Online Meeting
May 06.2020

Challenges and advantages of electro mobility for the grid integration

PROSPECT2030 | HSMD | Prof. P. Komarnicki, Dr. P. Lombardi, Dr. C. Wenge

AGENDA

RES
Status quo in EU and in Germany

Integrating volatile RES:
Problems and solutions

Multi criteria planning methodology : Analytic Hierarchy Process

Study case: Siberian Isolated Power Systems

NEED OF CHANGING ENERGY SOURCES

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particulate matter

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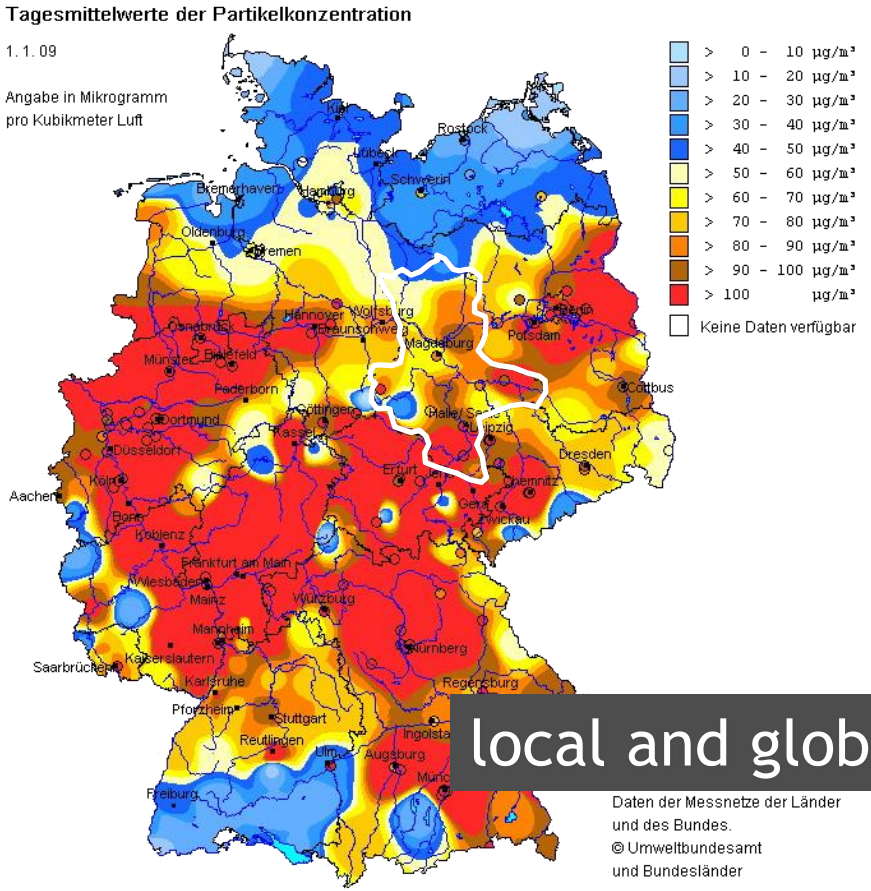

