

# Charging infrastructure AC/DC fast charging

Advanced technology from SCHRACK  
Technik Energie

Christian Hofstadler



# AGENDA

## AC/DC fast charging

- Our company
- Basics: How does BEV charging work?
- Charging systems and plugs
- Fast charging at home
- AC/DC fast charging
- In the future: inductive charging

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Get Ready. **Get Schrack.**

## Founding and development

- **Founded as „Schrack Projekt- und Service GmbH“ Fall 2008**

Turnover 2009: 280.000 €

- Employees: 3

- business areas:

Metering, Lighting

- **Schrack Technik Energie GmbH**

Turnover 2014: 5.500.000 €

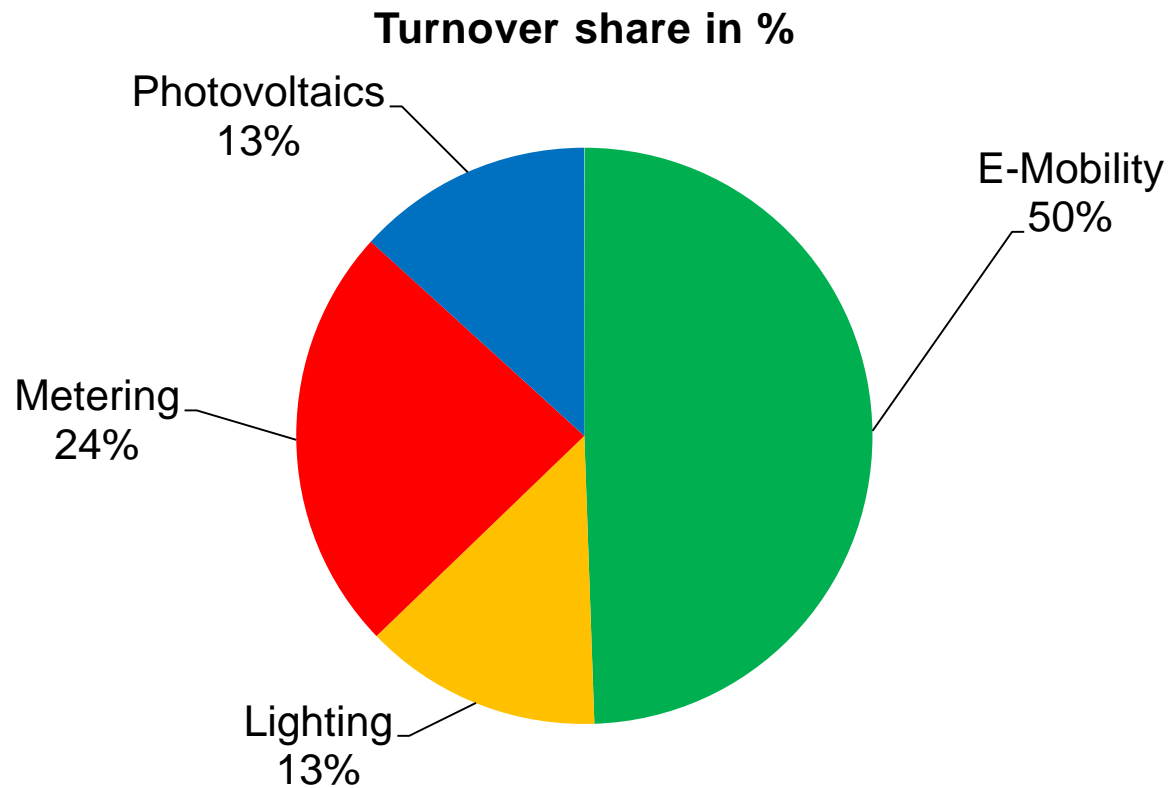
- Employees: 8

- business areas:

E-Mobility, Metering, Photovoltaics,  
Lighting



## Business areas 2014



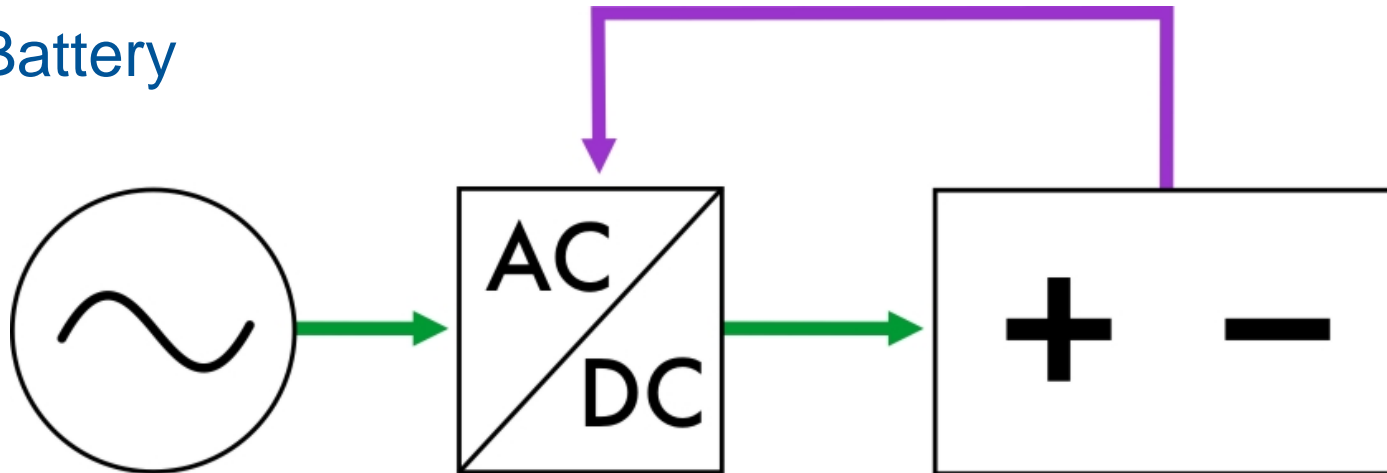
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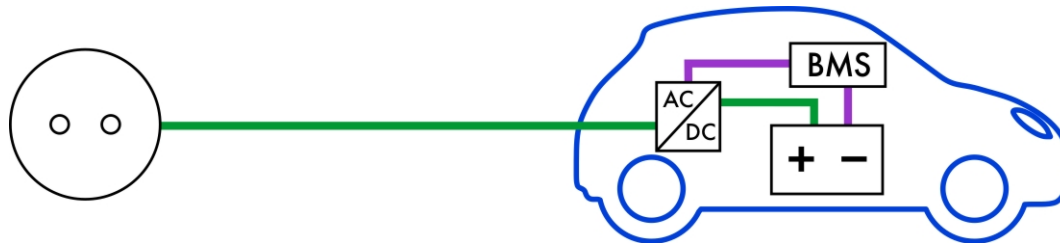
## Basics: The EV charging unit

