CHARGING INFRASTRUTURE FOR ELECTRIC VEHICLES AND IT´S ENERGY ECONOMICAL FOOTPRINT

JENS EICKELMANN

CAR-Weebinary 23rd of June 2021

PION
ELECTRIFYING SOLUTIONS

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JENS EICKELMANN

Ostfalia
University of
Applied Sciences
CEMO – Centre for Energy and Mobility

CAR
Creating Automotive Renewal

Interreg
South Baltic

EUROPEAN UNION

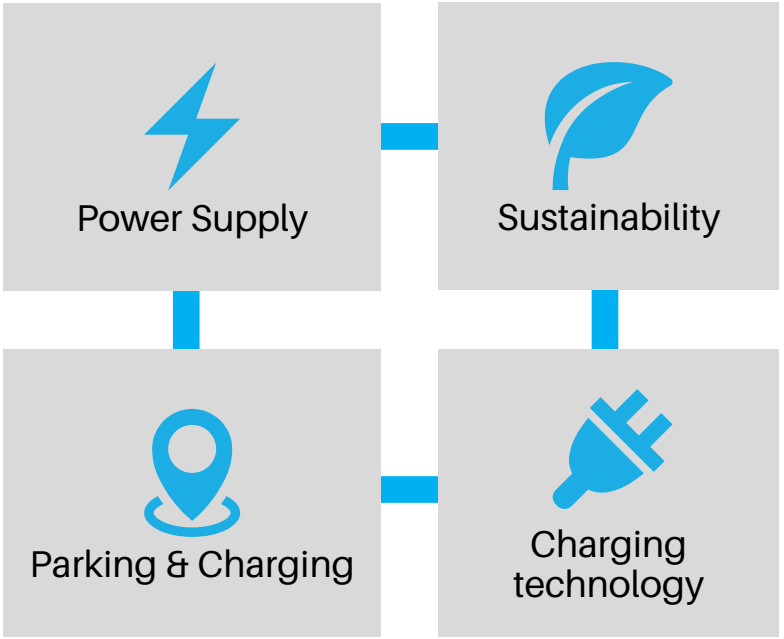
about PION Technology AG

PION
ELECTRIFYING SOLUTIONS

FACTS AND FIGURES

PION at a glance

- Manufacturer of charging infrastructure for e-mobility
- Executive Board:
  - Jens Eickelmann
  - Matthias Folkers
- Based in: Osnabrück
- Founded in: 2018



Our mission statement

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CREATING THE ENERGY AND MOBILITY TURNAROUND WITH MODERN CONCEPTS

- Increasing urbanization requires new and holistic infrastructure concepts
- In addition to sustainable construction and operation, the ability to integrate into urban planning is crucial

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Good design increases the quality of life, which is why we don't build ugly metal boxes that you would like to hide.

We made design to last.

Organic shapes look good and make them easier to use. Because that's what matters.

High-strength concrete protects the technology and ensures that your investment is really sustainable.

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Wherever you want to charge your car.

With PION you have the right solution - equipped with all the necessary features you really need - and nothing more.

residential

semi public

public

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Public charging for customers and guests with 2 x 22 kW

Charging of vehicle fleets with 11 kW

Timeless elegance for the home

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Basement system

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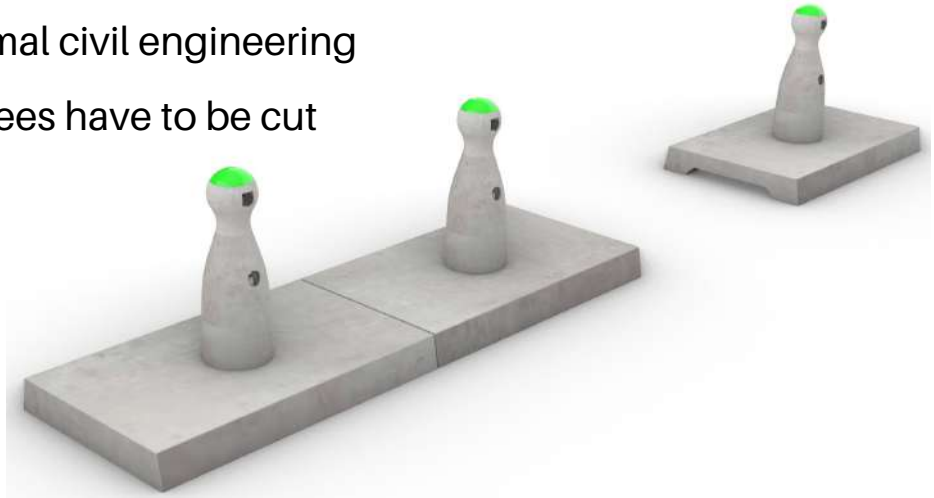
GROWS WITH IT´S REQUIREMENTS

