Wireless charging – update on latest activities in research and demonstration of the current technologies

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Denis Naberezhnykh
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What is Wireless Power Transfer (WPT)?

Static
While parked the car is recharging automatically

Source: SAET
Why use Wireless Power Transfer (WPT)?

Source: TRL
Why use Wireless Power Transfer (WPT)?

Source: TRL
Ongoing projects in wireless power transfer for EVs - **UNPLUGGED**

- **UNPLUGGED** – Lead socioeconomic impact and social acceptance analysis

**European Research Project**
- 17 partners
- 7 countries
Ongoing projects in wireless power transfer for EVs - UNPLUGGED

What is your general opinion on the following statements?

- Totally disagree
- Disagree
- Neutral
- Agree
- Totally agree

Wireless charging for cars and vans should be undertaken directly on the road: charging while driving.
Wireless charging for taxis should be undertaken directly on the road: charging while driving.
Wireless charging for buses should be undertaken at the garage or on the parking place in front of my house.
Wireless charging for cars should be undertaken at home, e.g. in the garage or at the end of the day.
Wireless charging for taxis should be undertaken at taxi depot or at home at the end of the day.
Wireless charging of cars should be undertaken in public car parks, e.g. shopping centres, town centres, other leisure activity car parks.
Wireless charging of taxis should be undertaken in taxi ranks.
Wireless charging of buses should be undertaken at bus stops and bus stations.
Wireless charging of all electric vehicles should be undertaken while stationary at traffic lights, junctions, rail crossings and other types of mandatory stops en route.
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When deciding whether to invest in wireless charging vehicles and infrastructure, how important are the following features in your decision?
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When deciding whether to invest in wireless charging vehicles and infrastructure, how important are the following features in your decision?

- Not at all important
- Slightly important
- Somewhat important
- Quite important
- Extremely important
- Don’t know

Features:
- CO2 reduction
- Air quality improvement
- Reduced running costs
- Improved practicality/simplicity of charging
- Automation and user friendliness
- Luxury/ Premium function
- Technological innovation/ leadership
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Funded through the Low Carbon Network Fund
- Purpose:
  - Evaluate impact of high-powered wireless chargers on the distribution network
  - Understand implications of bus operations on these impacts
  - Opportunities to help address greater demand from the network

- IPT Power requirements
- Capacity needed
- Harmonic effects
- Bus Battery SOC
- Network Mitigations
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- 8 buses on a single route
- 2 chargers at either end of the route – necessary to complete the route
- 1 charger at mid-point – allows for flexibility to study demand

WPD-owned inductive charger that will be flexibly used based on Bus battery SOC. Data will be compared with impacts on the network and the network condition.
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Based on the 9.5m WrightBus StreetLite EV
- 2 x 85kW motors for traction
- 54 Passengers
- 129kWh Batteries (588V)
- 12,900Kgs GVW
- 4 x 30kW Induction Plates
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Wolverton

- Bletchley
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Power usage profile
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Some anomalies – to be investigated in future analysis
Ongoing projects in wireless power transfer for EVs – Electric Boulevards

- Power factor variations
Ongoing projects in wireless power transfer for EVs - ZeEUS

- ZeEUS – Lead UK demo evaluation activities, provide expert advice to transport operators on EV and WPT technology

European Demo Project
• 40 partners
• 10 countries
Ongoing projects in wireless power transfer for EVs - ZeEUS

Example route

Green Sections: Bus operates as full electric vehicle
Blue Sections: Bus operates as diesel hybrid

GPS system triggers zero-emissions mode automatically as bus enters ZEV zones

City Centre ZE Zone
Recharge Station
Feeder roads between communities
Suburban population centres
Recharge Station
Ongoing projects in wireless power transfer for EVs - ZeEUS

- Demonstrations in UK (London and Glasgow)
- End of route wireless charging
- Starting summer 2015
- London working towards having worlds 1\textsuperscript{st} Zero emission Zone from 2020
Dynamic WPT

**Position 1**

Vehicle detection & recharging system in stand-by

**Position 2**

Vehicle is charging by passing over the recharging pad and receiving transmitted power

**Position 3**

Transmitted power depends upon:
- Speed
- Power unit
- Track length

Vehicle has been automatically recharged while driving.
Ongoing projects in wireless power transfer for EVs - FABRIC

- FABRIC – Sub-Project Lead
  (Charging solutions, evaluation of results and road infrastructure integration)

European Research Project
- 24 partners
- 9 countries

Feasibility analysis and development of on-road charging solutions for future electric vehicles
Ongoing projects in wireless power transfer for EVs - FABRIC

- Largest Europe-wide feasibility study on dynamic wireless power transfer
- 29 Partners (TRL is one of 5 core project partners)
- Will demonstrate up to 3 dynamic solutions in two test sites (Italy and France)
Ongoing projects in wireless power transfer for EVs - FABRIC

Road Operator

Distribution System Operator

City and Local Authority

Vehicle Manufacturer

EM and Safety

Requirements

Specifications
Ongoing projects in wireless power transfer for EVs - FABRIC

Feasibility analysis and development of on-road charging solutions for future electric vehicles
Ongoing projects in wireless power transfer for EVs - FABRIC

**Low Traffic**
- Original
- 5s smoothing
- 20s smoothing
- 60s smoothing

**Medium Traffic**
- Original
- 5s smoothing
- 20s smoothing
- 60s smoothing

**High Traffic**
- Original
- 5s smoothing
- 20s smoothing
- 60s smoothing
Ongoing projects in wireless power transfer for EVs – UK feasibility for dynamic WPT

- TRL commissioned to do the feasibility study
- Expected to be completed by Summer 2015
- Followed by on-road trials on UK motorway
- Prepare the SRN for future EV take up and facilitate their adoption
- Contribute to reducing GHG emissions and air pollution
Thank you

Denis Naberezhnykh
Head of ITS and Low Carbon Vehicle Technology, TRL
Tel: 01344770689
Email: dnaberezhnykh@trl.co.uk