



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



Dynamic charging for more efficient FEVs: The FABRIC project

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FABRIC project manager

UNPLUGGED Final Event, Zaragoza
26-03-2015



FABRIC FP7 Integrated Project

Budget: 9 M€
Duration: 48 months

Funding: 6.5 M€
Start: 1 January 2014

Jan 2018

Coordinator:



Dynamic wireless
charging of FEV



Liaison with other
projects

Innovation
Collaboration



User requirements
Technical feasibility
Standardization/
Interoperability



POLITECNICO
DI TORINO



Jan 2014

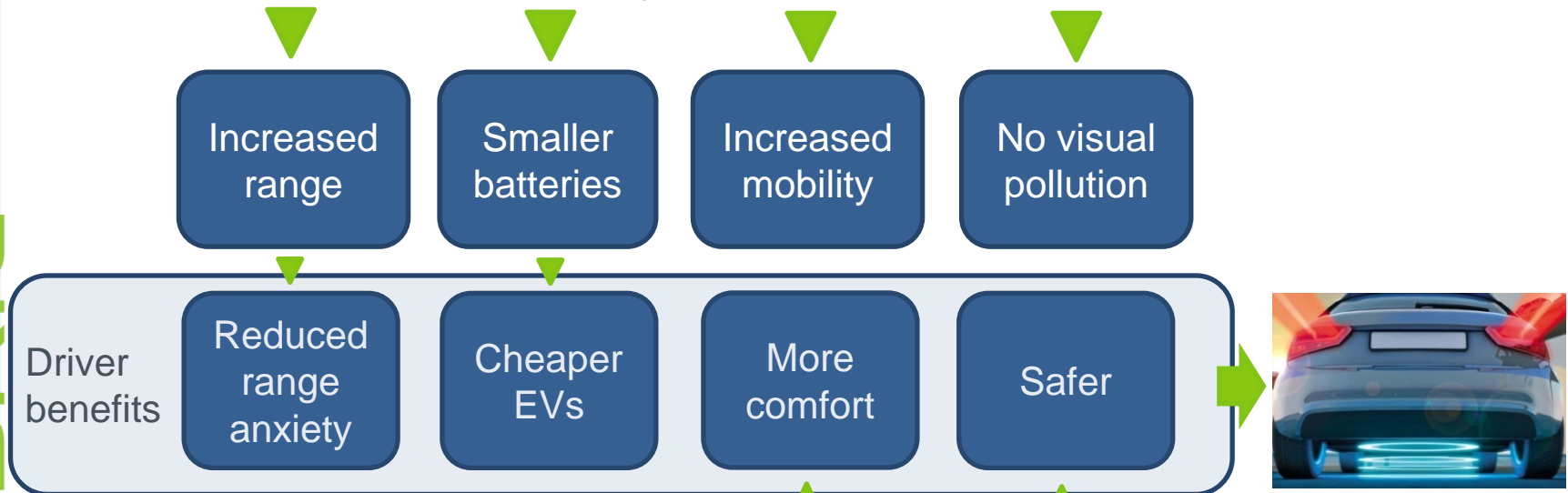


TECNOSITAF S.p.A.



Motivation: Why dynamic charging?

- Allows EV charging while travelling (dynamic) or during short stops ideal for urban environment (stationary)



- Drivers do not have to deal with dirty and potentially dangerous cables (rain, cable vandalism, cable wear, etc) + Easier charging process



Roosegaarde and Heijmans

FABRIC objectives

DEVELOPMENT

- Three wireless EV charging prototypes able to support dynamic charging
- Supporting ICT
- Integration with road and grid infrastructure

