MEET IN ASIA PACIFIC FOR THE WORLD’S LEADING TRANSPORT TECHNOLOGY EVENT
ACTIVATING GLOBAL MOBILITY SOLUTIONS
ITS—ENHANCING LIVEABLE CITIES AND COMMUNITIES

MELBOURNE 2016
23rd World Congress on Intelligent Transport Systems
Melbourne Convention and Exhibition Centre
10–14 October 2016

www.itsworldcongress2016.com  I  #ITSWC16
Angelos Amditis  
Research Director, ICCS

“Feasibility analysis and development of on-road charging solutions for future electric vehicles”
Electromobility trends (I)

Electric Vehicles
- Range increases due to battery breakthroughs
- New models
- Global adoption increases steadily

Infrastructure
- Static charging infrastructure is deployed fast
- Very fast supercharger deployment (>250km range in 20 minutes)

Batteries
- EV batteries' price dropping
  - Battery energy density increases linearly
# Project Overview

<table>
<thead>
<tr>
<th><strong>FABRIC</strong></th>
<th><strong>FeAsiBility analysis and development of on-Road chargIng solutions for future electric vehiCles</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EC Call</strong></td>
<td><strong>GC.SST.2013-1 “Feasibility analysis and technological development of on-road charging for long term electric vehicle range extension”</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of action</th>
<th>Project budget</th>
<th>EU Funding</th>
<th>Project Start-End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research &amp; Innovation</td>
<td>€ 9 m</td>
<td>€ 6.5 m</td>
<td>1 January 2014</td>
</tr>
</tbody>
</table>

**Partners**
- ICCS, CRF, SCANIA, VOLVO, VeDeCom (Renault), SAET, ERTICO, AMET, ATA, CEA, CIRCE, ENIDE, FKA, TUB, HITACHI, KTH, MECT, POLITO, QIE, SaNeF, TRL, TNO, TECNO, UNIGE-DITEN, IREN
Project Overview

Targets:
- Range extension of EVs via dynamic wireless charging.
- Development and testing of three dynamic wireless charging prototypes - Including ICT modules and e-roads
- Feasibility analysis for large scale deployment of the technology.
Project Timeline

01/2014

Project Start
- 25 partners
- 9 countries
- €9m

03/2016

Milestone x1
- HW prototypes
- ICT

04/2016

Milestone x2
- Site-internal grid
- Pavement

06/2016

Milestone x3
- Efficiency
- Reliability

2/2017

Milestone y1
- Energy viability study

10/2017

Milestone z2
- Environmental LCA

12/2017

Completion
- Efficiency estimation
- Contribution to standards
- Feasibility studies results

04/2017

Milestone y2
- Installation and maintenance costs

Final Milestone

Industrialization Steps
- Standardisation
- Financial viability
- Existing infrastructure

Public support
- PPP
- Regulatory framework
- Raise awareness

New Research Direction
- Interoperability
- ICT
- eRoaming
Project Result 1 – Charging prototypes (VEDE)

- Evolution of QUALCOMM HALO static charging pads for dynamic charging.

- Novelty:
  - Higher power transfer comparing to the static solution (>20kW @85kHz)
  - New proprietary communication/control protocols (Confidential)

- Improvement vs current charging technologies:
  - New charging scenarios (opportunistic, on the go) especially in urban environment
  - Higher speeds than the ones tested so far for wireless dynamic charging (aiming for 90km/h)

- Intellectual property generated:
  - QUALCOMM patents for dynamic charging pads
Project Result 2 – Charging prototypes (POLITO & SAET)

- Evolution of ECOFEV technology by POLITO to support dynamic charging. Higher power transfer rate.

- Novel design by SAET. Different electrical architecture and physical design.

- Novelty:
  - Novel components to increase efficiency and reduce cost

- Improvement vs current charging technologies:
  - Potential patents for POLITO regarding the novel components

- Different solutions but interoperable: The vehicle will have the same secondary coil, developed by POLITO.
Project Result 3 – ICT for dynamic charging

- Three ICT “modules” were developed:
  - Charging management: Real time load balancing to ensure the secure grid operation, make sure that demand is kept lower than supply and distribute appropriately the supply among the charging EVs.
  - HMI for guiding and informing the driver before, during and after charging.
  - Lane keeping system that utilizes the HMI and guides the driver in order to minimize misalignment and maximize charging efficiency.