- Well thought out from the basement to the top of the roof
- Natural roll-on protection
- Including cable bushings
- Minimal civil engineering
- No trees have to be cut



Housing technology

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ALL PIONS ARE MADE OUT OF CONCRETE

- **Why concrete?**
- Material with excellent strength and durability!
- Excellent climatic conditions in the housing due to flat temperature differences due to the insulating effect of the material
- Easily recyclable at the end of the life cycle e.g. in road construction or as recycled concrete
- Housing can be completely colored or covered with a glaze
- Customer-specific branding possible through haptic relief

Housing technology

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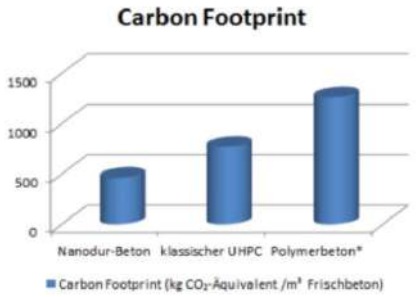
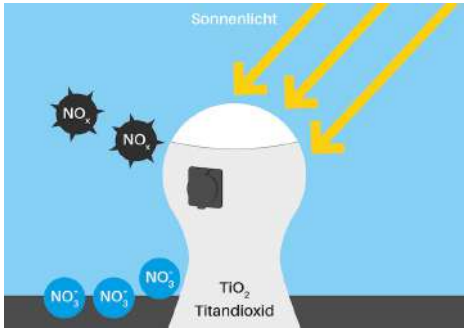
ALL PIONS ARE MADE OUT OF CONCRETE

- The housing material consists of water, sand and cement
- The production of the concrete which is used by PION emits less CO_2 than reaction resin concrete, steel or cast (manufacturer information)
- Optional treatment with titanium dioxide TiO_2 makes the concrete photocatalytic
- With the help of sunlight, nitrogen oxides (NO_1, NO_2) are filtered out of the air and converted into nitrates (NO_3)
- The reaction product is fertilizer
- 6 PIONs unfold the cleaning effect of a tree



Source: Ducrete



Housing technology

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ALL PIONS ARE MADE OUT OF CONCRETE

- During the normal carbonation of concrete over the entire product life cycle, CO_2 is absorbed from the air:
  $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
- In the optimal case, up to 40% of the CO_2 emissions resulting from cement production, can be bound again.
- The carbonation increases the strength even further.

Energy consumption for 45 million electric vehicles

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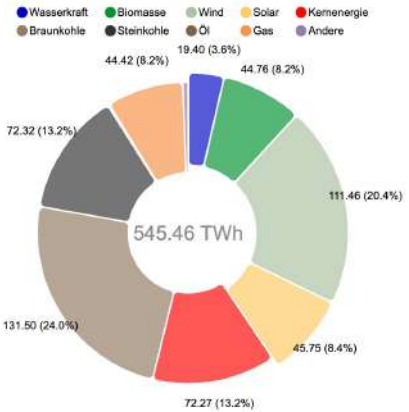
ENERGY CONSUMPTION FOR 45 MILL. EVS

- Assumption: The 45 million cars registered in Germany are all electric. How much energy will be required for this additionally?
- According to KBA, all cars in Germany drive a total distance of 630.8 billion km. The average annual mileage per car is 13,727 km. Assuming 18 kWh consumption per 100 km, this results in an energy consumption of 2745.4 kWh per year.
- Additional energy requirement for all vehicles corresponds to 111.2 TWh!
- This corresponds to approx. 20% of the total electricity generation of 545.36 TWh in Germany today!
- In 2018, however, Germany exported around 50 TWh, so half of the required energy amount to other European countries!
- To avoid this, it depends on intelligent energy management to optimize generation, distribution, storing and consumption
- Luckily, we won´t have 45 million cars within the next couple of years, so we have got some time left to do our homework