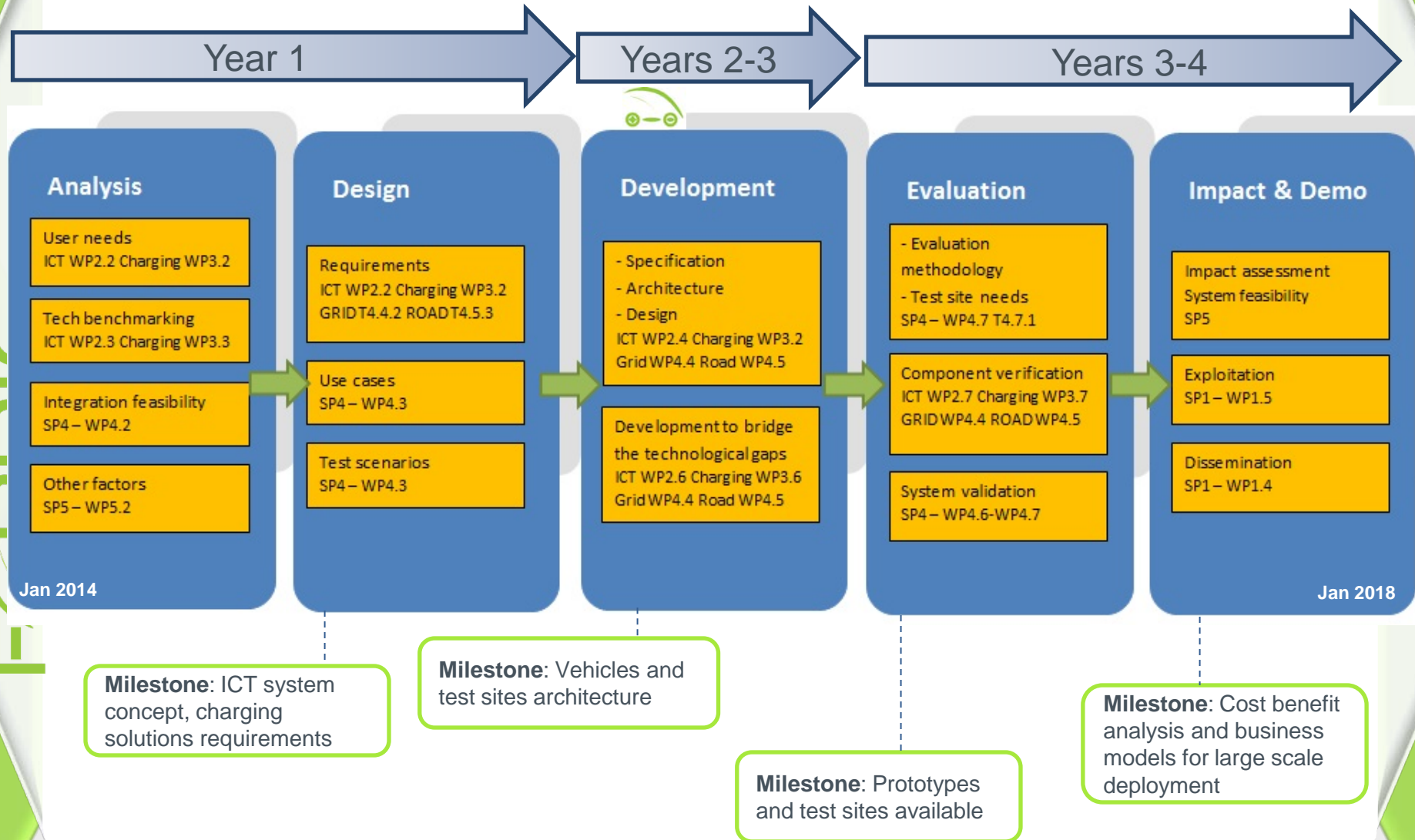
TESTING

- ITALY
- FRANCE
- SWEDEN

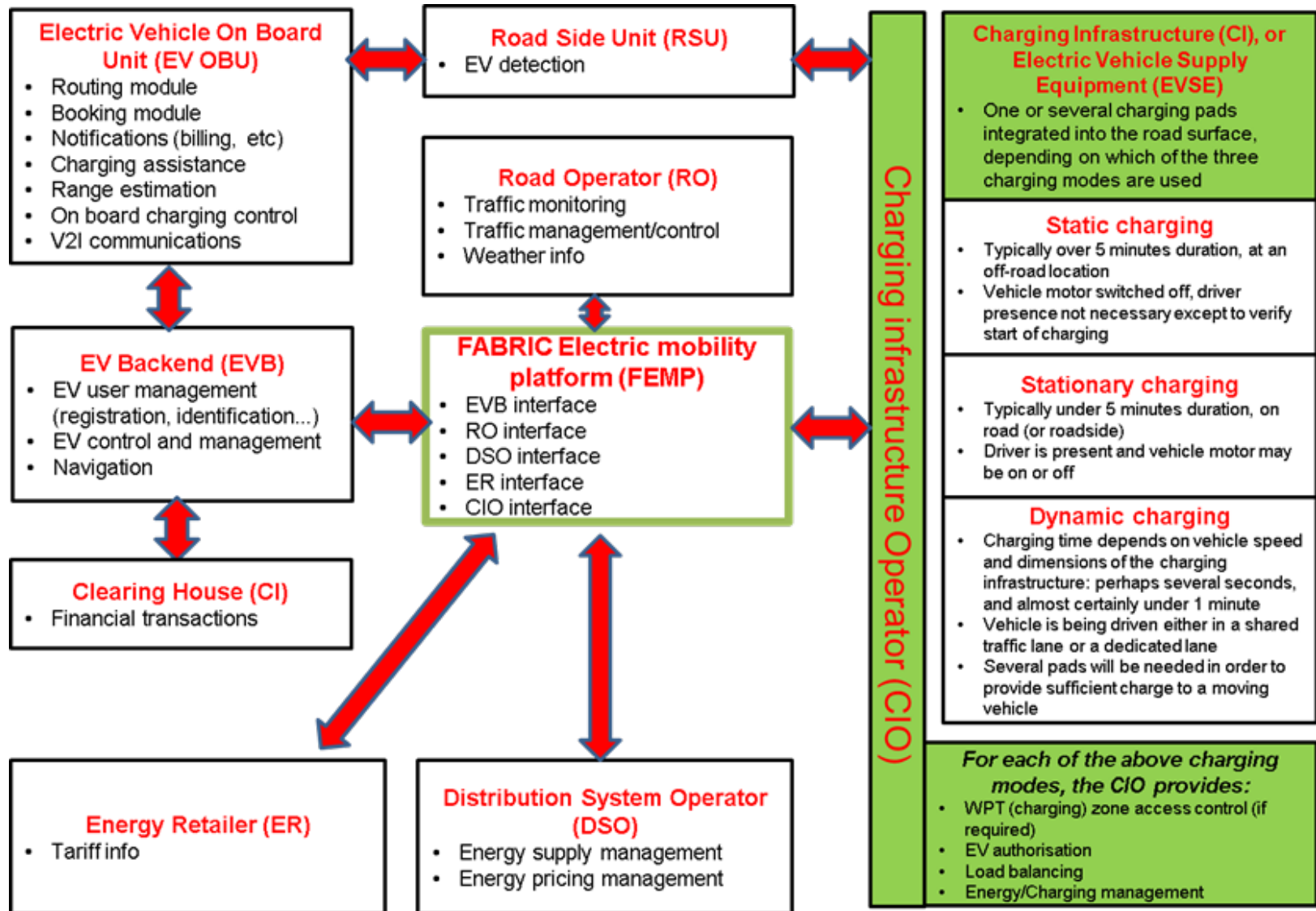
FEASIBILITY

- GRID
- ROADS
- BUSSINESS
- ENVIRONMENT

