FABRIC

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

Versailles-Satory test site integration of a DWPT solution and achievements

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VEDECOM
Final Event Conference Turin, Italy, June 21st 2018

VEDECOM: collaborative RESEARCH HUB on new mobility

VEDECOM, hub de recherche coopérative créé en 2014
VEDECOM, a cooperative research hub created in 2014

Industriels	Académiques	Territoires
Industrials	Academics	Local authorities

Certified as **Institut for Energy Transition** in 2014 by

Agence Nationale de la Recherche ANR

Founders

cetim, ESIGELEC, ESTACA, ifp Energies nouvelles, IFSTTAR, PSA Groupe, Groupe Renault, Safran, Université de Versailles St-Quentin-en-Yvelines / Université Paris-Saclay, Valeo

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VEDECOM IN THE CENTER OF 3 MAJOR SOCIETY CHALLENGES

Mission

Develop **disruptive technologies** and a **cross-disciplinary vision** of new usages, for **sustainable, safe, efficient** and **affordable mobility**

To contribute to air quality improvement in urban areas and CO2 massive reduction

By **moving** Electric Vehicle from niche to **mass market**

Vehicle electrification

To offer sustainable, safe and efficient mobility

By **accelerating the introduction of automated cars**, with or without driver

Driving delegation and connectivity

To optimize mobility systems on territories

By **analysing** and **experimenting new services** linked with green, autonous and connected vehicles

Shared mobility and energy

TRAINING

VEDECOM : an ecosystem & a centre for excellence

Agenda

1. INTRODUCTION
2. TEST SITE, DYNAMIC WPT SOLUTION AND CAR DESCRIPTION
3. TEST METHODOLOGY
4. MAIN RESULTS AND DISCUSSION
5. MAIN CONCLUSIONS

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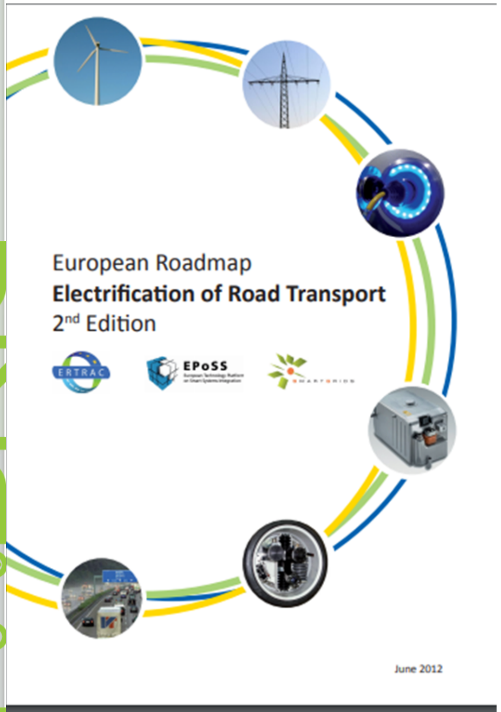
2012 European Electrification Roadmap



