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"Europe meets IEVC" Workshop

Static and Dynamic Fast Inductive Charging: The FastInCharge project concept

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Inductive Charging

❖One of the main obstacles for the mass deployment of electric vehicles is their rather limited travel range as well as the relatively high price of their battery.
❖*Fast charging* could effectively deal with such issues, offering the drivers the ability to charge their vehicle at a really small amount of time.

❖Inductive charging is a particular fast charging solution which can further simplify the process of charging:

- ➢The need for any physical connection between the EV and the station is eliminated
- ➢Issues involved with the use of wire, like potential hazards due to electrocution or precautious measures to deal with harsh environments (like rain or snow), can easily be avoided.

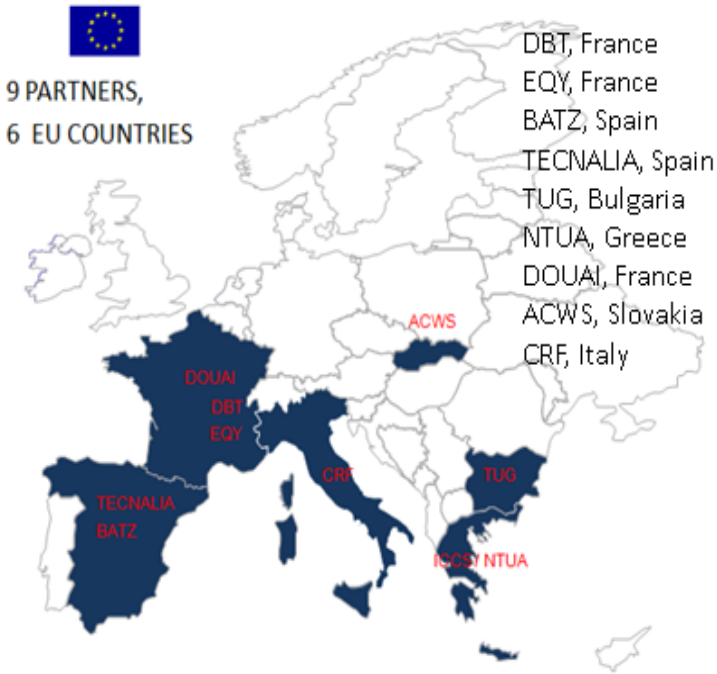
➢*Dynamic* or *On-route inductive charging* can eliminate any concerns connected with the limited travel range of the vehicles.

- ▪A huge battery is no longer required in order for the vehicle to perform a long range trip
- ▪Hence the battery size, and the final price of the battery, could be significantly decreased.

FastInCharge Project

Smart infrastructures and innovative services for Electric vehicles in the urban grid and road environment

- "FastInCharge" is funded from the European Union's Seventh Framework Programme FP7/2007-2013 with a budget of 2,397,042.60€.
- The project has already started since October 2012 and will last 36 months.
- The consortium comprises 9 organizations from 6 European Member States. Particularly:
  - 1 Company specialized in charging infrastructure for electric vehicles (DBT)
  - 1 automotive industry (CRF).
  - 1 industrial group of automotive engineering (BATZ),
  - 3 research organizations, specialists of automotive engineering, contactless power and management systems (Tecnalia, TU Gabrovo, NTU Athens),
  - 1 end-user, demonstration site (Douai),
  - 1 autocluster (ACWS) ,
  - 1 Company specialized in innovation management (EQY)