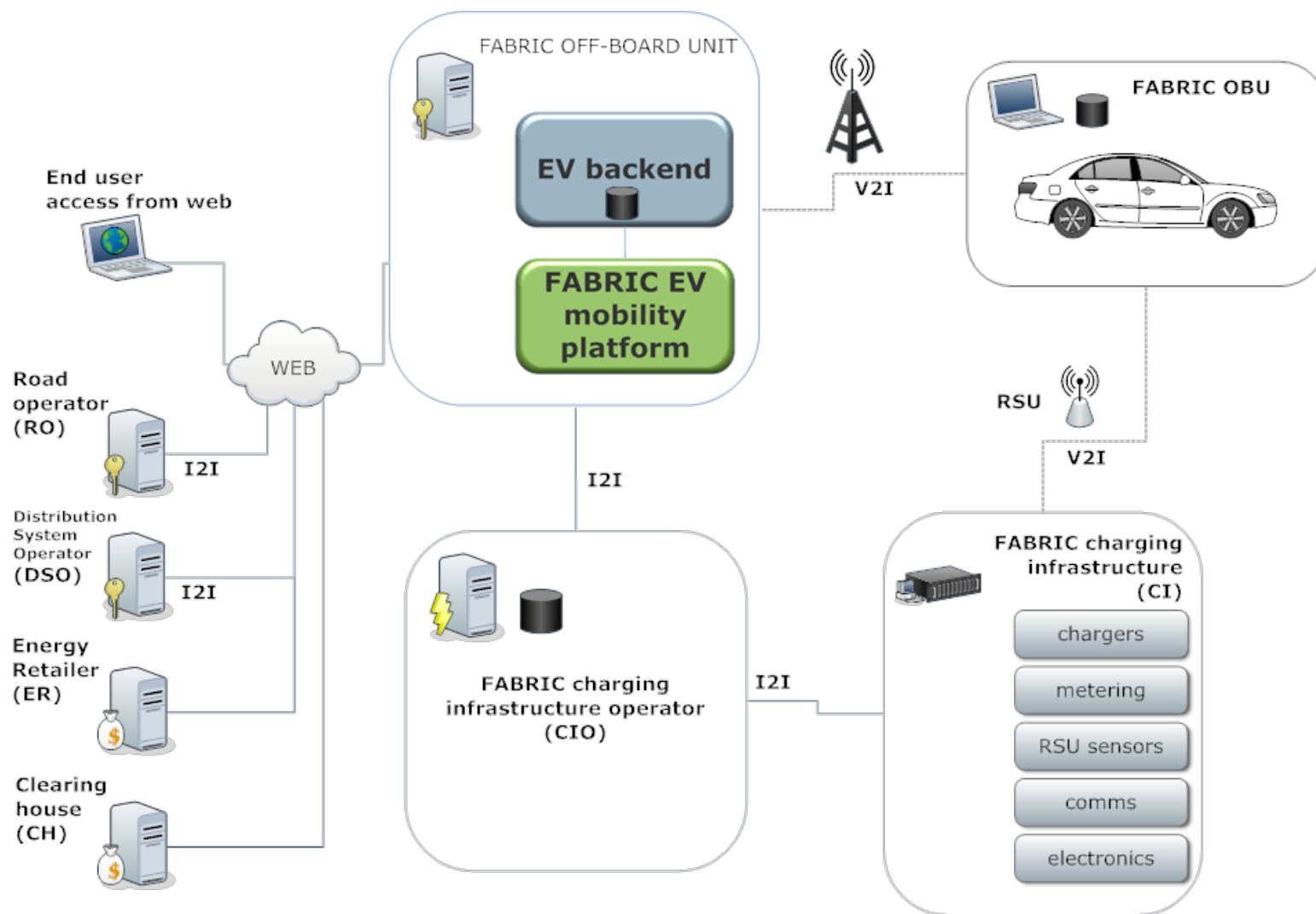
Project workflow and schedule



ICT architecture



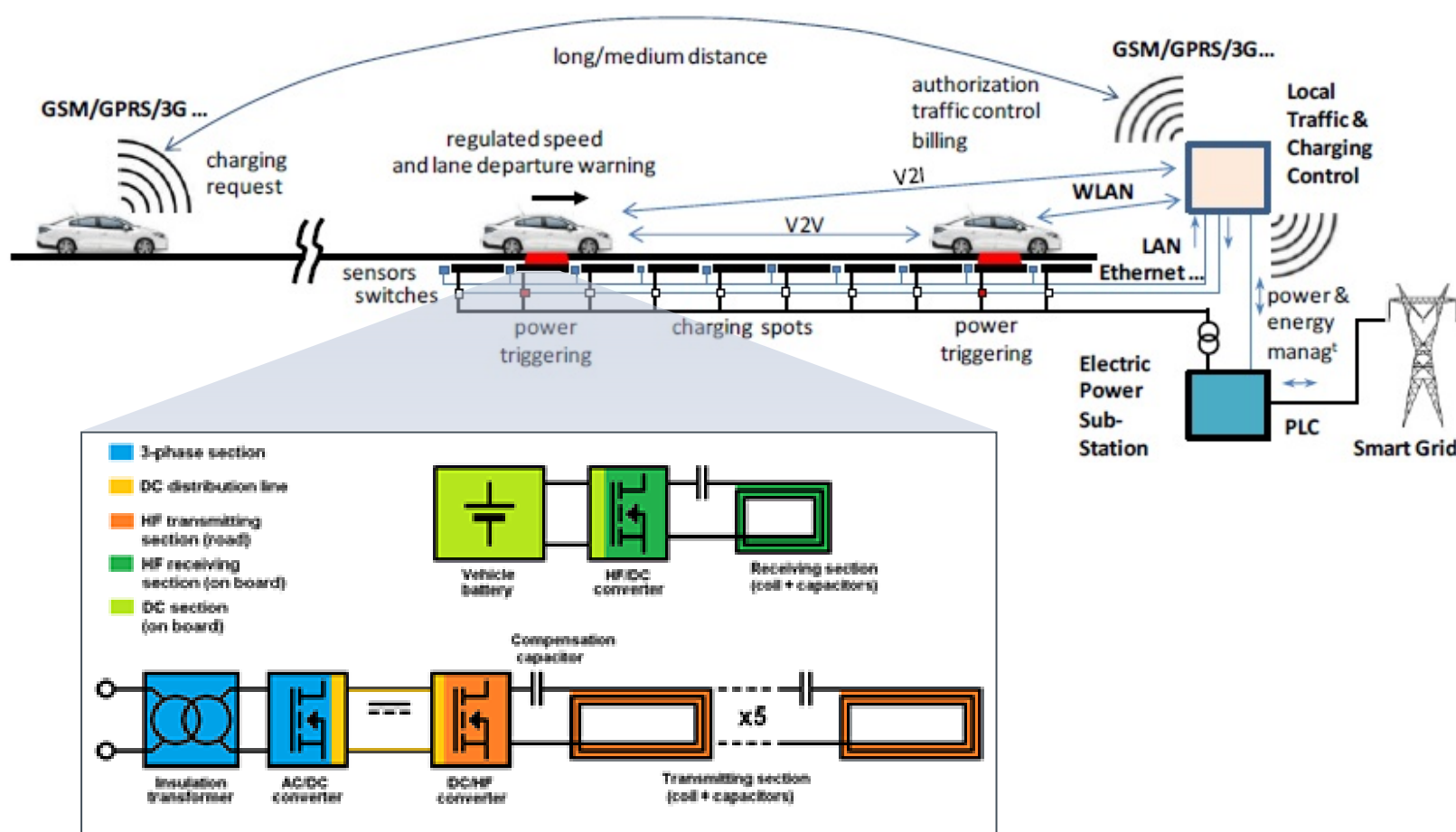
ICT architecture



FABRIC prototypes – POLITO, IT (I)