local and global effects

Daten der Messnetze der Länder
und des Bundes.
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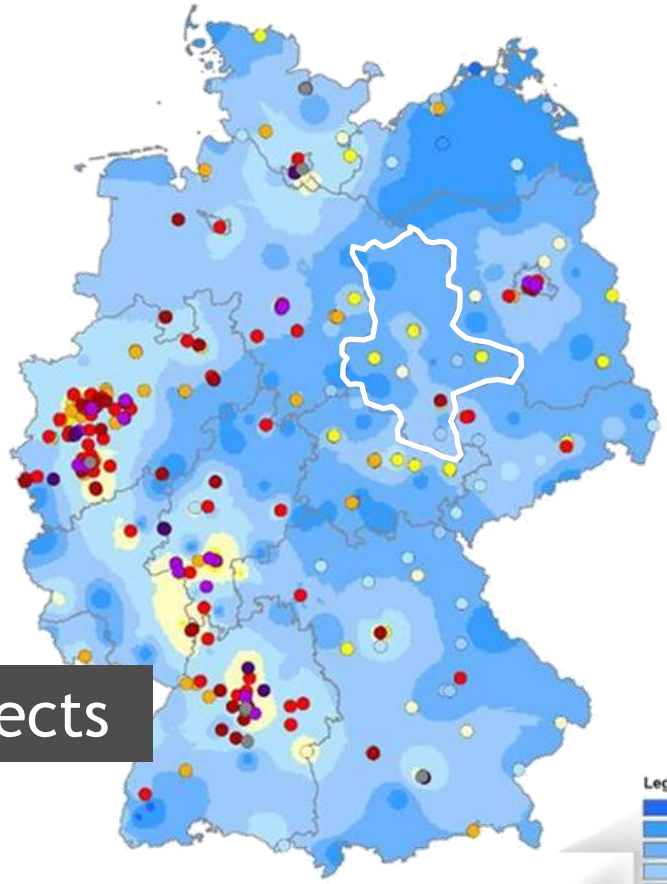
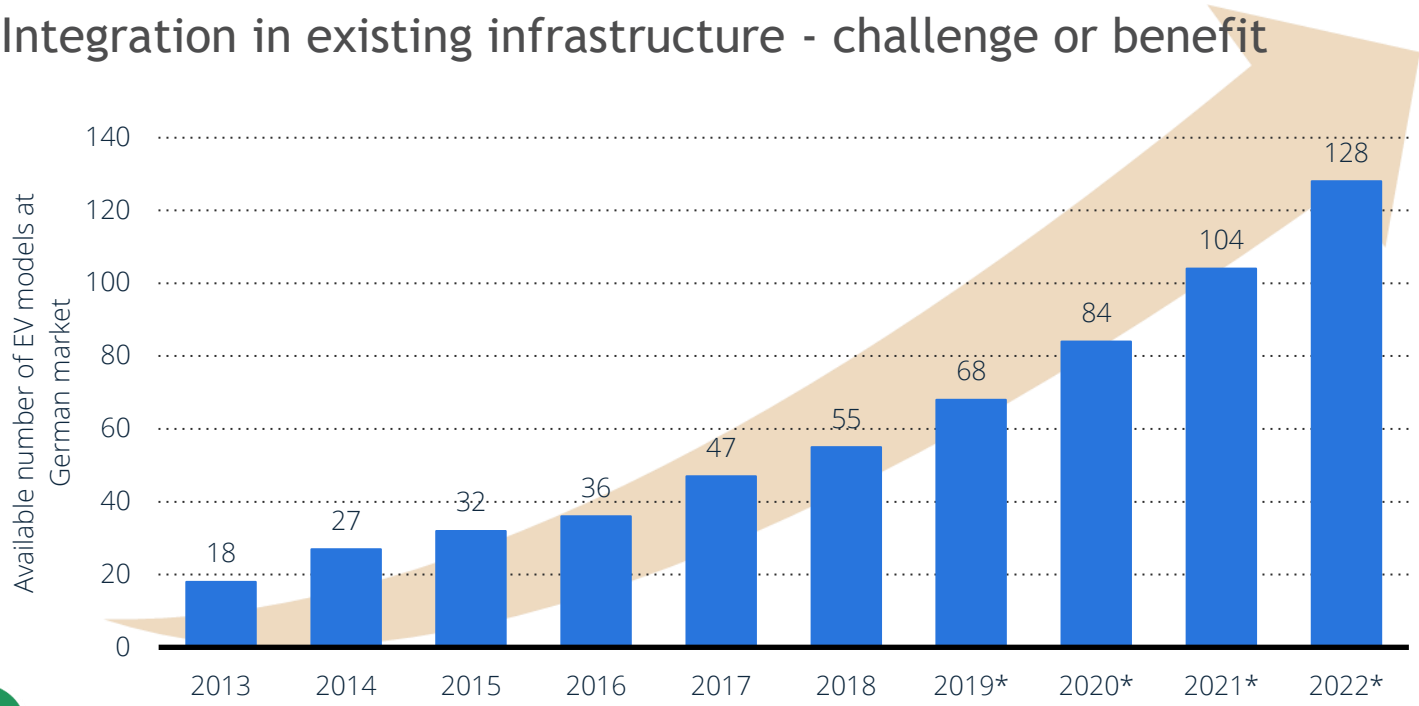
und Bundesländer



Die vom Umweltbundesamt zusammengestellten Karten und Daten zur aktuellen Immissionssituation dienen der orientierenden Information der Bevölkerung.
Auf Grund der weiträumigen Betrachtung ist eine kleinräumige Interpretation nicht zulässig.

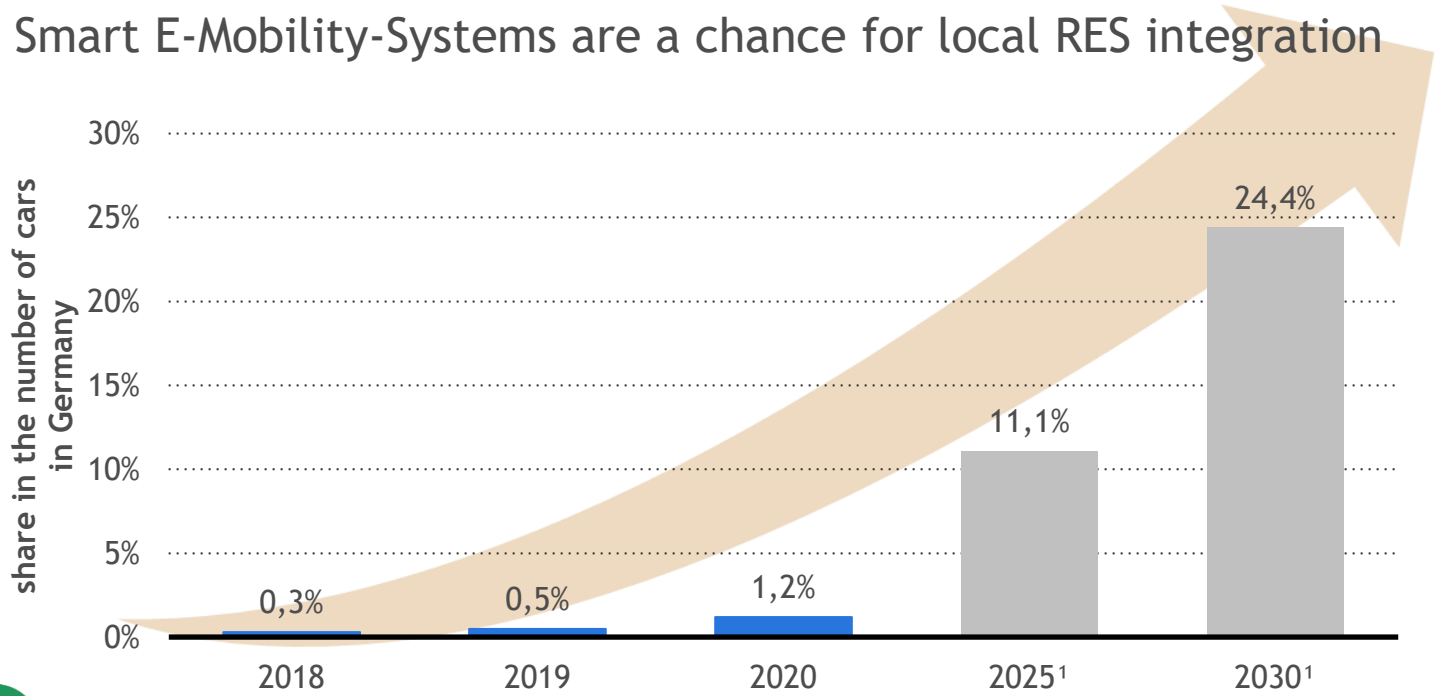
ELECTRIFICATION OF MOBILITY STARTED

- Global change in energy sectors – use of RES
- Expansion to renewable energies and electrification of mobility sector
- Change to green mobility; electric vehicles driven with RES
- Number of EV-Models on market increases rapidly
- Integration in existing infrastructure - challenge or benefit