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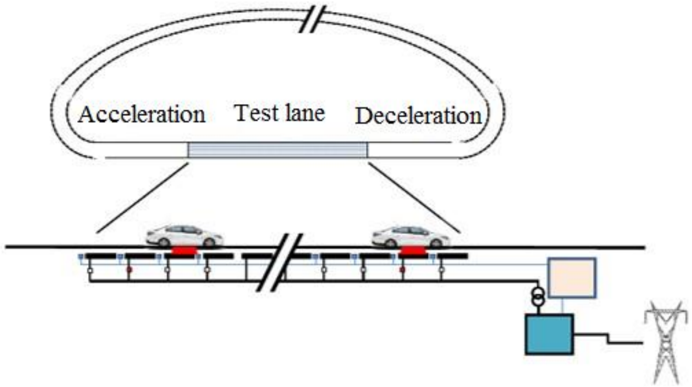
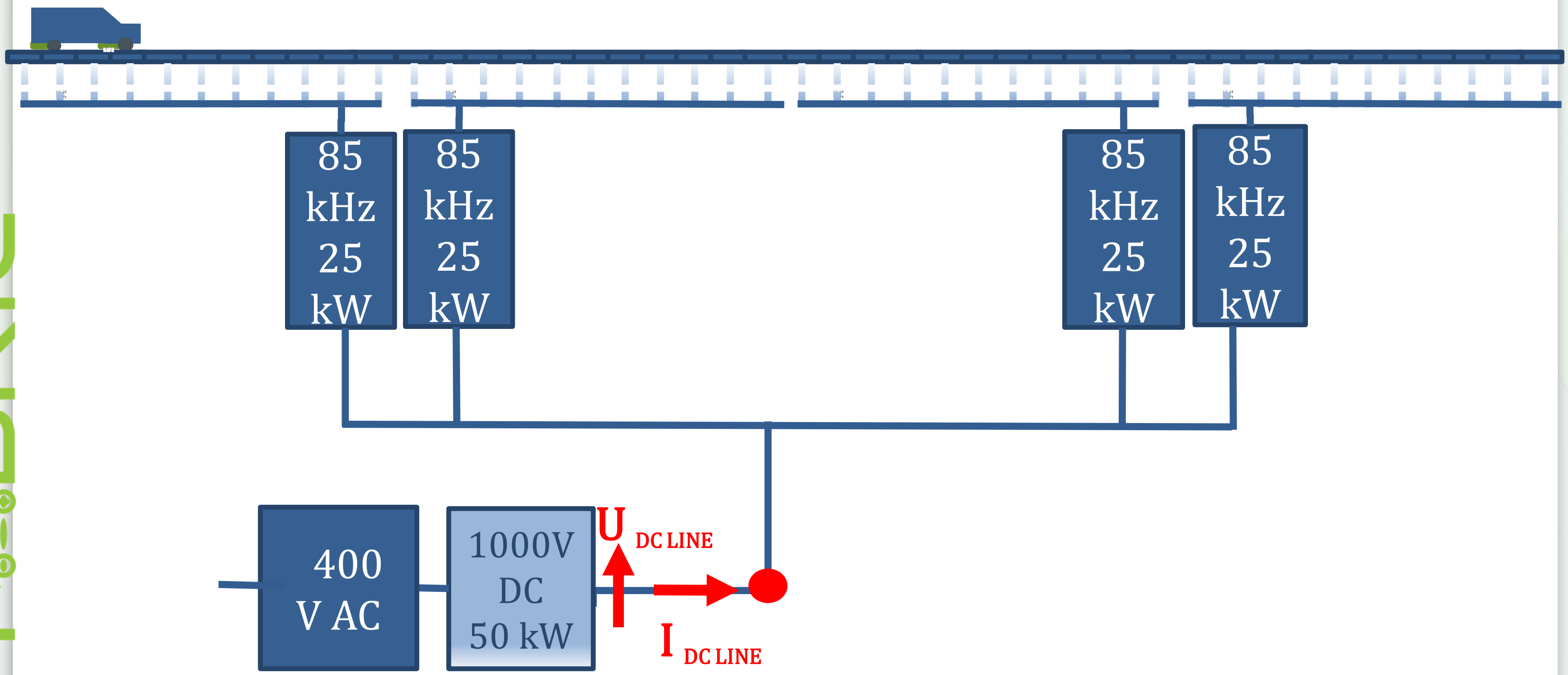
The French test site in Versailles - Satory