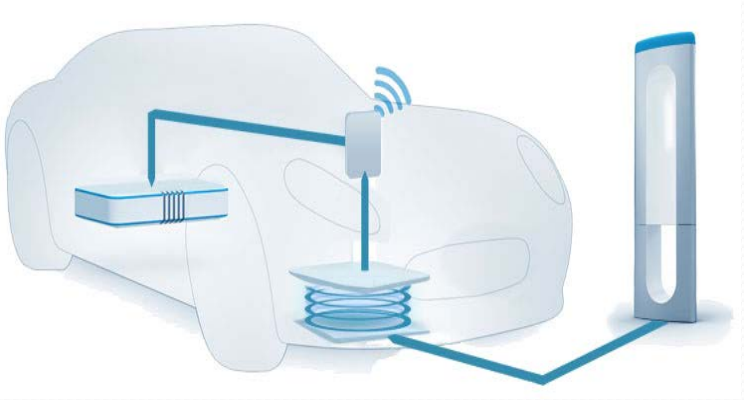


FastInCharge Project

Smart infrastructures and innovative services for Electric vehicles in the urban grid and road environment

Project's scope:

❖The FastInCharge project aims at fostering the democratization of electric vehicles in the urban environment by developing an easier and more comfortable charging solution to ease the Electric Vehicles (EV) use by the large public and facilitate their implementation in the urban grid.
❖In this scope, a complete charging infrastructure will be developed and demonstrated in order to:



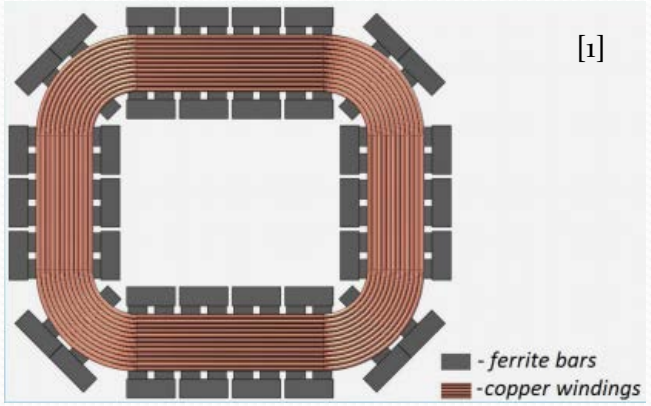
1. *Address consumers' acceptance of electric vehicles by getting rid of the autonomy issue,*
2. *Test its implementation and assess its easy feasibility,*
3. *Optimize the energy delivery to stations and its interaction with the grid and vehicles,*
4. *Study the impact of its integration in the urban environment to foresee eventual problems that would occur in the frame of a real integration.*

FastInCharge Concept: Static Inductive Charging

❖The magnetic coupler proposed in the *FastInCharge project* is a rectangular shaped pad, with a mass of 28kg and dimensions 700mm X 800mm X 90mm .

❖The system is able to provide an output power of 30kW, with an efficiency of up to 92% [2].
❖An air gap of 70-90mm between the two coils is achieved, while the tolerance to horizontal misalignment reaches ±150 mm [2].

