Loss Analysis for Flux Leakage of In-Motion WPT

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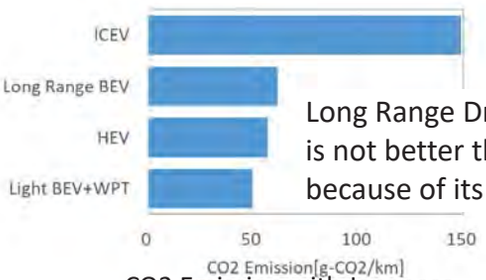
In-Motion WPT

Problems of EV
- Short cruising range
- Charging facilities
- Well to wheel CO2 emission

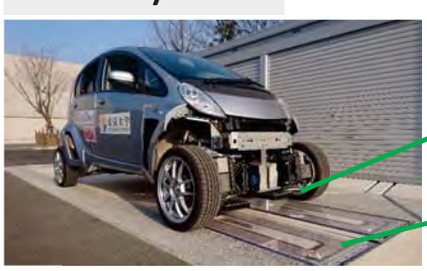


Long Range Drive BEV is not better than HEV because of its HEAVY battery.

CO2 Emission with Japanese Power Supply Configuration (Calculated)

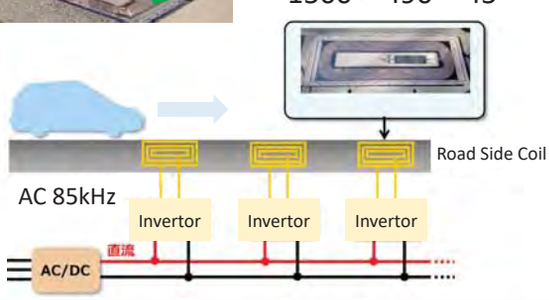
Our Solution :
In-Motion Wireless Power Transfer on Public Road
- Infinity cruising range
- People don't have to have their own charger
- It can reduce vehicle's battery

WPT System

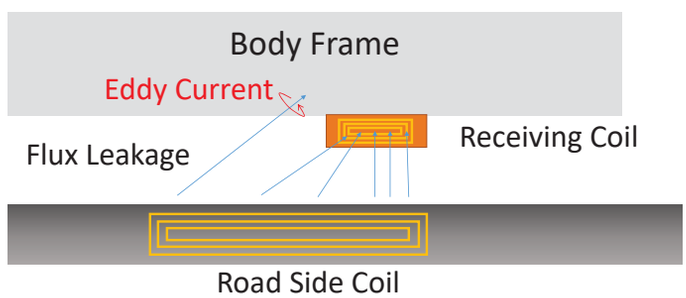


Receiving Coil
380 × 250 × 40

Road Side Coil
1500 × 490 × 45



Problem



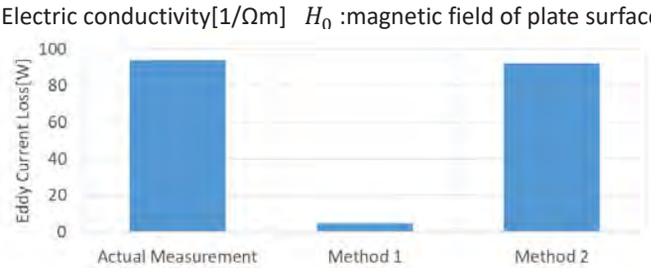
Flux leakage occurs eddy current loss
- Vehicle's body frame is made of metal
  But→No other low cost and high durability material
- Road side coil is bigger than receiving coil
  But→Need longer in-motion charging time for enough charge

CAE and Actual Measurement(Unit Test Model)

Method 1: Only CAE (4million mesh)
Method 2: Calculate H_0 by CAE and analytical calculation based on CAE result

$$P_{loss} = \left(\frac{D}{\delta\pi} * \frac{1}{\frac{\mu\sqrt{2}\delta\pi}{\mu_0 D}} \right)^2 \frac{1}{27} {H_0}^2 \sqrt{\frac{\mu\omega}{\sigma}} S * e^{-2j\omega t}$$

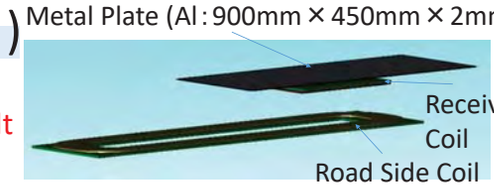
P_{loss} :eddy current loss[W] D :equal value of diameter[m]
δ :skin depth[m] μ :Permeability S :cross section area of plate [m2]
σ:Electric conductivity[1/Ωm] H_0 :magnetic field of plate surface[A/m] ω :frequency[rad/sec]



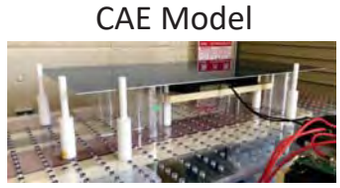
Eddy Current Loss(6.5kW Power transfer)

In-Motion WPT system is too big to make mesh model for calculating eddy current accurately enough.
Analytical calculation based on CAE is the better way to analyze eddy current loss of in-motion WPT system.

Metal Plate (Al : 900mm × 450mm × 2mm)

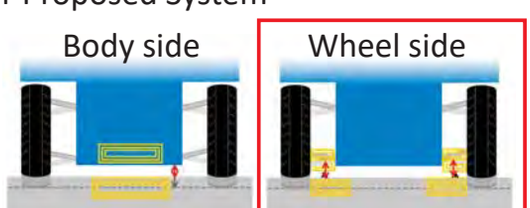


CAE Model



Unit Test

■Our Proposed System



Few metal parts around receiving coil
In-Motion WPT on wheel side is the best way!