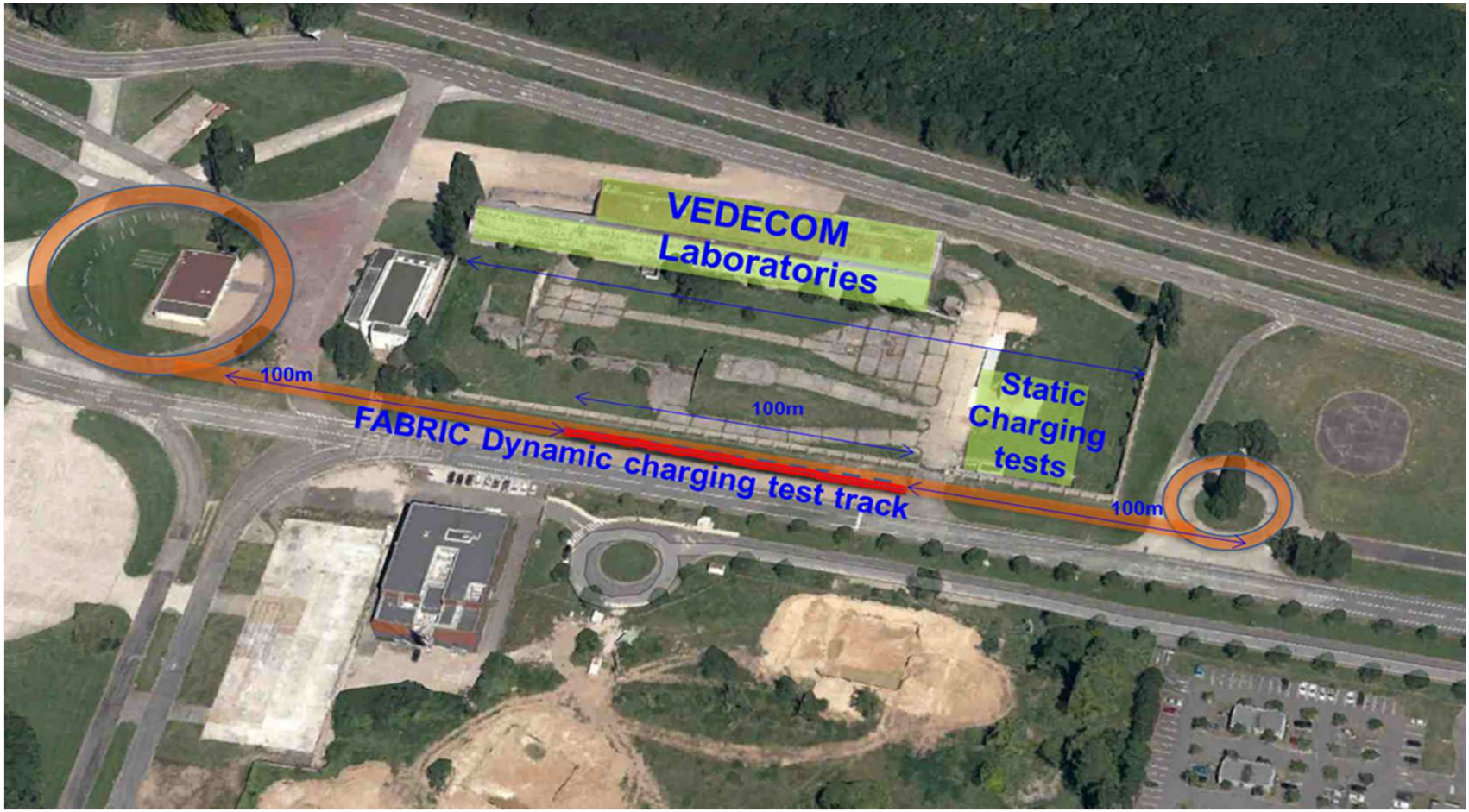
Pictures of the Italian implementation



The electronics of the Italian solution

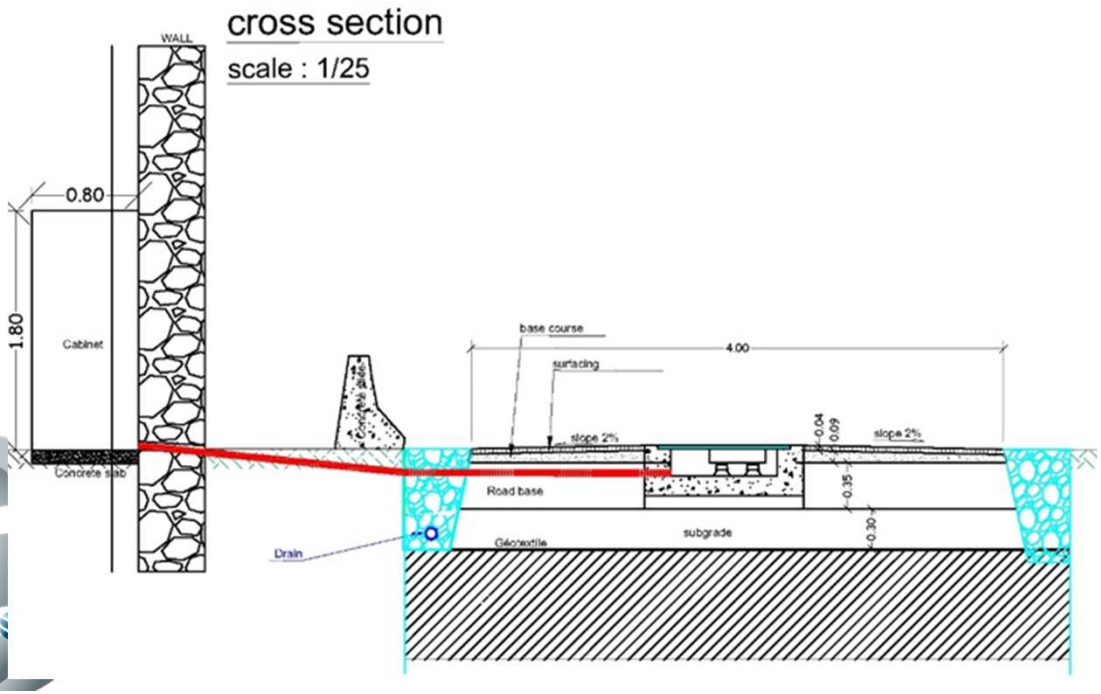


FABRIC test site in France (IFSTTAR facility, near Versailles)



French test site – system design

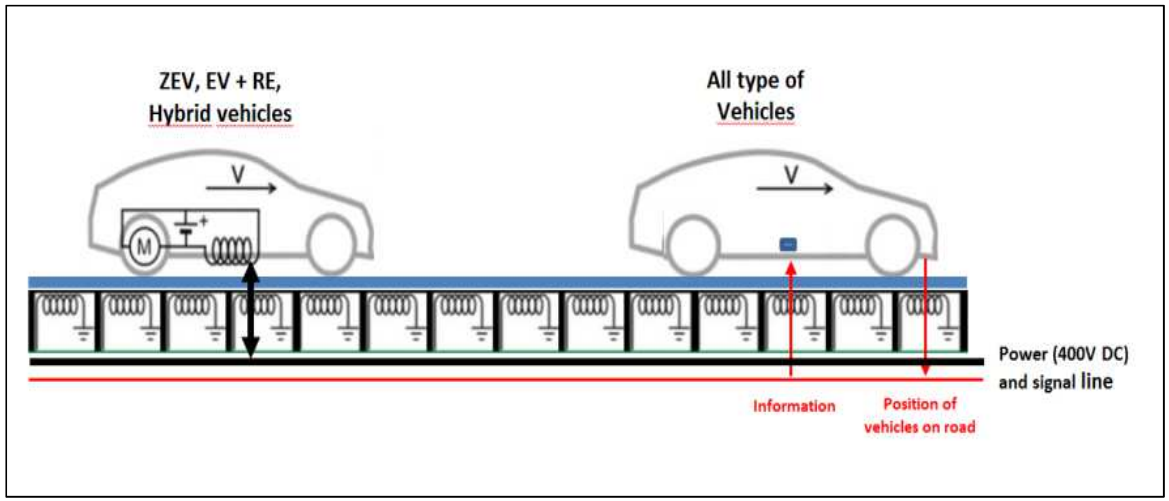
- A 100 m long gutter has been excavated (80x20 cm)
- Electronics and coils are placed in the gutter, covered by trays in composite material
- The track is divided in 4 independent sections, feed by 4 cabinets
- Power supply : 250 kVA, 400 v AC from EDF

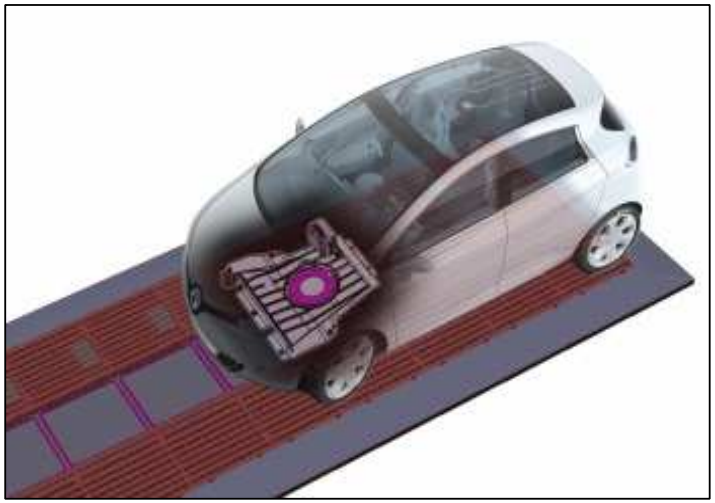


Electrical characteristics

Performances	Value
Nominal output power	20 kW
Nominal power transfer frequency (min - max)	85 kHz
Target efficiency- DC supply to vehicle DC bus	>80%
Misalignment tolerances – lateral y axis	+/- 20 cm

Costs estimates





Energy transfer efficiency from 80 to 90%, based on prototypes, depending on :

- Lateral misalignment (need lane control assistance)
- Air gap

Estimated costs (preliminary) :

- 4 M€ /km (2 M€ electronics, 2 M€ power supply and road construction)
- 4 Md€ /1000 km per year; 20.000 km to be progressively electrified (highways and national roads) in 20 years

Road marking for a charging lane (UK)

Thank you
Any questions ?