- ▀ Mains 1ph / 3ph, 230 V / 400 V
- ▀ Rectifier
- ▀ BMS
- ▀ Battery



## Mode 1: charging at wall plugs

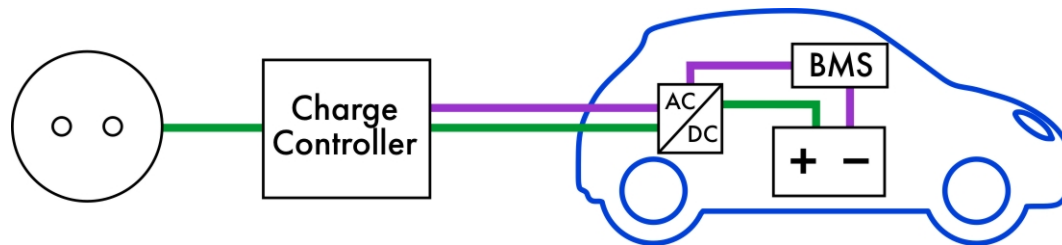
- Use the standard „Schuko“ outlet
- No communication and control of power
- Charge duration: 8 hours and more!
- Max. power: 2-3 kW





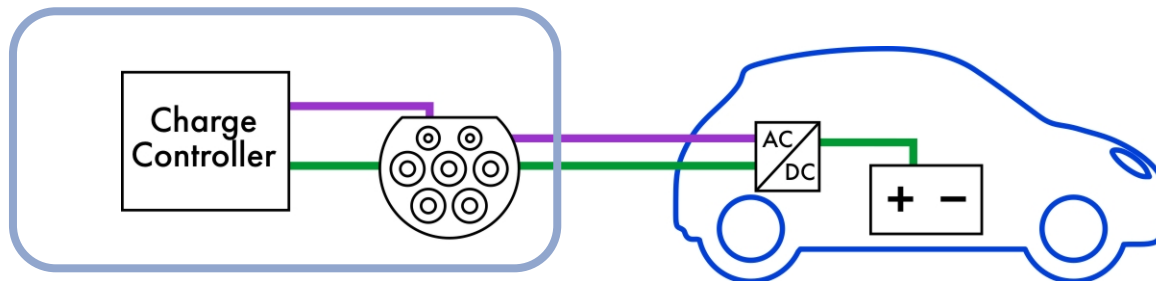
## Mode 2: charging with in-cable controller

- Charge controller integrated into charging cable
- Safety features: RCB, Plug temperature monitoring
- However: charging duration still 8 hours and more
- Supplied by EV manufacturer: emergency charging



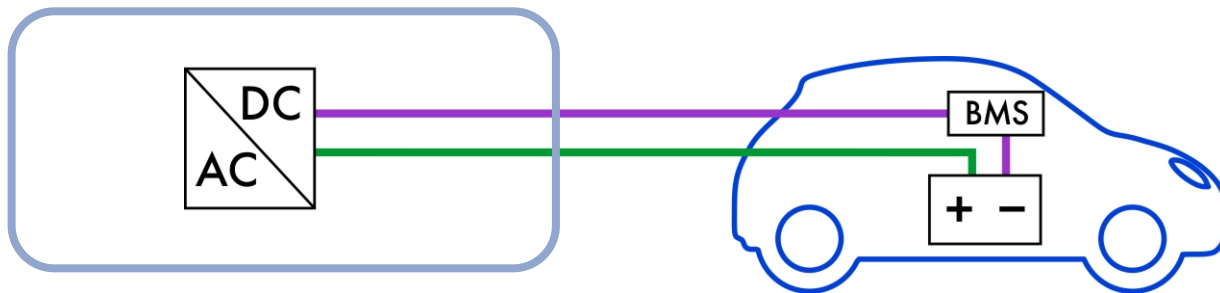
## Mode 3: charging using Type 2 plugs

- 1ph. 230V oder 3ph 400 V, 16 - 63 A
- Charge controller und plug on the charging station
- Communication with the EV's BMS
- Load management possible
- Charging station negotiates available power with EV

