Functional integration of Electric Vehicles within the Energy supply network

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Outline

Electric Vehicle – Infrastructure Network

The Power Transfer Technology

Dynamic Wireless Power Transfer: Project FABRIC

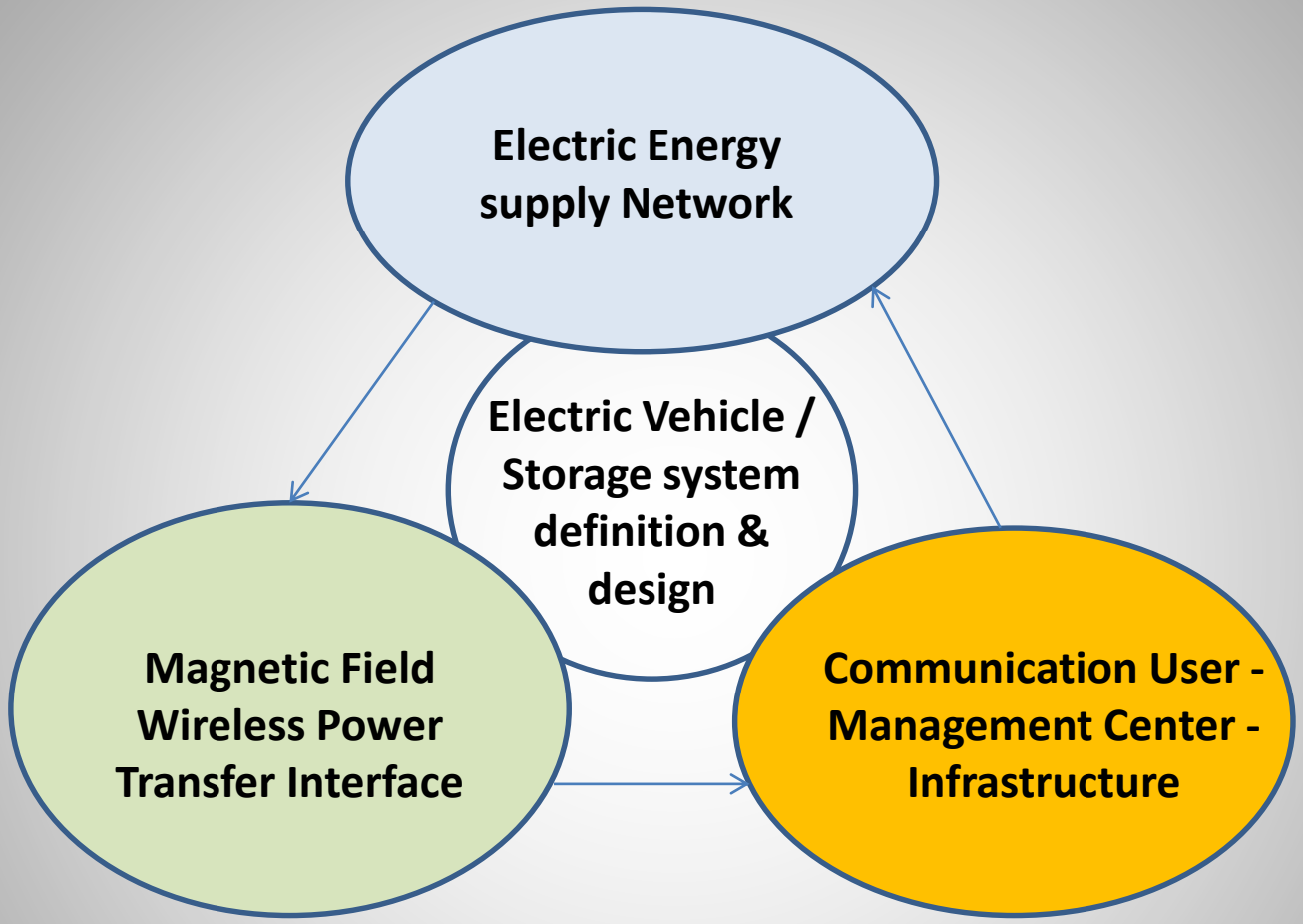
User – Grid Interaction

Grid Balancing

System Optimization

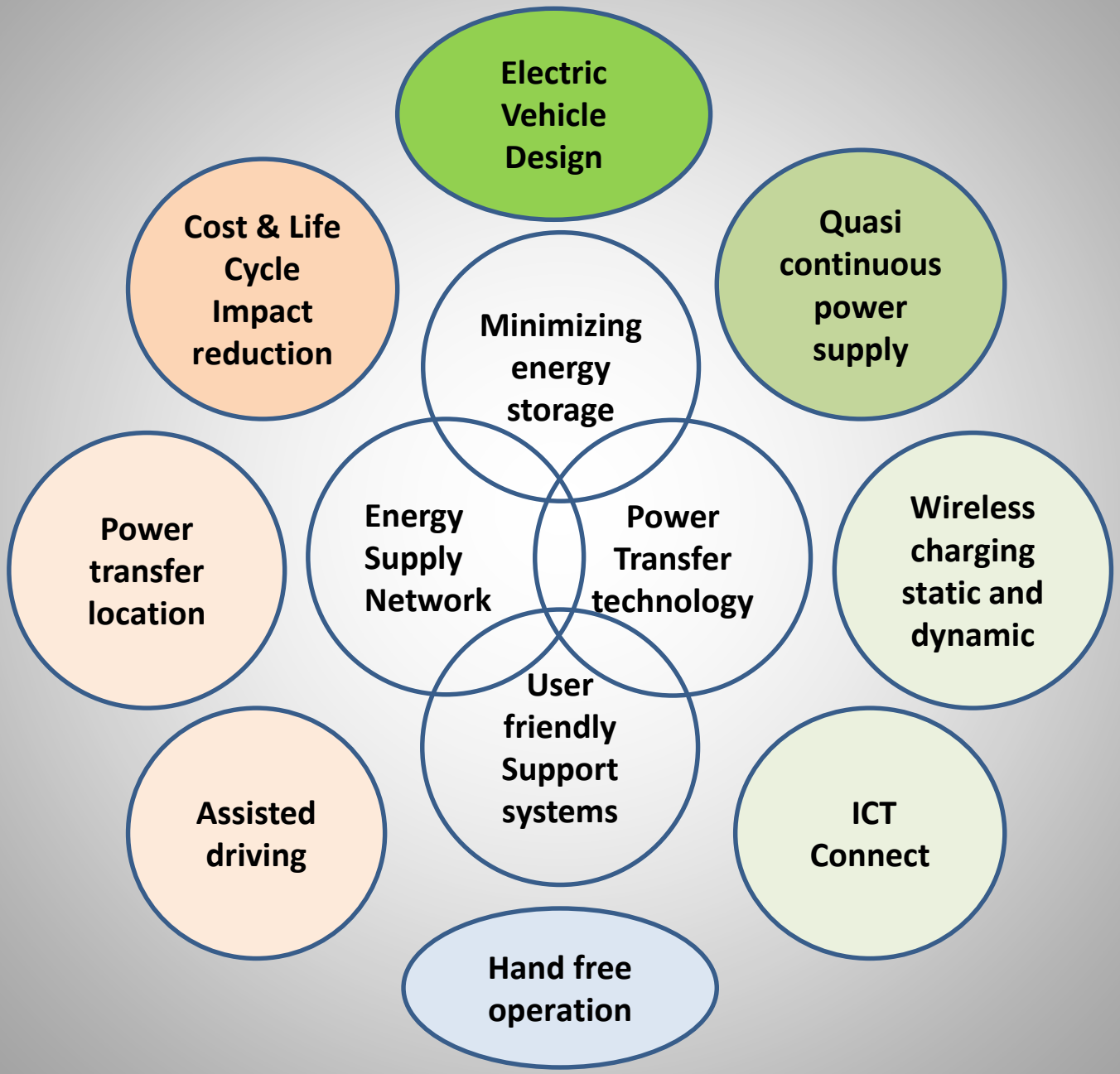
Conclusions

Electric Vehicle in the frame of the Mobility system

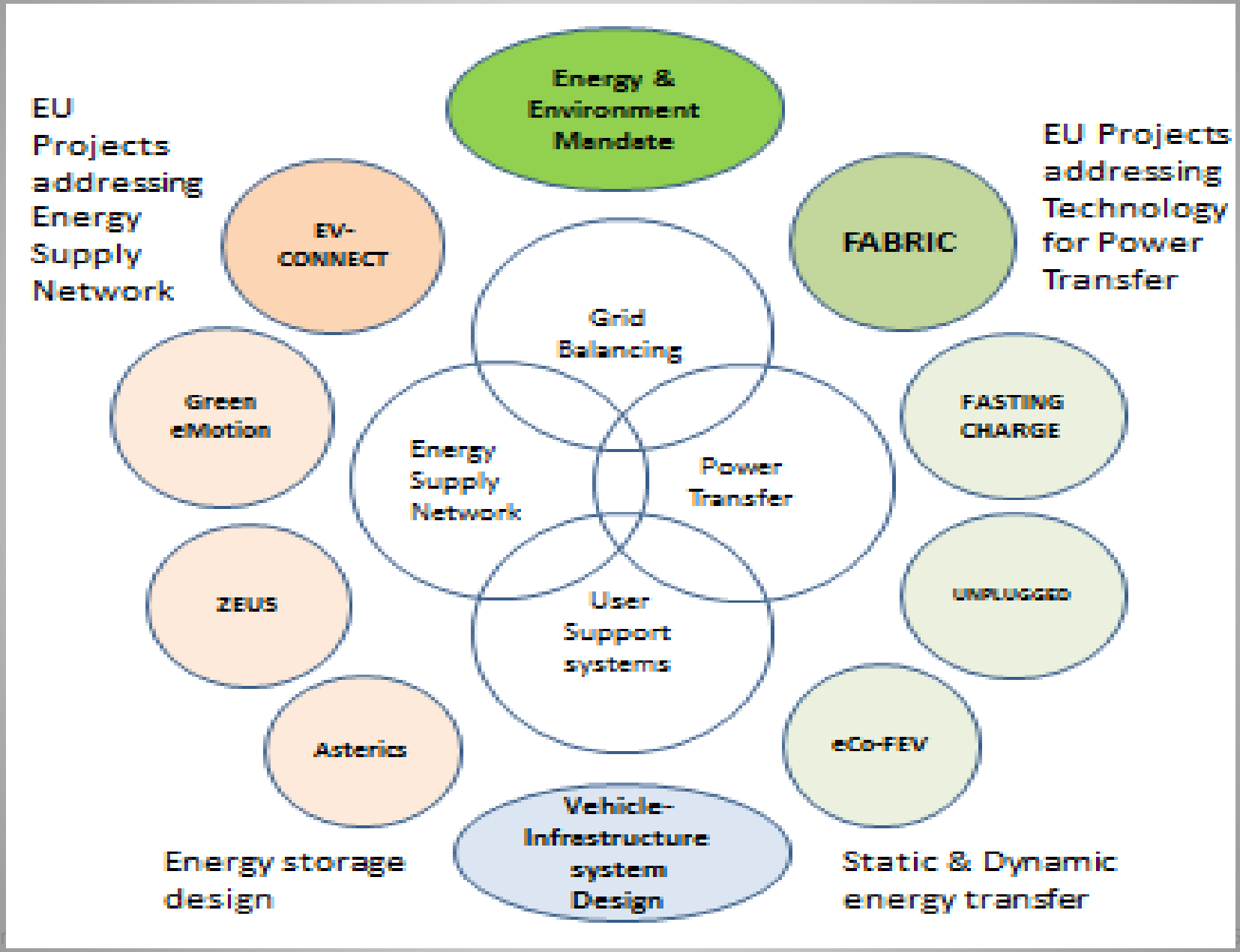


The key elements of the Electric Mobility system

Toward an integrated vehicle – infrastructure system design



EU Project support to the Electric Mobility system



Addressing the optimization of the Electric Vehicle design and use within the electric infrastructure system (I)

From a road map of actions to foster infrastructure development, defined in the EU Project EV-CONNECT, coordinated by ASCAMM

Creating a European Electric Vehicle Information-Communication Network to provide a central contact point for information and advice services on e-Mobility to users, industries and public representatives

Development of public and private accessible charging infrastructure, strategically located, with respect to the mobility missions needs

Promoting the cultural education of the public to electric mobility and professioal formation of operators to act on electric vehicles and infrastructure

Promoting and organizing demonstration events for University and High School students (Formula Electric Italy) putting in light new technologies and making use of the results of Formula Electric events.