- Proprietary software, different for the two pilots.

- Several publications at IEEE transactions/conferences

- Improvement could be expected if driving was done automatically in the charging lane
Project Result 4 – 3 Test tracks (e-roads)

- Two test tracks were constructed in the project:
  - Satory (100 m) integrating VEDECOM solution
  - Susa (>100 m) integrating POLITO & SAET solutions
  - Grid adaptations to support the charging load
  - Custom made covers for Satory to withstand EV weight

- An additional test track in Malaga will be tested:
  - Supports heavier vehicle (small bus)
  - Power rating at 50kW
  - Tests at 10km/h

- Improvement over current technology:
  - Longer tracks than the SotA for DWPT
  - Reusable track for testing new pads (Satory)
  - Testing at higher speeds
Project Result 5 – Feasibility studies

- The main bulk of the feasibility studies began from the second half of 2016 and will continue until the end of the project (also based on FABRIC test results).

- A preliminary feasibility assessment examined several large-scale deployment scenarios based on actors’ requirements and available FABRIC deliverables.

- Currently the following activities are taking place:
  - Integrated LCA/LCC system for evaluation of E-roads
  - Definition of technical specifications for construction, maintenance and operation of E-roads

- The corresponding reports may contribute as guidelines to decision makers, city authorities and stakeholders. Public deliverables are available at the website.
FABRIC—preliminary feasibility assessment

A first feasibility study approach examined several large-scale deployment scenarios based on actors’ requirements and FABRIC deliverables.

<table>
<thead>
<tr>
<th>Deployment scenario</th>
<th>Preliminary feasibility assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan deployment for heavy freight vehicles</td>
<td>Possible, but with risks</td>
</tr>
<tr>
<td></td>
<td>Strong policy involvement needed</td>
</tr>
<tr>
<td>Metropolitan deployment for buses</td>
<td>Feasible if enough incentives</td>
</tr>
<tr>
<td></td>
<td>given</td>
</tr>
<tr>
<td>Metropolitan deployment for general light vehicles</td>
<td>High economic risks for stakeholders – incentives needed</td>
</tr>
<tr>
<td>Metropolitan deployment for service vehicles / taxi’s</td>
<td>Economic feasibility not available yet</td>
</tr>
<tr>
<td>International freight corridors</td>
<td>Feasible but concerns on interoperability and legal agreements</td>
</tr>
<tr>
<td>Long-haul national freight corridors</td>
<td>Feasible, but high risks due to utilisation</td>
</tr>
<tr>
<td>Short-haul freight corridors</td>
<td>Feasible</td>
</tr>
<tr>
<td>National deployment for general light vehicles</td>
<td>Not feasible short – mid term</td>
</tr>
<tr>
<td>International deployment for general light vehicles</td>
<td>Not feasible short – mid term</td>
</tr>
<tr>
<td>International deployment for all vehicles classes</td>
<td>Requires large changes, thus unlikely to be feasible for the short-mid term</td>
</tr>
</tbody>
</table>
Next steps

- Validation of the integrated test sites
- Testing
- Test results analysis

Feasibility studies:
- Assessment of impact on the grid of large-scale deployment.
- Assessment of maturity, reliability, efficiency and stability of the supply chain.
- Cost-benefit analysis and business models of large-scale deployment.
- Deployment scenario analyses for achieving environmental targets, standardization and harmonization.
Need for direct investment or incentives by authorities and government on modernizing the grid and making sure that it can cover the future needs of electromobility including the special characteristics of dynamic charging (high frequency of high-power, low-energy peaks).

- Standardisation efforts should include dynamic charging.
- Regulations regarding the physical characteristics of the installations and safety levels.

New research directions:
- Synergies with developers of conductive solutions, to investigate how to utilize the same electric infrastructure and grid connection systems.
- Promote communications research focusing on security and reliability.
- Advance eRoaming, to achieve seamless transition between existing charging networks thus improving drastically the business potential outlook.
How to contact FABRIC

Website [www.fabric-project.eu](http://www.fabric-project.eu)

LinkedIn group

Join the ERG

Coordinator: [a.amditis@iccs.gr](mailto:a.amditis@iccs.gr)
Thank you for your attention

Angelos Amditis,
Research director, ICCS
a.amditis@iccs.gr