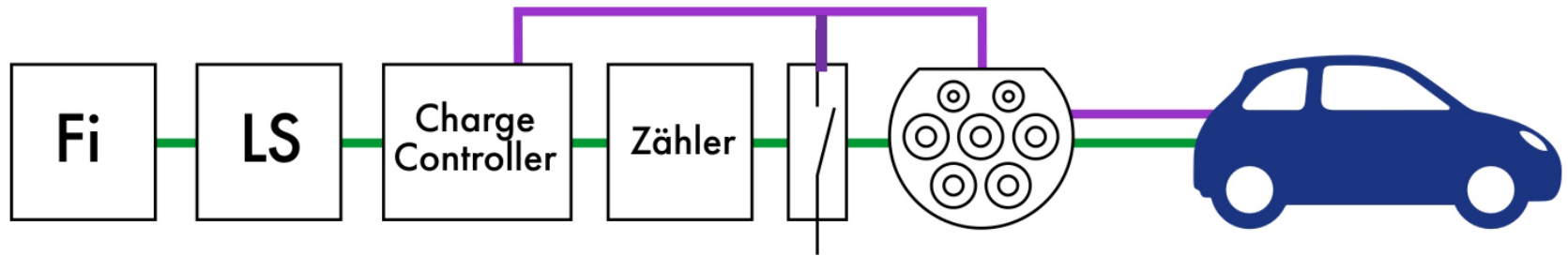


## Mode 4: External charger

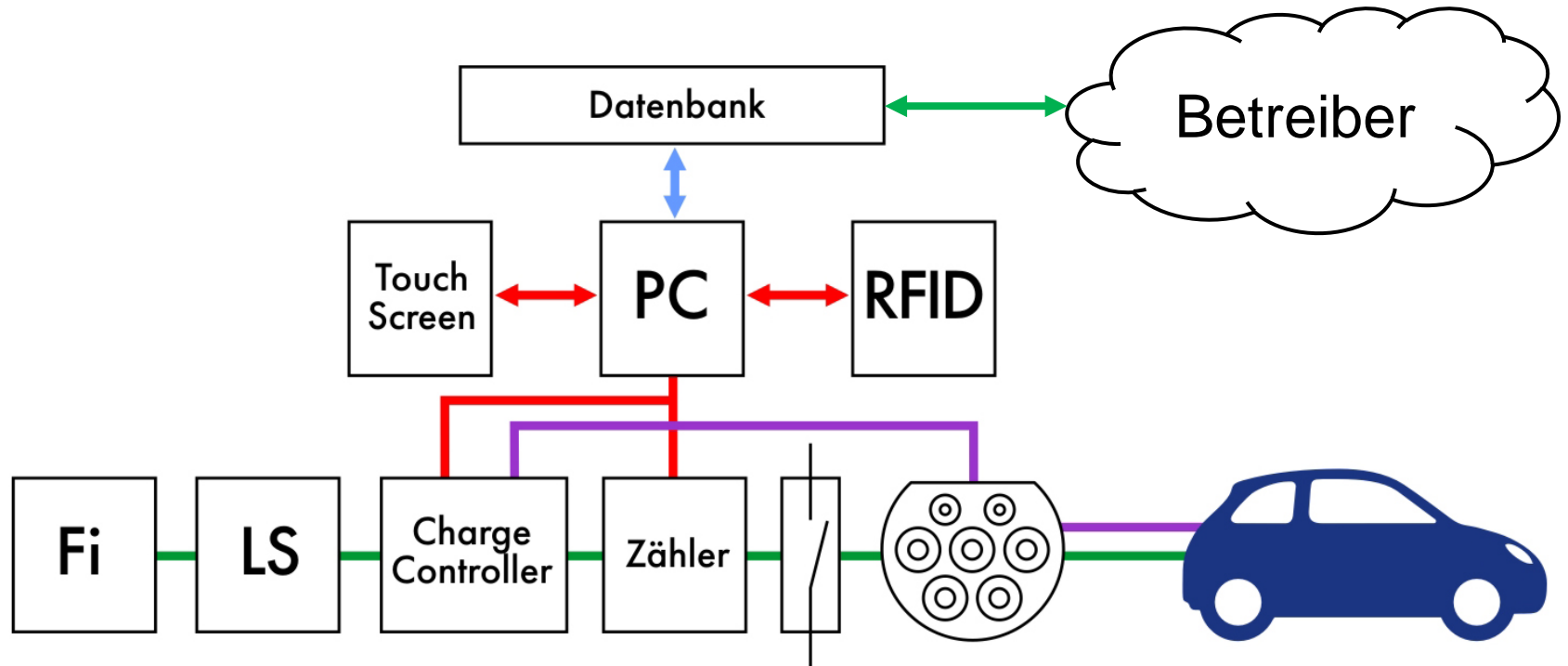
- Special DC-Plugs, 50 kW, soon 120 kW!
- Charger is in the charging station
- Communication via CAN BUS or ISO 15118  
„Powerline GreenPHY“