Net electricity generation Germany
Source ENERGY CHARTS Fraunhofer ISE

Charging technologies

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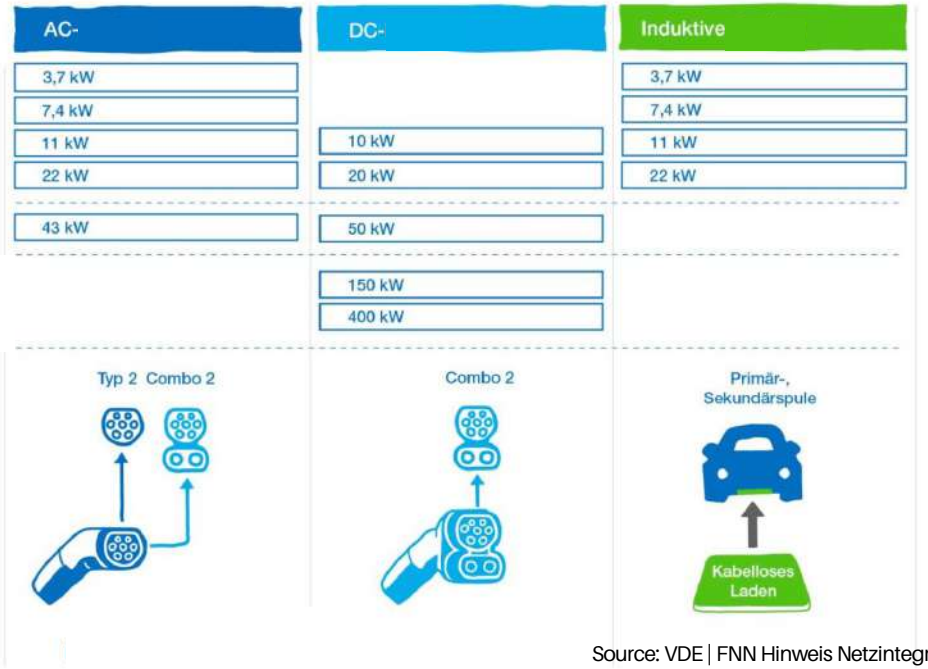
Standard charging

Quick charging

HPC High Power Charging



Source: VDE | FNN Hinweis Netzintegration Elektromobilität

Charging Power of EVs

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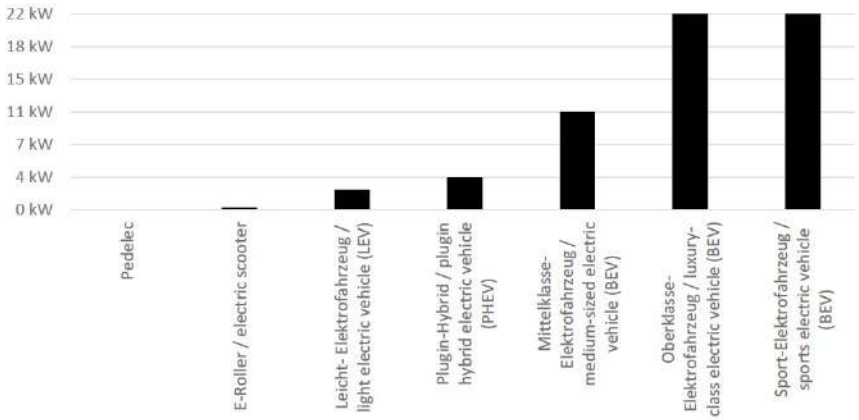
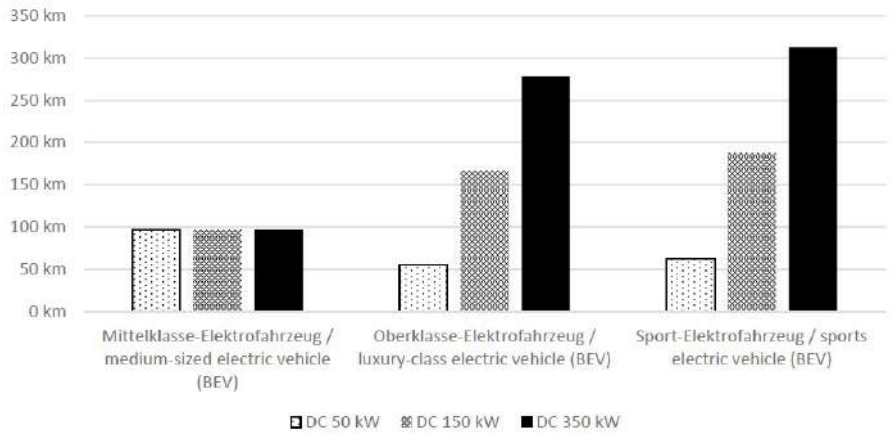
AC Charging Power of dedicated EVs