FastInCharge Concept

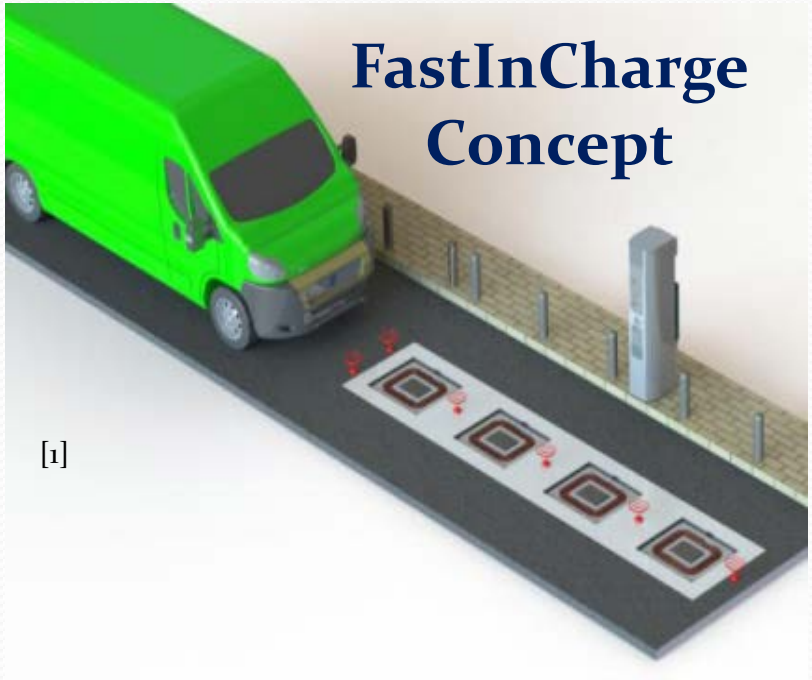


[3] Stefan Milchev, Nikolay Madzharov, Anton Tonchev, "Inductive technology for battery charging", webinar: "Sustainable fast charge for future vehicles and transport. Inductive technology for electric vehicle charging System integration", http://fastincharge.eu/webinar.php
[2] Nikolay D. Madzharov – Anton T. Tonchev, "INDUCTIVE HIGH POWER TRANSFER TECHNOLOGIES FOR ELECTRIC VEHICLES", Journal of ELECTRICAL ENGINEERING, Vol. 65, No. 2, pp. 125–128, 2014

FastInCharge Concept: Dynamic Inductive Charging

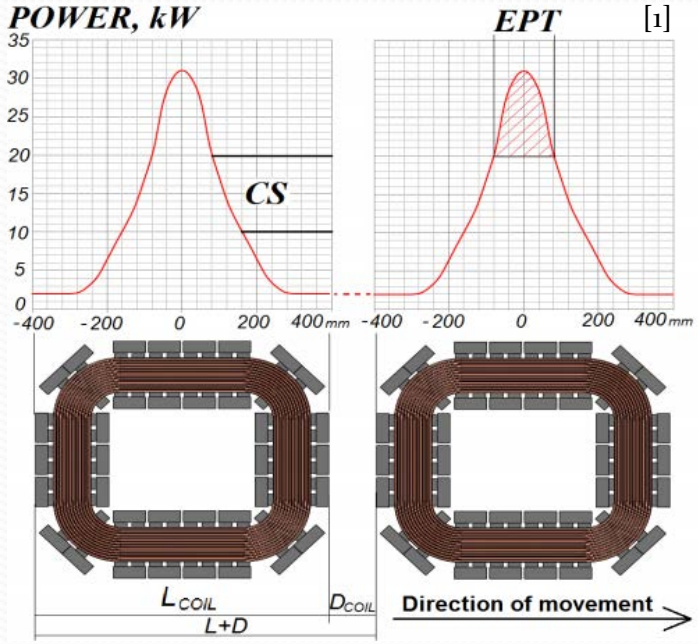
❖Dynamic inductive charging is a solution that is also considered within the scope of the FastInCharge project.

❖The on-route or dynamic stations will comprise four primary coils, similar to the ones developed for the static stations.



❖ Instead of constantly delivering power to all of the charging coils, the structure enables a smart concept so that power is delivered to one charging coil at a time:

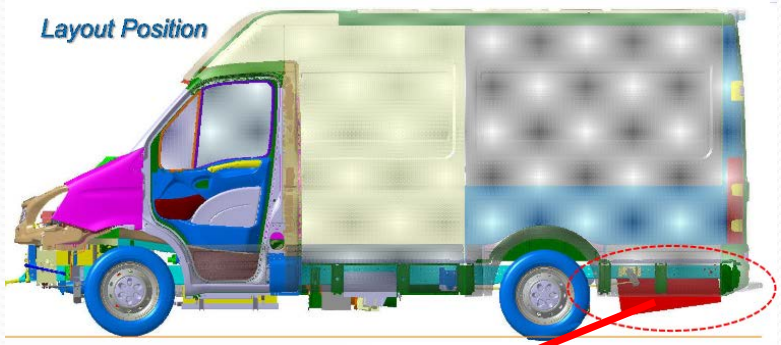
- When a vehicle approaches the station, power is provided to the first charging coil.
- As soon as the vehicle moves away from the first charging coil power is provided to the second one.