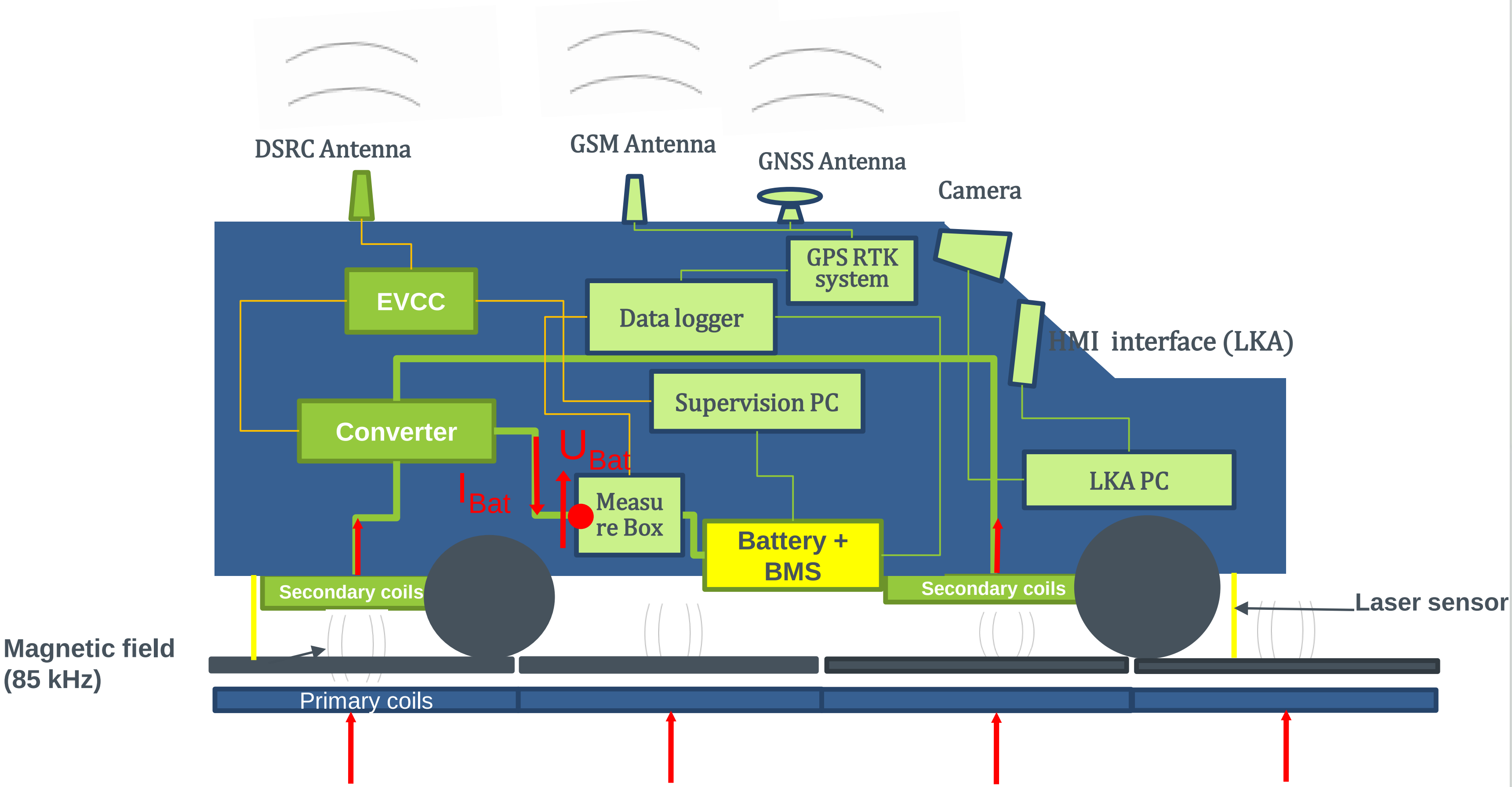
Prototype DWPT system specifications

Maximum power into vehicle	20 kW
Maximum speed	100 km/h
Alignment tolerance	+/- 20 cm
Vehicle pad size	350 mm *600 mm
Base pad width	450 mm
Track length	100m
Number of Vehicles capacity	2

