Technical Sessions
PAVEMENT MANAGEMENT & PERFORMANCE

Dynamic electric charging on motorways

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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

<table>
<thead>
<tr>
<th>Static charge</th>
<th>Dynamic charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>Conductive</td>
</tr>
<tr>
<td>Wireless</td>
<td>Wireless</td>
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</tbody>
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**Operational**
- Slow or fast charge

**In Test**
- Designed for bus in South Korea
  - Promising results: > 95% efficiency
- R&D
  - European project « Fast in charge »

**Operational**
- Slow or fast charge

**In Test**
- Developed by Siemens and Scania in Sweden

**R&D**
- in South Korea and Germany
  - European R&D project FABRIC

**Standard in progress**
- 3 plugs, 4 modes of charge

**Obstacle**
- Heavy visual impact
Feasibility analysis and development of on-road charging solutions for future electric vehicles

Paving the way for large scale deployment of electromobility
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

**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 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!
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

<table>
<thead>
<tr>
<th>Performances</th>
<th>Value</th>
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<tbody>
<tr>
<td>Nominal output power</td>
<td>20 kW</td>
</tr>
<tr>
<td>Nominal power transfer frequency (min - max)</td>
<td>85 kHz</td>
</tr>
<tr>
<td>Target efficiency- DC supply to vehicle DC bus</td>
<td>&gt;80%</td>
</tr>
<tr>
<td>Misalignment tolerances – lateral y axis</td>
<td>+/- 20 cm</td>
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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?