Dynamic charging prototype no.1 – Italy (POLITO, CRF)

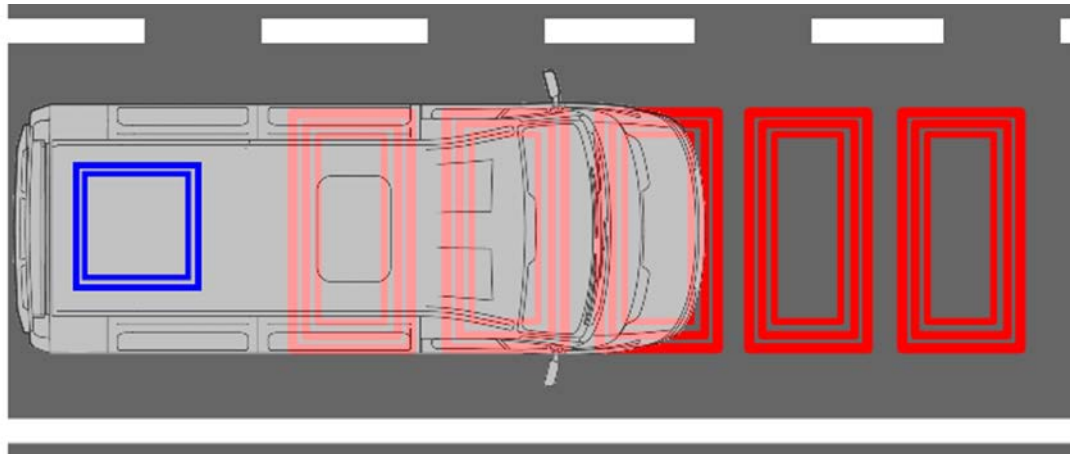
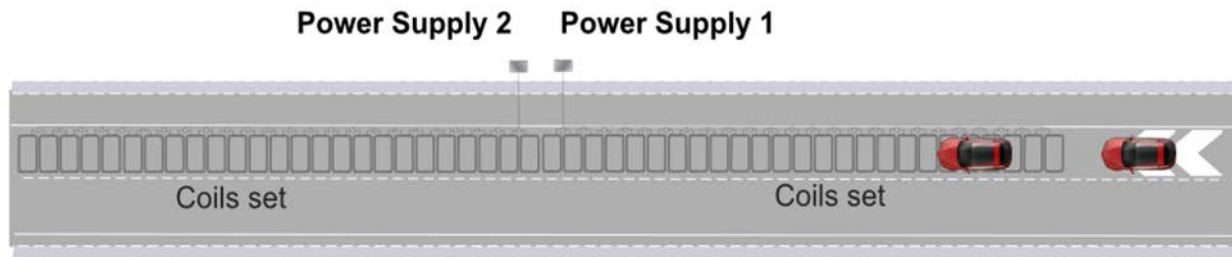
- 200m test track, 20kW, ~150kHz



FABRIC prototypes – SAET, IT (II)

Dynamic charging prototype no.2 – Italy (SAET)

- 50m, 10-150kHz load-resonant power frequency



Source: SAET

FABRIC vehicle prototype – IT



Battery charger
Vacuum pump
Electro-hydraulic pump
DC/DC converters
Fuse/relays
Fluid heater

Zebra batteries

DC box

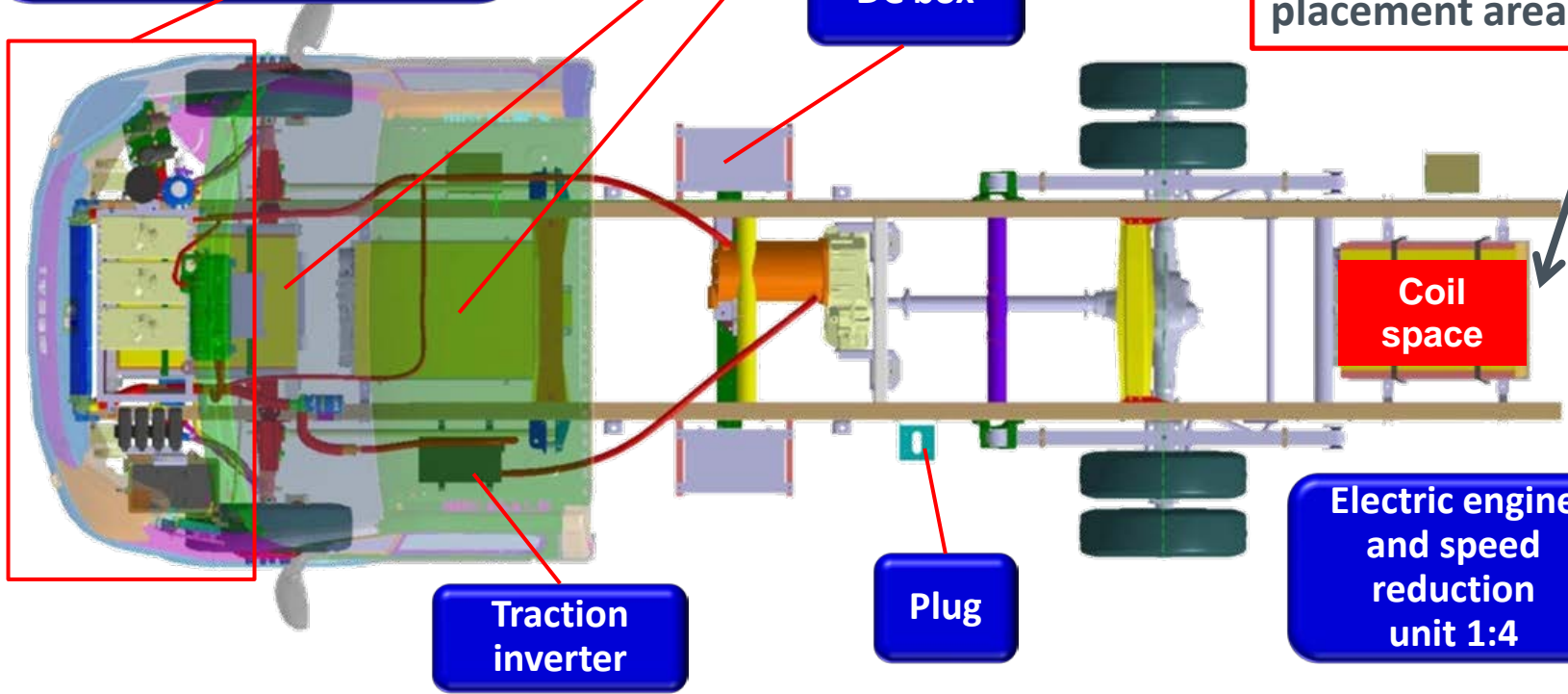
Coil and power
electronics
placement area

