

# EEVC-2015



**European Battery, Hybrid  
& Fuel Cell Electric Vehicle Congress**

**Brussels, 2<sup>nd</sup> - 4<sup>th</sup> December 2015**

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# Optimization of the Electric Mobility efficiency with new technologies

Integrated Electric Vehicle – Infrastructure system

User – Vehicle – Grid interaction

Vehicle – Infrastructure Network

Vehicle – Infrastructure system optimization

Inductive Energy Transfer

Dynamic Wireless Power Transfer: EU Project FABRIC

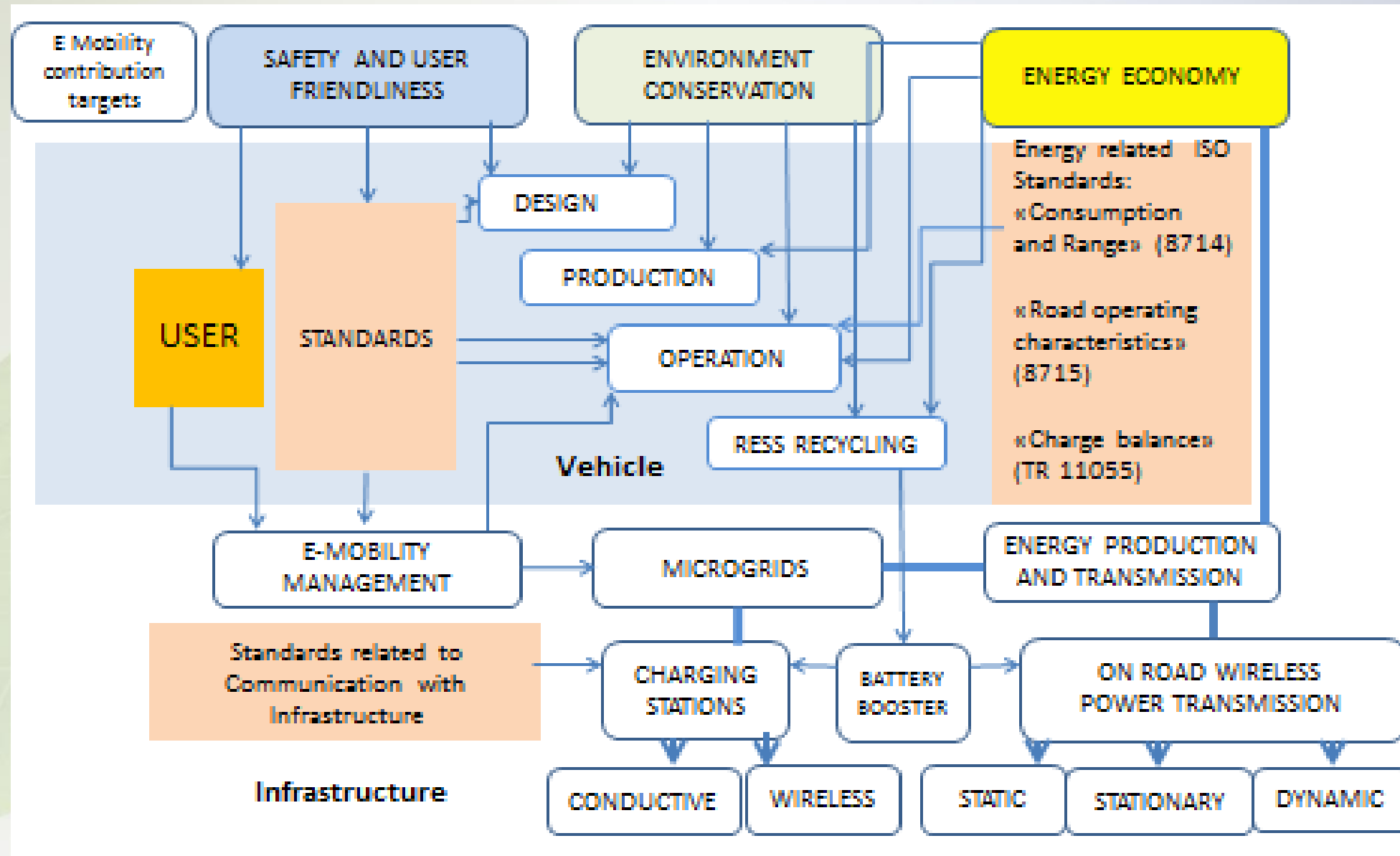
Impact on the Grid

Demand side management for dynamic wireless charging

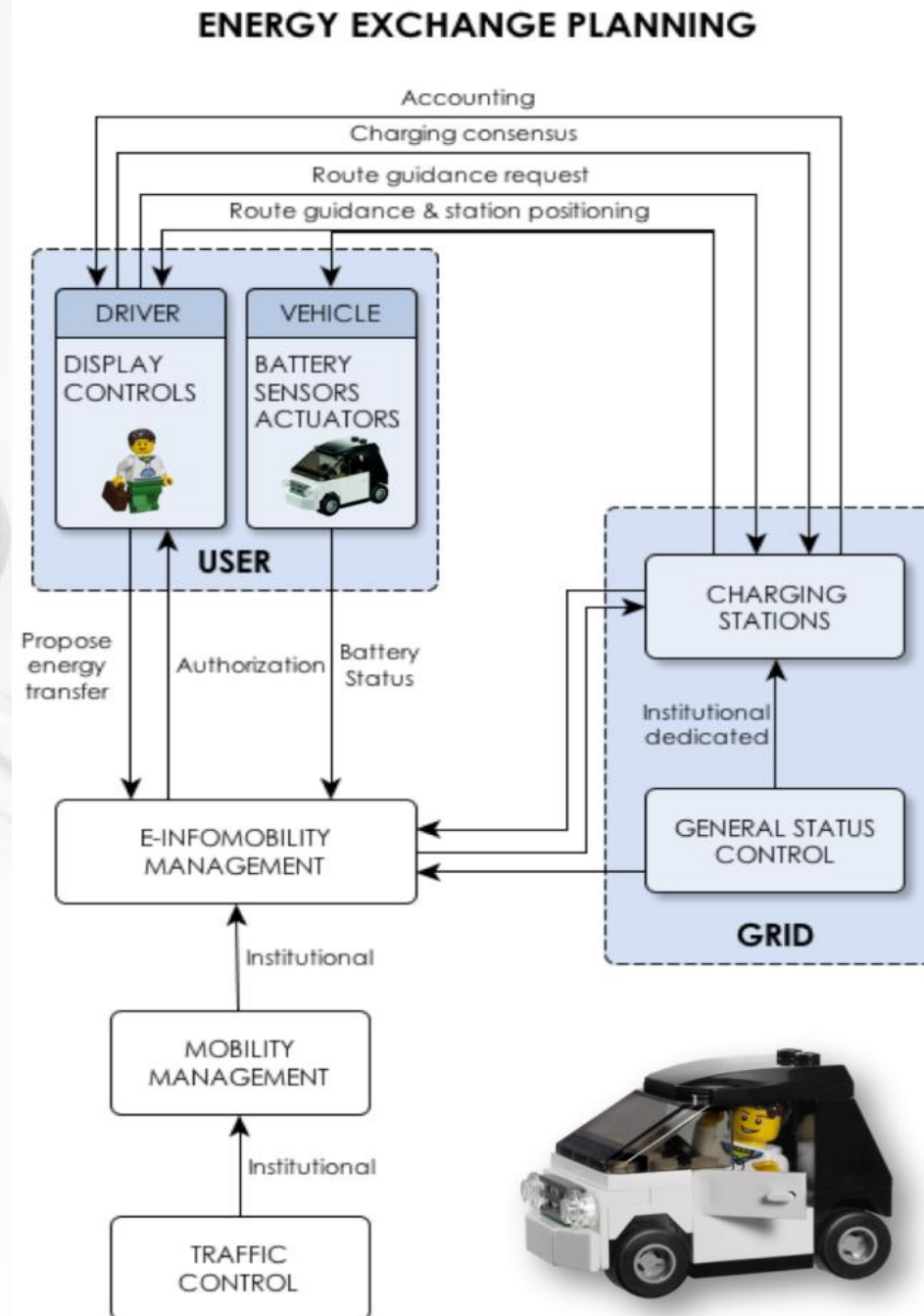
Standard supporting vehicle – infrastructure interaction

Conclusions

# Integrated Electric Vehicle – Infrastructure



# User–Vehicle–Grid interaction



# Vehicle – Infrastructure Network

An action road map to foster infrastructure development  
defined within the EU Project EV-CONNECT

- **Creating the European Electric Vehicle Network,**  
that provides to public representatives, industries and users  
a central contact point for information and advice services on e-Mobility.
- **Development of public and private accessible charging infrastructure.**
- **Training program and courses on new electromobility concepts.**
- **Promoting and organizing demonstration events for University and High School students (Formula Electric Italy) and enhance participation of University teams.**
- **Dissemination and making value of the results of Formula Electric events.**



**EUROPEAN COMMISSION**  
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# Vehicle - Infrastructure System optimization