Prototype DWPT system electric infrastructure

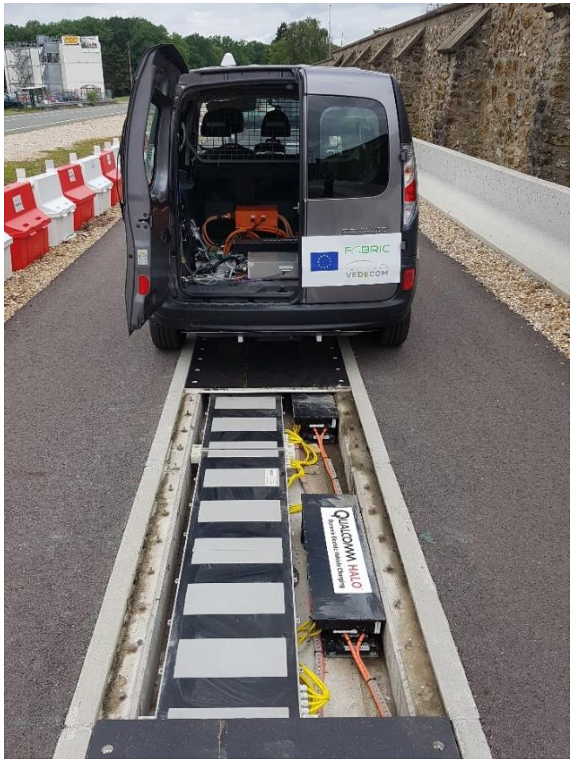


Complete car additional equipment



Charging lane and car prototype implemented

View of the 100m experimental track equipped with DWPT system & first integrated car prototype (delivered in September 2016).



Fully integrated & instrumented second car prototype (delivered in March 2017)

video describing the charge system and showing the track operated can be seen at https://www.youtube.com/watch?v=2t0E4AcVu6o

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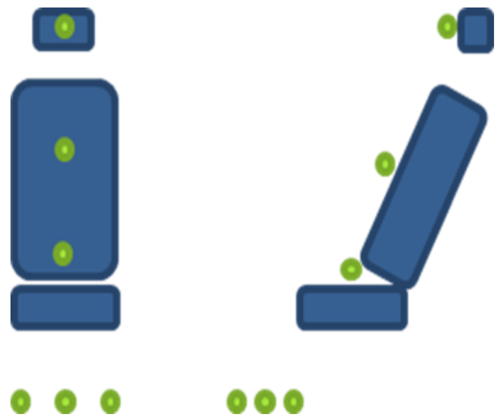
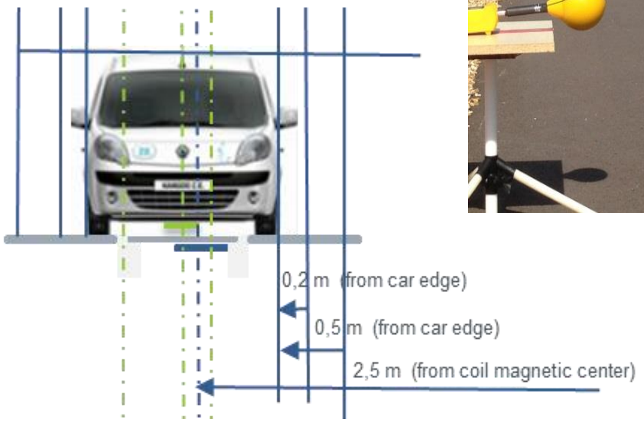
Electromagnetic field exposure & EMC

