
Refuel with solar power
E-mobility with SMA
SMA

Agenda

- **Motivation**
- **E-Mobility background information**
- **SMA EV Charger**
- **Competitor comparison**
- **Outlook**

E-mobility as a new challenge for end customers and installers

Solar power professional

- New market, new products, new regulations
- Multiple contact persons for PV, battery-storage systems, energy management and wallbox
- Compatibility of the wallbox with the existing (PV) system

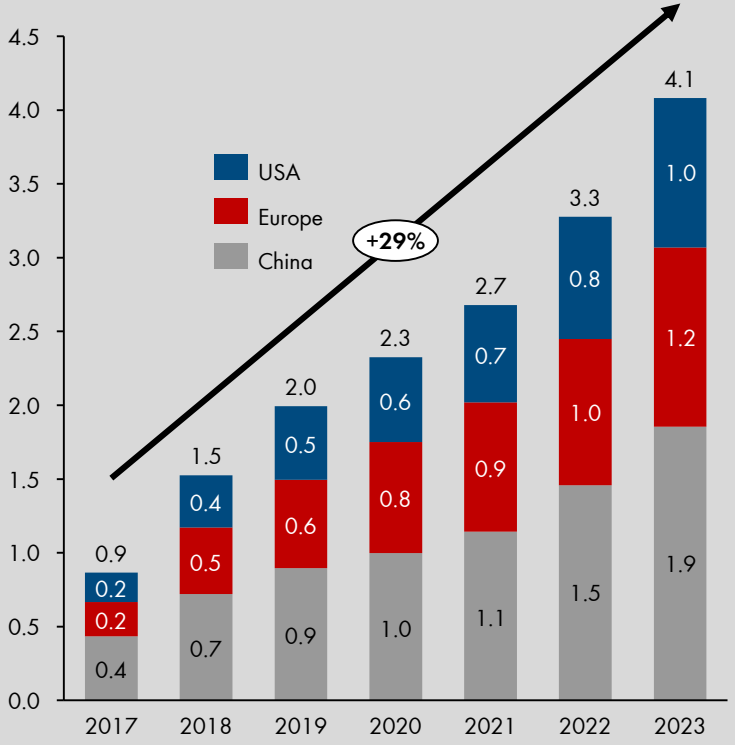
End customer

- Quickly ready to drive
- Cost-effective charging
- Zero-emissions driving
- Prevention of overload on the house connection
- Rapid replacement of defective devices

SMA Energy Systems Home

Revolution in E-Mobility forces Demand for Charging infrastructure

Forecasted annual Sales of PEV (PC + LCV) in million units [1]



Passenger Car (PC) Evolution

2016: Hyundai Ionic
Battery: 28kWh
Range: 250km
Charge: 70kW

2018: Audi Q6 e-tron
Battery: 90kWh
Range: 500km
Charge: 150kW

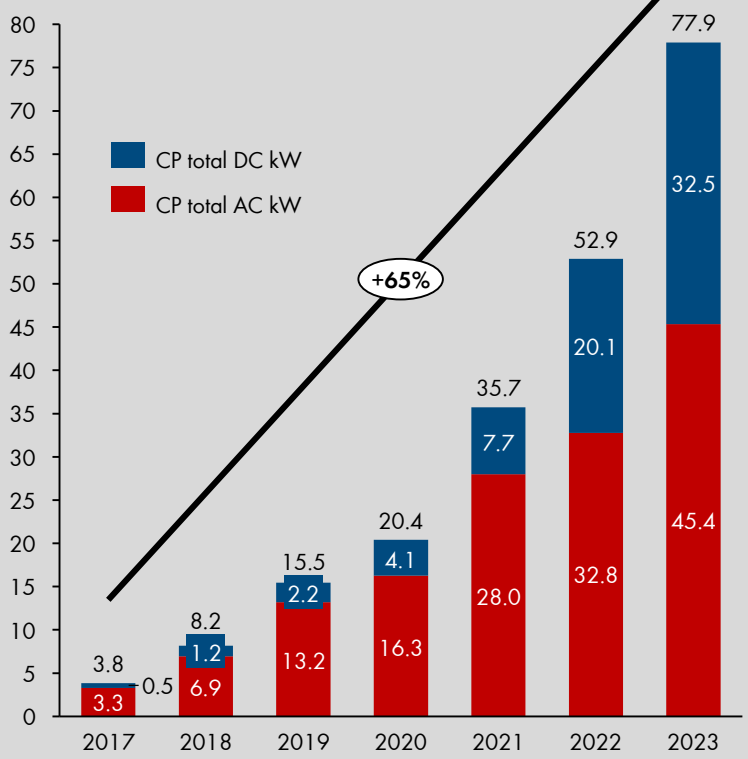
2020: VW, Audi, Porsche
Battery: 95kWh – 150kWh
Range: 500km +
Charge: 150kW - 350kW