# Inner workings of an AC fast charger



## ... with metering and backend connection



# AGENDA

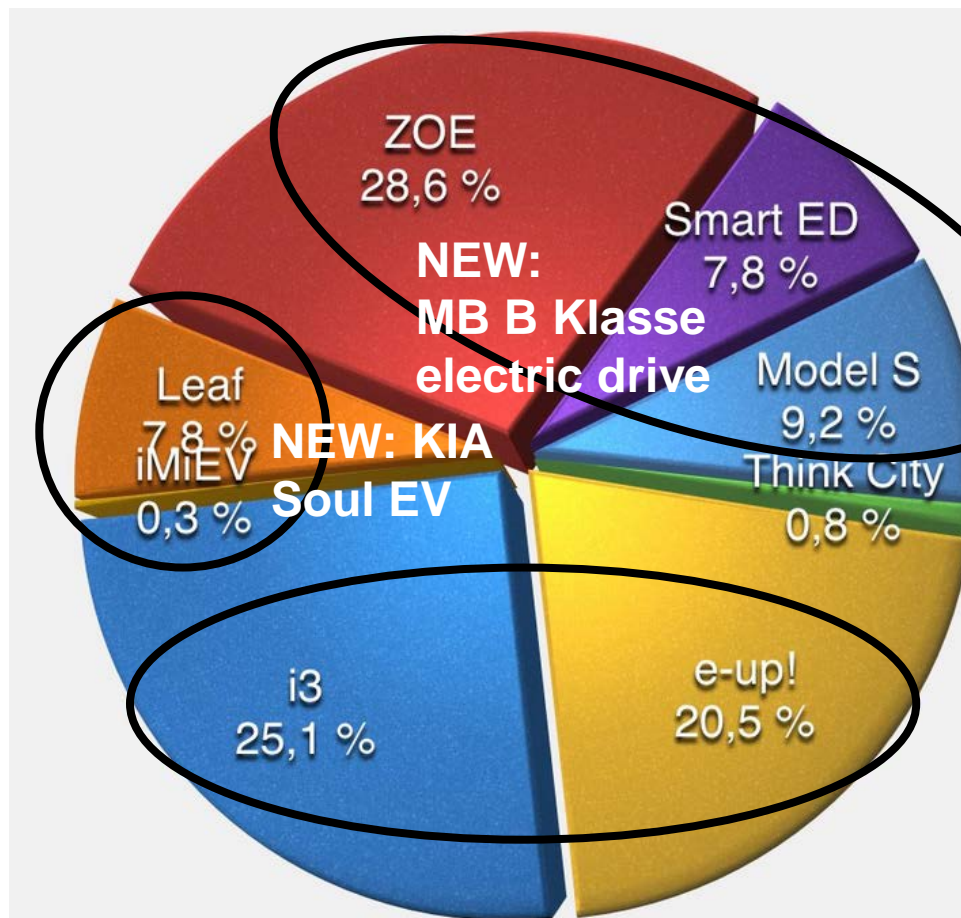
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## Plugs for EV Charging

	Schuko	Typ 2	CHAdeMO	COMBO
Spannung	230 V	400 V	500 V	500 V
Strom	16 A	16 A/32 A/63 A	125 A	125 A
Phase	1ph AC	3ph AC	DC	DC
Leistung	2 kW (3,7 kW)	22 kW /44 kW	50 kW	50 kW
Ladedauer	8 h	1 - 2 h	20 min	20 min

## EVs sold in Austria (2014)



Source: [http://www.statistik.at/web\\_de/statistiken/verkehr/strasse/kraftfahrzeuge\\_-\\_neuzulassungen/](http://www.statistik.at/web_de/statistiken/verkehr/strasse/kraftfahrzeuge_-_neuzulassungen/)



### The one phase „Dilemma“

- Typ 2 allows charging with 3 phase current, but ...  
Many EVs use only one phase!
- Cause and consequences ...
- A charging station with 11 kW rated power is utilized with 3.7 kW only

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## Home charger „Wallbox“

- Fixed installation (at home / at work)
- Easy to use
- No metering
- Key/RFID
- Fast charging?



## Which plug type to use?

### ■ Plug Typ2

■ Advantage: adapter for Typ1 possible

### ■ Fixed cable – Type 2 or Type 1

■ Advantage: easy to use, do not need to open trunk

■ Disadvantage: Decision for Type 1 or 2 necessary!



## Safety and economic considerations

■ RCD Type B (sensitive for DC residual current)

