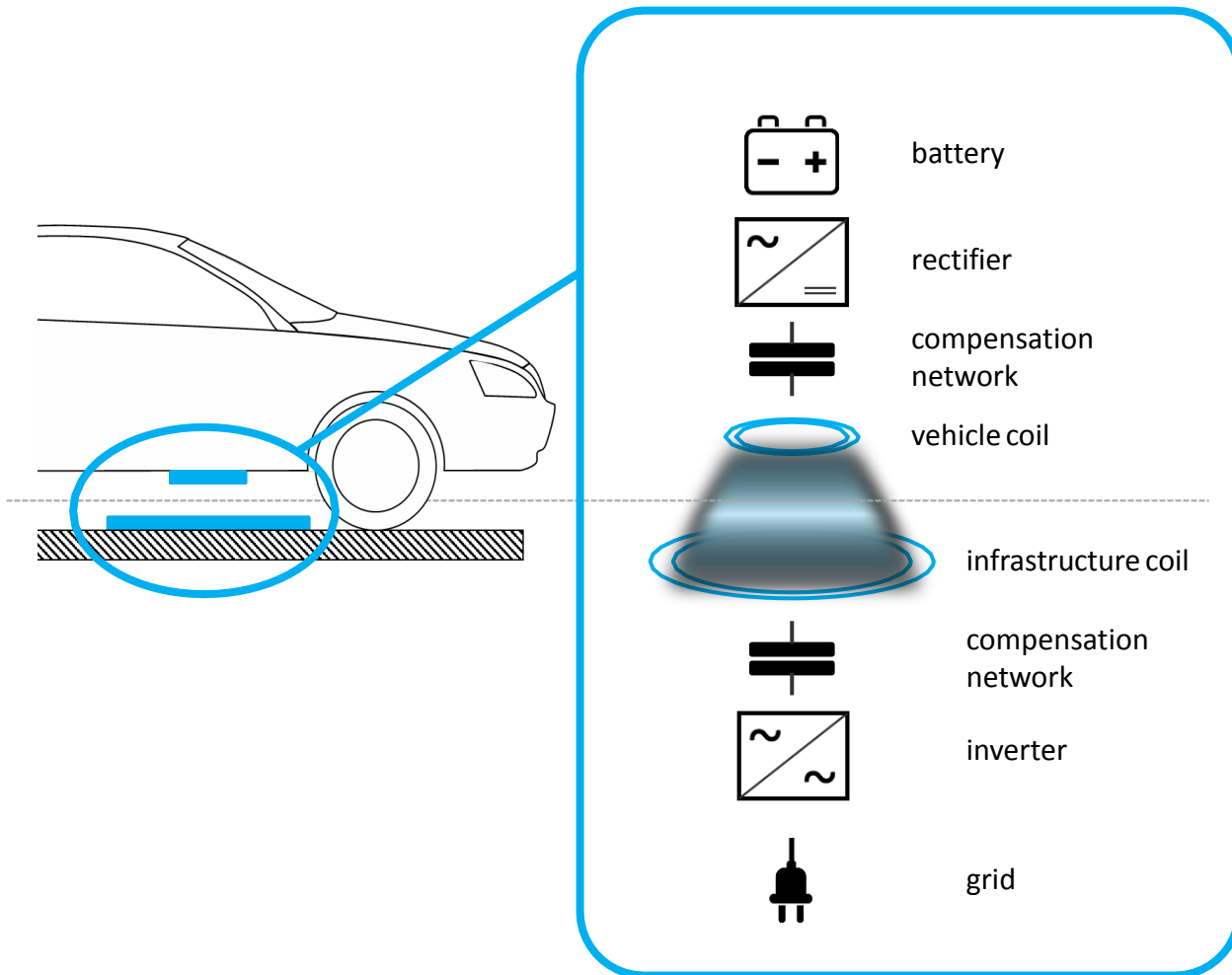


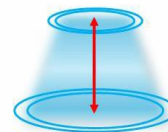
Functioning principle of inductive charging systems for electric vehicles