Light Commercial Vehicle (LCV) Evolution

2016: StreetScooter Work
Battery: 40kWh
Range: 200km
Charge: 11kW

2018: StreetScooter Work XL
Battery: 76kWh
Range: 200km
Charge: 11kW

Forecasted annual Sales of Charging Points (CP) in GW [1]



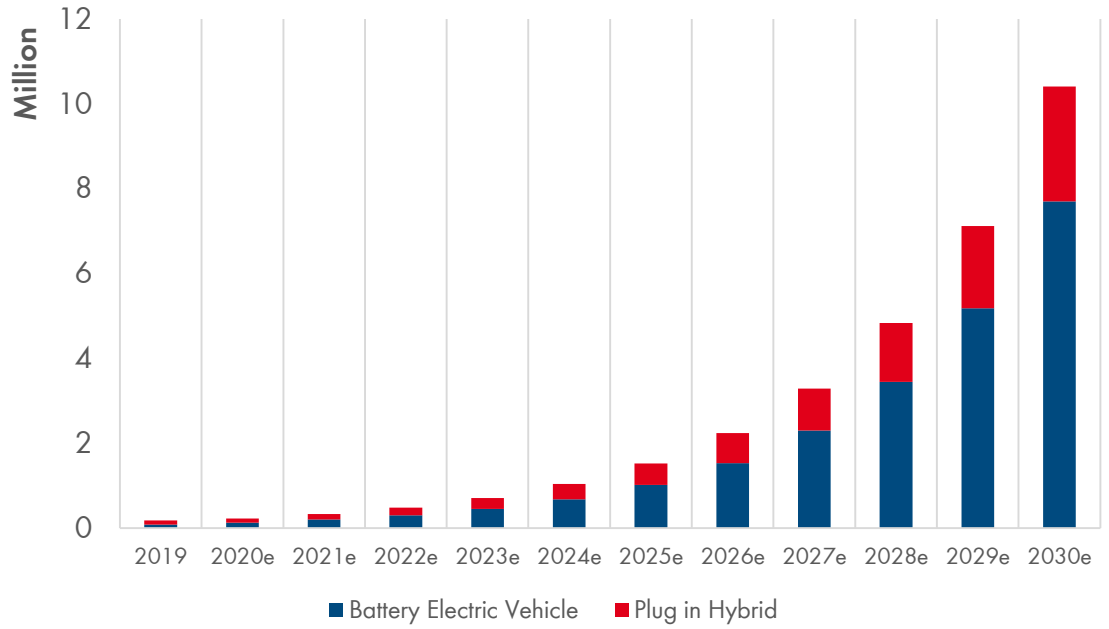
[1]Source: Bloomberg New Energy Finanace, complemented with ACEA and EAFO databases for EU and FHWA for US

The market for electric vehicles is growing rapidly – PV providers will participate

Market data for Germany

- Around 250,000 electric vehicles are currently registered
- By 2030: more than 10 million electric vehicles
- 80% of charging at home*