Inside the vehicle probe location



Outside the vehicle measurements



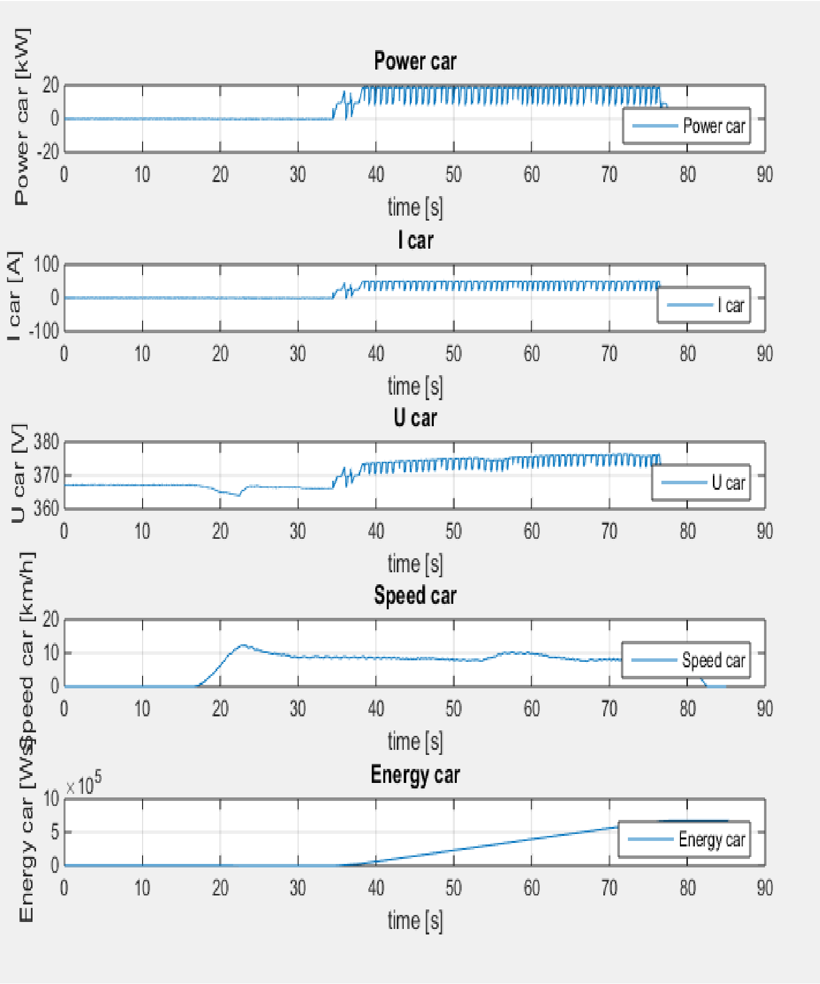
ICNIRP (*) 2010 common reference document for exposure limits

(*)INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION,ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS (1HZ – 100 kHz), HEALTH PHYSICS 99(6):818-836; 2010. (1HZ – 100 kHz), HEALTH PHYSICS 99(6):818-836; 2010.

EMC

Functional verifications.

Electric measurements, charge performance indicators & definitions



System efficiency & Average power received by the battery

The system efficiency is calculated after a whole test run and is defined as the ratio between :

- Energy received by the battery (DC):

$$E_{bat}\ (U_{bat},\ I_{bat})$$

- Energy sent by the grid after DC conv.:

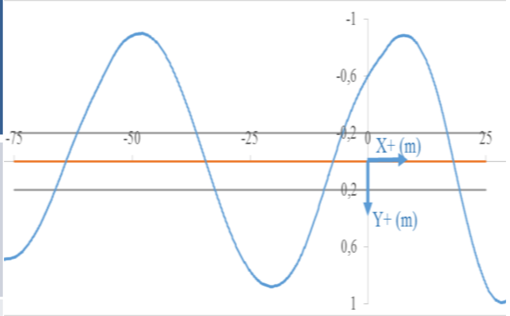
$$E_{DCline}\ (U_{DCLine},\ I_{DCLine})$$

The average power Pa received by the battery (over the whole active track length) is defined as the ratio of E_{bat} over the Time of charge (T_c)

$$P_a = E_{bat} / T_c$$

Influence factors on charge performance, metric , functional limits & test plan

Influence factors	Metric (indicator)	Data source	Nominal	Functional limits
Misalign-ment	Average deviation during charge	GPS RTK	0 cm	+/- 20 cm
Speed	Average speed during charge	Veh. CAN	50 km/h	0/100 km/h
Air gap	Static	Tape (laser)	175 mm	+/-25 mm



54 tests plan

- Three levels for each studied parameters (misalignment, speed, air gap).
- Tests repeated twice;
- Total 2*2*3*3= 54 tests.