Maximum milage growth after 15 Minutes of DC- charging



Source: VDI 2166 Part 22

Uses cases für EV charging

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Usecase	private charging		Public charging	
				
	residential charging	Fleets, parking lots	Curbe side – street lamp charging, service stations, parking lots	
Charging technology	AC or DC	AC or DC	AC	DC
Typical rated power	1-phase, 3.7 kVA 3-phase, 11 kVA 3-phase, 22 kVA (not common)	1-phase, 3.7 kVA 3-phase, 11 kVA 3-phase, 22 kVA	1-phase, 11 kVA 3-phase, 22 kVA 3-phase ,43 kVA (not common)	3-phase, 22 kVA 3-phase, 55 kVA 3-phase, 150-450 kVA (not common)
Load – flexibility management	Grid-friendly control, Load management	Load management	no controlling Possibly in combination with „over night“ charging tariff	no controlling Possibly in combination with load management or energy storage

- The individual use cases have a direct impact on the energy economical “footprint” of the connection at the network level (HV, MV, LV)
- the network classification (rural, suburban, urban, ...)
- who is the consumer of electrical energy (german energy law)

Based on Source:
VDE | FNN Hinweis Netzintegration Elektromobilität

Szenarios for ramping up emobility

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- **Question:** How many chargepoints are required to ramp up electromobility? (scientific approach)

Need of charging infrastructure in Germany

Szenario in 2030	Number of cp at home	company	Charging hub cityside	Charging hub traffic axes	Parking lots	Street side	Public charging
Reference szenario	7.068.000	2.618.000	27.300	21.400	243.000	420.000	711-000
Poor availability of residential cp	**5.446.000**	**2.507.000**	**33.300**	**21.700**	**303.000**	**486.000**	**843.000**
High availability of residential cp	**8.691.000**	**2.664.000**	22.000	21.100	190.000	382.000	615.000
Digital offerings	7.068.000	2.612.000	**21.900**	**18.500**	220.000	405.000	666.000
Parking management	7.068.000	2.628.000	27.500	18.600	244.000	235.000	525.000
HPC Charging	7.068.000	2.652.000	31.900	18.600	**131.000**	256.000	**437.000**

Based on Source:
„Nationale Leitstelle Ladeinfrastruktur" Table 15

Effect on cost of energy

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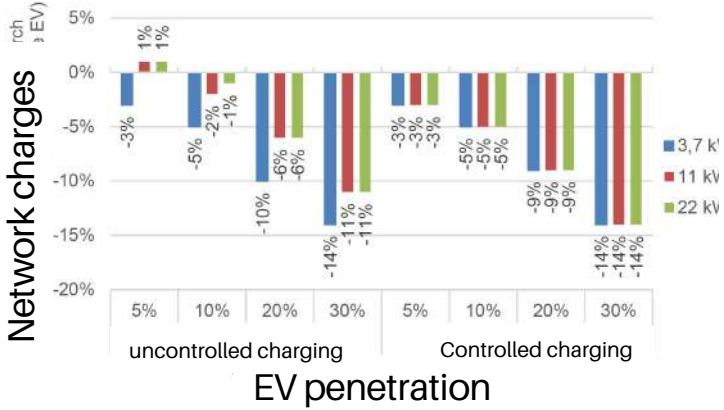
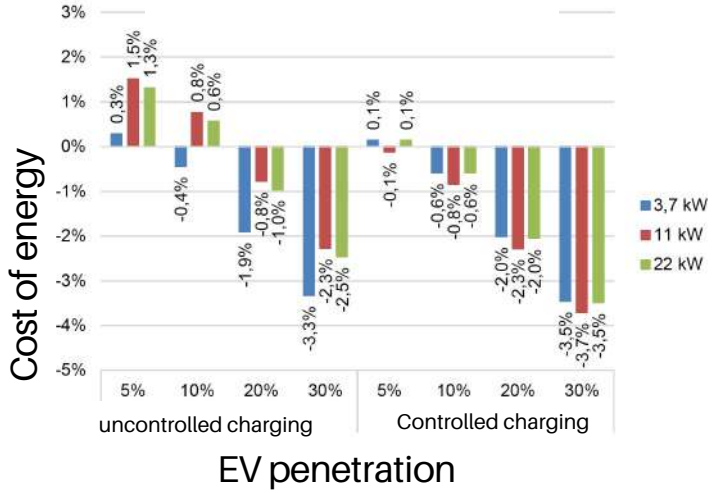
- Example: electric vehicles on a suburban low-voltage network
- Boundary conditions: suburban area with family house (2.5 people per household)
- Annual electricity consumption 5000 kWh per household
- 60 kWp PV via10 houses