ELECTRIFICATION OF MOBILITY STARTED

- How much do EVs change the local energy demand ?
- How many charging stations are needed and where?
- Do we need fast charger and does it match with existing infrastructure?
- Electric vehicles are on market and will become more
- Smart E-Mobility-Systems are a chance for local RES integration



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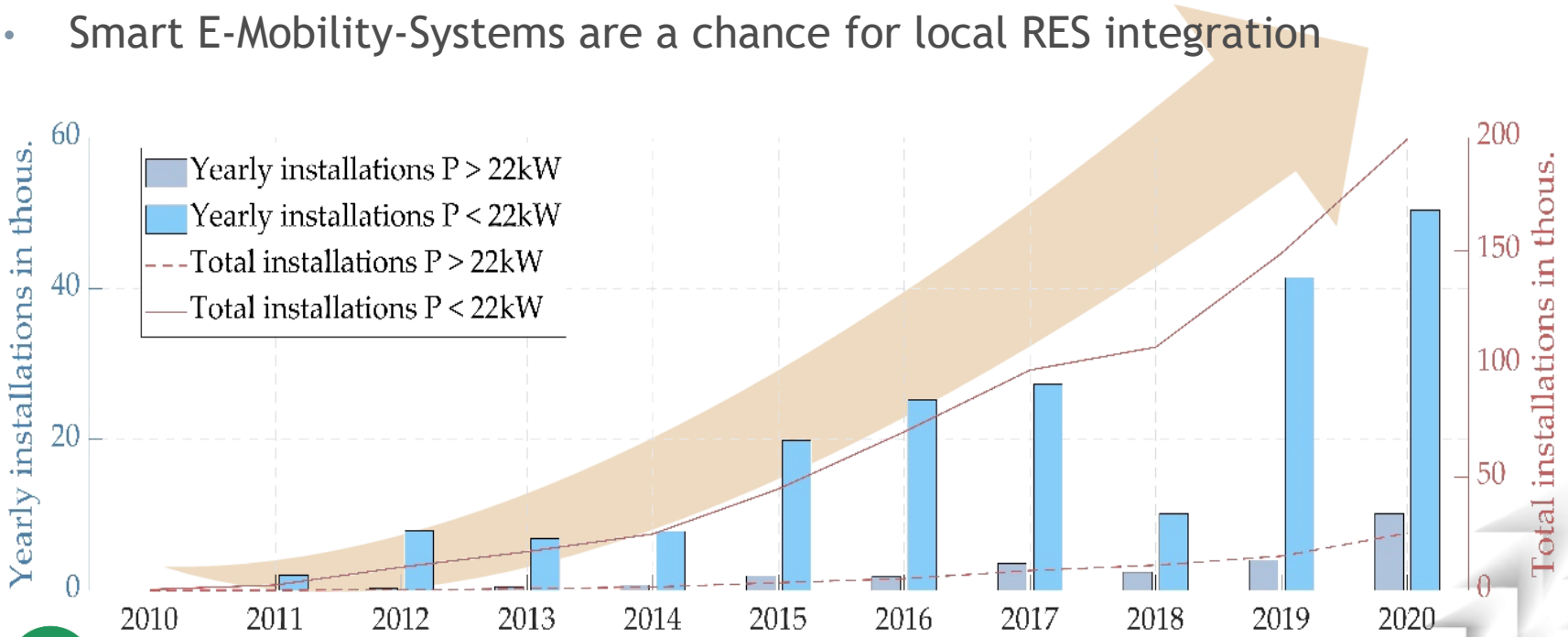
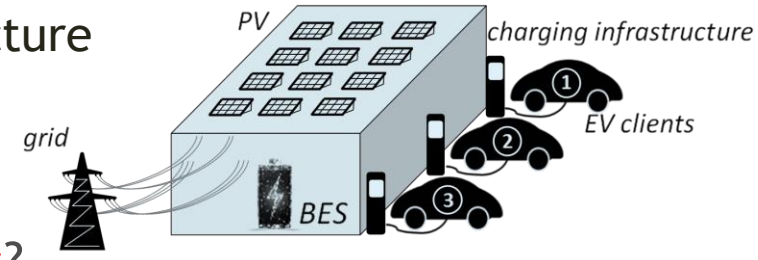


EXAMPLE INTEGRATION EV FLEET

general Questions

- How is the range of EV's and do they fulfil my requirements?
  - →Analysing existing fleet and use
- How and where can I charge?
  - → Analysing energy demand and charging options
- What charging infrastructure do I need?
  - →Analysing EV profiles and infrastructure



Advanced Questions

- What potential for EV integration exists?
  - → Analysing infrastructure (load, generation and storage)
- Could EV (EV infrastructure) support grid/ ancillary services?
  - → Question of power electronics (charger) and ICT