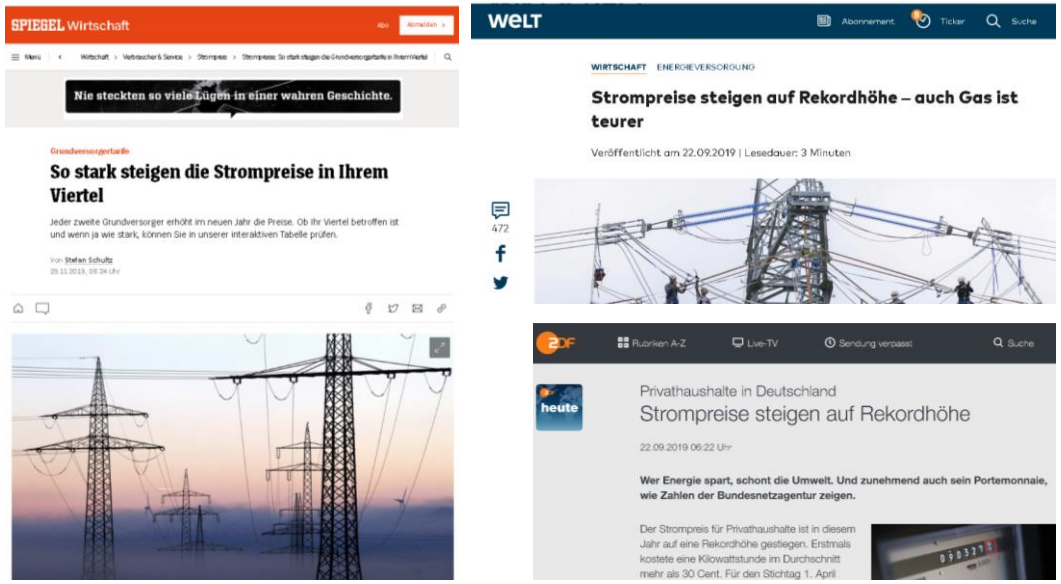
Amount of electric vehicles in Germany as of January 1, of the respective year**



*Estimate of the Federal Association of the Energy and Water Industry **Federal Motor Vehicle and Transport Authority; projection based on previous growth

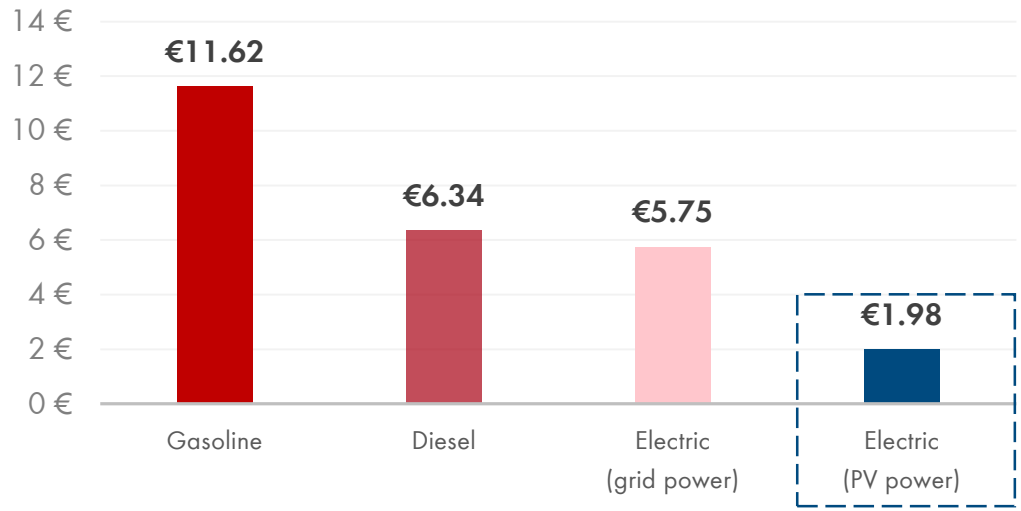
Photovoltaics and e-mobility – the perfect combination

Independence from rising electricity prices



Fuel at unbeatable prices

Comparison of fuel costs per 100 km *



▶ **Solar power is consistently low-priced at currently around 11ct/kWh**

Photovoltaics and e-mobility – the perfect combination

15,000 km annual road performance

- **Savings ~ €300 per year at**
- **50% solar coverage rate**

(Comparison grid current vs. solar power)