EV-CONNECT Project study domains

Focused on 3 different regions... The geographic scope will then be extended

Catalonia
Area: 32,106.5 km²
Census: 7,539,618
GDP: €200.3 billion

Piedmont
Area: 25,402 km²
Census: 4,646,251
GDP: €127.0 billion

Belgium
Area: 32,106.5 km²
Census: 11,099,554
GDP: €353.6 billion

Catalonia Piedmont Belgium

EV CONNECT roadmap

EUROPEAN COMMISSION
Enterprise and Industry

ascamm technology centre

ATA ASSOCIAZIONE TECNICA DELL'AUTOMOBILE

Vrije Universiteit Brussel

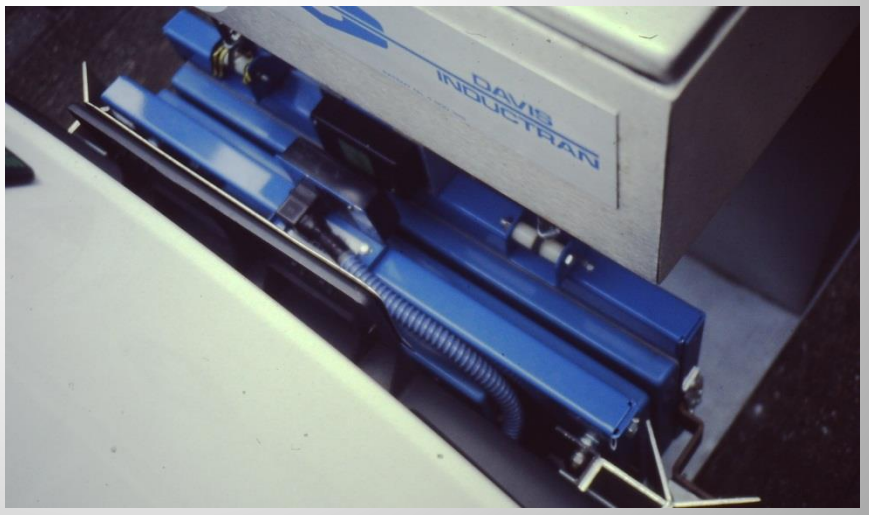
Addressing the optimization of the Electric Vehicle design and use within the electric infrastructure system (II)

Impacting factors

- **Strategically structured energy supply infrastructure network** (based on mission requirements)
- **Battery size** (impact on weight, volume, cost, energy and environment for manufacturing and recycling)
- **Energy supply continuity** (the energy transfer grid to vehicle should be most direct as possible, for minimizing losses in charging - discharging)
- **User friendly Vehicle – Infrastructure interface system for battery charging** (Hand free operation)
- **Drive assisted approach to charging station** (automatic alignment)
- **Electric info-mobility Management and Communication Centers** (for user-infrastructure interaction and dispatching coordination)

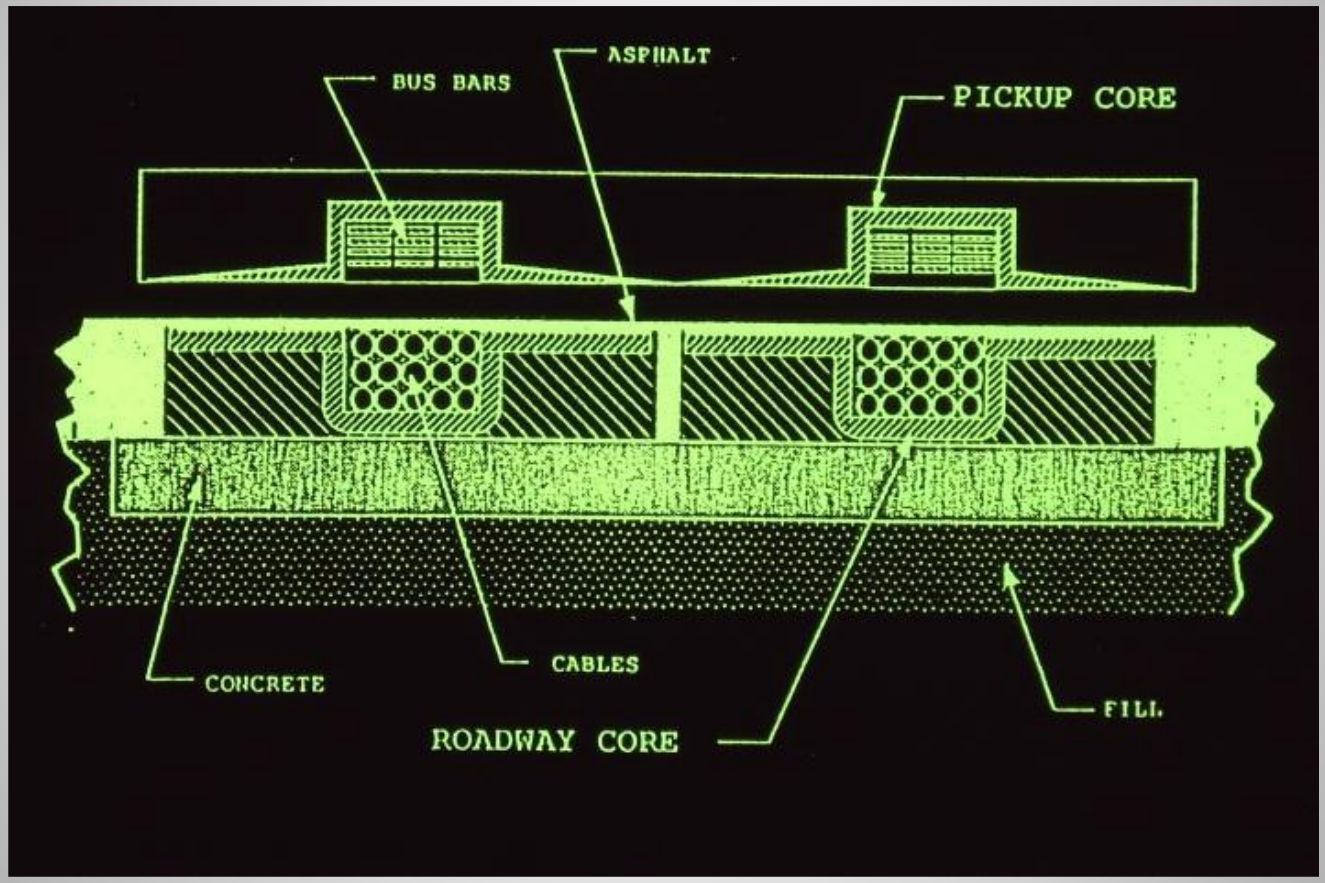
Power transfer technology

Inductive power transfer to vehicle with hand paddle (Hugues – GM)