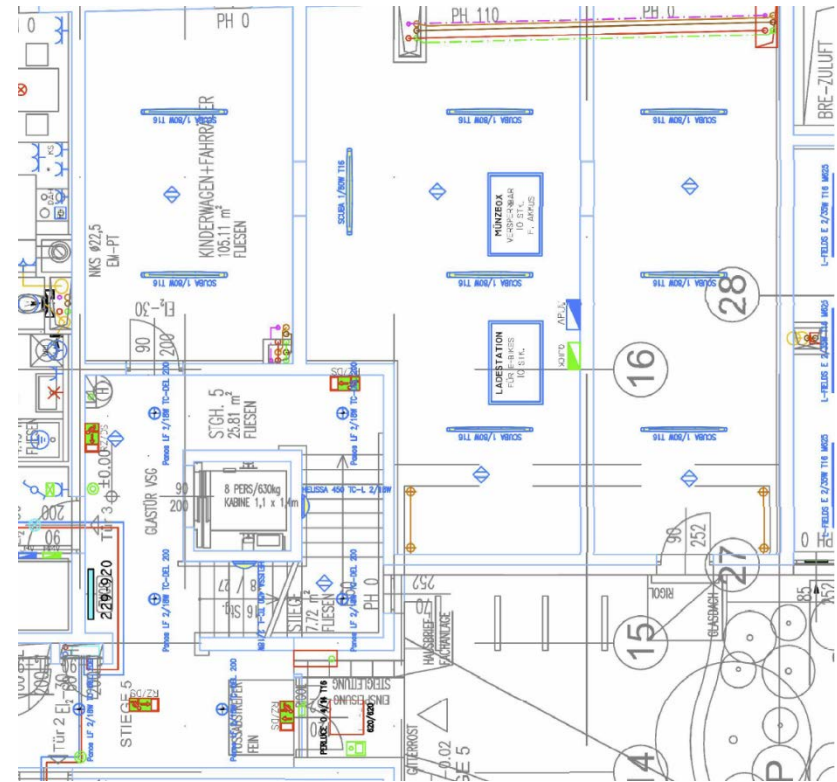
■ Wiring

For instance: EV charging with **3,7 kW**;  
**100 cycles of 20 kWh** per year, wiring length **15 m**:

Wiring gauge	Voltage drop	Thermal losses	Total losses/year
1,5 mm <sup>2</sup>	5,4 V	87 W	48 kWh
2,5 mm <sup>2</sup>	3,3 V	53 W	29 kWh
4,0 mm <sup>2</sup>	2,1 V	33 W	18 kWh
6,0 mm <sup>2</sup>	1,4 V	22 W	12 kWh

## Preparations for AC fast charging

- Wiring
  - 5x6mm<sup>2</sup>
- Space in circuit box
  - For fuses, breakers,...
- Mains power supply
  - At home: 11kW - 22kW => but: most domestic mains are limited to 25A!



## PV-load balancer (i-Charge HOME PV)

- Optimize consumption of PV power
- Customer can „force charging“

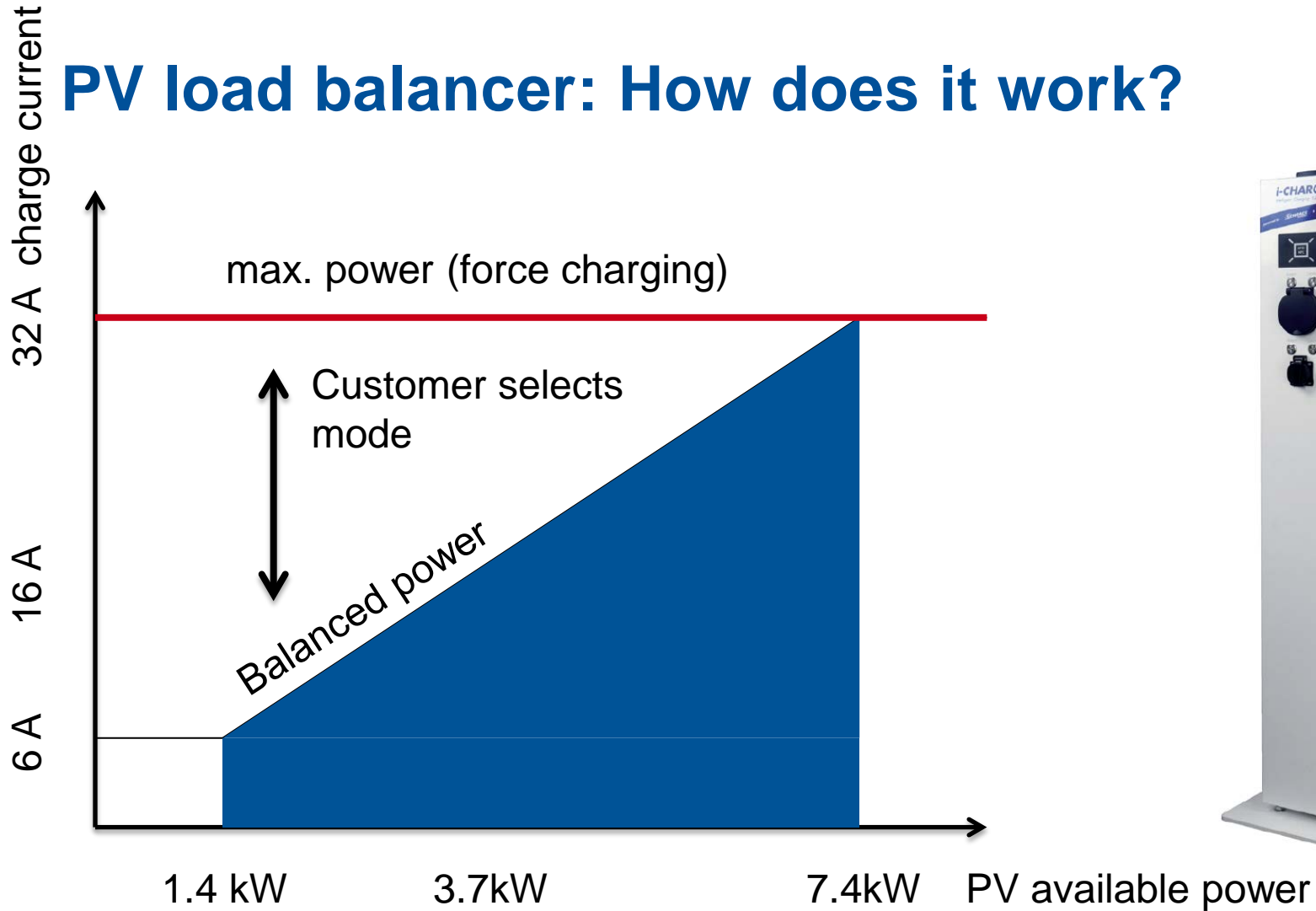


Full charge (20kWh)

- on mains power (25ct.): € 5,00
- PV, feed into mains (7ct.)  
then on mains (25ct.): € 3,60
- PV, load balancer (7ct.) € 1,40



# PV load balancer: How does it work?





## PV load balancer: interfaces

- Integrates into home automation

Smart Fox: [www.smartfox.at](http://www.smartfox.at)

PowerDog: [www.power-dog.eu](http://www.power-dog.eu)

- Other interfaces

- 0-10V analog control

- KNX, serial RS485, Ethernet ...