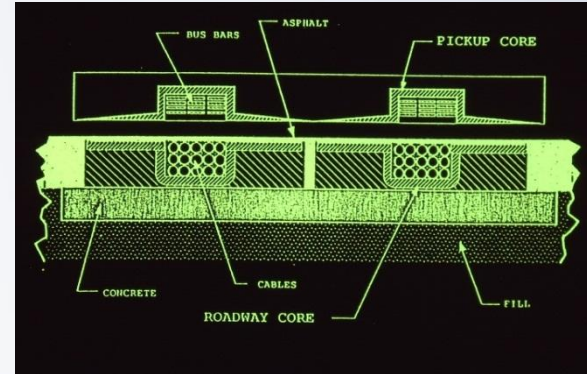
A trade-off battery –charging infrastructure facility network: basic considerations

- Sizing the storage system based on the range extension required to the overnight charge
- The vehicle daily mission range in Europe is less than 50 km for the 75% of vehicles and less than 100 km for the 91% of vehicles
- The energy request for battery construction is a considerable part of the energy for construction and recycling of the vehicle  
(e.g. 35% for a 33 kWh Li-ion over 10 year operation for 20000 km/year)
- Establishing a strategically located infrastructure system
- Providing an electric info-mobility management and communication centre for governing the electric vehicle-infrastructure system
- Providing a user friendly charging system as vehicle – infrastructure interface

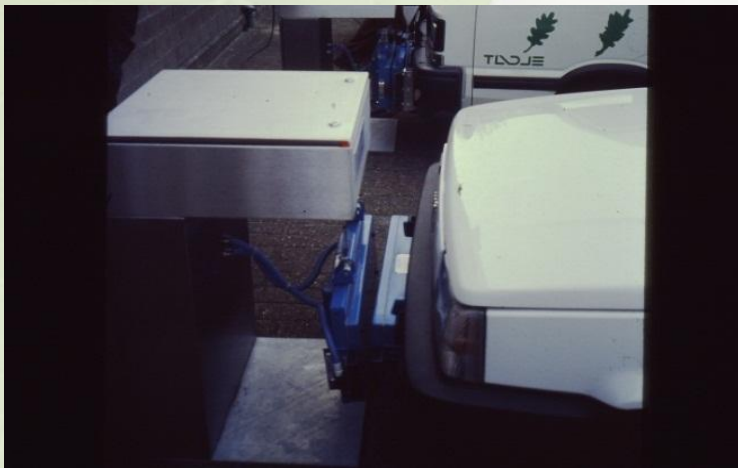
# Inductive energy transfer



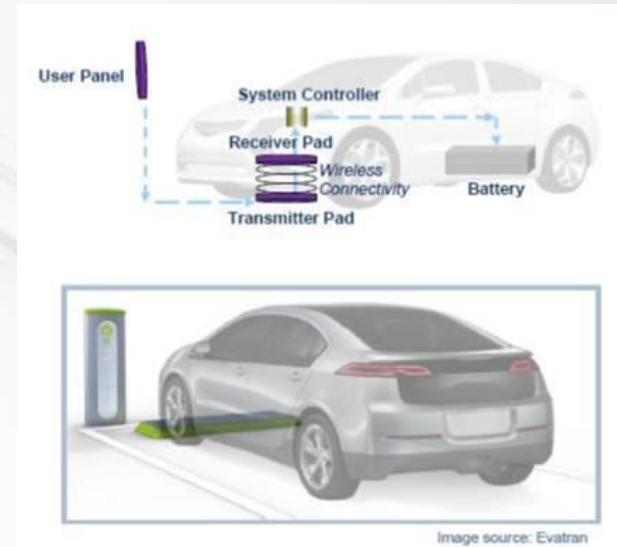
Charging with hand operated inductive paddle (Hugues-GM)



Inductive power transfer with vehicle in motion  
(Lawrence Livermore Laboratory)