Power transfer to vehicle by frontal inductive connection (Vrije Universiteit Brussel)

Inductive power transfer with vehicle in motion



Concept of inductive power transfer system (Lawrence Livermore Laboratory)

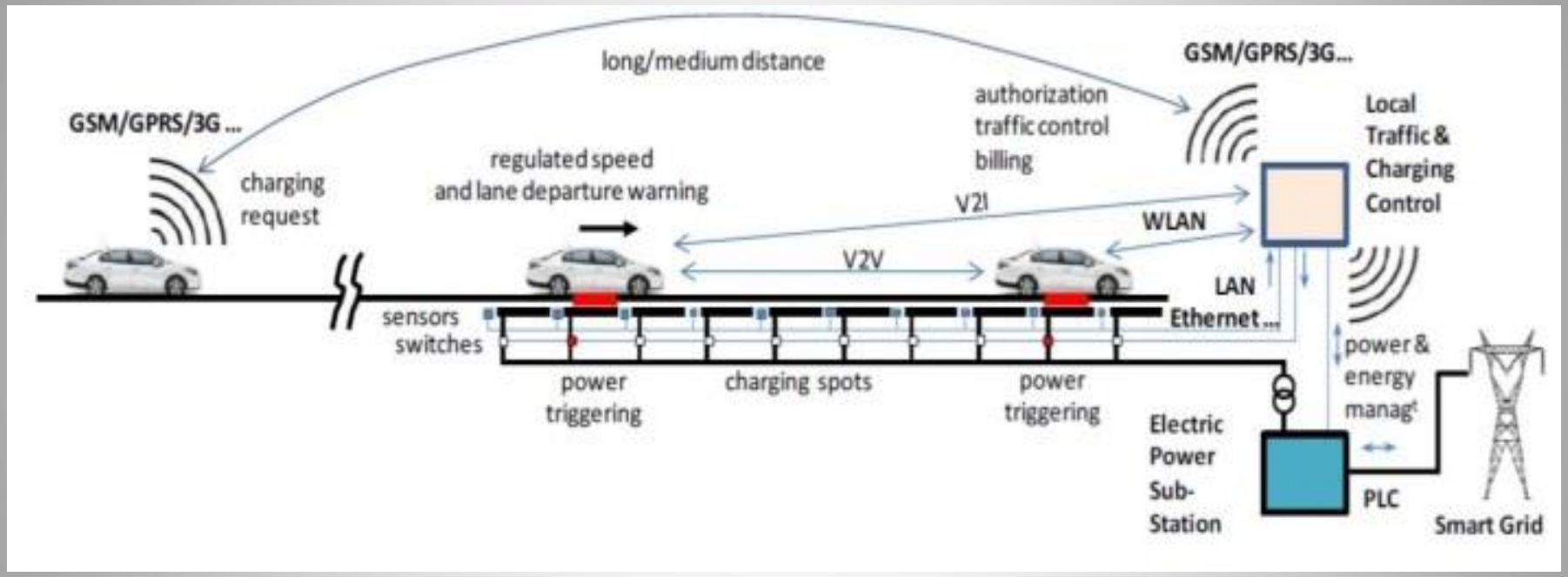
Magnetic Field Wireless Power Transfer

Image source: Evatran

Magnetic field inductive power transfer through resonant circuits

The Project FABRIC

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



FABRIC objective: to develop, test and evaluate the efficiency of dynamic charging prototypes, to assess the feasibility of large-scale deployment of dynamic wireless charging

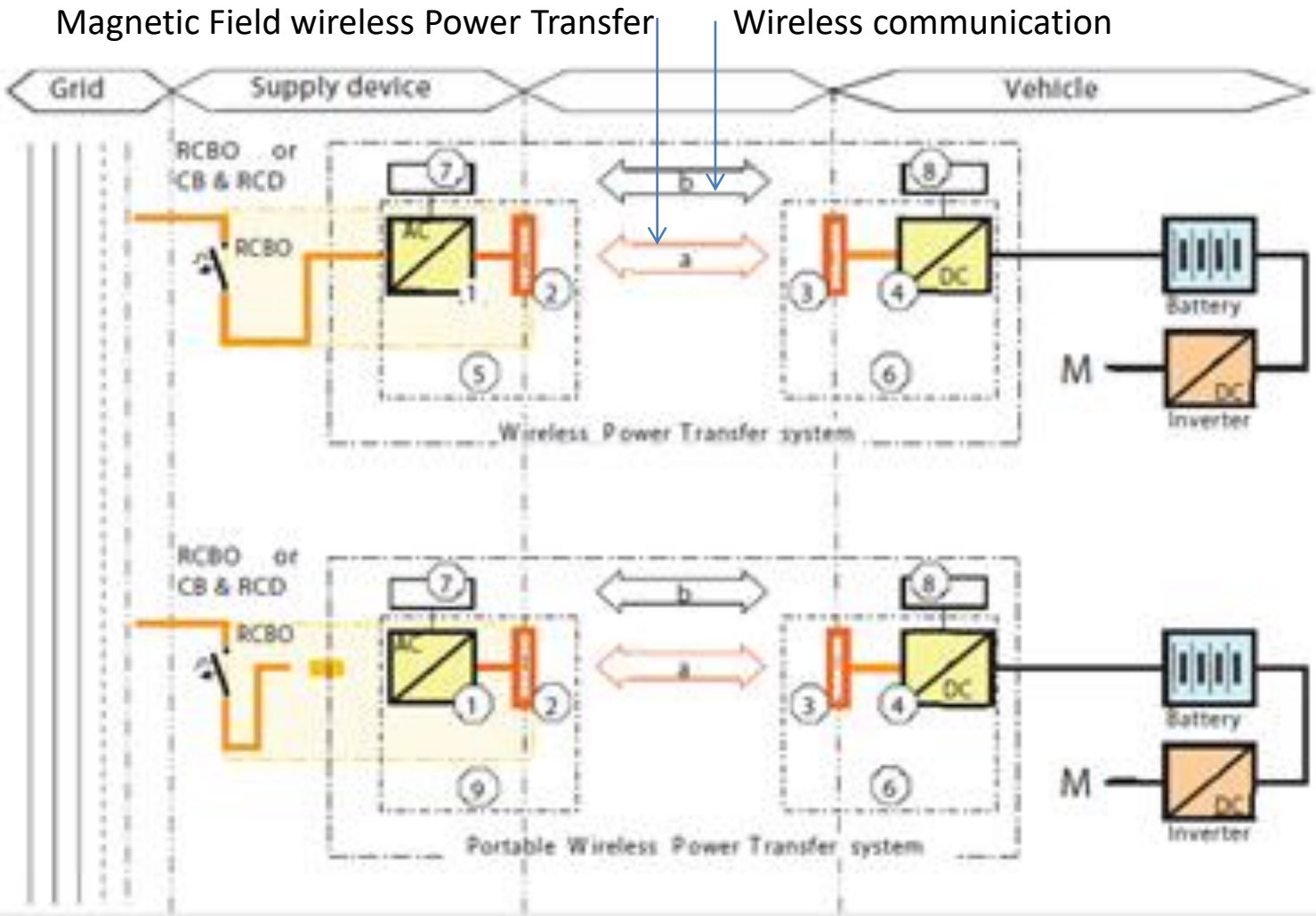
FABRIC - Prototypes

Objective: Develop three diferent **dynamic** charging prototype solutions to assess their efficiency and compare with existing solutIons

- Vedecom/Qualcom solution: 85 kHz, 20 kW
- POLITO solution: 20-200kHz, 20 kW
- SAET solution: 80-100kHz, 50 kW