# Charge at home and on the journey: The mobile charger

- Compatible with all EVs
- mobile!
- Easy to use
- Robust steel casing
- Water resistant (IP44)



# MOBILE CHARGER

## Adapter



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# Charging on the road – easy and safe

- AC quick charging:
  - 43kW power, but only one EV:  
Renault ZOE R210
- DC quick charging:
  - 20 – 50 – 120kW
  - Three „competing“ systems:  
CHAdeMO  
CCS  
Tesla Supercharger

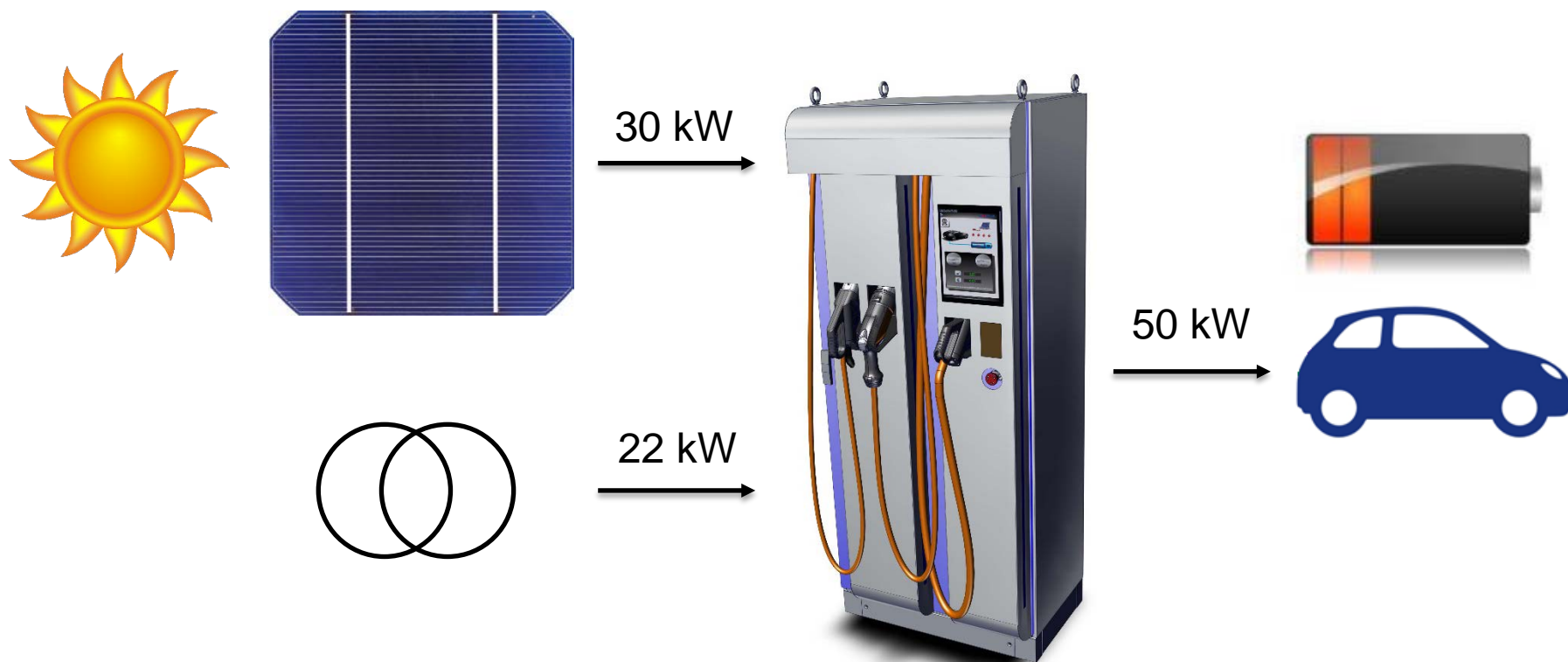


# NEW: i-Charge Triberium AC/DC quick charger

- First charger in Ebreichsdorf
- 60kW DC:
  - CHAdeMO
  - Tesla (using CHAdeMO adapter)
  - CCS
- 43kW AC Type 2
- 30, 60, 120 kW modules
- 800V ready!