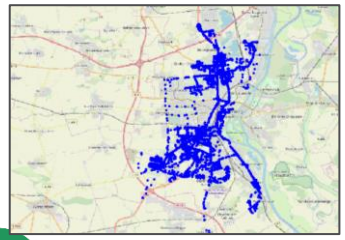
DEFINING OF DEMAND

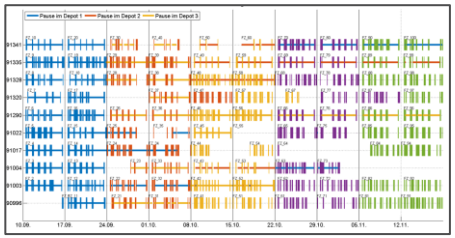
EV fleet demand estimation

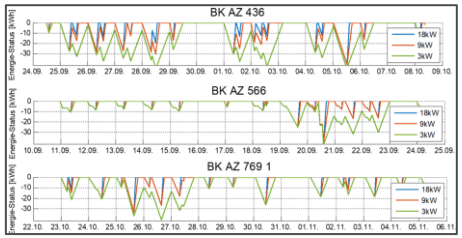
- General valuation of the size of the fleet and use profiles
- Evaluation of individual drive characteristic, daily kilometers…
- Selection of vehicle types according to purpose and requirements
- Critical evaluation of the range
- Evaluation of the invest and operating costs

EV charging infrastructure planning

- General valuation of the size of the fleet and usage profiles
- Evaluation of the potential loading time
- Selection of the type and number of charging stations
- Evaluation of the invest and operating costs







DEMAND OF CAPACITY IN GRID

AC-charging

- AC-stations 230V – 3,6kW *(ca. 15km / hour)**
- AC-stations 400V – 22kW *(ca. 100km / hour)**

Fast charger

- DC-charger > 50kW (>200km/hour)*
- → 200kW state of the art

* Estimation of recharging an electric vehicle based on the range

a) b) c) d) e) f)

IS EV INTEGRATION POSSIBLE?

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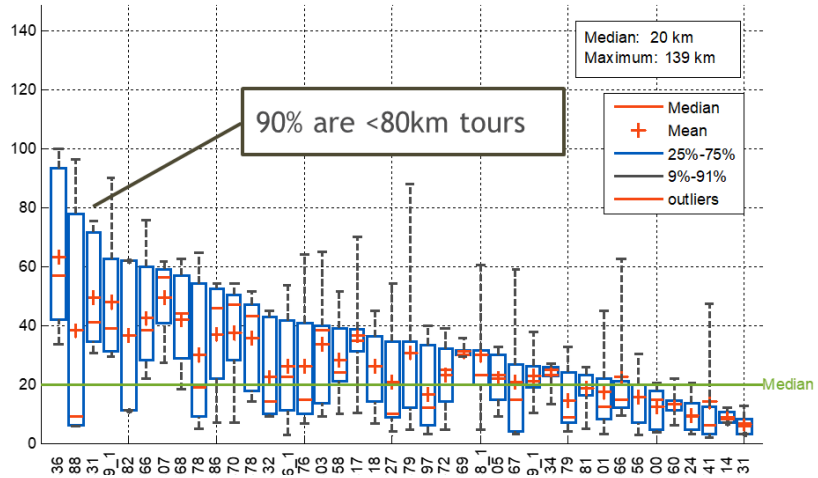
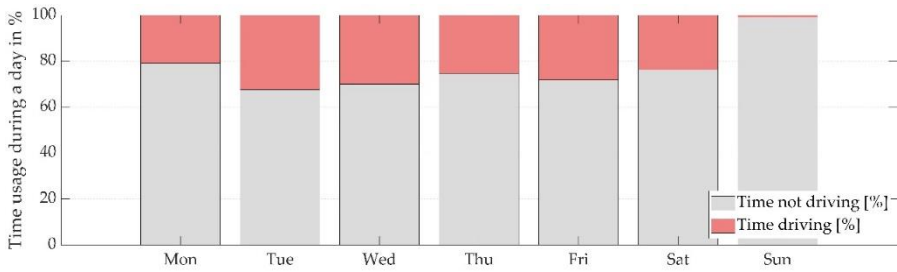
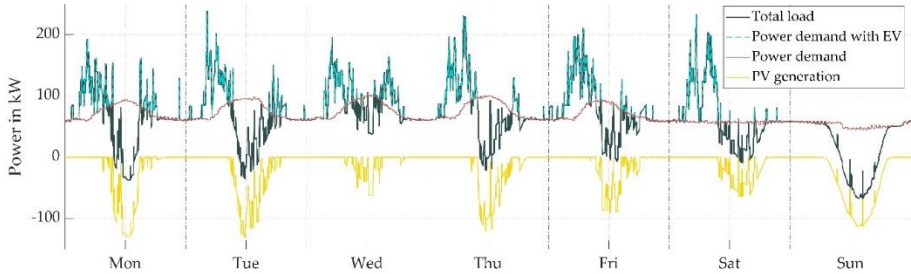
Results of different studies