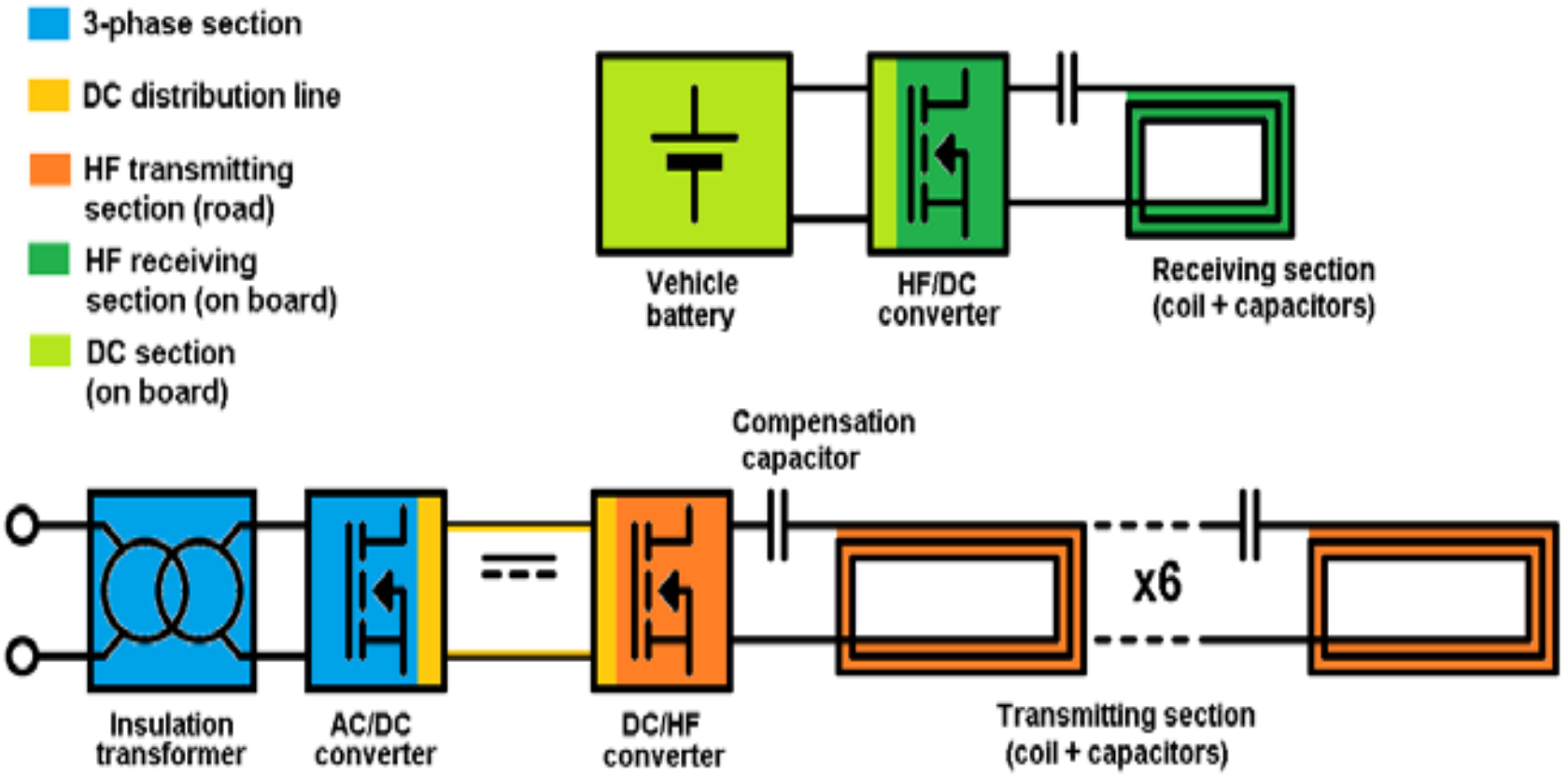
Air gaps: 20 cm

General scheme of WPT between primary and secondary element (infrastructure and vehicle)



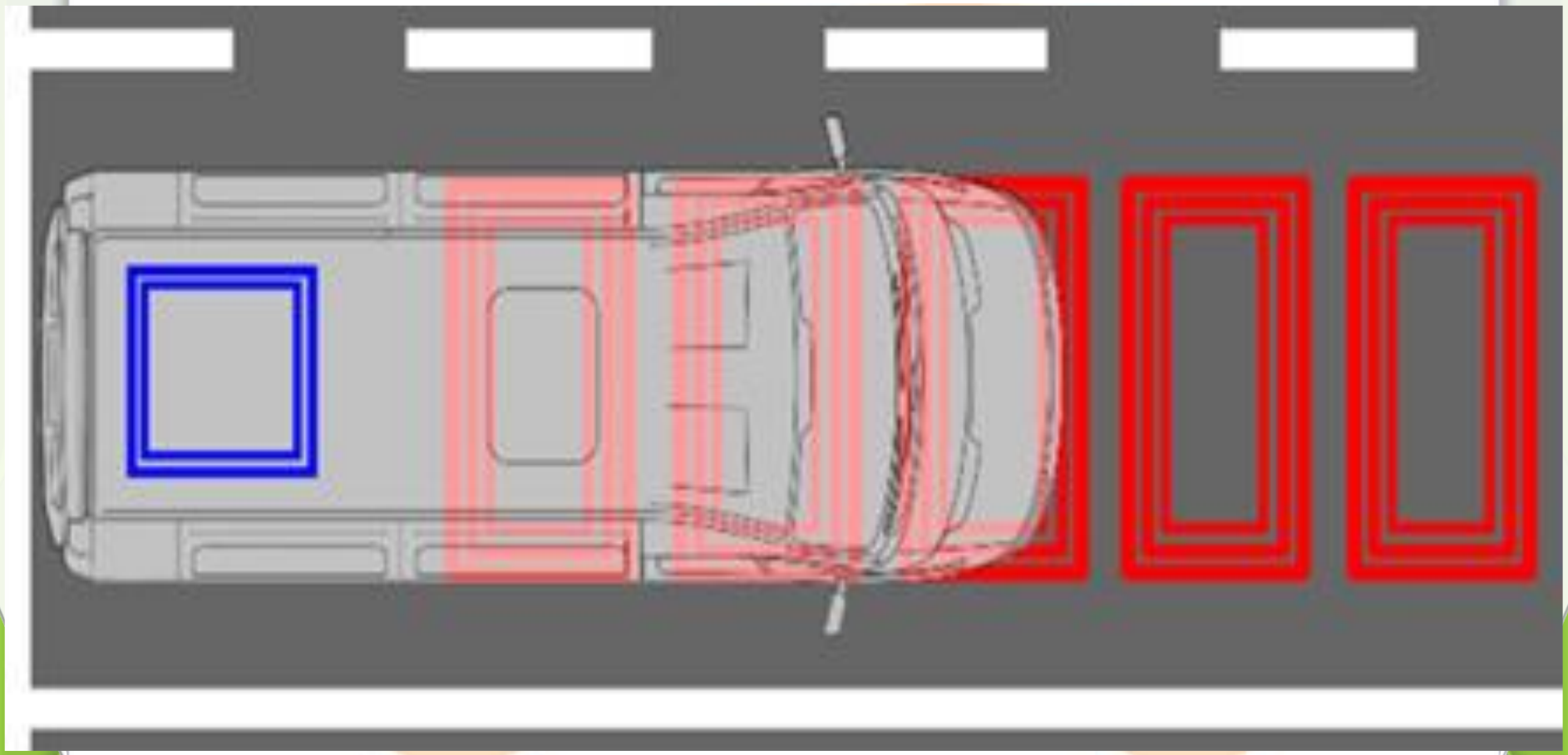
Italian test site: PoliTo solution: 20-200 kHz, 20 kW

Basic scheme of the system on board and in the infrastructure (PoliTo)