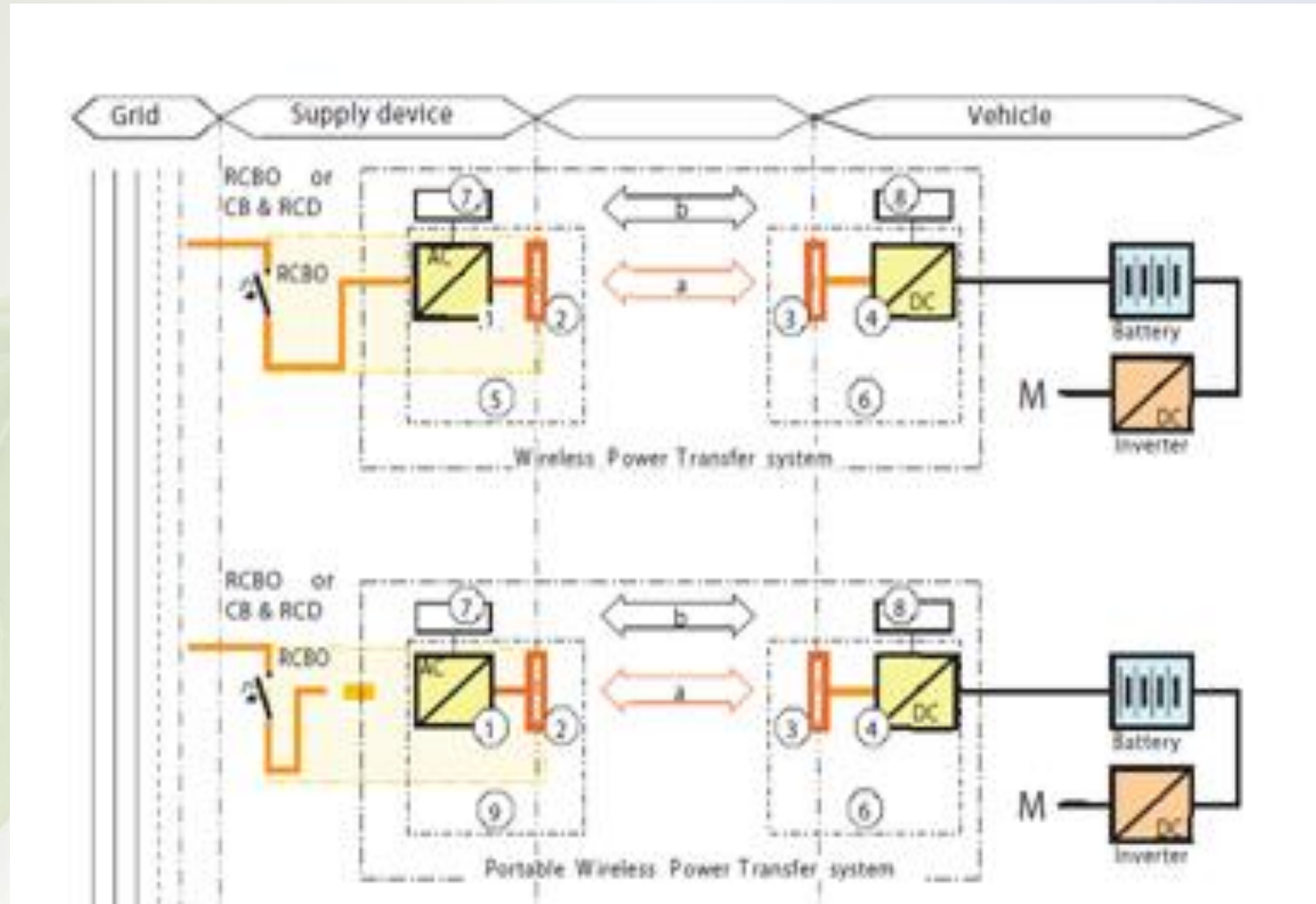


Inductive charging at the Vrije Universiteit Brussel



Concept of static wireless power transfer

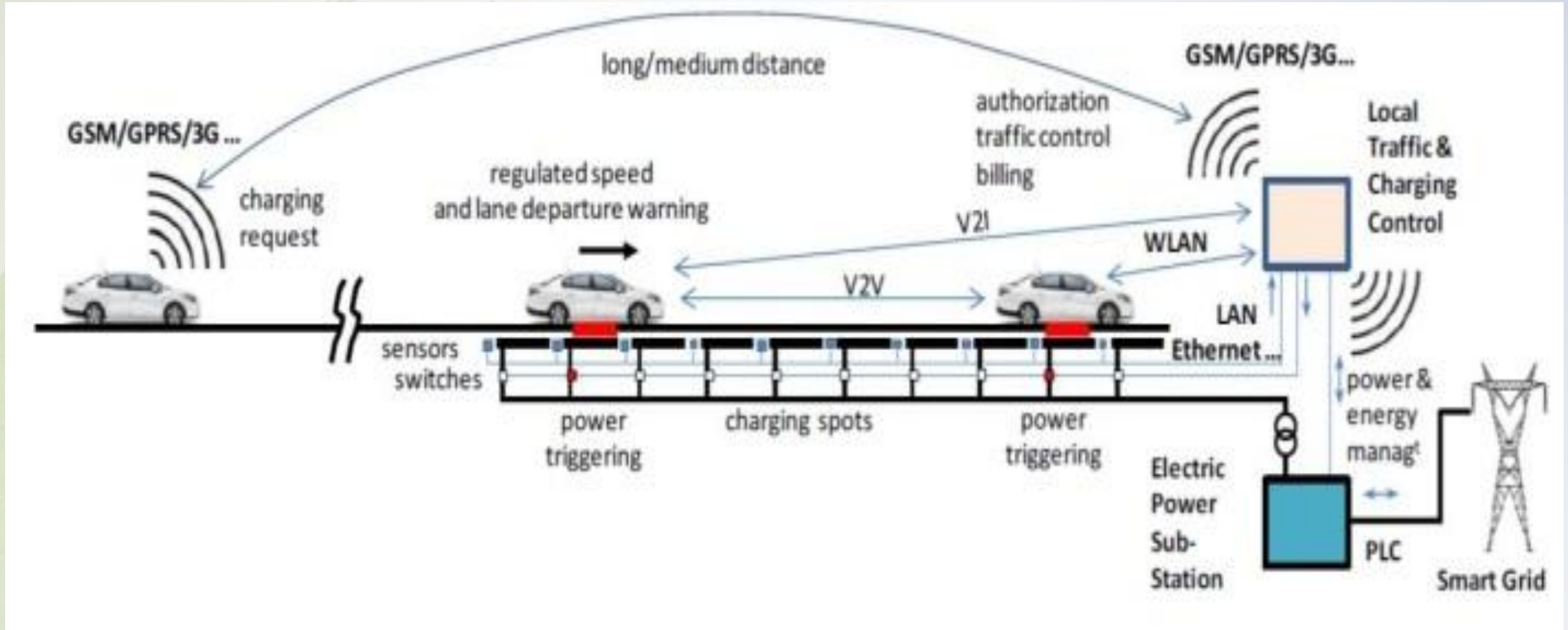
# Wireless Power Transfer



General scheme of Wireless Power Transfer (from Standard IEC 61980-1)



# Project FABRIC: Dynamic Wireless Power Transfer



Power transfer by activating segments of inductive infrastructure during transit of the vehicle

# FABRIC Programme development lines

Basic objective is to develop, test and evaluate the efficiency of dynamic charging prototypes, to assess the feasibility of large scale deployment of dynamic wireless charging.