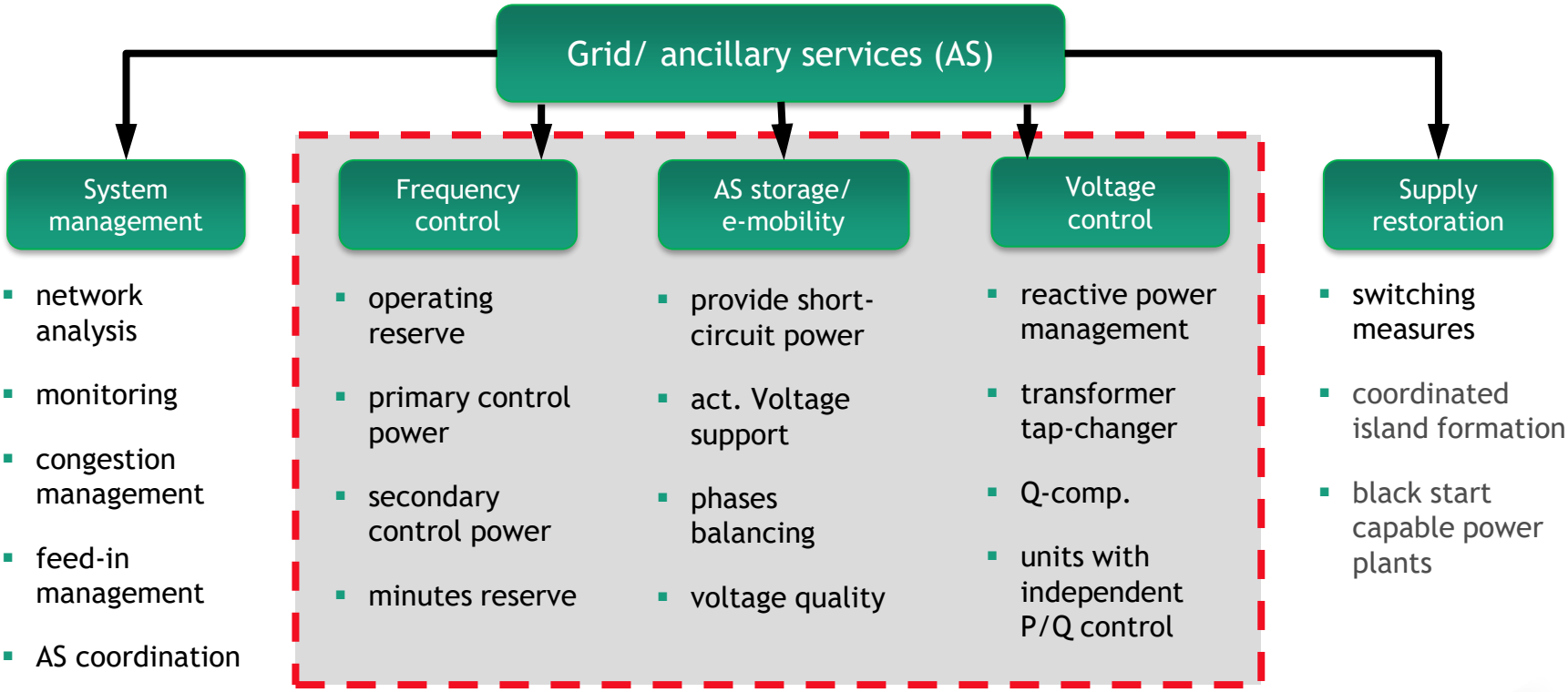
- 90% of tours could be fulfilled by EV's, the last 10% with PHEV
- High potential of Demand Side Management (DSM)
- High potential for RES optimized charging
- Fast charger are not needed for intelligent fleet and charging management
- High potential of energy and cost optimisation*
- High potential of grid/ ancillary services (AS)*
- *potential increases with size of fleet