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EM exposure (EMF) and EMC

Car	Driving cond (air gap nominal)	Power (kW)	Speed (km/h)	Probe location (extra vehicle)	Probe location (intra vehicle)	EMF (ICNIRP 2010 compliant)
EV2	Nominal	20	20	Height: 50 cm Distance to track center line :1,5 m		Yes
EV2		20	20			Yes
EV2		20	30			Yes
EV2		20	40			Yes
EV2		20	50			Yes
EV2		20	60			Yes
EV2		20	70			Yes
EV2		20	70			Yes
EV2		20	20		Feet Pass	Yes
EV2		20	20		Feet Rear	Yes
EV2		20	30		Feet Pass	Yes
EV2		20	40		Feet Pass	Yes
EV2		20	50		Feet Pass	Yes
EV2		20	60		Feet Pass	Yes
EV2		20	70		Feet Pass	Yes
EV2		20	70		Feet rear	Yes
EV1+EV2	Nominal	18	20	Height: 50 cm Distance to track reference line: 1,5 m		Yes
EV1+EV2	≠ 50 m distance between 2 cars	18	20			Yes
EV1+EV2		18	50			Yes
EV1+EV2		18	70			Yes
EV1+EV2		18	70			Yes
EV2	Stationary 5"	20	5-10-5-STOP			Yes
EV2	Stationary 5"	20	5-10-5-STOP			Yes
EV2	Zig zag	20	20			Yes
EV2	Target 15 cm right	20	40			Yes
EV2	Target 15 cm left	20	40			Yes