[1] Stefan Milchev, Nikolay Madzharov, Anton Tonchev, "Inductive technology for battery charging", webinar: "Sustainable fast charge for future vehicles and transport. Inductive technology for electric vehicle charging System integration", http://fastincharge.eu/webinar.php

FastInCharge Concept

- The efficiency of the whole system highly depends on the air gap between the two coils
  - A mechanical system will be developed within the scope of the FastInCharge project in order to ensure that the gap between the two coils remains at the appropriate values



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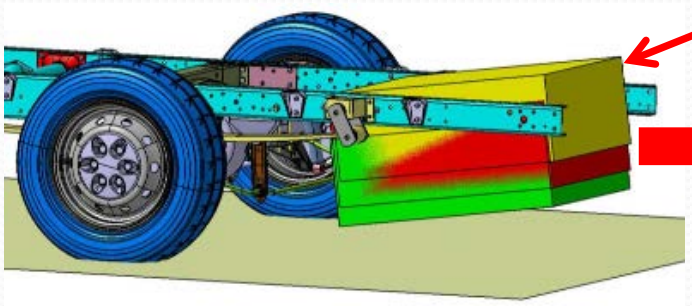

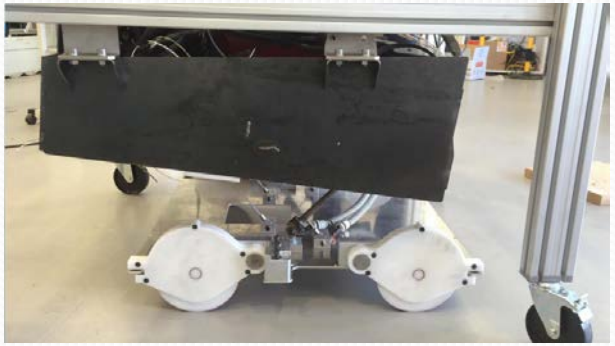

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Defining The Energy Demands of Static Inductive Charging

❖Inductive charging is a newly developed technology, therefore there is no operational experience concerning its demand profile.

❖However, the operational behavior of fast stationary inductive charging will resemble the respective one of fast conductive charging.

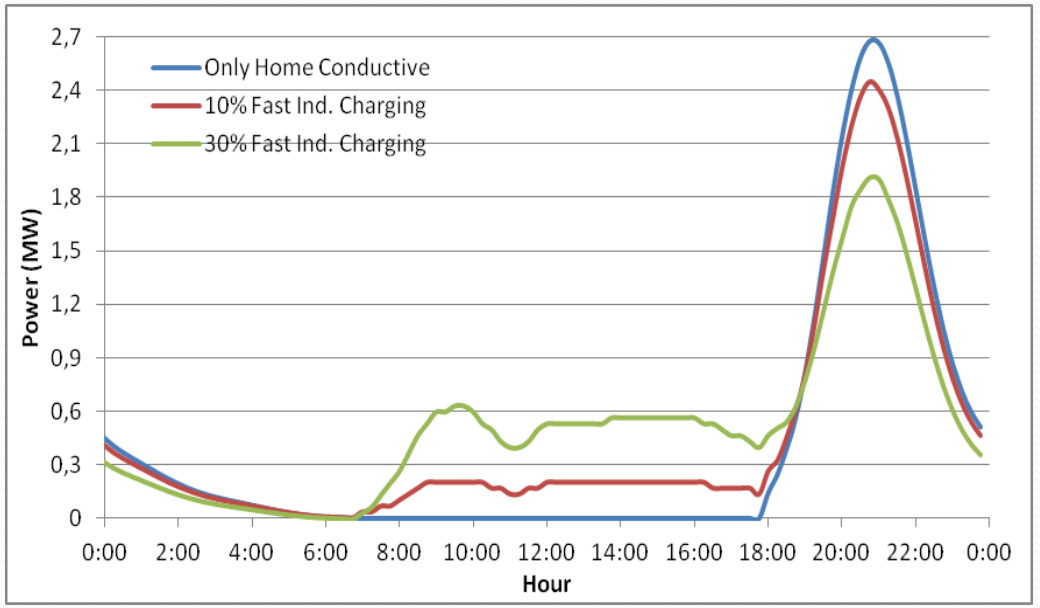
❖After processing real data on fast conductive charging stations the following parameters are defined:

1. The hour of the day a charging event is expected to occur
2. The duration of each charging event

❖According to the aforementioned parameters the energy needs for inductive charging can be defined

❖In case no inductive charging stations are installed in the grid, a significant peak of 2.67MW can be observed in the EV demand in the evening hours.

❖In case that 10% of the EV fleet relies on fast inductive charging solutions the EV demand during the evening is decreased (2.45 MW), while an increase can also be observed in the morning and middle-day EV demand.



❖In case of a mass deployment of fast inductive charging stations, where 30% of the drivers rely on fast inductive charging solutions the peak in the evening demand is decreased to 1.91MW, while a significant increase of more than 0.6MW in the morning demand can also be observed

Energy Management System

❖As the number of installed inductive chargers in the grid increases, the load profile of the network will be significantly modified, due to the high charging power (approximately 30kW) served from this type of chargers.

➢The additional charging demand may provoke grid issues such as voltage excursions, network overloading etc.

❖Consequently, an *Energy Management System* is necessary in order to mitigate potential disturbances in the normal operation of the grid.

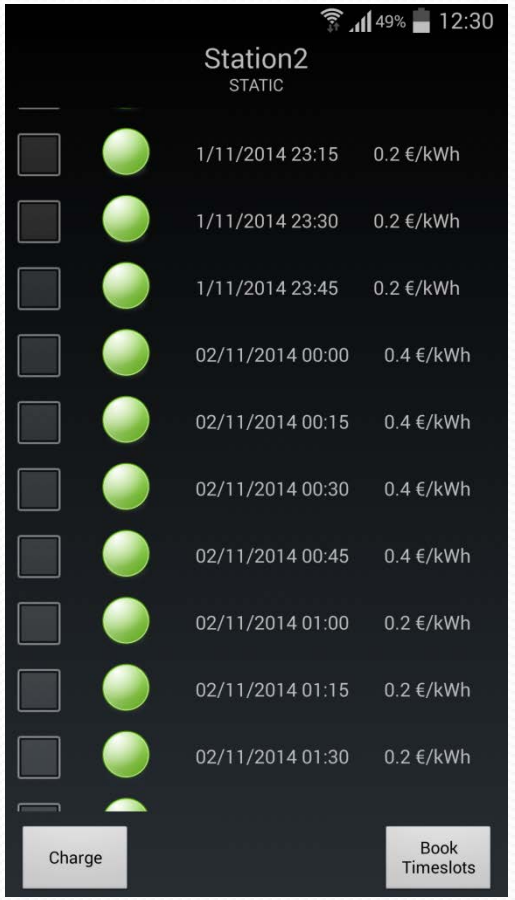
❖A graphical user interface has been developed in order to facilitate the interaction between the user interface and the management system.

❖The different coloring of the charging stations indicates their current availability:

- ***Green**:* The station is available and the EV can charge as soon as it reaches the station
- ***Orange**:* The station is busy either because another EV is charging at that moment or the charging station is booked.
- ***Red**:* The station is not available either due to network operational issues or due to maintenance purposes.

Energy Management System

- By tapping on a charging station icon, the detailed information for this station appears as shown in the figure.
  - Charging station availability (15-minutes intervals)
  - Electricity cost per timeslot
- The "Charge" button allows the user to automatically request the next timeslots in order to charge their EV.
- Moreover, the EV user is able to book a future timeslot by checking the available timeslots and pressing the "Book Ttimeslots" button.



FastInCharge Project:
www.fastincharge.eu

Thank you very much
for you attention!!!

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