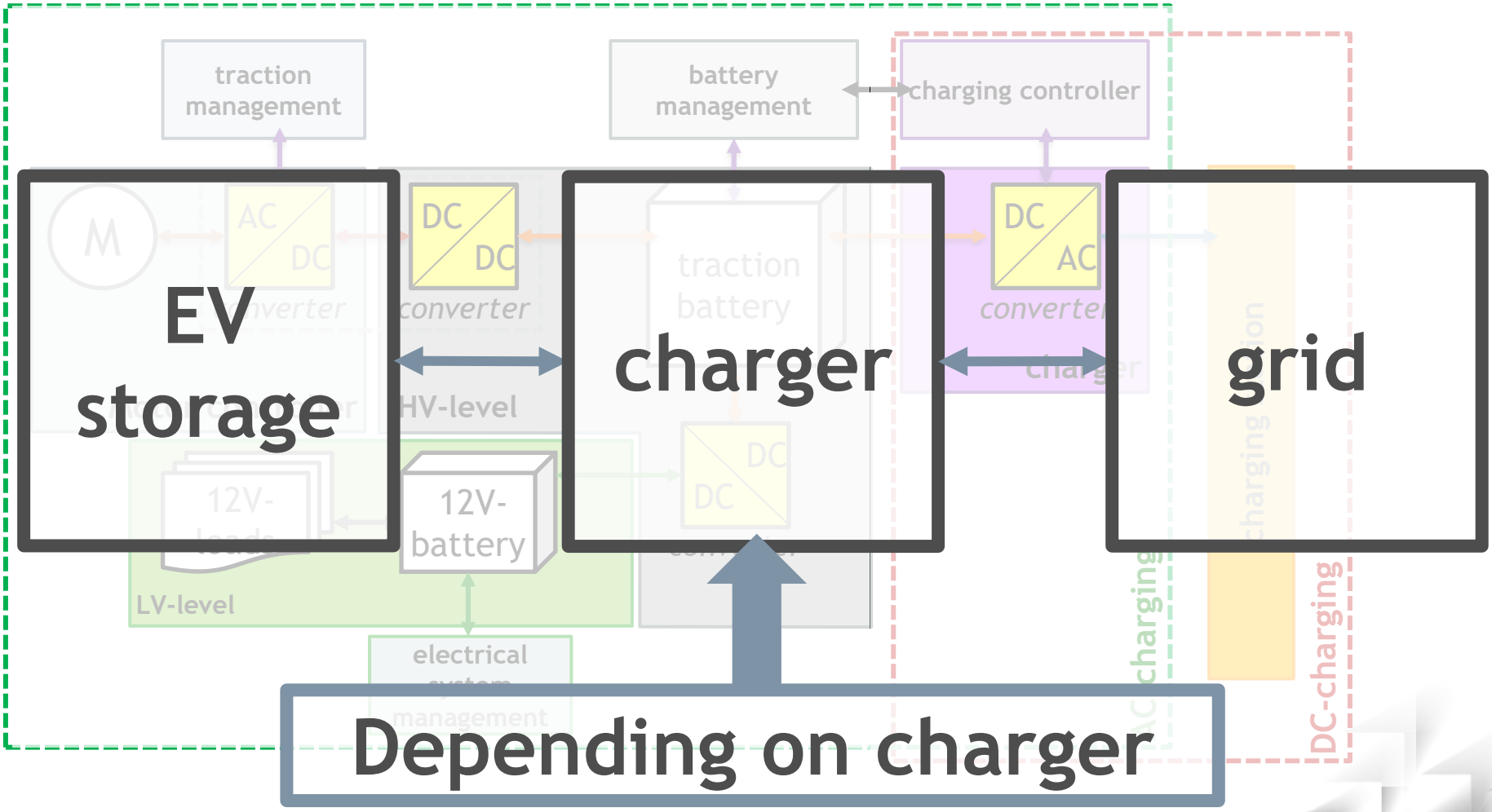


POTENTIAL FOR GRID SUPPORT WITH EV'S



ANCILLARY SERVICES WITH EV

typical electrical system structure of an electric vehicle



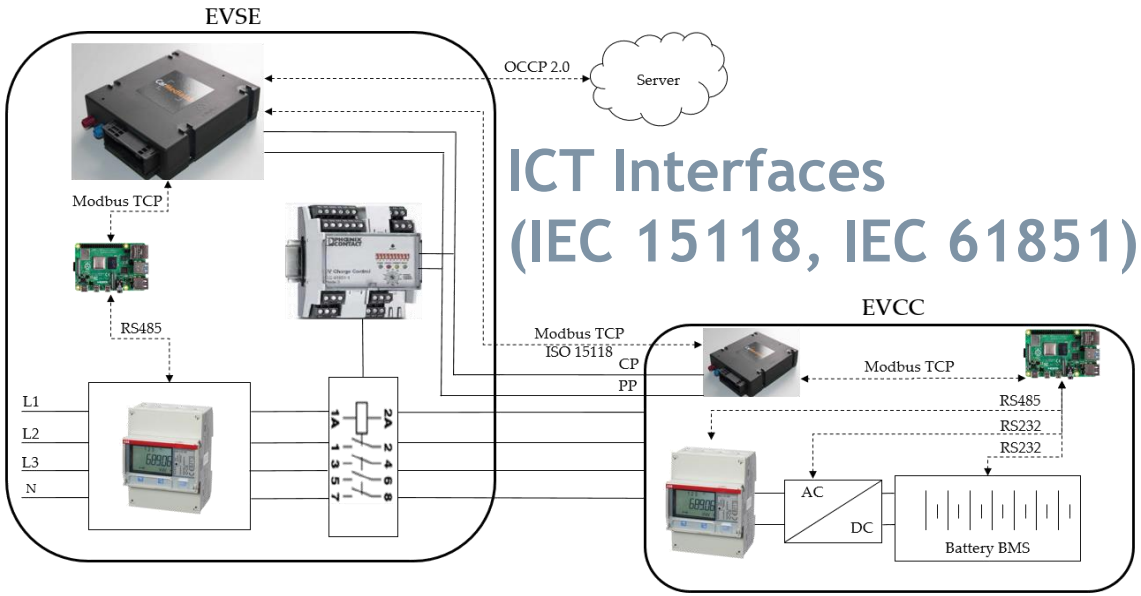
POSSIBLE ACTIONS WITH CHARGER

Active value	Effect in the distribution grid
Active power control	• Charging curve according to renewables, tariff, etc. (Power operating points according to schedule) • Frequency support (Power operating points according to local frequency measurement) • Voltage support (Power specification according to local network voltage) • Short-circuit power supply (Power specification according to local network voltage)
Reactive power control	• Voltage support (cos (phi) / reactive power operating points according to local grid voltage)
Phase-selective active power control	• Phase symmetry (active power withdrawal according to phase voltage)
Distortion reactive power	• Voltage quality (active filters according to harmonics)