Coil
space

Electric engine
and speed
reduction
unit 1:4

Traction
inverter

Plug



FABRIC prototypes – VEDECOM, FR (III)

Dynamic charging prototype no3 – France (QUALCOMM, VEDE)

- 100m test track, QUALCOMM charging pads in series, 85kHz, >20kW



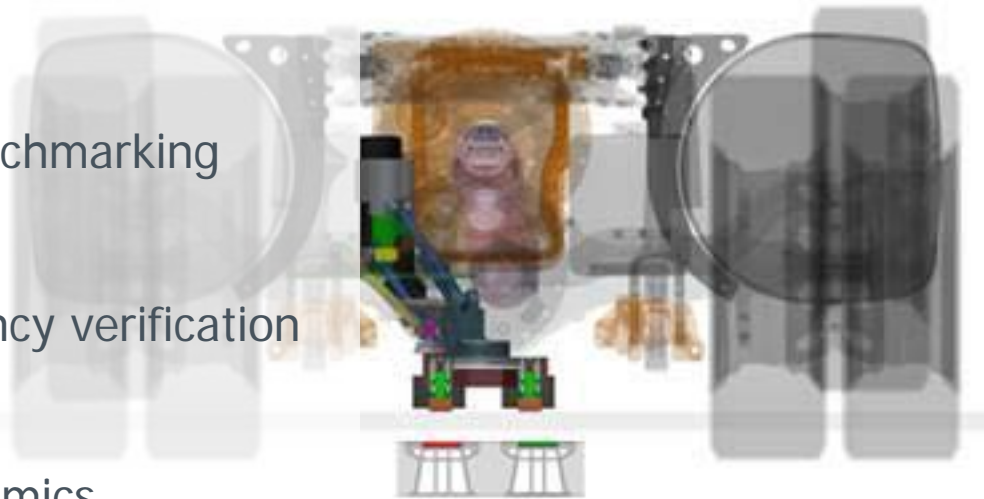
QUALCOMM HALO™

qualcommhalo.com

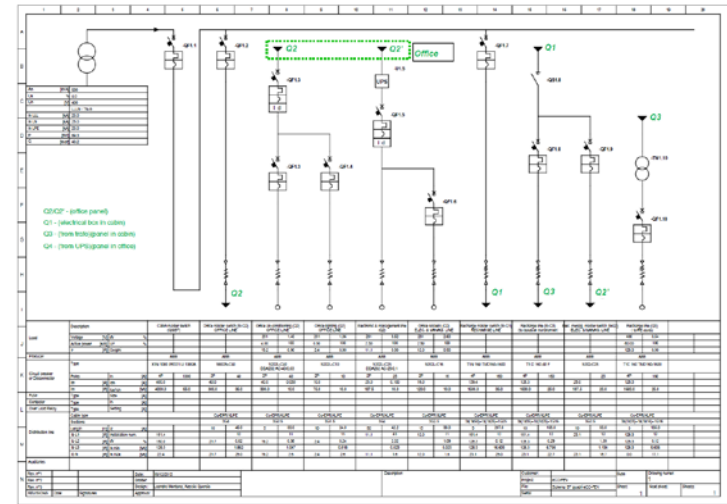
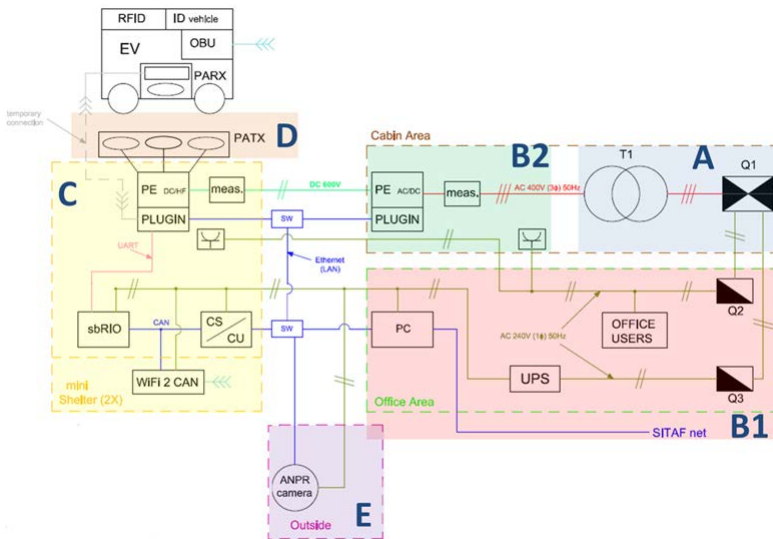


Other prototype testing

- Volvo GTT ATR/cars test site in Hällered
- Test track for conductive electrical road tests (DC 750V)
- Test track is 435m long, electrified part of the track is 275m.
- Technology evaluation results
- Demo of the track and system
- EM emissions measurements
- Conductive charging technology benchmarking
- Preliminary tests
 - expected power transfer efficiency verification
 - electro dynamic forces
 - electric circuit dynamics
 - overvoltage/under voltage dynamics



