OAK RIDGE National Laboratory

High Power and Dynamic Wireless Charging at Oak Ridge National Laboratory

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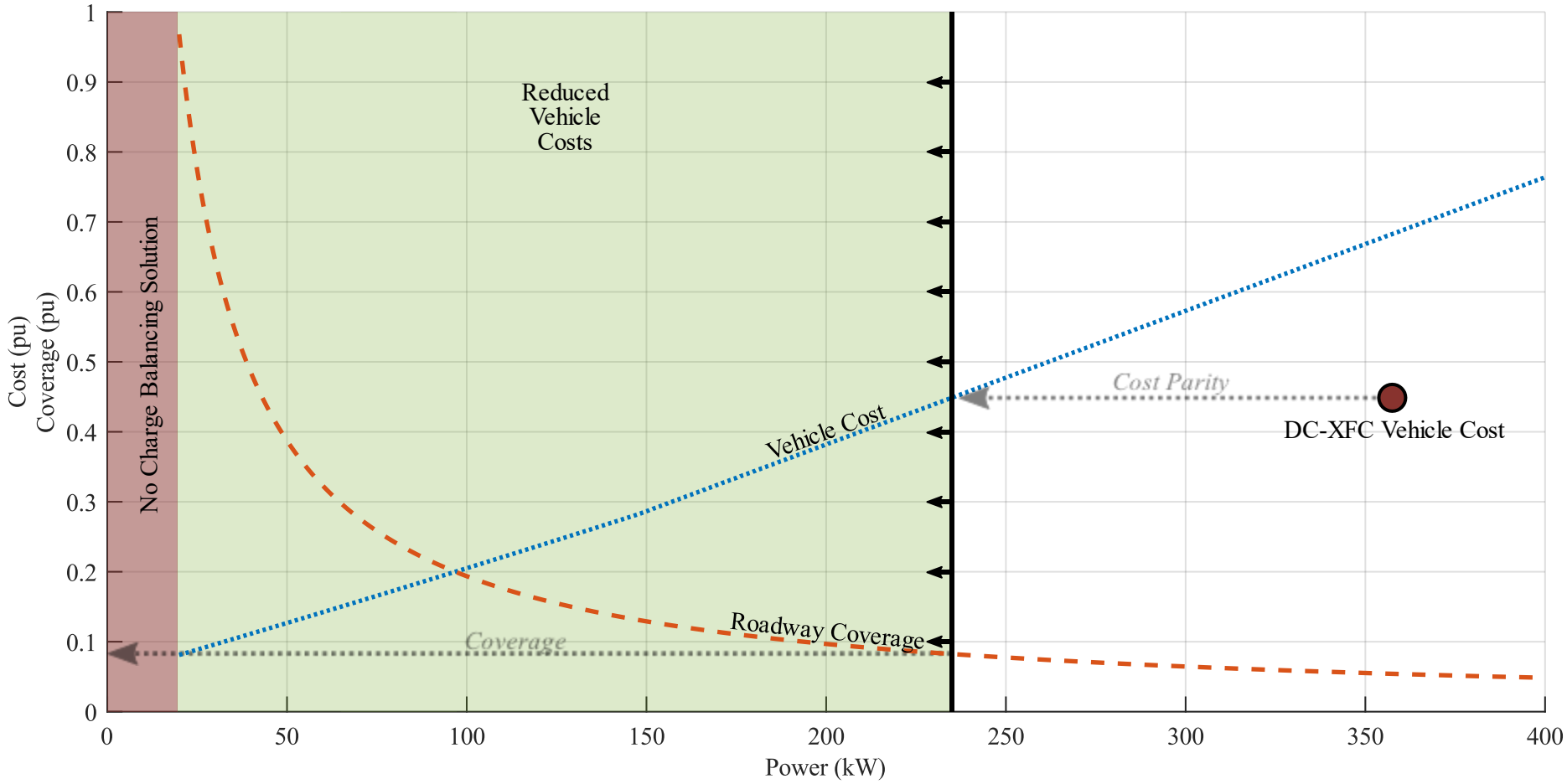
U.S. DEPARTMENT OF ENERGY

High Power DWPT Feasibility Study

LD Vehicle Assumptions	
Average Speed	65MPH
Minimum Battery Capacity	37kWh
DC-XFC Battery Capacity	112kWh, 4C ΔSOC=80%

