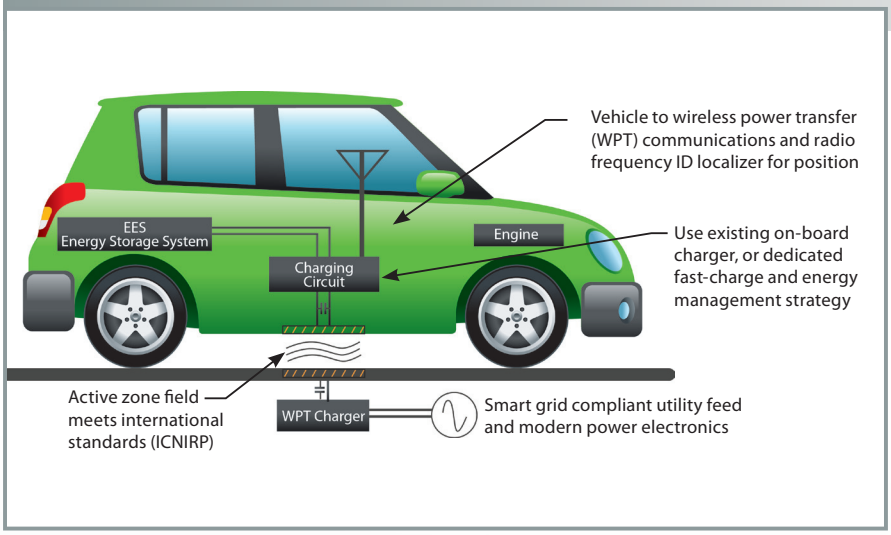
Wireless Charging System for Electric Vehicles

UT-B IDs 200902250, 201102637, 201102638, 201102639, 201102667



Technology Summary

ORNL researchers have made wireless power transfer more efficient by using an air core transformer loosely coupled to a storage battery. By reconfiguring the transformer and altering the resonance frequency, power is transferred to the battery with little energy loss and fewer demands on the primary circuit. The technology can be used for wireless charging of stationary electric vehicles in garages and parking lots or in-motion vehicles on the roadway.

Conventional charging systems maximize power by aiming for the highest power load, near resonance frequency. However, when operating near the resonance point, there is a loss of efficiency. The ORNL technique shows that sufficient power for the battery can be transferred from the primary to secondary circuits without significant energy losses if the operating frequency is set at 50% to 95% of the resonance frequency of the circuit. The electrical power is then transmitted to the chargeable battery, which is electrically coupled to the secondary circuit through the air core transformer.

A number of supporting technologies developed at ORNL enhance the wireless energy transfer system: A coupling coil that further reduces energy loss; the outer surface of a copper conductor for carrying electricity covered with a coating of carbon nanotubes or graphene; and, a wireless power transfer alignment system that includes a floor-mounted coil and a vehicle-mounted coil that, when magnetically coupled together, enables the transmission of power from the floor to the vehicle for wireless battery charging.

A related technology addresses information transfer between a charging infrastructure and the vehicle being charged. The technology features a bi-directional communication system in the wireless charging apparatus. The information transfer can occur when the vehicle is stationary or in motion.

Another system features an apparatus that tests the electrical vehicle charging system. It consists of a receiver/capture coil connected to a controllable load bank. The system includes an operator panel connected to the receiver/capture coil and load bank and a validation tool that confirms the installation has been correctly done.

Advantages

- An improved wireless energy transfer system that reduces energy losses during transfer of charge to the battery
- Other receiving components of the system draw less power from the primary circuit compared to competing technologies
- Problems associated with approaching resonance are avoided, where the voltage and current across the capacitor become too extreme for any practical capacitor

Potential Applications

- Plug-in hybrid and electric vehicles
- Can be installed in residential and commercial garages, parking lots and roadways
- Large, efficient wireless power transfer between stationary and moving objects

Patent

Matthew B. Scudiere. *Off-Resonance Frequency Operation for Power Transfer in a Loosely Coupled Air Core Transformer*, U.S. Patent Application 12/858,070, filed August 17, 2010.

John M. Miller. *Coupling Coil ac Resistance Minimization Using Graphene Coatings*, U.S. Patent Application 61/510,206, filed July 21, 2011.

John M. Miller. *Regulation Control and Energy Management Strategy for Wireless Power Transfer,* U.S. Patent Application 61/510,210, filed July 21, 2011.

John M. Miller and Perry Todd Jones. *WPT EVSE Installation and Validation Tool*, U.S. Patent Application 61/510,231, filed July 21, 2011.

Inventors Point of Contact

Matthew B. Scudiere and John M. Miller
Energy and Transportation Science Division
Oak Ridge National Laboratory

Licensing Contact

David L. Sims
Technology Commercialization Manager,
Building, Computational, and
Transportation Sciences
UT-Battelle, LLC
Oak Ridge National Laboratory
Office Phone: 865. 241.3808
E-mail: simsdl@ornl.gov