Analysis of the grid - SITAF test site (Italy)

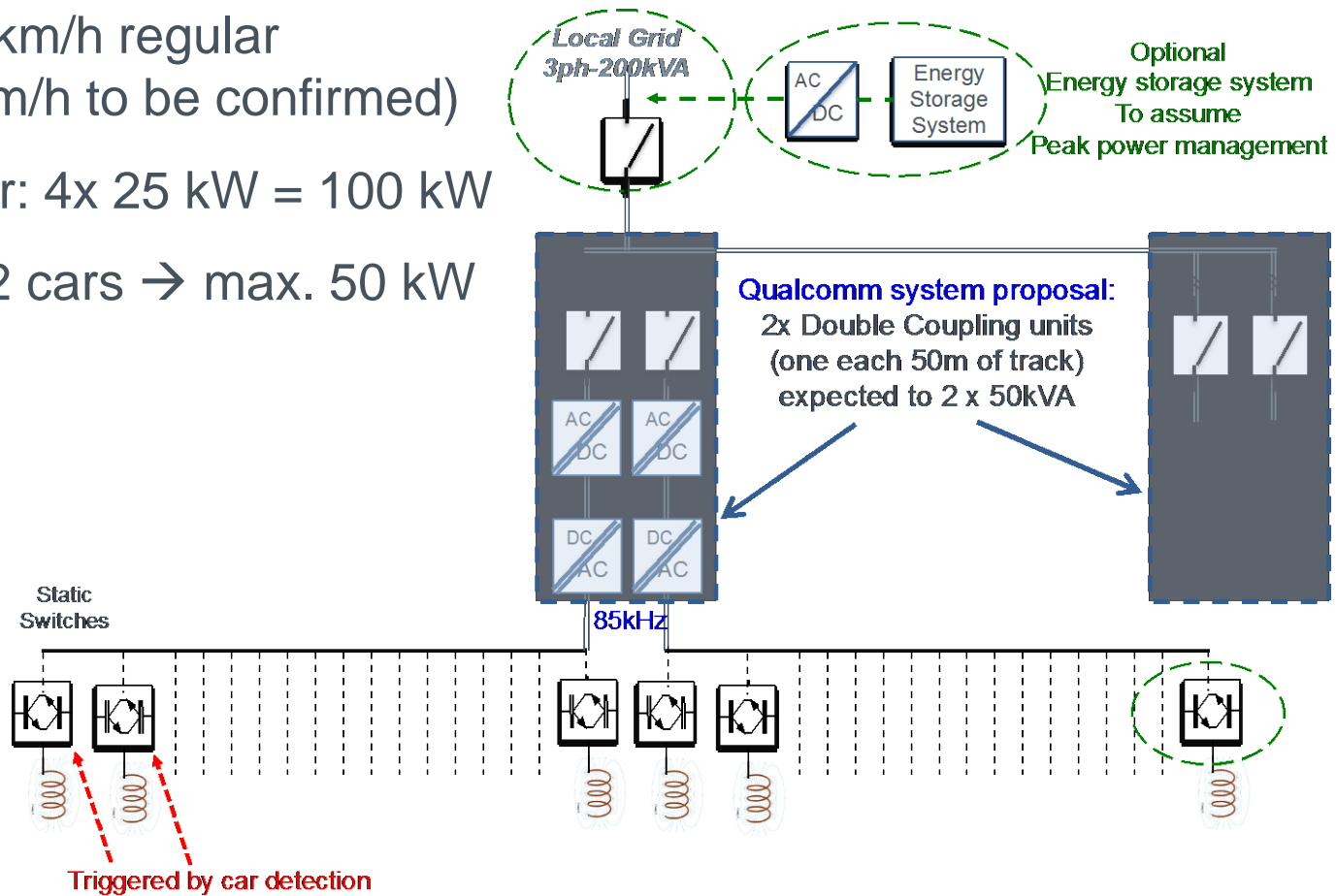


- Speed: to be defined
- Peak power: 25 kW
- Storage foreseen at DC bus (supercaps?)



Analysis of the grid - Satory test site (France)

- Speed: 60 km/h regular (up to 90 km/h to be confirmed)
- Peak power: $4 \times 25 \text{ kW} = 100 \text{ kW}$
- Tests with 2 cars \rightarrow max. 50 kW



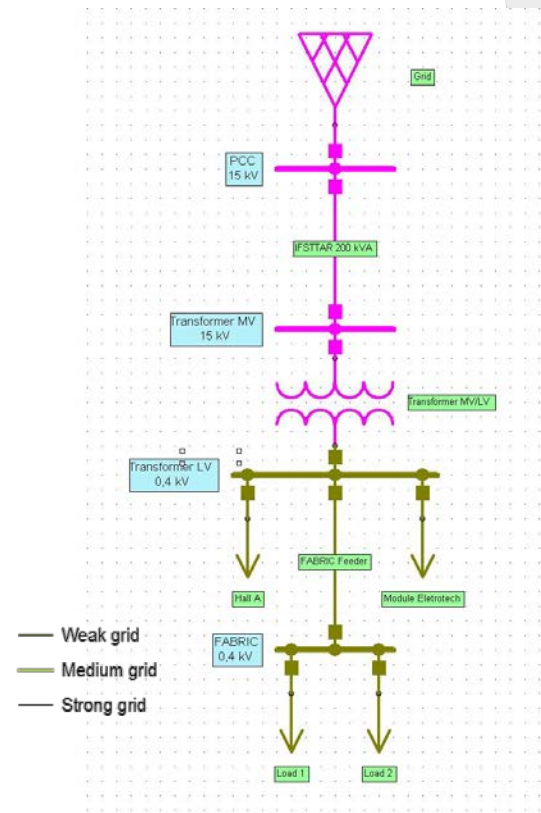
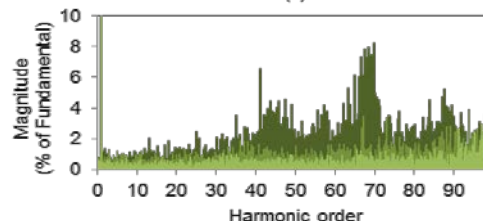
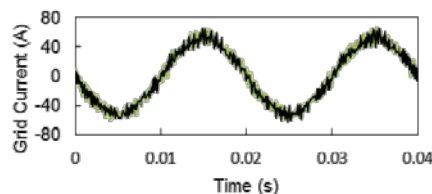
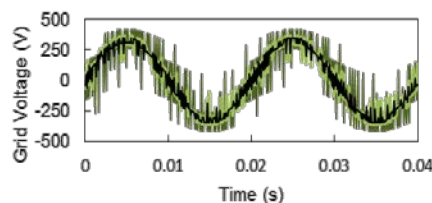
Analysis of the grid – test sites