## Three test sites with different solutions:

- **Italy**, with two types of primary coils under the road surface, to study also the interoperability of the secondary on-board coil with the infrastructure.
- **France**, with several charging spots embedded in the road surface, based on QUALCOMM HALO wireless charging solution
- **Sweden**, where also results on conductive charging system with vehicle moving, including cars, other than busses and heavy vehicles

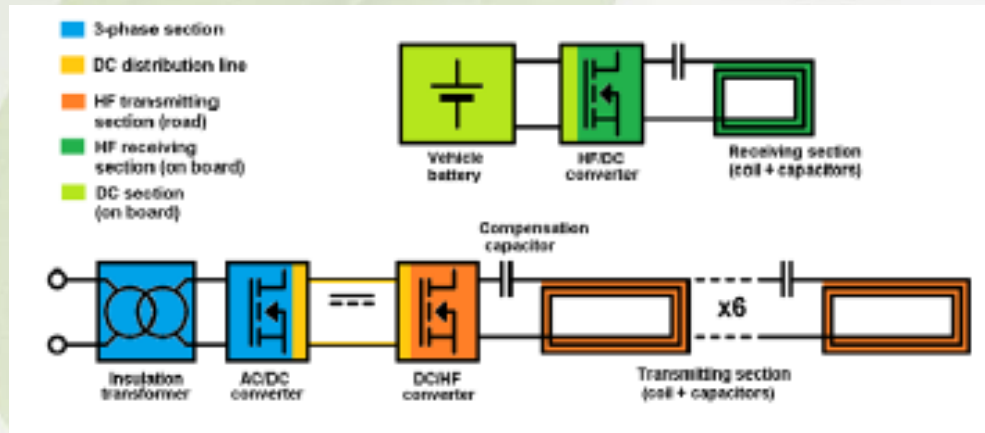
# FABRIC – prototypes (I)