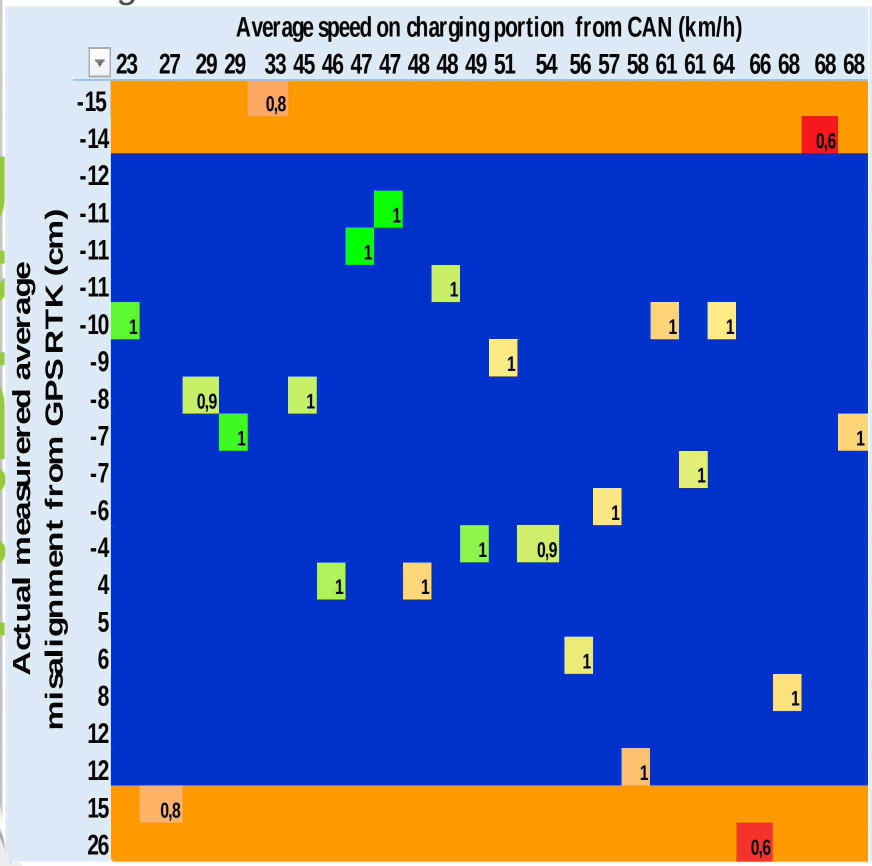
EMC

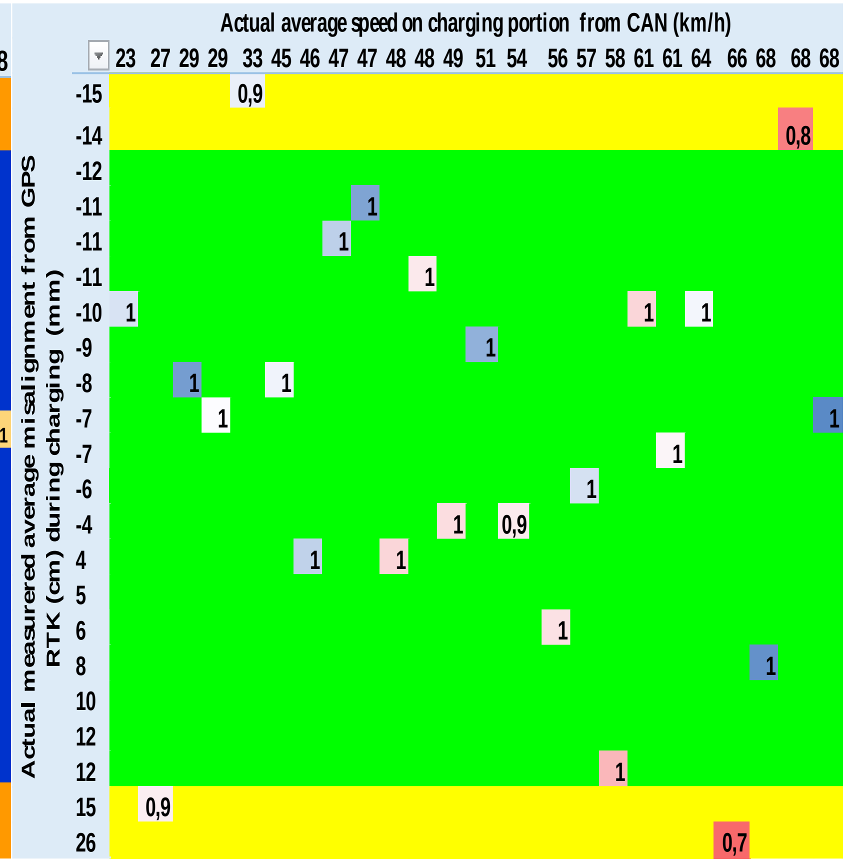
- No issues with basic functions activated during charge (wipers, turn signals and lightening system, mobile communication)
- No issues detected 1 year (> 1000 tests) of CAN monitored tests
- Complementary investigations needed

Charge performance

Indicator of average power received by the battery (expressed as ratio between the measured value vs the maximum recorded value) as a function of average speed and average misalignment.

Efficiency indicator (expressed as ratio between the measured value vs the maximum recorded value) as a function of average speed and average misalignment.





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MAIN CONCLUSIONS-1

EMF

- EMF exposure complies with FABRIC ICNIRP 2010
- Further methodology development needed

EMC

- No EMC issues detected (1 year)
- future investigations needed

Charging current shapes

- Ripple could be reduced
- Optimal trade-off level between costs, efficiency and battery life TBF

Energy efficiency

- FABRIC methodology for future standard ?
- 80-90 % levels could be reached with different design approach.

MAIN CONCLUSIONS -2

Influence of misalignment , speed, air gap in functional range

- Misalignment: most significant influence

Grid impact

- No issues with 2 vehicles
- Wider scale experimentation needed

ICT technologies

- LKA great open-loop feedback system
- Fully automated trajectory control needed

Experimental track concept

- Easy access to PE components
- Adequate for future road integration studies and validation of prototype DWPT system

Acknowledgment

Special acknowledgment to:

- IFSTTAR for the support on road design and EM characterisations;
- Renault for the supplied integrated vehicle prototypes;
- Qualcomm-Halo teams :The tests were performed on a prototype Qualcomm WPT system loaned to VEDECOM and supported by Qualcomm engineers throughout installation and testing.

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Thank you!

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INSTITUT VEDECOM

DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