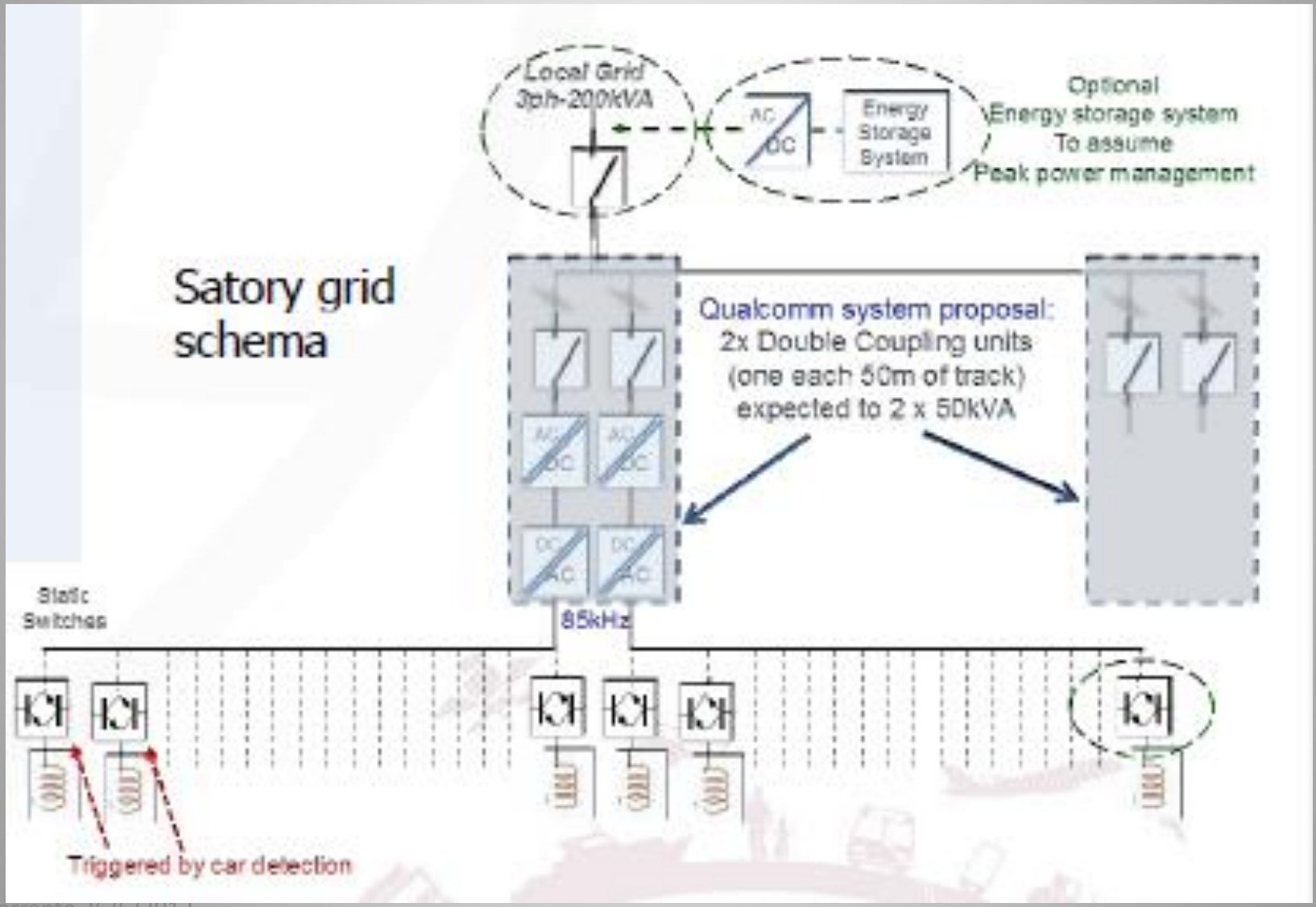


Vedecom/QUACOMM solution: 85 kHz,20 kW, to be tested in France

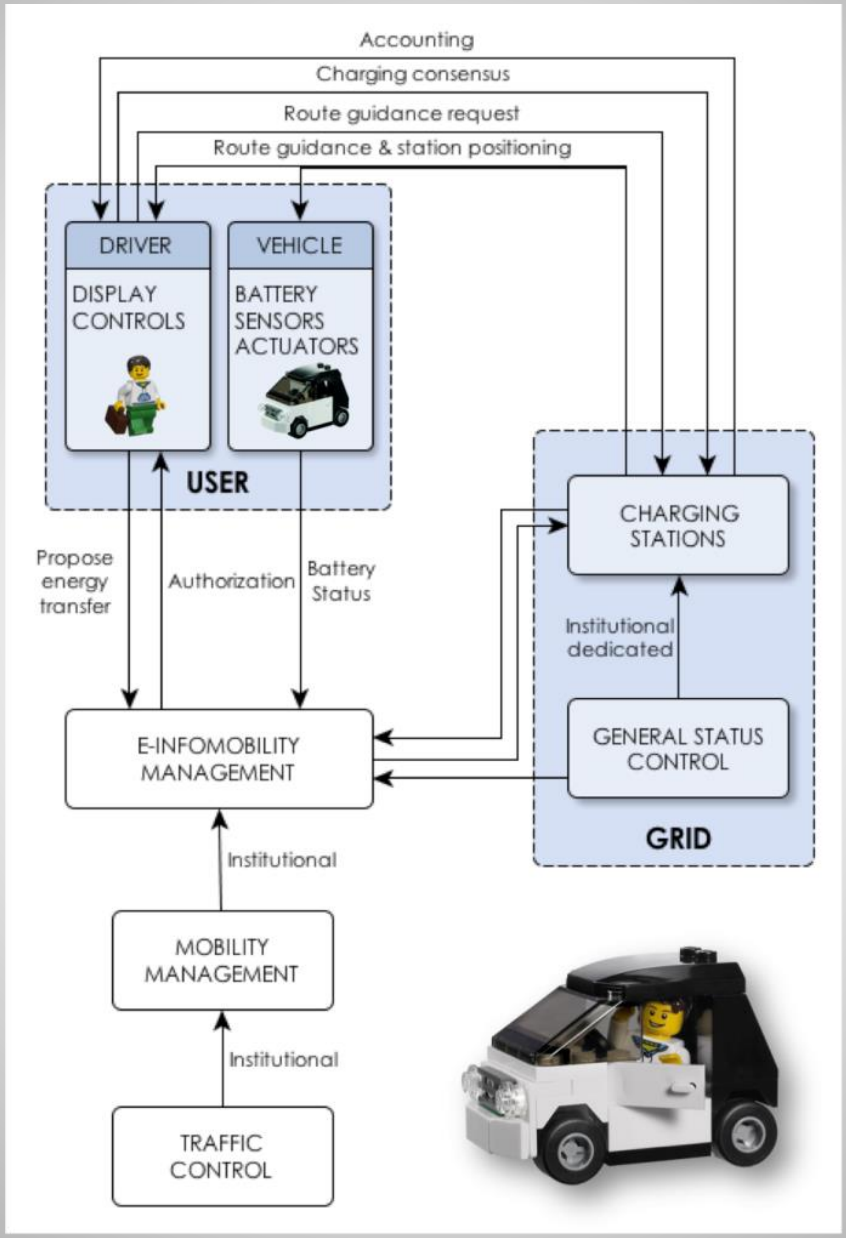
SAET solution: 80 – 100 kHz, 50 kW, to be tested in Italy