Vedecom/QUALCOMM  
solution:  
85 kHz, 20 kW



# FABRIC – prototypes (II)

POLITO solution:  
20 – 200 kHz, 20 kW

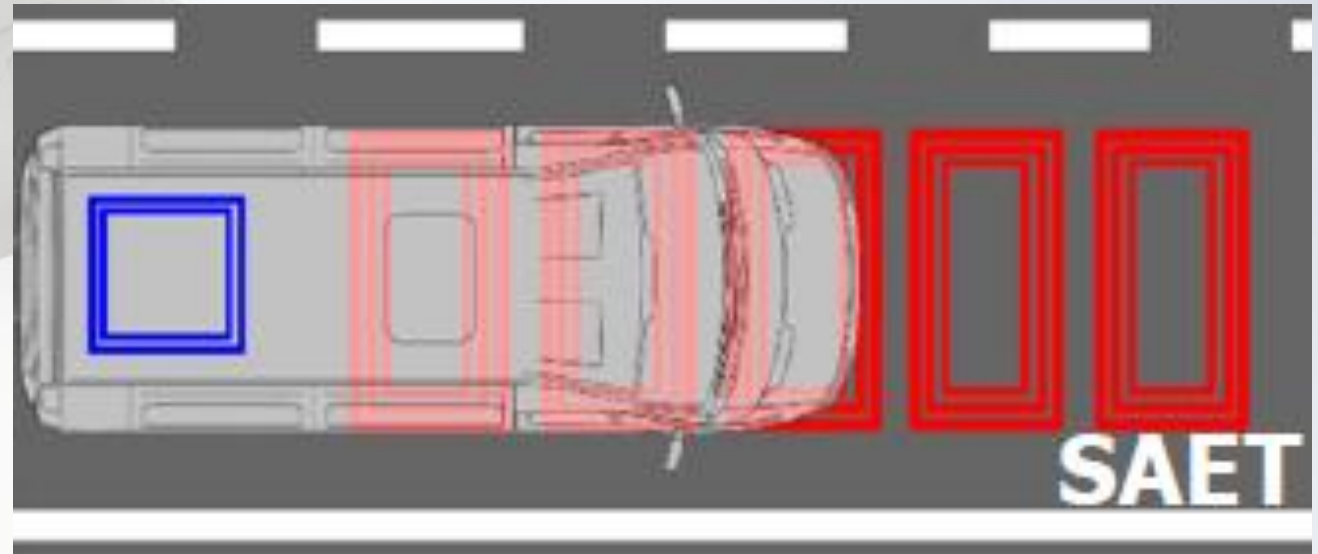




# FABRIC – prototypes (III)

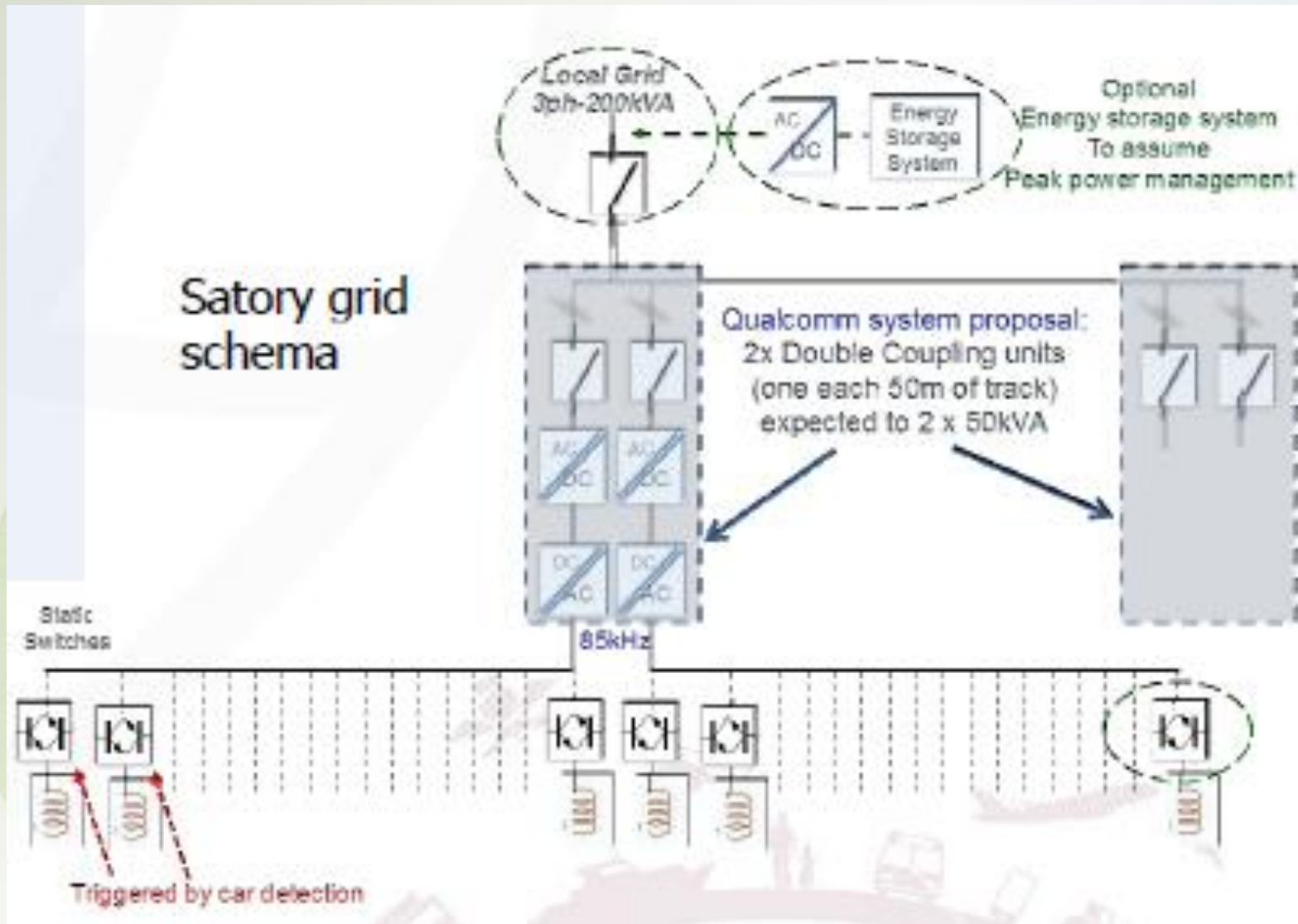
SAET solution :  
80 – 100 kHz, 50 kW

Air gap  $\sim 20$  cm





# Impact to the grid (I)



# Impact to the grid (II)

Impact studies on the grid have been completed, with reference to local test sites.

Some results, after simulation for various traffic models, with reference to local test sites, are as follows:

- The power demand can fluctuate from 2 to 8 MW in some milliseconds
- The integration of Rechargeable Energy Storage Systems (RESS) could act as a supportive power buffer to reduce the daily demand peaks.