Minimum Coverage DWPT Solution	
Power	235kW
Battery Capacity	59kWh
C-Rate	4.0
Roadway Coverage	8.2%
Electrified Miles	5,500 Miles



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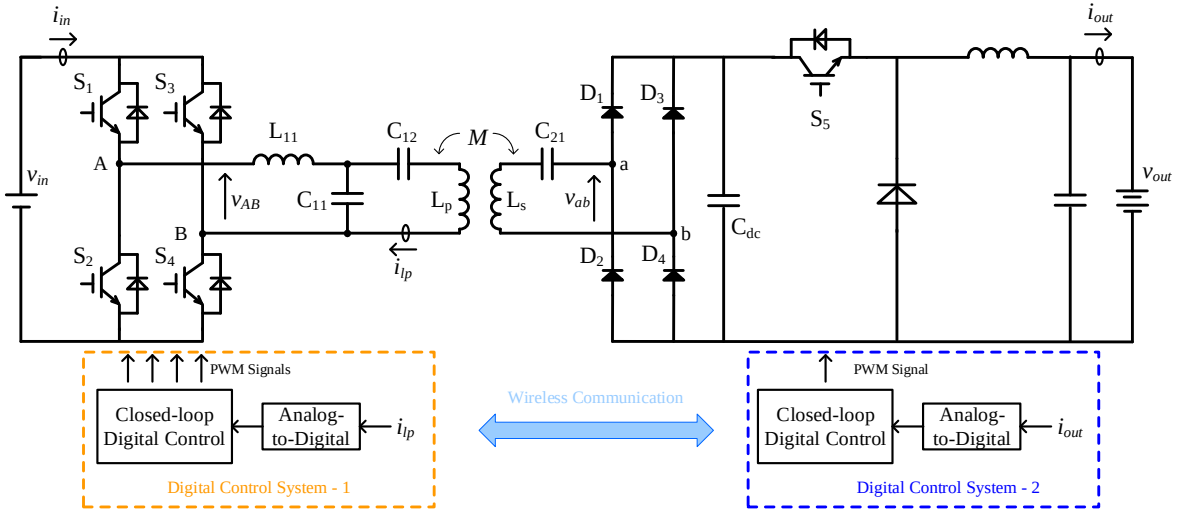
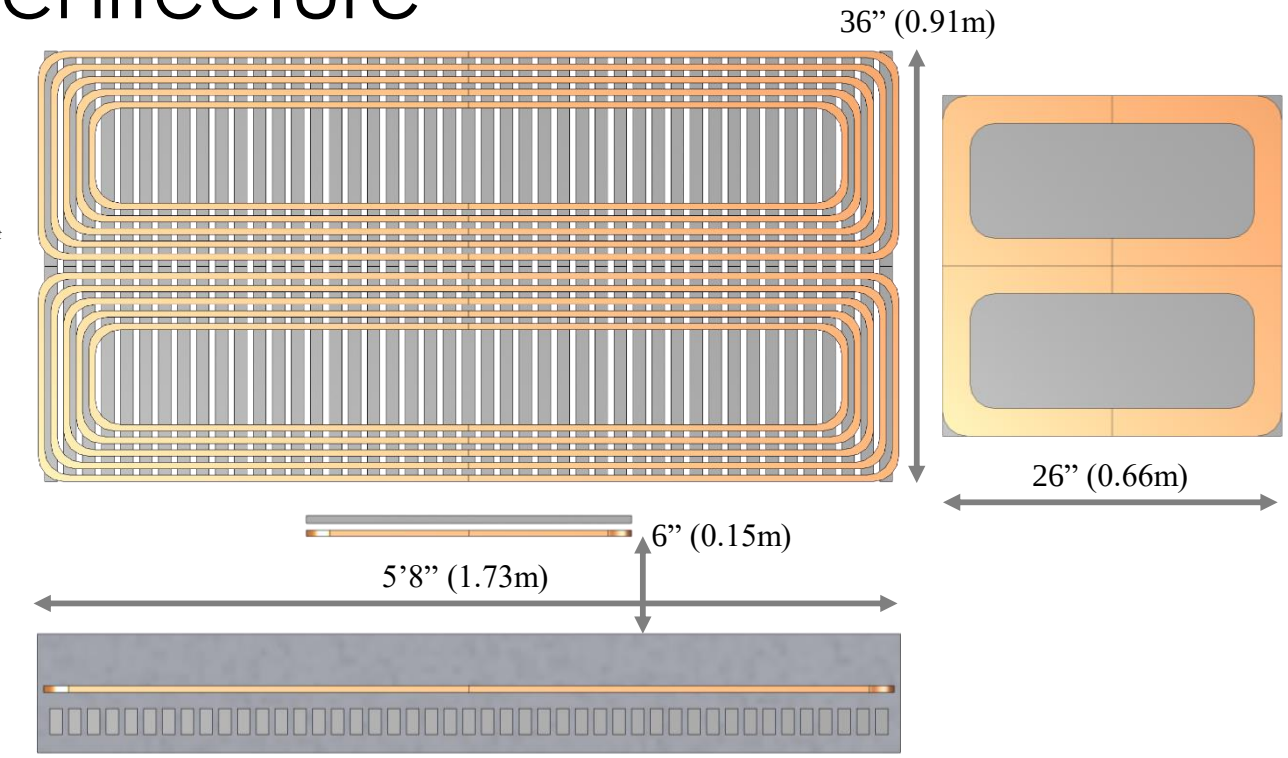
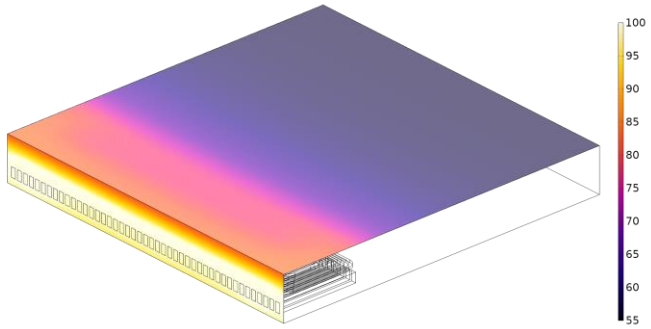
Project Partners: National Renewable Energy Laboratory, Idaho National Laboratory