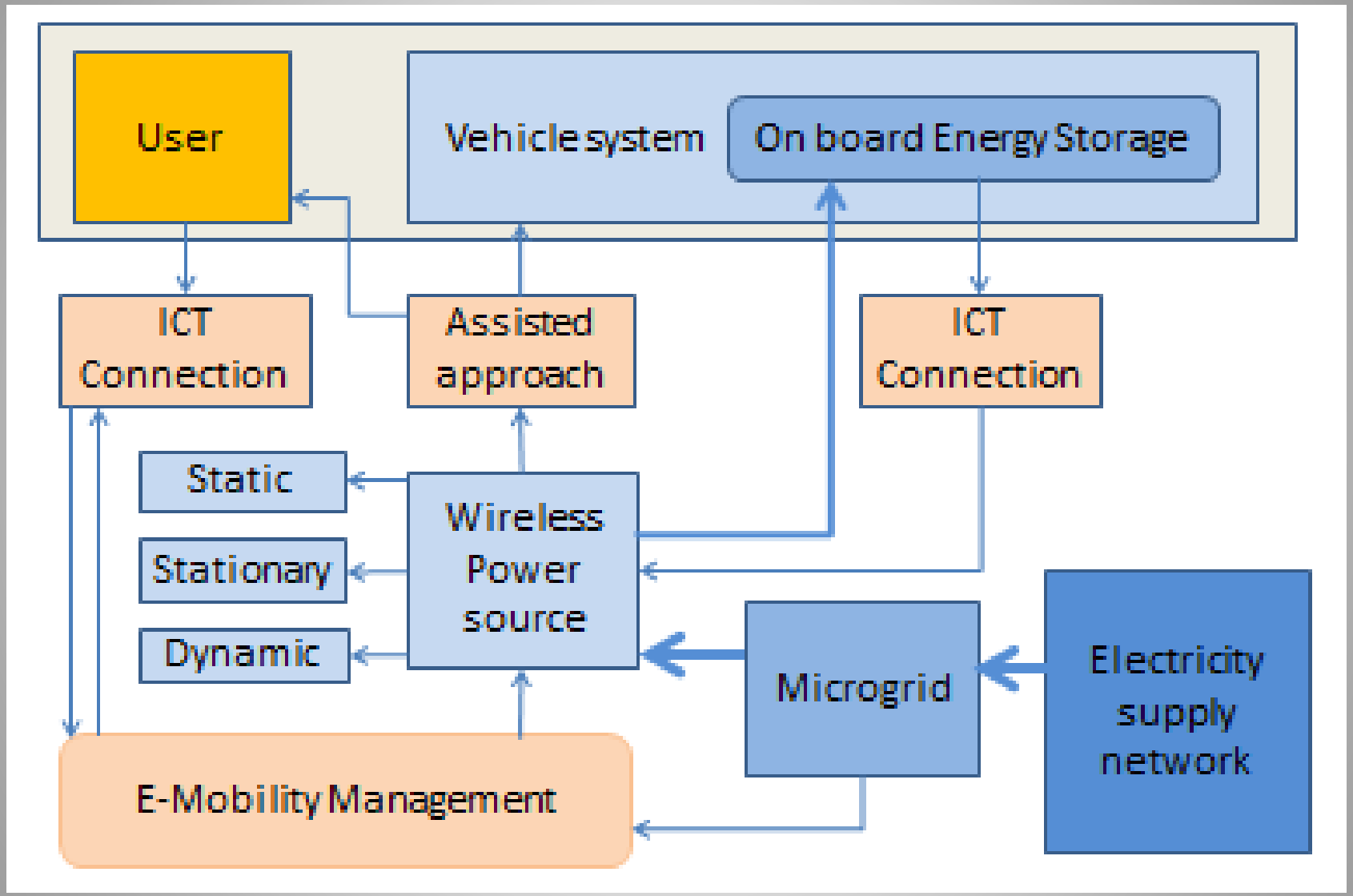
Connection to the grid



Interaction User – Grid : communication flow



Integrated system Vehicle – Infrastructure with Wireless Power Transfer



Demand side management and Grid balancing

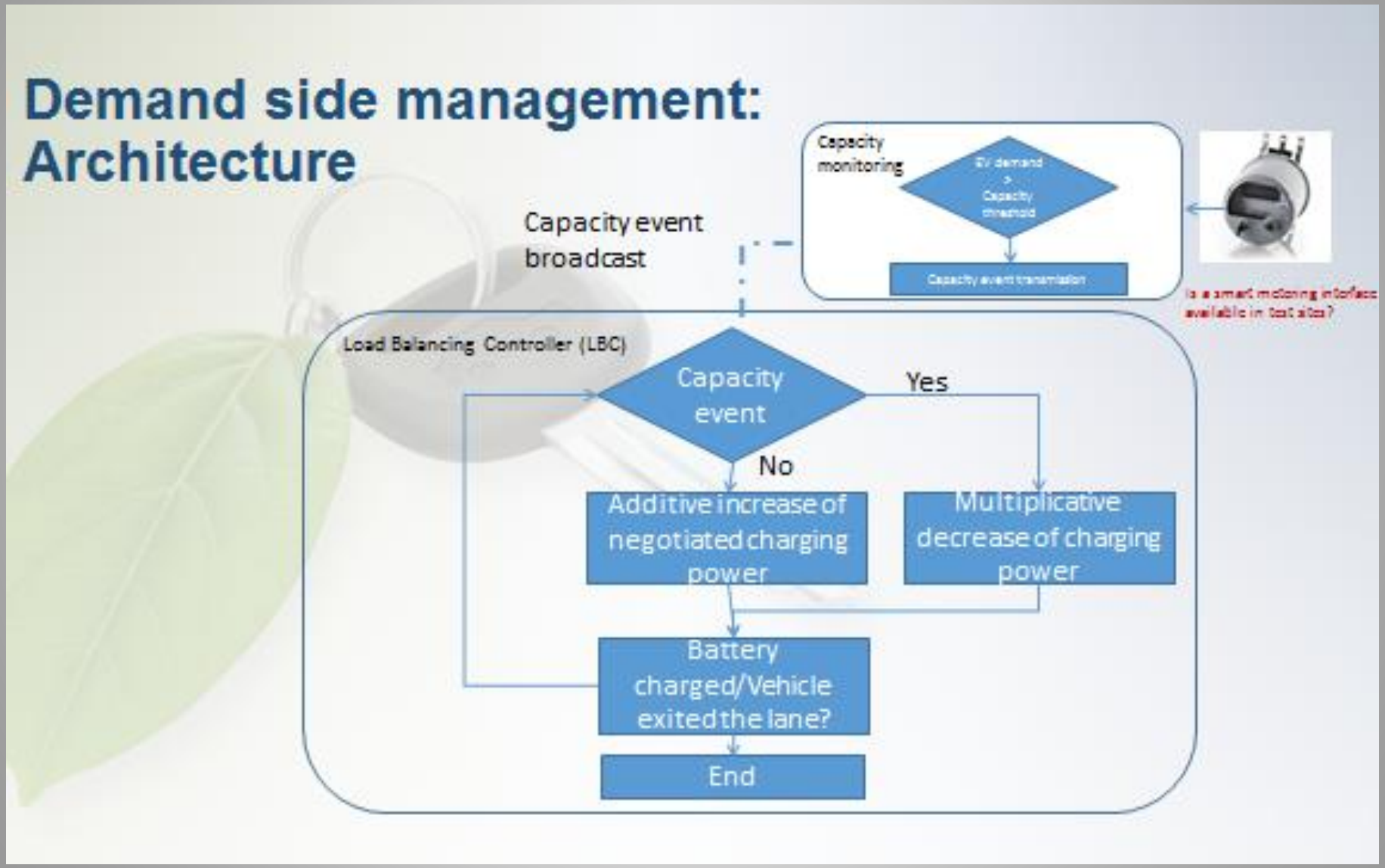
A primary goal of FABRIC is to develop a system able to ensure the equilibrium between the overall demand and the grid supply for shaping the demand of users accordingly.
Other related obyectives are: Grid stability, cost effectiveness, environmental friendliness and user satisfaction.

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

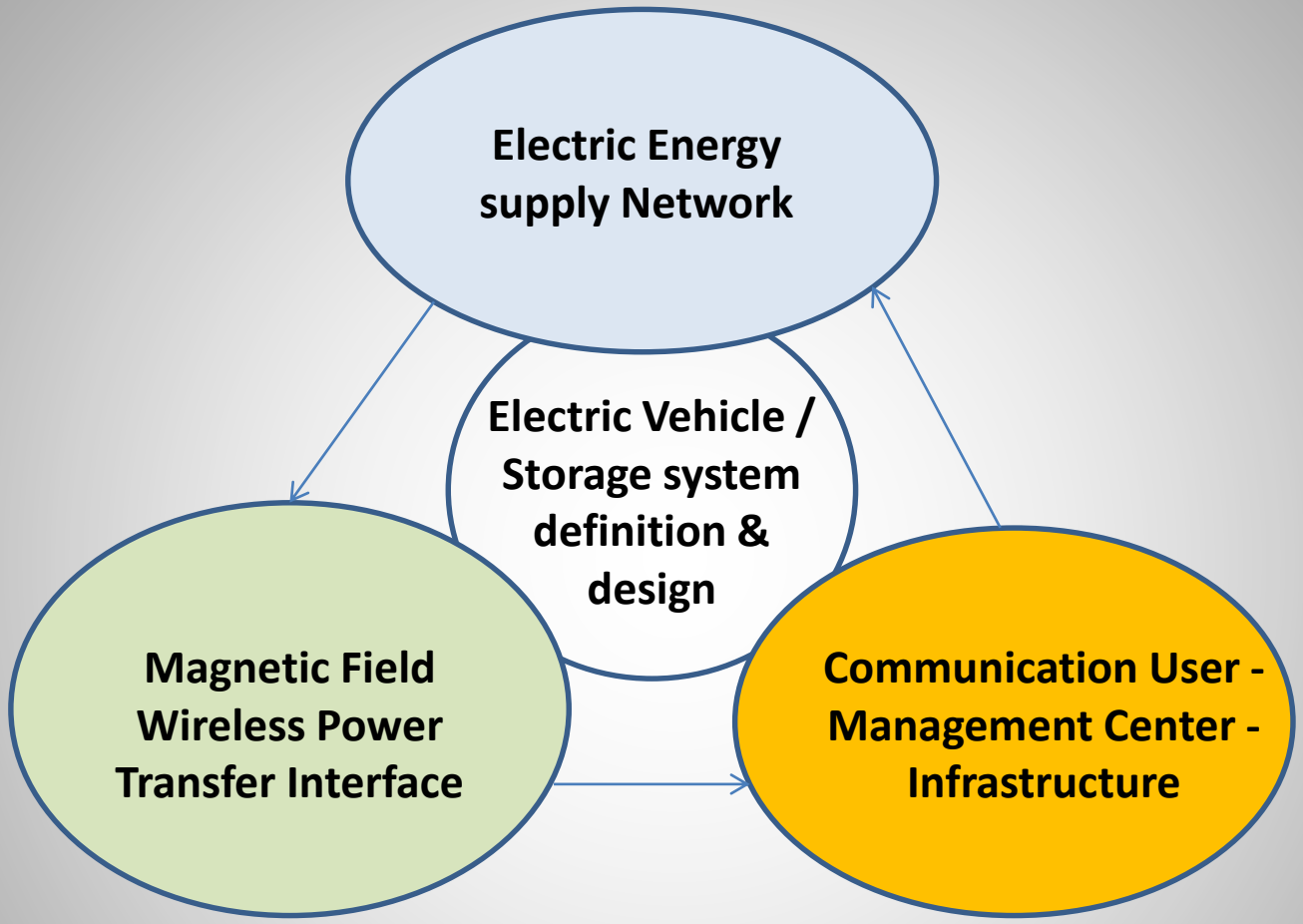
- **Static**
- **Stationary, with vehicle moving at very low speed**
- **Dynamic**

An operational Management Centershould flexibly act as a liaison between the user and the infrastructure, through an user friendly communi9cation network for routing the user to the charging facility and selected charging mode, on the basis of the grid situation and the availability of the infrstructure to deliver energy according to approprate timing and vehicle demand.