- The use of end-of-life RESS of the electric vehicles could cope with the cost aspects with the system in operation.
- The analysis of harmonics and power flow at the test sites (max power Satory: 100 kW, SITAF: 45 kW) reveal that minimal adaptations are required so as to simultaneously charge two vehicles per section

# Demand side management for dynamic wireless charging

**Primary goal:**

**To ensure the equilibrium between the overall demand and supply of the grid for shaping the demand of users accordingly**

**Additional related objectives:**

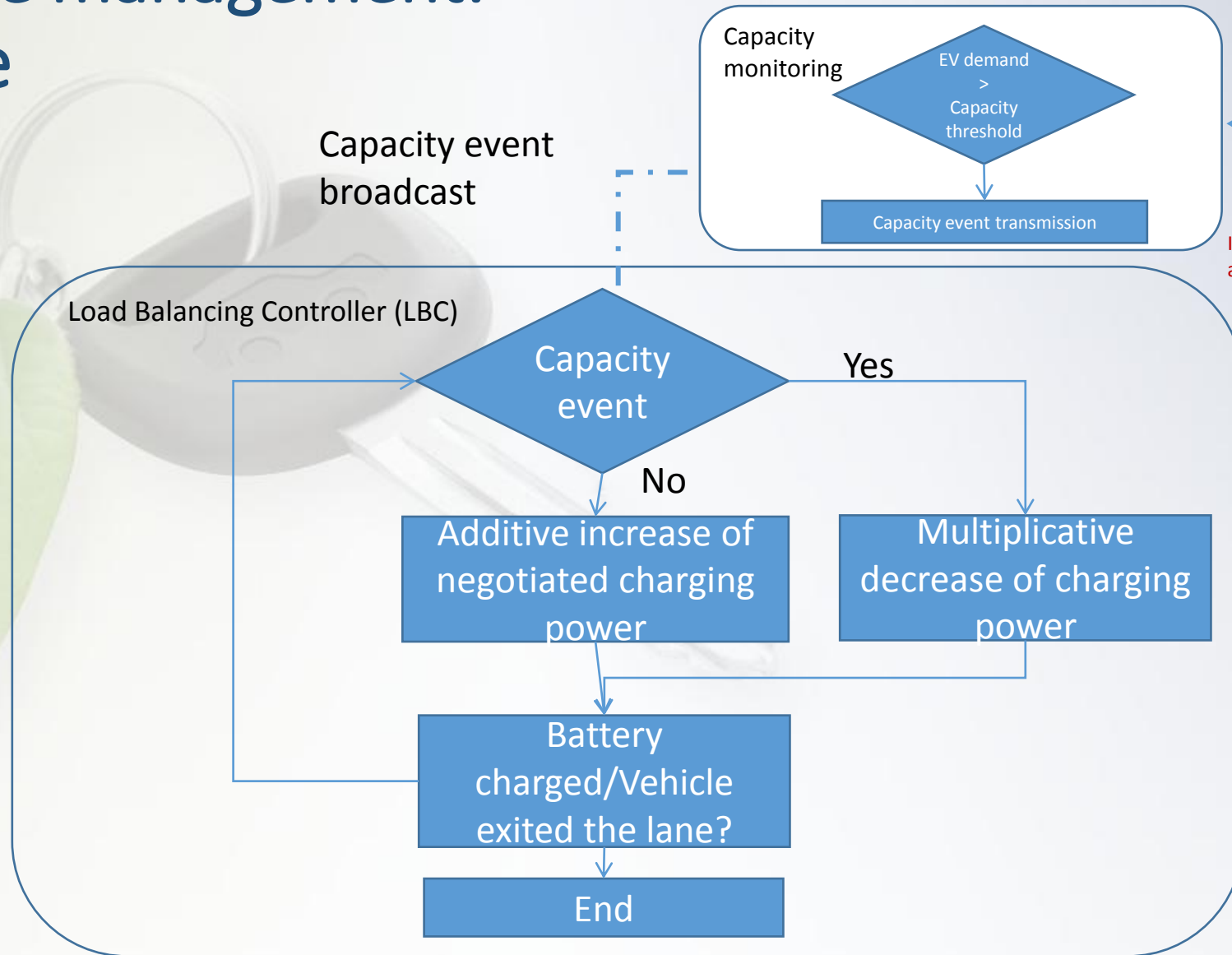
**Grid stability, cost efficiency, environmental friendliness, user satisfaction.**