High Power DWPT System Architecture

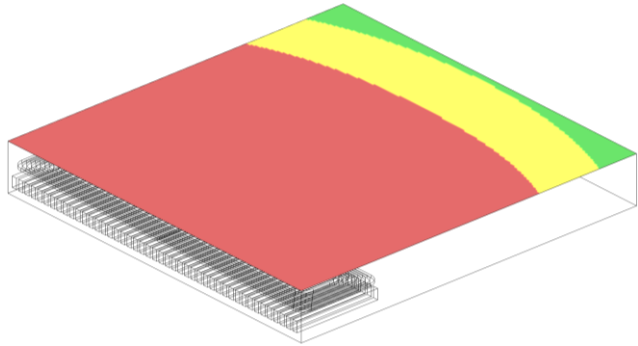




DWPT System Parameters	
V_{in}	800V
V_{dc}	400V - 800V
V_{out}	360V - 420V
P_{out}	200kW
Couplers per 12ft	2
Parallel Inverters	2
Vehicle DC-DC Converter Phases	4



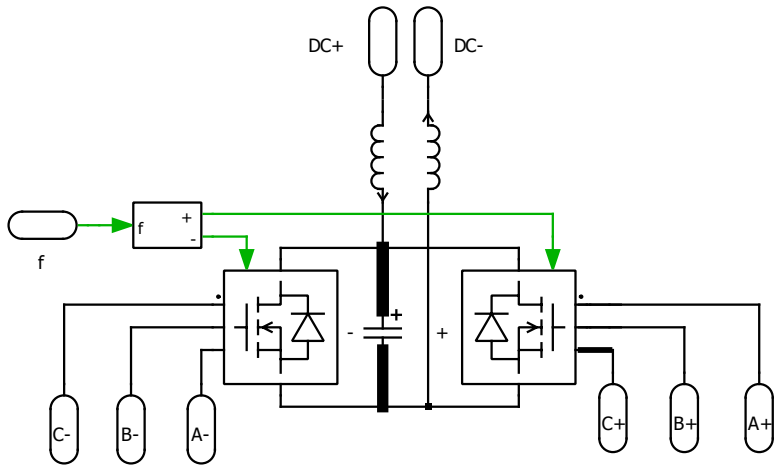
Thermal analysis of DWPT system embedded in concrete with ambient temperature of 55C (half lane of 6’width).