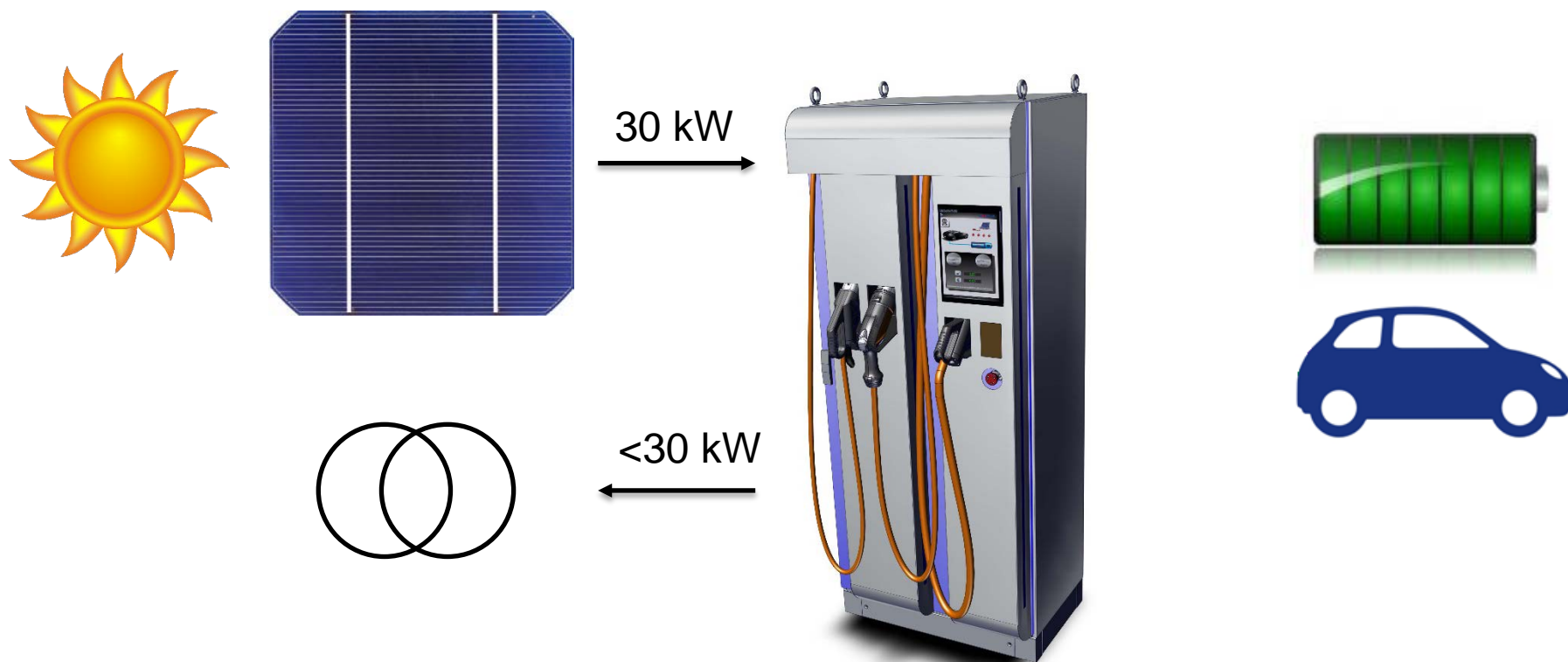
## Integration of photovoltaics



■ Saves grid connection fees!