Conclusion: A higher penetration leads to a lower electricity price despite the increased electricity purchase costs due to the sharply lower network charges

Source: Fraunhofer ISI, 2018

Using green energy with emobility

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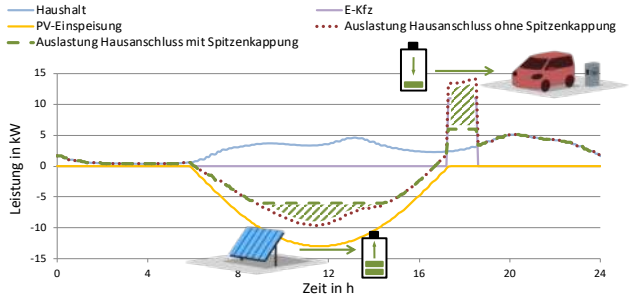
- **Question:** Which factors influence the need for energy network expansion with increasing penetration of electric vehicles?
- Charging power 3,7 kW, 11 kW, 22 kW
- Charging profile of the electric vehicle with flexibility potential
- PV and Energy storage
- Reduction of the peaks through intermediate storage from the PV system in lunchtime and charging of the electric vehicle from the storage in the evening hours
- Additional added value: Provision of Q (U) by the battery inverter and thus restriction of the voltage range violation.
- Rural networks with long distances are more likely to violate the tension band than in cities

Nutzung von PV-Speichersystemen

Grundgedanke: Spitzenkappung in den Mittagszeit und Abendstunden



- Reduktion der Spitzen durch Speicherung von Energie aus PV-Anlage in der Mittagszeit und Laden des Elektrofahrzeuges in den Abendstunden aus dem Speicher
- PV-Anlage alleine als Maßnahme nicht ausreichend, weil die Spitzen zu unterschiedlichen Zeitpunkten sind

Customer Energy Management System

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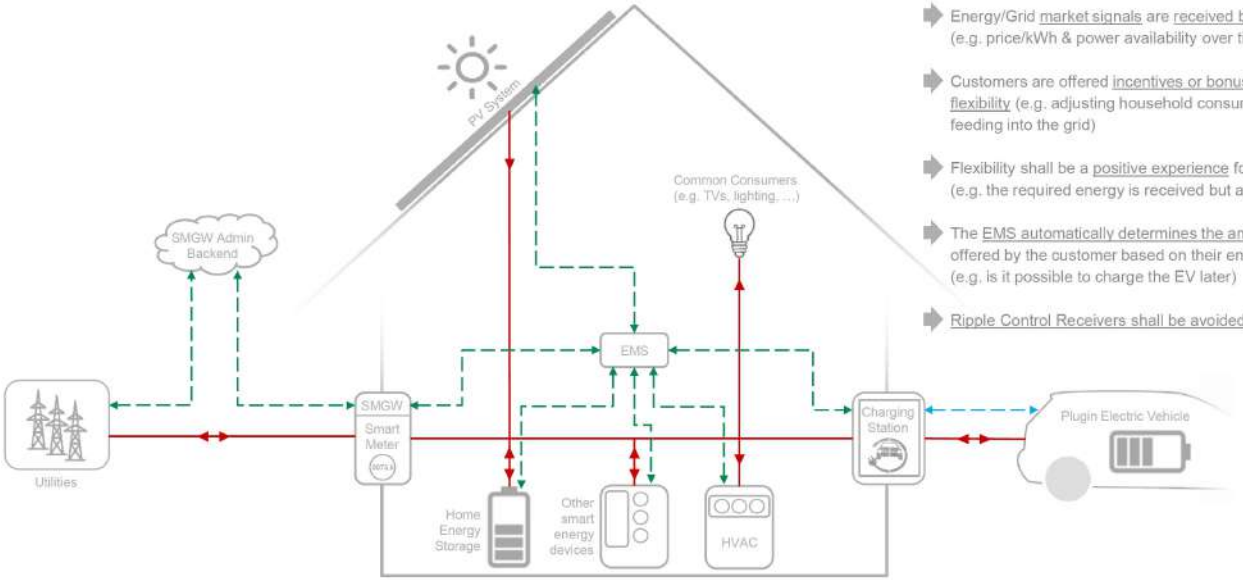
VISION 2030 CEMS