Map of critical electromagnetic field emission regions on the surface of the roadway; Green – below 15uT_{rms}, Yellow – between 15uT_{rms} and 27uT_{rms}; Red – Above 27uT_{rms}

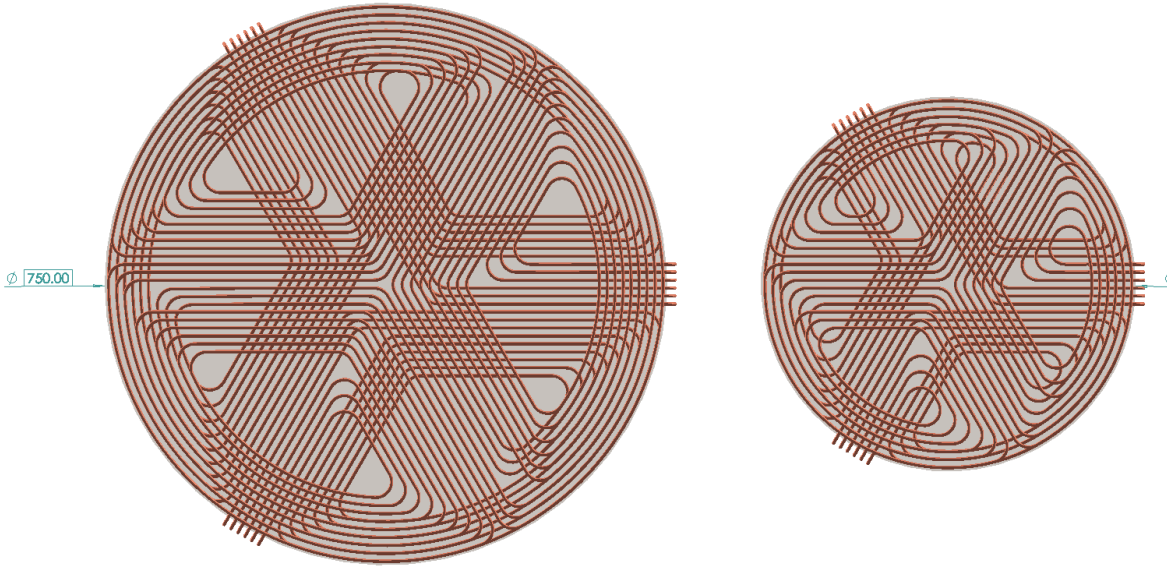
Three-Phase Wireless Charging (100kW and 300kW)

- Charge Point: Front end up to 1000 V_{dc}
- Single ground assembly, multiple vehicle assemblies
  - Hyundai Kia: 100kW
  - Ceres (formerly SF Motors): 300kW
- 125mm misalignment tolerance
- Double-sided LCC Tuning
- Dual Three-Phase HF Inverter Design

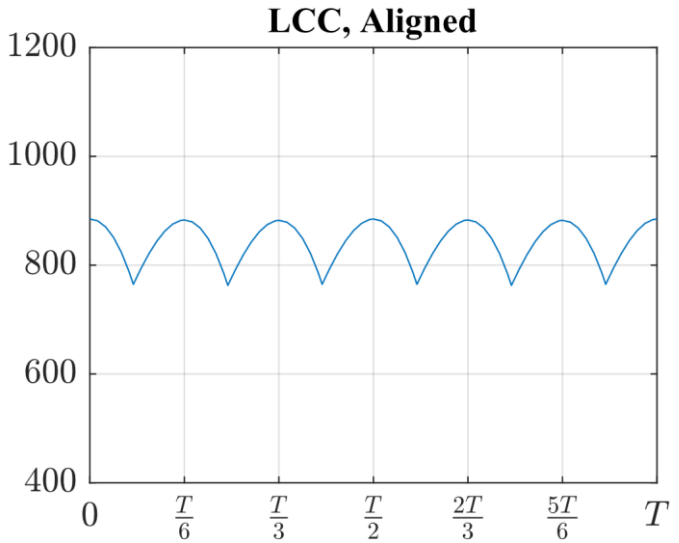


Dual Three-Phase HF Inverter Schematic

Ground Coupler	
OD	750mm
Current Rating	321A_{rms}
Phase Voltage	3.0kV_{rms}
Ferrite Mass	31.8kg
Litz Wire Mass	12.9kg
Total Mass	44.7kg



300kW three-phase ground and vehicle couplers



Three-phase rectifier output current

300kW Vehicle Coupler	
OD	500mm
Current Rating	321A_{rms}
Phase Voltage	1.2kV_{rms}
Ferrite Mass	11.3kg
Litz Wire Mass	5.7kg
Total Mass	17.0kg

Diameter of 100kW coupler is ~375mm