1. Power flow analysis

- MV/LV Grid model for each test site
- Result: Max. allowed power:
 - Satory: 100 kW
 - SITAF: 45 kW

2. Harmonics analysis

- Different converter topologies produce different harmonics
- 4 Cases are studied:
 - Diode bridge
 - IGBT (hysteresis control)
 - IGBT (PWM control)
 - IGBT (PWM multi level)



Analysis of the grid – Impact simulation

Parameters:

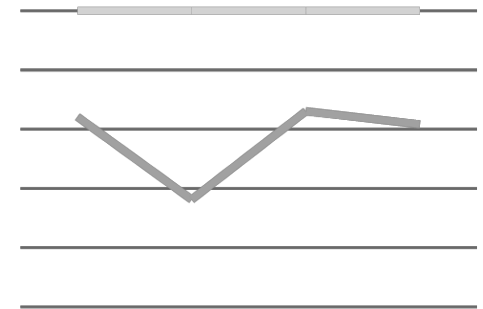
1. Charging lane length (8km)
2. Vehicle speed & length
3. Minimum headway
4. Traffic (urban/interurban)
5. Maximum charging pad power level (50kW)

Scenario	P	V	h	l	d
Light traffic	0.15	36/108	5/10	5	570/1090
Medium traffic	0.50	36/108	5/10	5	1900/3500
Heavy traffic	0.75	36/108	5/10	5	2600/5000

Charging events are created according to traffic, lane length



Charging events are translated to a power level according to the charging duration



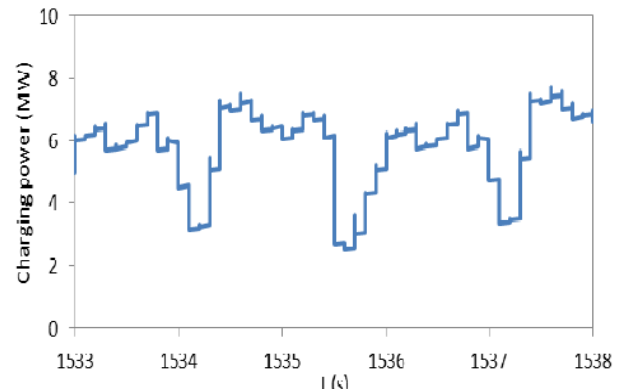
Source: SAET

Analysis of the grid – Impact simulation

Demand analysis

- Substantial amount of switching associated to vehicles passing over charging pads
- Demand fluctuates from 2-8 MW in some seconds
- Unrealistic power **jump** in the grid load
- Max step 4MW in 100ms

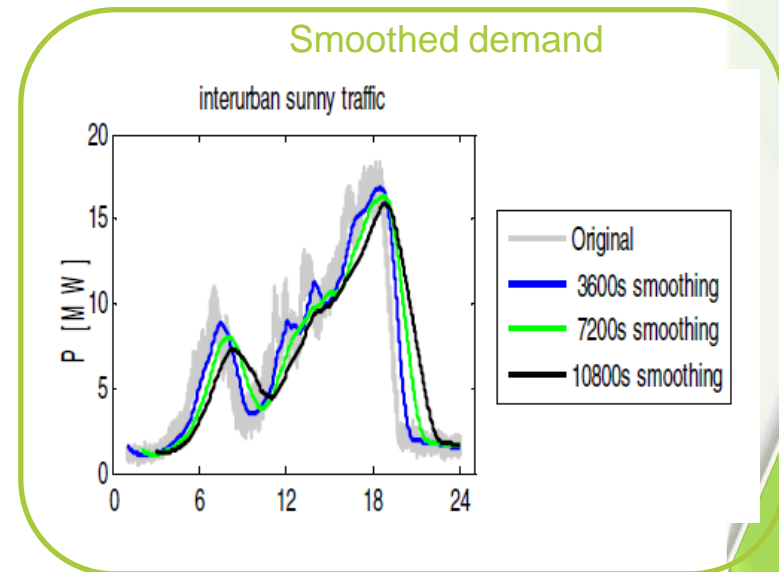
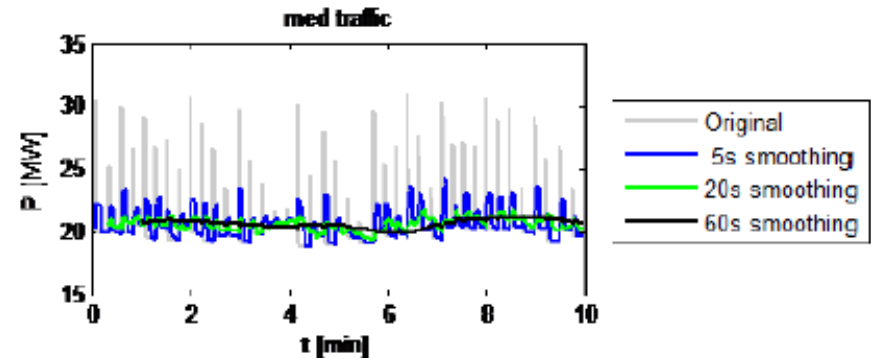
Demand 5s