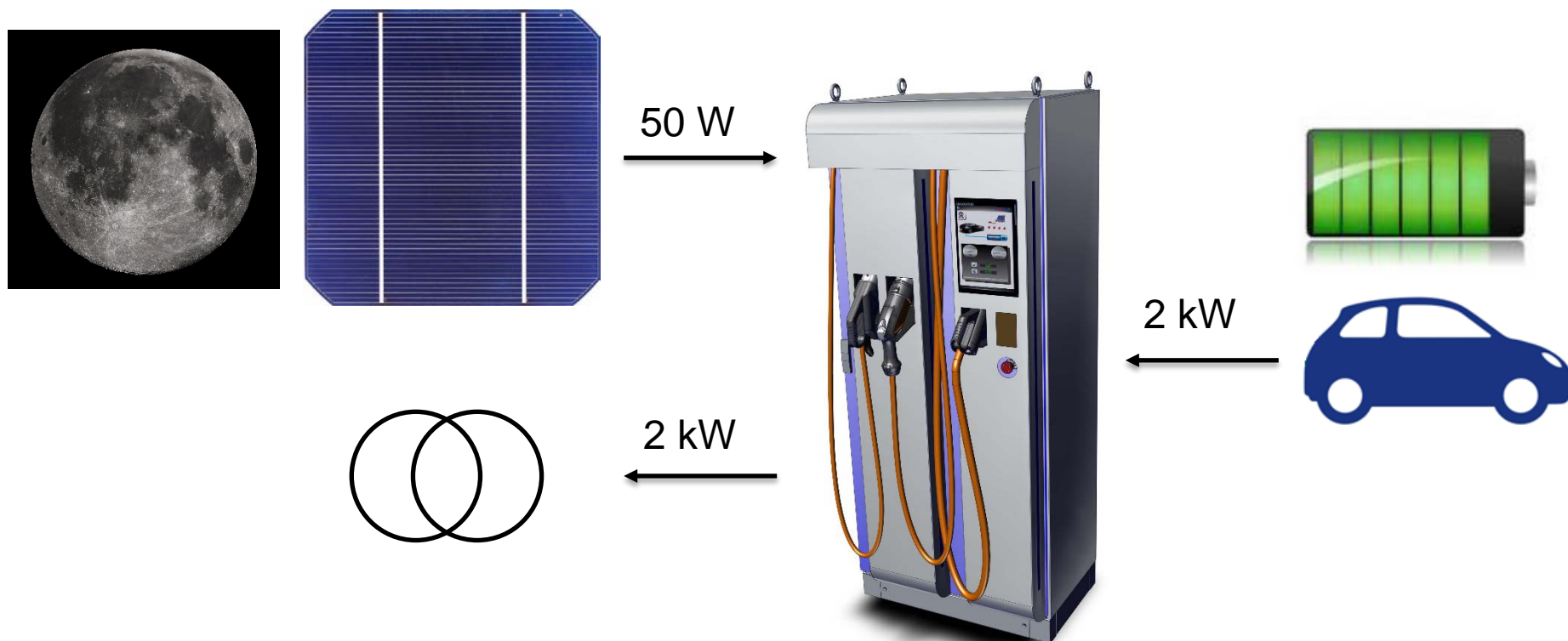
## Integration of photovoltaics



■ Save costs for PV inverter!



## Integration of photovoltaics and V2G



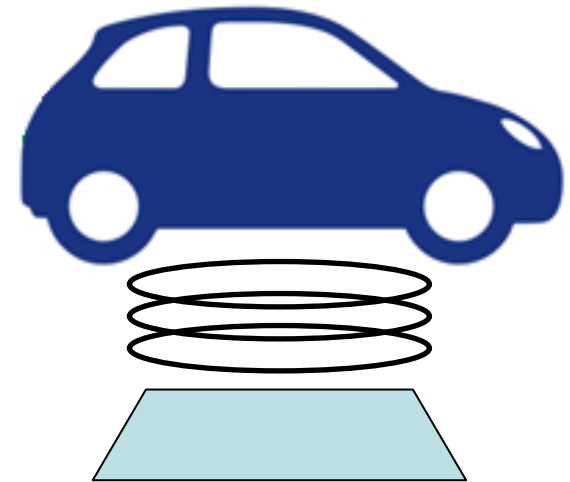
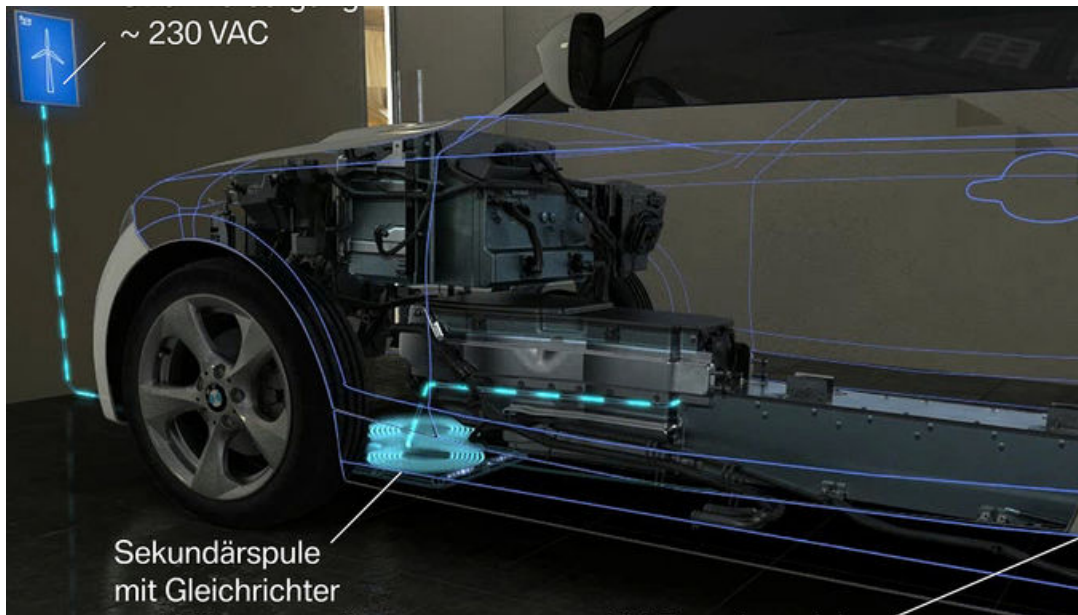
■ Save costs on UPS system

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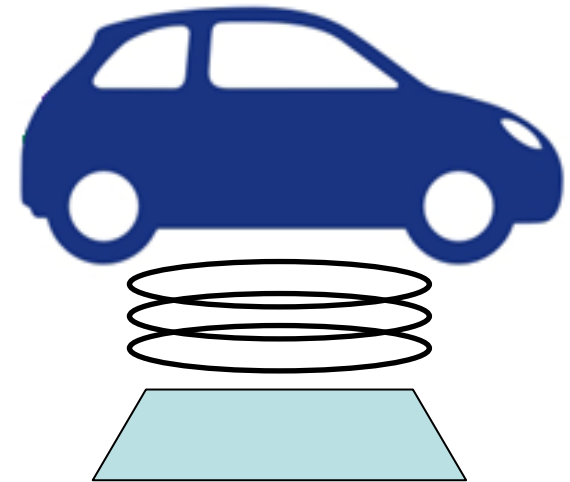
## Inductive Charging



- No more plugs!
- First successful tests with BMW i8 pace car

## Standards? Norms?

- OEMs must agree on
  - Frequency range
  - Communication protocol
- Efficiency
  - There are about 5% losses in the air gap!
- Safety
  - Vehicle must be placed exactly, coils aligned perfectly!



# Thank you!

Christian Hofstadler



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