**The technology developed in FABRIC is addressed to the application to different power transfer modes, provided interoperability features:**

- **Static**
- **Stationary, with vehicle moving at very low speed**
- **Dynamic**

**An Operational Management Centre should flexibly act as a liaison between the user and infrastructure, through an user friendly communication network for the routing the user to the desired mode of charging facility, on the basis of the grid situation and the availability of the infrastructure to deliver energy according to appropriate timing and vehicle demand.**

# Demand side management: Architecture



Is a smart metering interface available in test sites?

# FABRIC – preliminary feasibility assessment

**First feasibility study approach according to several large scale deployment scenarios, based on actors' requirements and FABRIC 1° year deliverables, in terms of technical, economical and policy aspects:**

- **Short-haul freight corridors**
- **Metropolitan deployment for buses (provided appropriate incentives)**
- **International freight corridors (provided interoperability and legal agreements)**
- **Metropolitan deployment for general light vehicles (with high economic risk for stakeholders)**
- **Metropolitan deployment for heavy freight vehicles (with high risk and with strong policy involvement)**



# Standard ISO, IEC, SAE, UL on wireless charging (source VDA)

## **ISO 19363** (scheduled for 10-2016)

Electrically propelled road vehicles – Magnetic field Power Transfer – Interoperability and Safety requirements

## **IEC 61980** Electric vehicle wireless power transfer (WPT) systems

- Part 1: General requirements
- Part 2: Specific requirements for communication EV and infrastructure
- Part 3: Specific requirements for the magnetic field power transfer systems

## **ISO/IEC 15118** (scheduled for 10-2016) Road vehicle to grid communication interface

- Part 6: General information and use-case definition for wireless communication
- Part 7: Network and application protocol requirements for wireless communication
- Part 8: Physical layer and data link layer requirements for wireless communication

## **SAE J2954** (Guideline scheduled for 06/2014)

Wireless Charging of Electric and Plug-in Hybrid Vehicles

## **SAE J2836/6 J2847/6 J2931/6** (Guideline scheduled for 06/2014)

Communication for inductive charging

## **SAE J1773** Electric Vehicle Inductively Coupled Charging (published as recommended practice)

## **UL 2750** Wireless EV charging

# Conclusions

**The Electric Mobility development addressing the rational use of energy, the safe and user friendly operability and the economic effectiveness should be based on a coherently structured and interactive vehicle - energy supply infrastructure system**

The vehicle design can be consistently laid down according to the energy supply from the infrastructure during its operative mission in the daily use.

The technology for grid to vehicle power transfer has to be user friendly and appropriate to the mobility needs and to the interoperability with various interfacing modes in the vehicle daily mission.

**The Wireless Power Transfer technology under study and development in the FABRIC project is addressing the ultimate application potential for general use in the various operational situation and exigencies of the Electric Vehicles.**





Thank you for your attention

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