*Assumption: Renault Zoe. Status: January 2020

Gasoline 8.1 l/100 km (€1.434/l).....€11.62

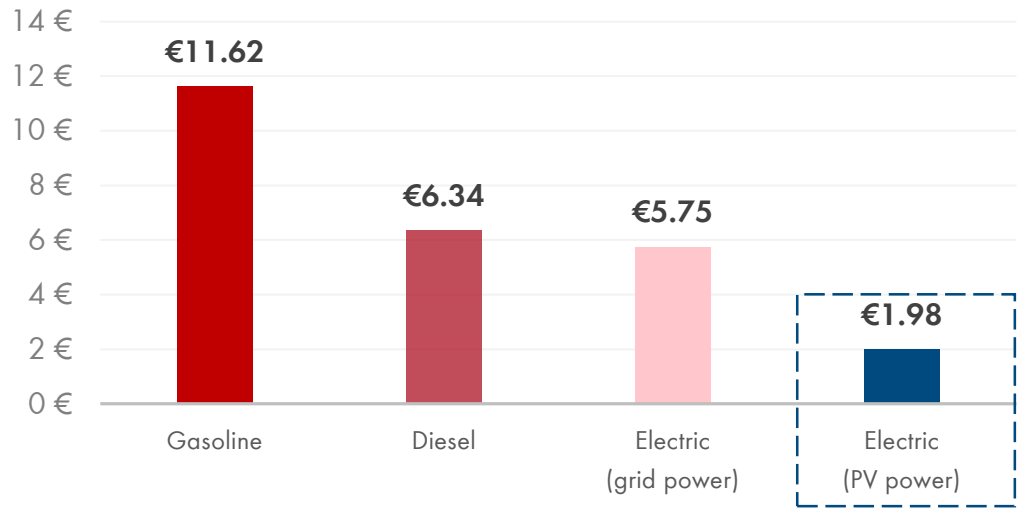
Diesel 6 l/100 km (€1.267/l)..... €6.34

Grid current 18 kWh/100 km (€0.3194/kWh)..... €5.75

PV power 18 kWh/100 km (€0.11/kWh)..... €1.98

Fuel at unbeatable prices

Comparison of fuel costs per 100 km*



Important background knowledge on e-mobility

- E-vehicle types
- AC vs. DC charging
- Charging modes
- Charging times
- Plug types
- Installation regulations in Germany
- Charging options

Vehicle types

Combustion engine	Hybrid	Plug-In Hybrid (PHEV)	Range Extended Electric Vehicle (REEV)	Battery-Electric Vehicle (BEV)	Fuel-Cell Electric Vehicle (FCEV)
Diesel or gasoline engine	Additional electric engine for charging the battery while driving (storing the brake energy)	Hybrid with additional option of charging from the utility grid	Range extension through power generation via the combustion engine	Drive power exclusively from battery	Power generation for electric motor from hydrogen via on-board fuel cells
					
e.g., VW Golf, Ford Focus, Toyota Corolla	e.g., Toyota Prius	e.g., Hyundai Ioniq, Audi A3 e-tron, Mercedes GLE 500 e	e.g., Opel Ampera (with range extender), BMW i3 (with range extender)	e.g., BMW i3, Renault Zoe, Nissan Leaf, Tesla Model S	e.g., Toyota Mirai, Hyundai Nexo