Analysis of the grid – Impact simulation

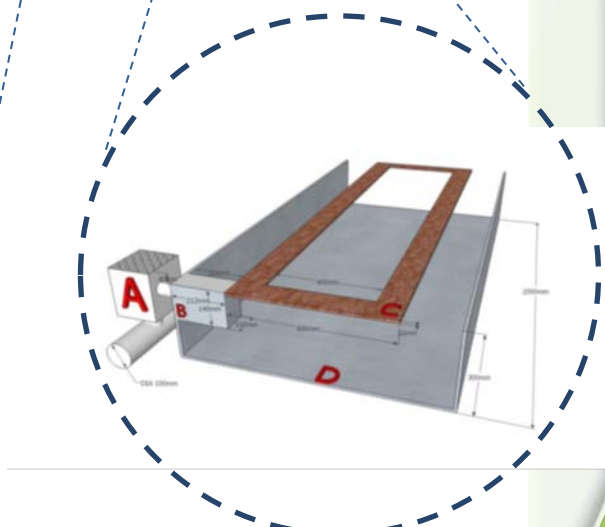
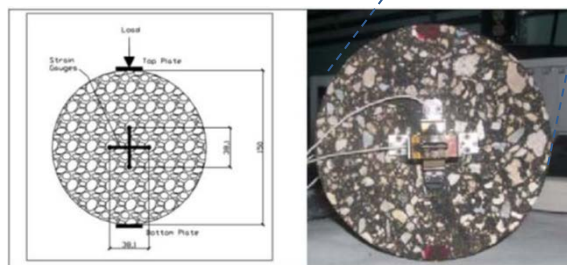
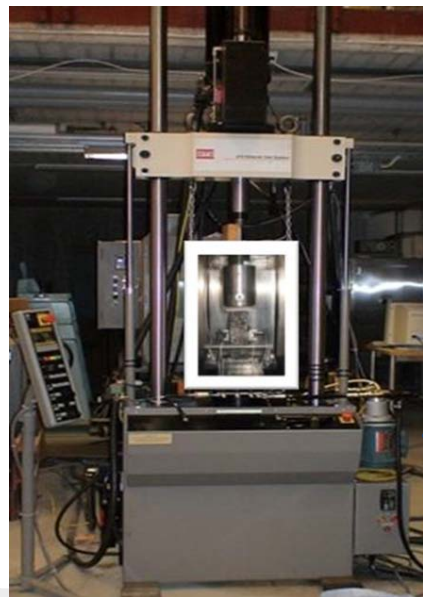
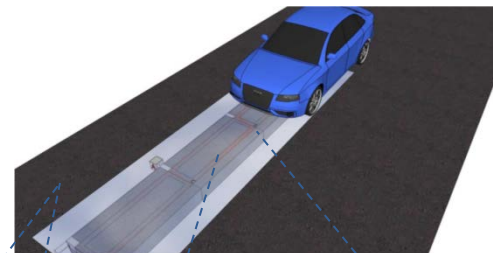
Requirements for Energy Storage System

- Energy Storage System modeled as a low pass filter to reduce fluctuations
- 5 seconds smoothing window reduces fluctuations substantially
- PSS almost independent of window size and dependant on traffic
- ESS increases linearly with the size of the smoothing window
- Small storage windows help to mitigate high frequency variations
- Larger smoothing windows help to reduce the daily demand peak but it costs!
- Combination of ESS with other methods (load shaping) must be deployed.



Analysis of the road – test sites

- 1st year:
 - Collection of charging solutions specifications and test sites data
- 2nd year:
 - Core samples analysis and highway road modeling
 - Stress and long term impact analysis



Contact with FABRIC

Website www.fabric-project.eu

LinkedIn group

ERG

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

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Paving the way for large scale deployment of electromobility.

Over the next four years the €9 million FABRIC integrated project will address the technology of feasibility, economic viability and socio-environmental sustainability of dynamic on-road charging of electric vehicles.

Latest Advances

Even though electromobility penetration levels worldwide are not impressive, the trend is upward and more car makers introduce electric models to the market. At the same time investments in EV charging infrastructure continue to grow.

[Read more...](#)

Objectives

The main scientific and technological objective of FABRIC is to conduct feasibility analysis of on-road charging technologies for long term electric vehicle range extension, technologies for long term electric vehicle range extension.

[Read more...](#)

Test Sites

FABRIC targets various types of vehicles, including passenger cars, light weight duty vehicles and heavy vehicles and buses. As a part of the project, an extensive part of Europe from Italy in the South through France, to Sweden in the North.

[Read more...](#)

Expected Impact

FABRIC is expected to pave the way for the future E-mobility. By addressing importance challenges related to charging and ICT solutions for electric vehicles, FABRIC will both increase the market share for EVs and contribute to meeting the environmental demands on future mobility.

[Read more...](#)

Project videos

The first project video is now released! Inside the video you will find more about FABRIC, the project expected impact and the use of the ICSS, the vehicle manufacturers, and the relevant stakeholders towards Electromobility.

[Watch here](#)

Consortium

saot group | TRL | |

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Useful Links

European Commission-DC Research and Innovation
7th Framework Programme - Transport
European Green Vehicles Initiative EVGI
European technology platform for the electricity networks of the future

Imprint

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FABRIC @ ESARS2015
Evi Brousta
dissemination expert at ICSS NTUA
3-5 March 2015 | Aachen, Germany
A FABRIC paper will be presented by ICSS during the ESARS2015. Learn more here: <http://www.fabric-project.eu/index.php/news-and-events/supporting-events>
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FABRIC presentation @ Medpower IET conference
Evi Brousta
dissemination expert at ICSS NTUA
4-11-2014 | Athens, Greece
Special Panel: Enabling Technologies for wireless charging of electric vehicles
Find the presentation performed by Yannis Damousis. ICSS here: <http://www.fabric-project.eu/index.php/news-and-events/supporting-events>
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Europe meets IEVC workshop @ Florence
Evi Brousta
dissemination expert at ICSS NTUA
Plenary, July 10 December 2014 (11:00-13:30)
IEEE- IEVC 2014
Find more: http://www.fabric-project.eu/index.php/news-and-events/FABRIC_Europe_meets_IEVC_Workshop_description_v11.pdf
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FABRIC Standardisation Workshop @ IEVC 2014
Evi Brousta
dissemination expert at ICSS NTUA
The FABRIC project is organising a workshop entitled "Wireless Charging: Related Standards and needs" in the framework of the IEEE-International Electric Vehicle Conference 2014. The ...
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for future electric vehicles

Thank you!



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