Negotiation User – Infrastructure addressing grid balancing

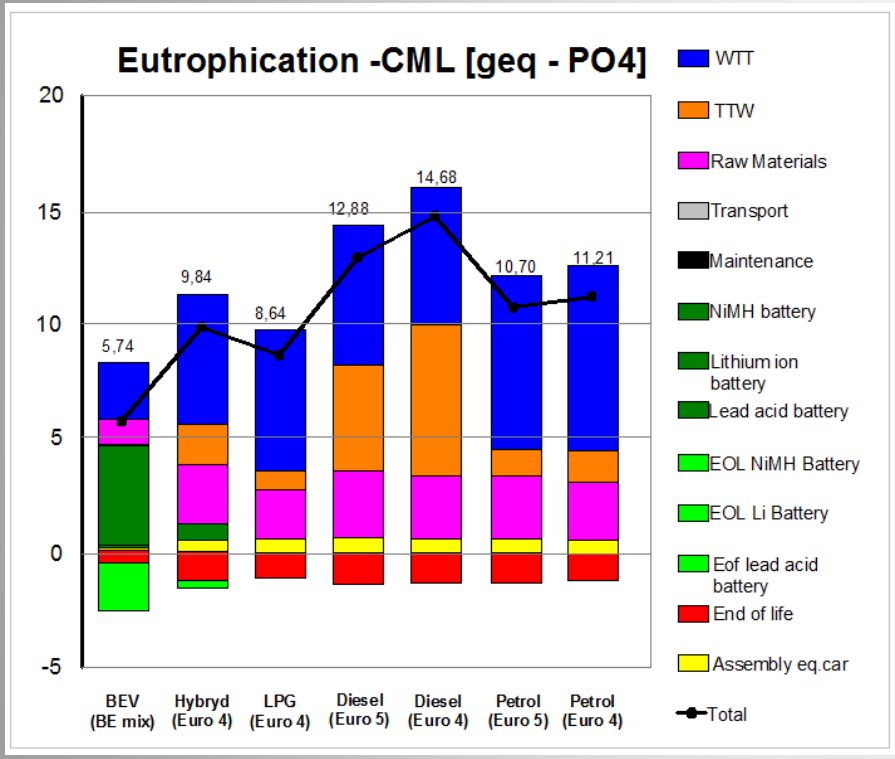


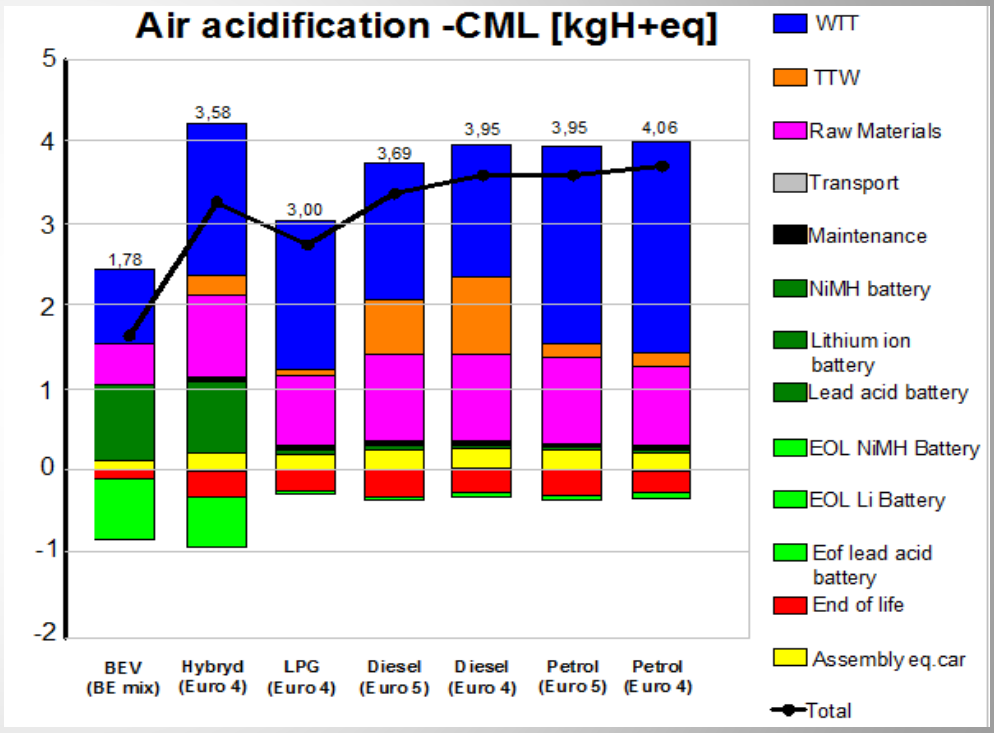
System optimization User – Vehicle -Grid

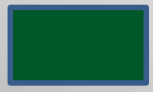


The key elements of the Electric Mobility system impacting the vehicle use and the definition of the on board storage system

Life Cycle impact of the electric vehicle on the environment and the human health (I)



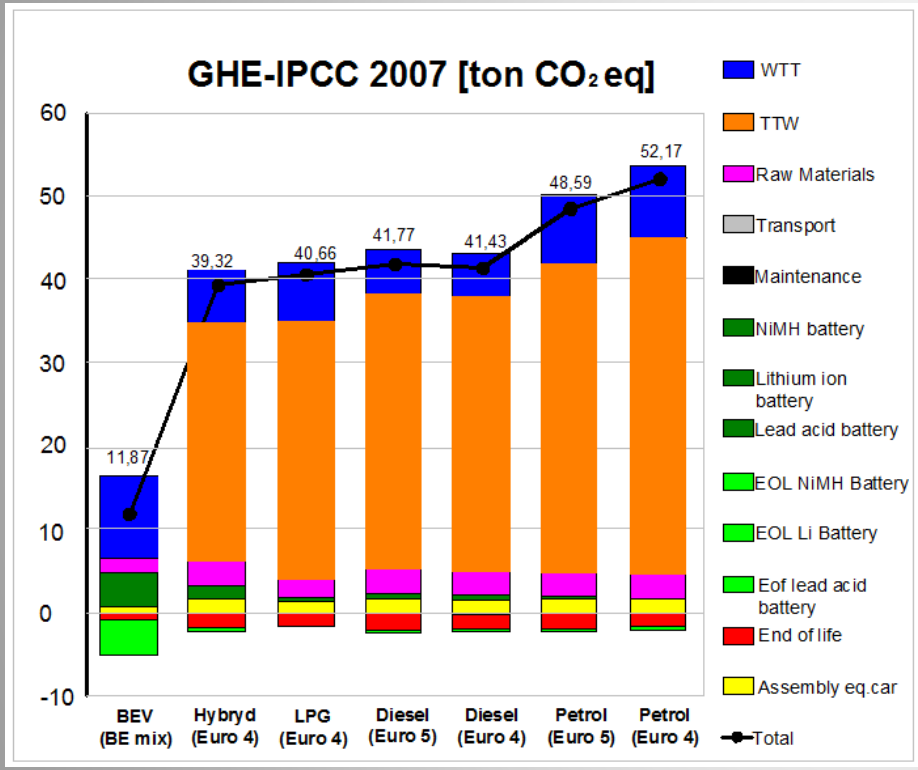


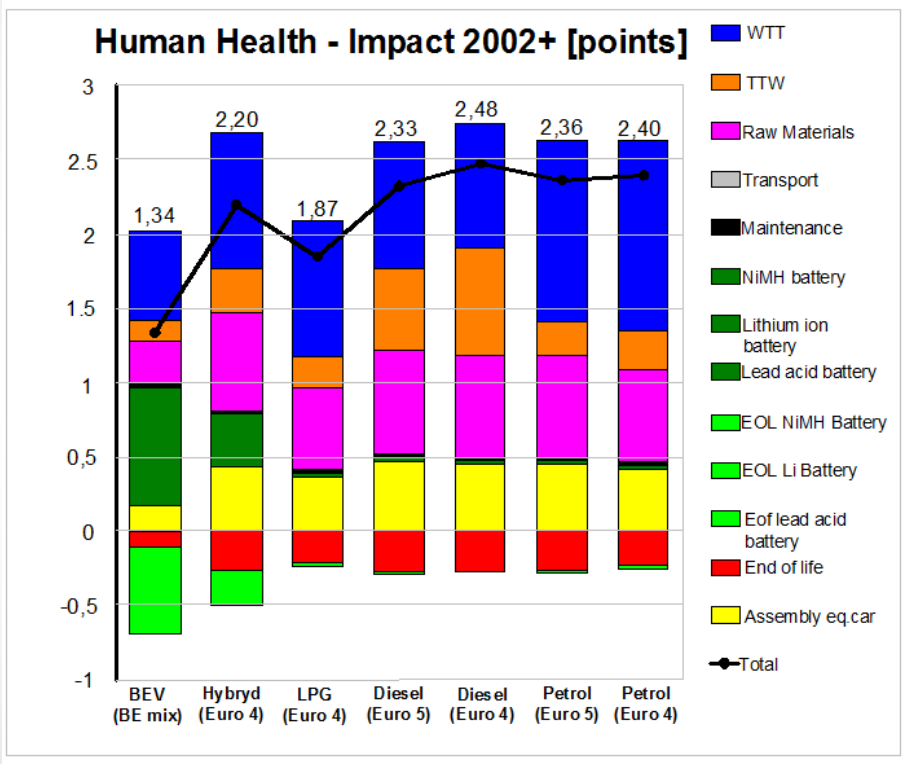


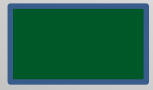
EOL

Battery impact

Life Cycle impact of the electric vehicle on the environment and the human health (II)



