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

Project VICTORIA
The first Spanish showcase for DWPT

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Agenda

1. Project VICTORIA at a glance
2. Inductive system: Infrastructure
3. The Bus
4. Inductive Charger
5. Results
1. Project VICTORIA at a glance

Objective:
- Inductive charging for urban bus

Project partners:
- Utility Endesa (Lead)
- Malaga city council
- CIRCE
- other companies

Developments
- CIRCE:
  - Conductive 50 kW CHAdeMO
  - Static inductive
  - Static en-route inductive
  - Dynamic inductive 50 kW
- Others:
  - Self guided bus
2. Inductive system: infrastructure

- Static charge: at initial bus stop
- Static on route charge: at initial and final bus stop
- Dynamic charge: 8 coils separated 12.5 m

Ground side:
Ten 50 kW inductive coils
2. Inductive system: infrastructure

- 2 distribution substations
- 2 static inductive chargers
- 700 VDC bus for dynamic inductive
- 1 cabinet for each 2 dynamic coils
- 20 kW/20 kWh Li-ion battery pack
3. The Bus

- Gulliver U520 ESP/LR
- 5.3 m length
- 100% electric
- Self-guided control to assure proper speed/misalignment
- Adapted for conductive and inductive charging
3. The Bus

Testing at CIRCE’s facilities (Zaragoza)

Testing at test site (Málaga)
4. Inductive charger

- Topology: SPS (CIRCE’s patent)
- Ground side coil: 800 x 600 mm
- Onboard coil: 2500 x 600 mm (due to dynamic charging if only static charging is needed it can be reduced)
- Misalignment: +/- 30% of the ground side surface
- Airgap: 0.15-0.25 m
- Total efficiency > 85% (prototype)
- EMI Shielding complying with ICNIRP 2010 and IEC 61851
4. Inductive charger

Coils size:
Red (ground coil),
Blue (onboard coil)

IPT Efficiency
4. Inductive charger

Lateral misalignment

IPT Efficiency

![Diagram showing inductive charger and lateral misalignment](image)

![Bar chart showing IPT Efficiency](image)
4. Inductive charger
4. Inductive charger

On-Board unit
5. Results

- Solutions with high power transfer capability (50 kW)
- Improved power quality → \text{THD less than 1\%}
- Reactive Power fully controllable
- \textbf{Total efficiency over 85\%}
- IPT efficiency over 91 \%
- Fewer EMC certification problems due to reduced noise
- \textbf{Small filters} → Reduction of cost and size
- Integrated with \textbf{Li-ion static storage} and ready to integrate with PV
Thank you!

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