Core functions

- Transfer of power via magnetic field to charge the vehicle battery
- Power gets transferred at a frequency range of 79-90kHz over an air gap
- Efficiency of power transfer 80 % minimum
- Control of power transfer via WiFi communication

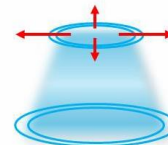
COIL DISTANCE



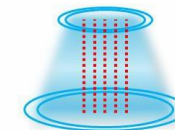
COMMUNICATION



POSITION TOLERANCE



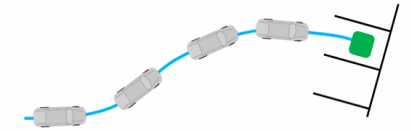
POWER AND EFFICIENCY



Auxiliary functions

Supporting functions beyond power transfer to ensure safe system operation.

POSITIONING



LIVING OBJECT PROTECTION



FOREIGN OBJECT DETECTION

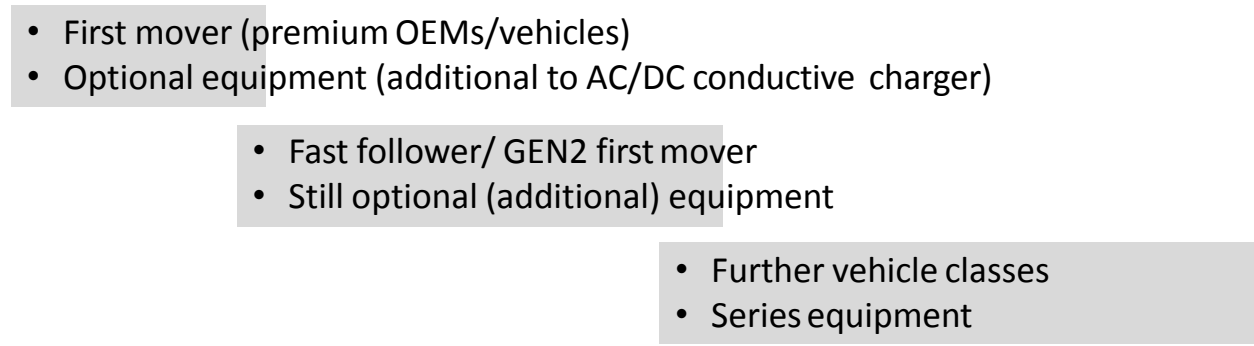


Status of technology deployment and potential future scenarios

POWER LEVELS



INDUCTIVE CHARGING SYSTEM GENERATIONS



MARKET DEPLOYMENT



Standards available (1st editions)

2020

2025

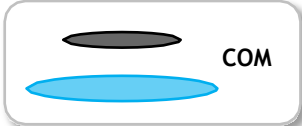
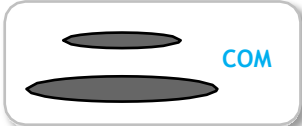
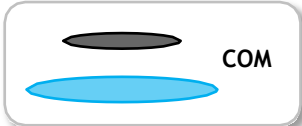
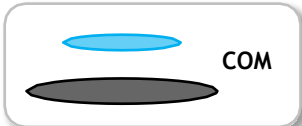
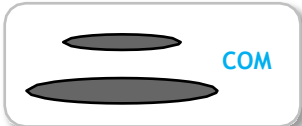
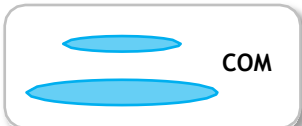
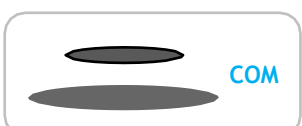
2030

General assumptions on potential technology deployment

Prospect (after 2030)

- **Semi dynamic** inductive charging; e.g lanes at traffic lights or taxi-lanes
- **Higher power (22kW)**; power currently limited due to available package space
- **Bi-directional charging**; investigations of technological feasibility and implementation started