Customer Energy Management System

Vision 2030

VDA Verband der Automobilindustrie

- Only a single certified meter shall be required
- Energy/Grid market signals are received by the EMS (e.g. price/kWh & power availability over time)
- Customers are offered incentives or bonuses for offering flexibility (e.g. adjusting household consumption or even feeding into the grid)
- Flexibility shall be a positive experience for the customer (e.g. the required energy is received but at a lower price)
- The EMS automatically determines the amount of flexibility offered by the customer based on their energy demands (e.g. is it possible to charge the EV later)
- Ripple Control Receivers shall be avoided



Charging Station = AC, DC or wireless | EMS = Energy Management System | HVAC = Heating, Ventilation & AC | SMGW = Smart Meter Gateway | Power ——— | Communication - - - - | ISO/IEC 15118 - - - -

HPC High Power Charging

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CHARGING WITH 400 KW

- High Power Charging (HPC) mit 400 kW
- Getting a 400 km recharge in 20 minutes

Charging Plaza

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„ SEED AND GREED“ IN HILDEN

- **Superlative charging park on A3 / A46**
- 20 Supercharger by Tesla (final 40)
- 8 CPs by Fastned (final 22)
- AC CPs (final 52)
- 336 kWp PV Generation
- 2 Wind generating plants (planned)
- 2 MWh Energy storage
- Sales area of the Schüren bakery

Conclusions

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ENERGY SAVINGS ARE GAINED BY

- Housing material of PION Chargers made of concrete for outdoor applications, with a lot of strength, stability, lilfetime endurance
- Carbon footprint, photocatalysis, carbonation of PION Chargers
- Differenz Use cases for EV charging to gain the lowest possible network expansion
- Improve the utilization of the network and thereby reduce costs for everyone
- Energy for driving needs to be regeneratively generated, stored and distributed

Further information

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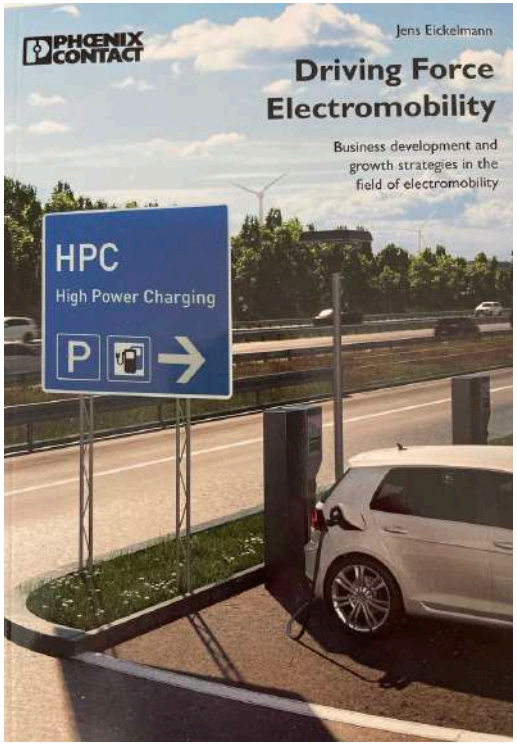
DON´T HESITATE TO GET IN TOUCH

- Please contact Jens Eickelmann, jens.eickelmann@pion-ag.com
- Contact your local Phoenix Contact dealer for a free version of

„Driving Force Electromobility“



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