MATCHING THEORY WITH PRAXIS

Load management → *active power control*

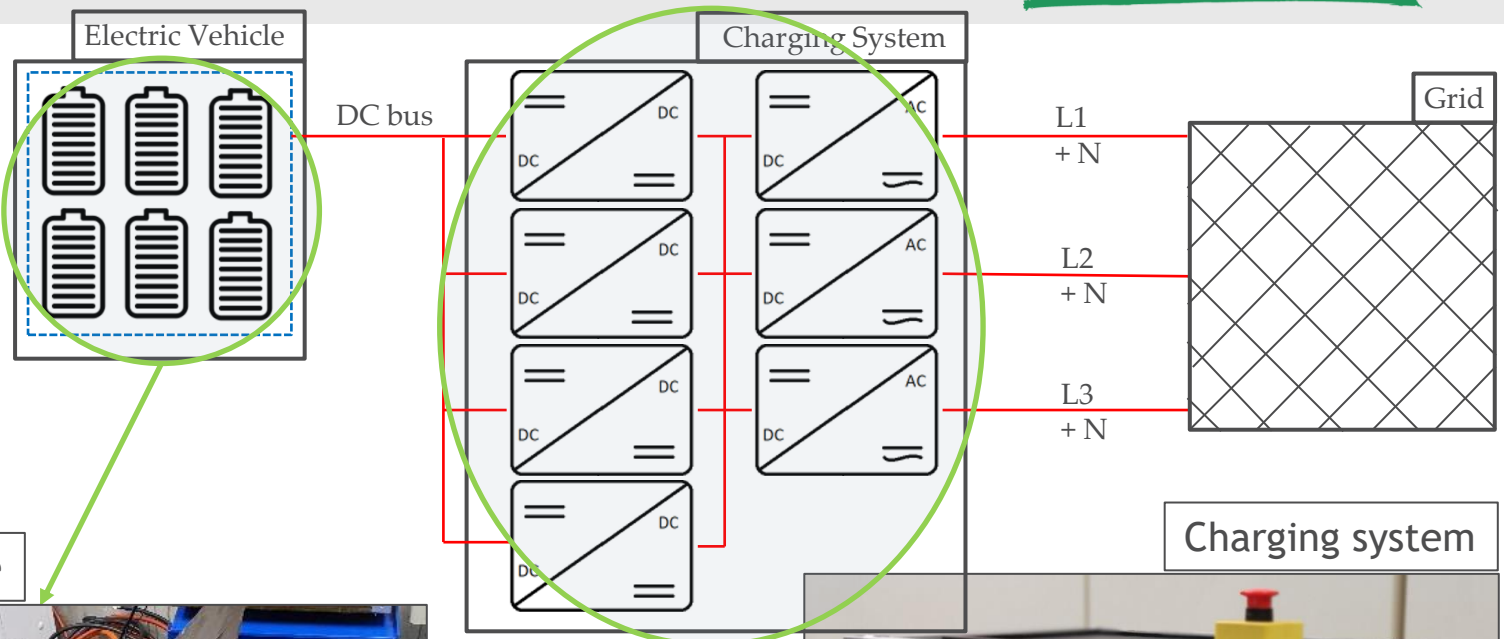
- Charging schedule calculation depending on RES, tariff, grid capacities, etc.
  (power control with charging schedule)
- *Bidirectional charger needed*



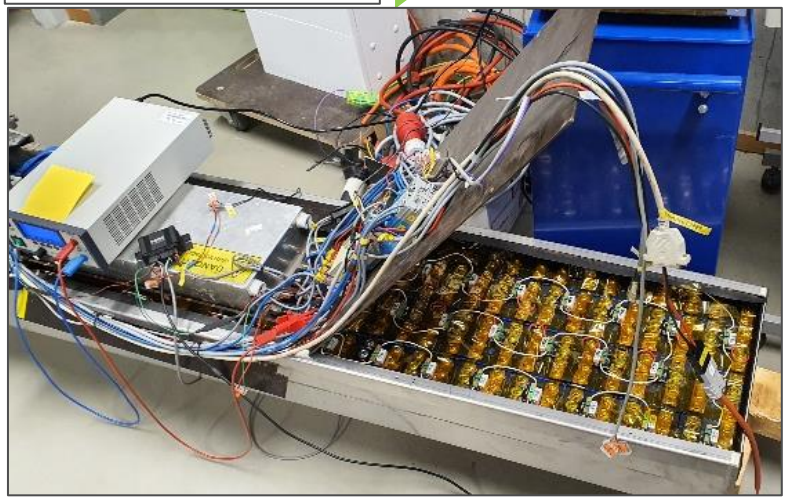
- Intelligent energy management
- Integrated intelligent charging infrastructure
- Intelligent EV