Key standardization activities

#	IS pub *	title	focus
IEC 61980-1	2019/20 (edition 2)	<i>Electric vehicle wireless power transfer (WPT) systems Part 1: general requirements</i>	
IEC 61980-2	2019/20	<i>Part 2: Specific requirements for communication between electric road vehicle (EV) and infrastructure with respect to wireless power transfer (WPT) systems</i>	
IEC 61980-3	2019/20	<i>Part 3: Specific requirements for the magnetic field wireless power transfer systems</i>	
ISO 19363	2019	<i>Electrically propelled road vehicles – Magnetic field wireless power transfer – safety and interoperability requirements</i>	
ISO/IEC 15118	2020 (edition 2)	<i>Road vehicles – vehicle to grid communication interface</i>	
SAE J2954	2017	<i>Wireless charging of electric and plug-in hybrid vehicles</i>	
SAE J2847-6	2013	<i>Communication for Plug-in Vehicles as a Distributed Energy Resource</i>	

* Planned publication of next IS according to current timelines

Potential hazards of inductive charging systems

ELECTRIC SHOCK

Common electric hazard related to the usage of electrical equipment.



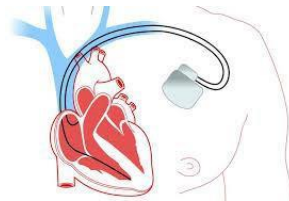
Not further detailed in this presentation since covered by several existing standards (which are referenced in the inductive charging standards).

EXPOSURE TO ELECTROMAGNETIC FIELD / DISTURBANCE OF MEDICAL IMPLANTS

Heating of tissue or nerve stimulation due to exposure to electromagnetic field.



Impacts on functionality of medical implants (e.g. pacemakers) due to potentially induced voltages.



OVERHEATING/ IGNITION OF OBJECTS

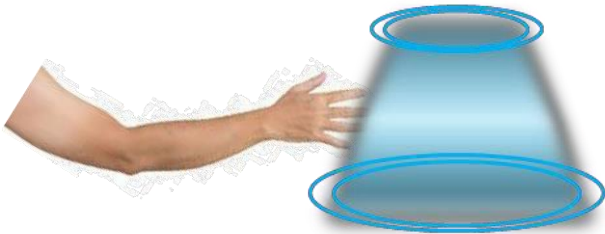
Objects exposed to the magnetic field heat up and can cause touch hazards. Heated objects might cause fire in combination with flammable material.



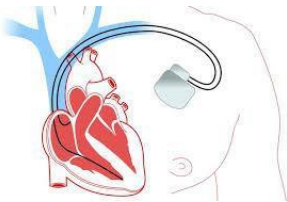
Protection mechanisms and related inductive charging standards (1/2)

EXPOSURE TO ELECTROMAGNETIC FIELD / DISTURBANCE OF MEDICAL IMPLANTS

Heating of tissue or nerve stimulation due to exposure to electromagnetic field.



Impacts on functionality of medical implants (e.g. pacemakers).



- ICNIRP Guidelines recommend maximum field strength as exposure limits for humans.
- These limits are applied in the standards for inductive charging systems: Persons may not be exposed to fields above the limits of ICNIRP Guidelines.
- This is either achieved
 - by keeping the field strength below the limits (limited transferrable power) or
 - by detecting a (part of a) body in areas where the field strength is above the limits.
- ISO14117 describes maximum field strengths to protect the functionality of medical devices.
- Also these limits are applied in the standards for inductive charging systems.
- Intense discussions on appropriate testing methods are currently ongoing between the experts of ISO14117 and the relevant inductive charging standards.

inductive charging standards covering/ developing the requirements

IEC 61980-3

ISO 19363

SAE J2954

Protection mechanisms and related inductive charging standards (2/2)

OVERHEATING/ IGNITION OF OBJECTS

Objects exposed to the magnetic field heat up and cause touch hazards. Heated objects can cause fire in combination with flammable material.



- Maximum permissible surface temperatures are specified in existing standards.
- The inductive charging standards describe the specific requirements by determining appropriate test objects and test procedures.
- Protection mechanisms are
 - either to ensure, that objects do not heat up above the permissible temperatures by system design (limited field strength)
 - or to detect the objects before they heat up before the exceed the permissible temperatures.

inductive charging standards covering/ developing the requirements

IEC 61980-3

SAE J2954