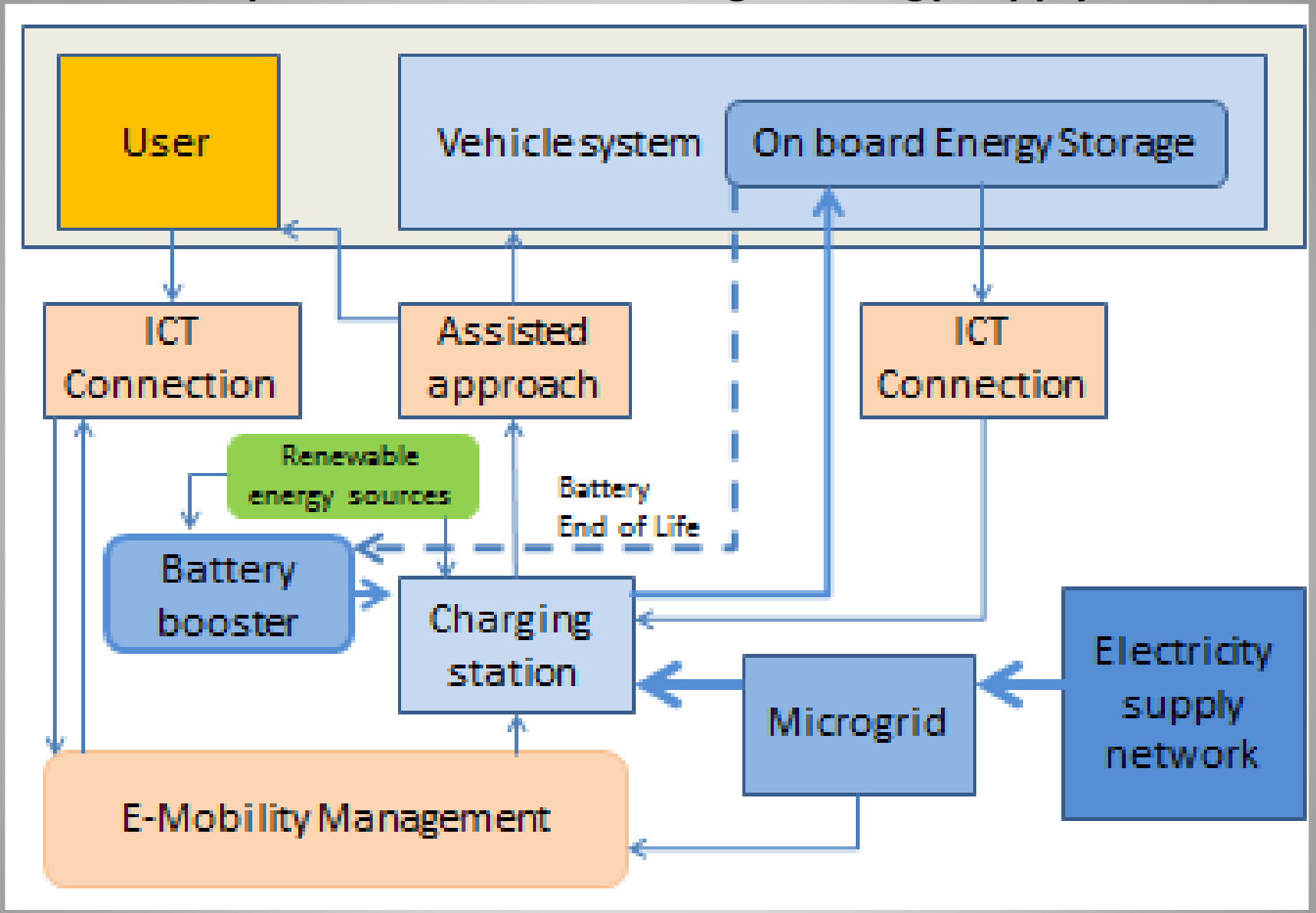




EOL

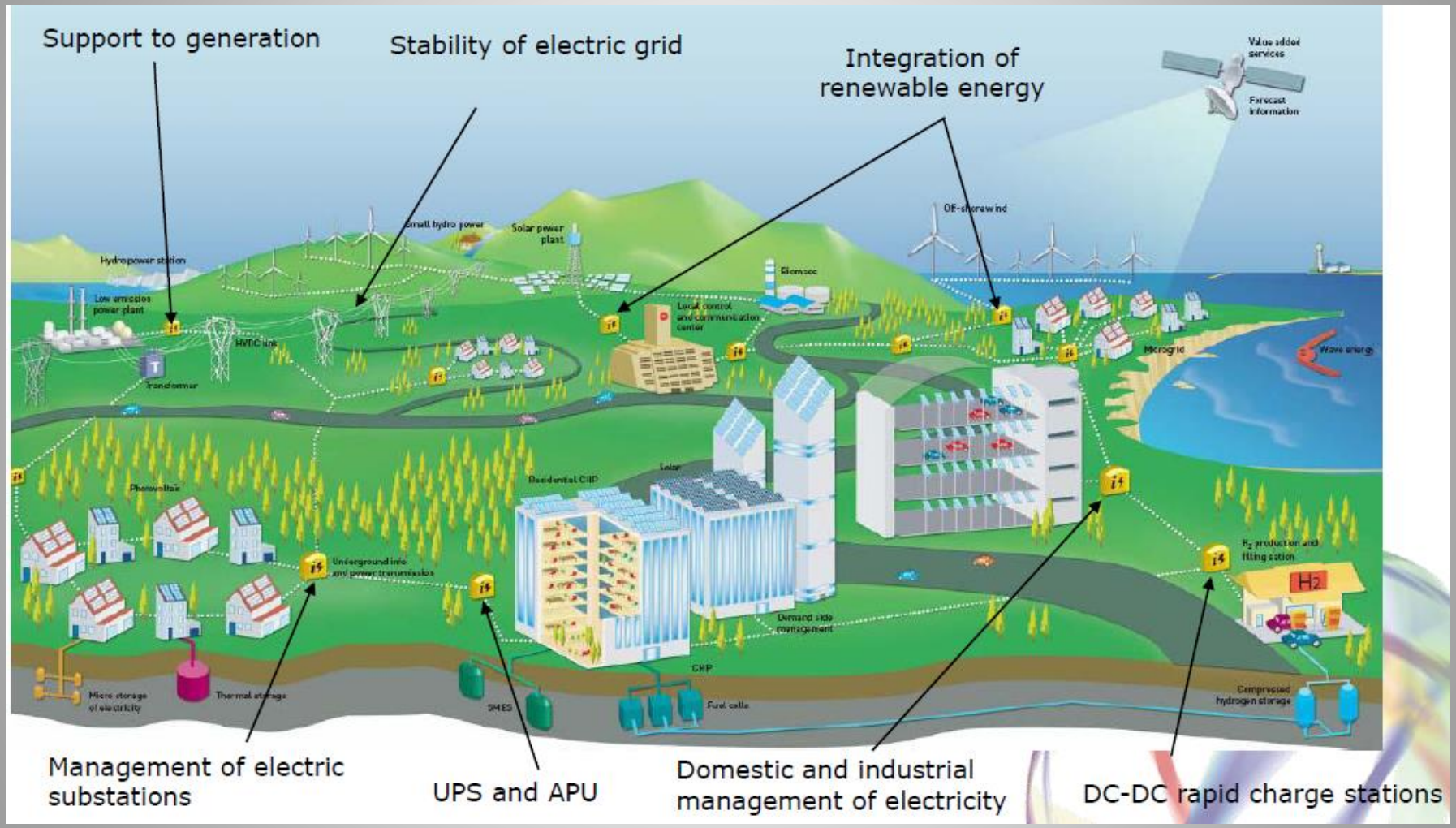
Battery impact

Optimization vehicle design –energy supply



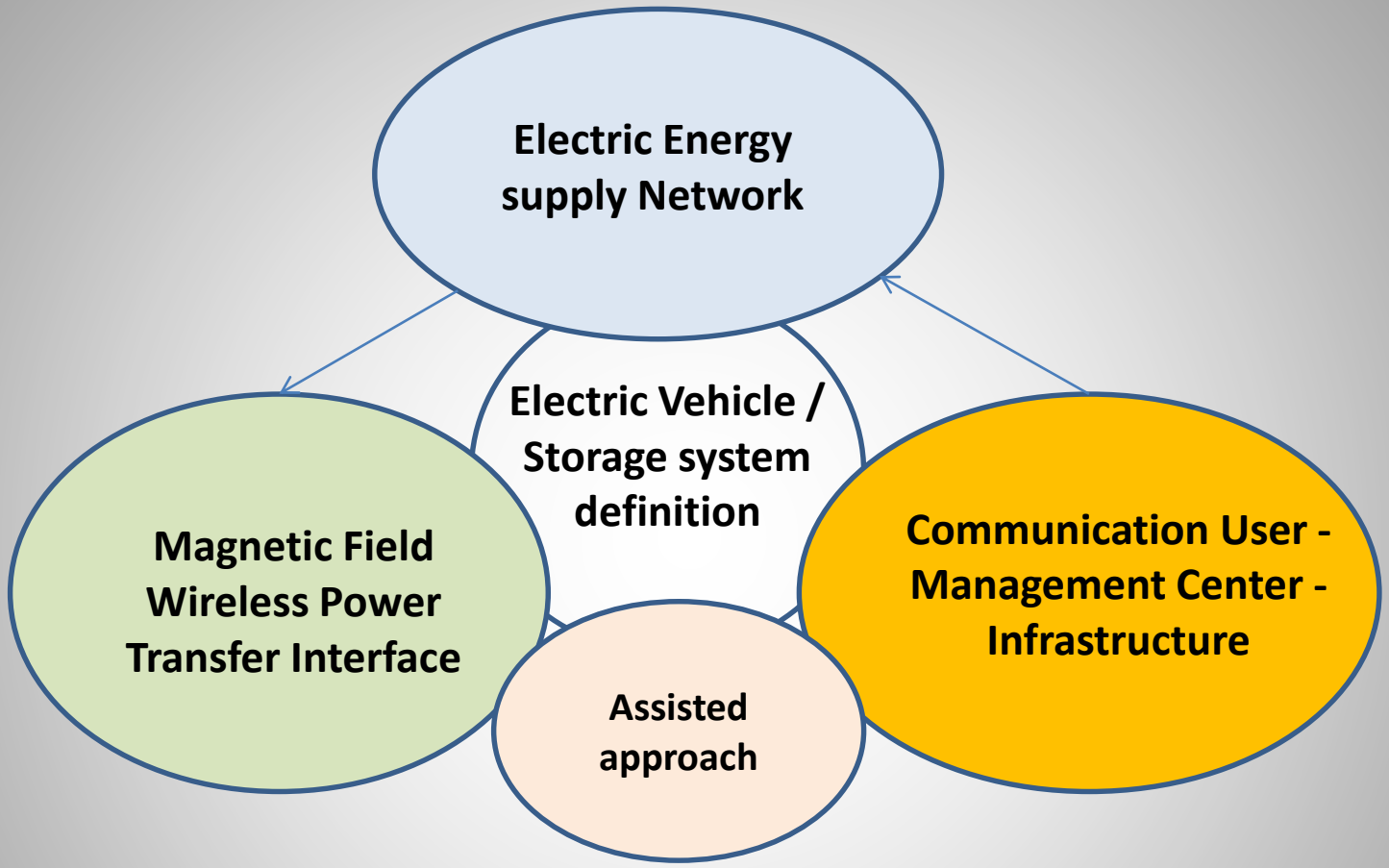
Use of End Of Life batteries as booster support to charging stations and renewable energy sources receiver

Storage systems use for electric energy network support



Source: STABLE Industrial Workshop – CeGASA International

System optimization User – Vehicle -Grid



The key elements of the Electric Mobility system impacting the vehicle use and the definition of the on board storage system

Conclusion

- **In the frame of the Intelligent Transport System the Electric Mobility can play an important contribution for the rational management of the energy and for the environment quality conservation**

- **The Electric Mobility system can be optimized considering the integration of the system User - Vehicle – Infrastructure with the governance of a Management coordination supported by information and communication network and operating the energy transfer Grid to Vehicle with a user friendly technology interface.**

- **The electric vehicle structure, with special regard to the battery, can be shaped in relation with the operational environment dedicated to the fullfillment of its mission, that are the infrastructure for energy transfer and the communication network for information links.**

- **The technology devloped in FABRIC Project, with the application modes possibilities, static, stationary and dynamic, with the quasi direct continuous wireless power supply, opens the way for the optimization of the battery sizing, minimizing the energy waste over the vehicle life cycle.**

Thank you for your attention

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