→ *standardized interfaces for communication*

MATCHING THEORY WITH PRAXIS

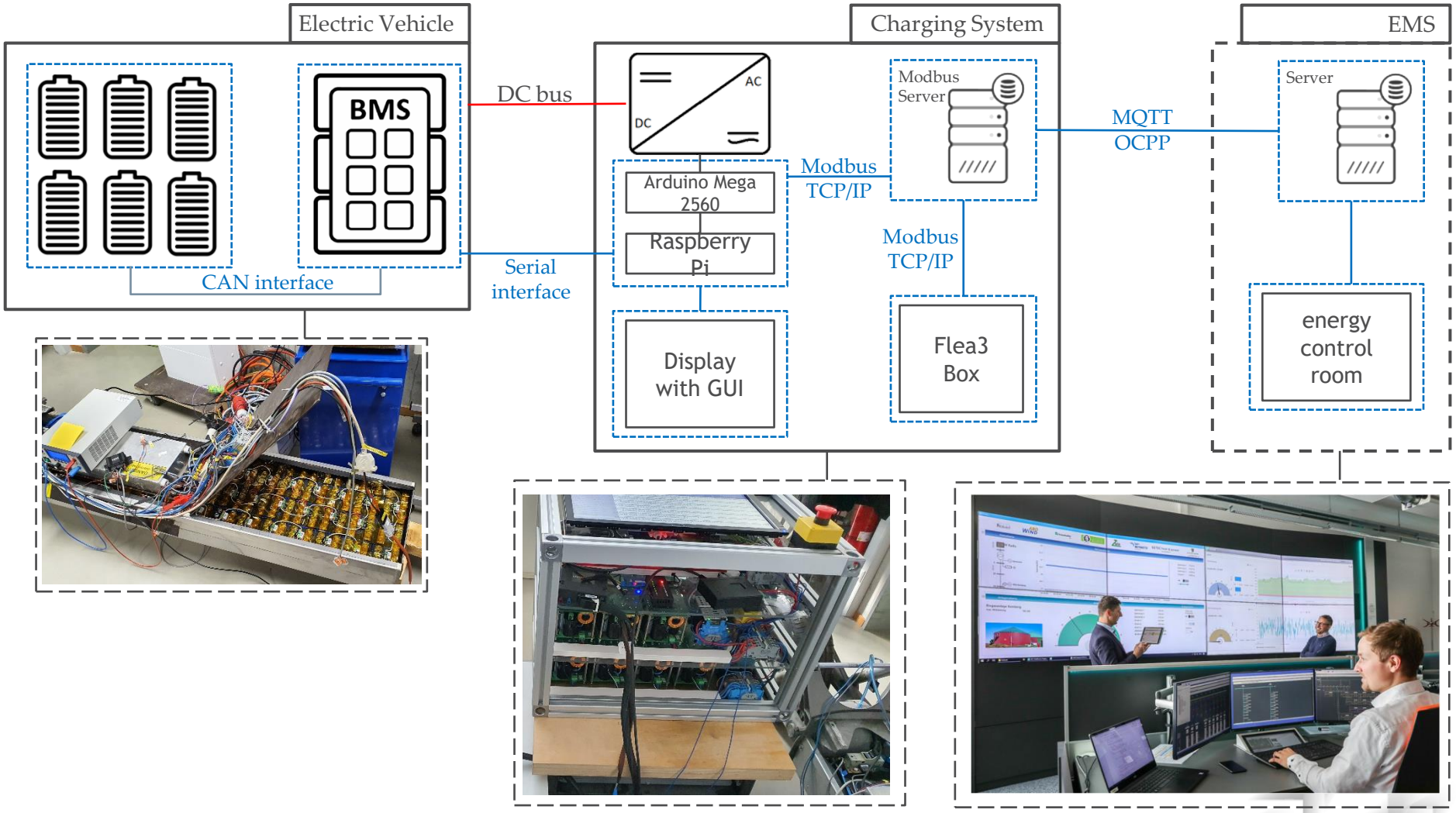


EV battery storage



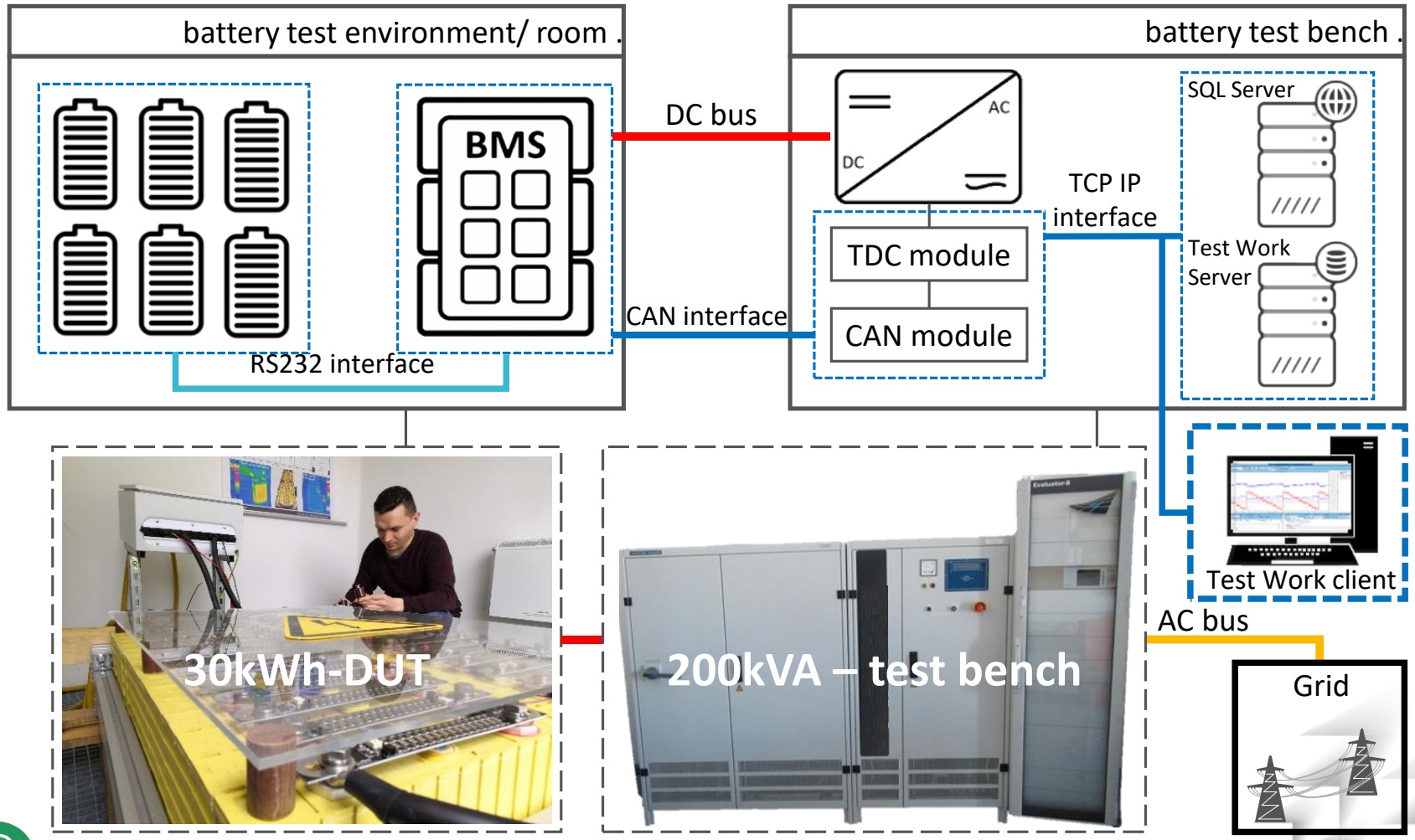
Charging system

MATCHING THEORY WITH PRAXIS



MATCHING THEORY WITH PRAXIS

Testing storage systems and interfaces



CONCLUSION

- EV will be part of mobility and strategies for integration are needed
- ICT is needed to fully use potential of EV's
- EV could be used for grid/ ancillary services
- Further standards are needed

THANK YOU FOR YOUR ATTENTION