National e-mobility platform

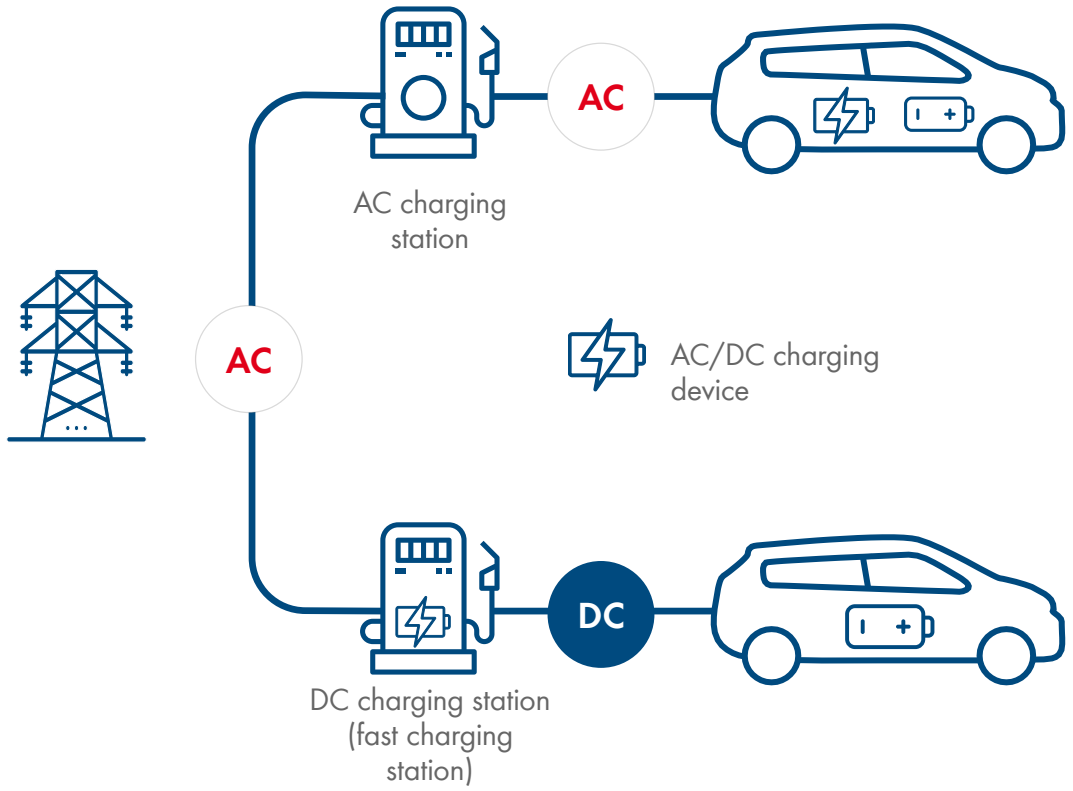
AC vs. DC charging

AC charging

- Charging device for rectification and battery charging control integrated into the vehicle
- Connection to the single- or three-phase alternating current grid through a suitable AC charging system (e.g., wallbox, charging station) via charging cable

DC charging

- Charging device for rectification and battery charging control integrated into the charging station
- Battery monitoring via communication interface between the vehicle and charging station



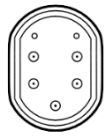
> An AC charging station (wallbox) is NOT an inverter (AC in/AC out)

Charging modes according to IEC 61851-1

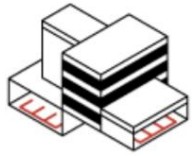
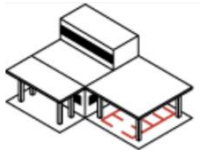
AC charging via emergency charging cable	AC charging via mobile charging station	AC charging via wallbox / charging station	DC charging via charging station
			
Mode 1 • Direct connection of the vehicle to the utility grid • General household socket • Simple cable	**Mode 2** • Direct connection of the vehicle to the utility grid • General household socket • Cable with integrated control and protection function	**Mode 3** • Direct connection of the vehicle to the utility grid • Special socket with integrated charging monitoring • Special line required	**Mode 4** • Indirect connection of the vehicle to the utility grid via an external charging device • External DC charging device with integrated charging monitoring • Firmly connected charging cable
			
e.g., emergency charging cable of the electric vehicle	e.g., mobile charging station NRGkick/go-eCharger	e.g., SMA EV Charger wallbox / Mennekes Amtron / Keba KeContact	e.g., DC boost charger elexon / ABB / Tesla Supercharger

Source: be.connect

Charging plug (on the vehicle) according to IEC 62196-2/ IEC 61851-24

	Type 1 plug	Type 2 plug	Type 3 plug (Scame)	Tesla Supercharger	CCS plug (Combo 1)	CCS plug (Combo 2)	CHAdeMo Plug
Charging type		**AC voltage**			**DC voltage**		
Plug							
Max. charging power	**Three-phase up to 7.4 kW**	**Three-phase up to 43 kW**	**Three-phase up to 22 kW**	**up to 120 kW**	**up to 350 kW**	**up to 350 kW**	**up to 150 kW**
Electric vehicles	e.g., Citroen C-Zero, Mitsubishi i-MiEV, Peugeot iOn	e.g., smart EQ fortwo, e.Go Life, VW e-Golf, Audi e-tron		e.g., Tesla model S, Tesla model 3	e.g., Chevrolet Spark EV, Jaguar I-Pace	e.g., Audi e-tron, Hyunda Kona, Opel Ampera-e	e.g., Peugeot iOn, Renault Zoe, Nissan Leaf
Information	**Older vehicles (frequently from Asian manufacturers)**	**EU standard since January, 2013**	**Outdated plug design; remaining stock in Italy and France**	**Tesla only**	**North American standard**	**EU standard**	**Japanese standard, often in Asian electric vehicles**

Charging Infrastructure

	Residential			Semi-public		Public
Location	Garage / parking space at home	Parking areas in multi-family homes	Employee parking on company premises	Customer parking lots / parking garages, shopping malls	Highway rest stops	Public parking / curb
						
Length of stay	Many hours	Many hours	Many hours	A few hours	A few minutes	A few hours
Typical charging power	AC up to 22 kW	AC up to 22 kW	AC up to 22 kW	AC up to 22 kW	DC up to 350 kW	AC up to 22 kW/ DC up to 350 kW

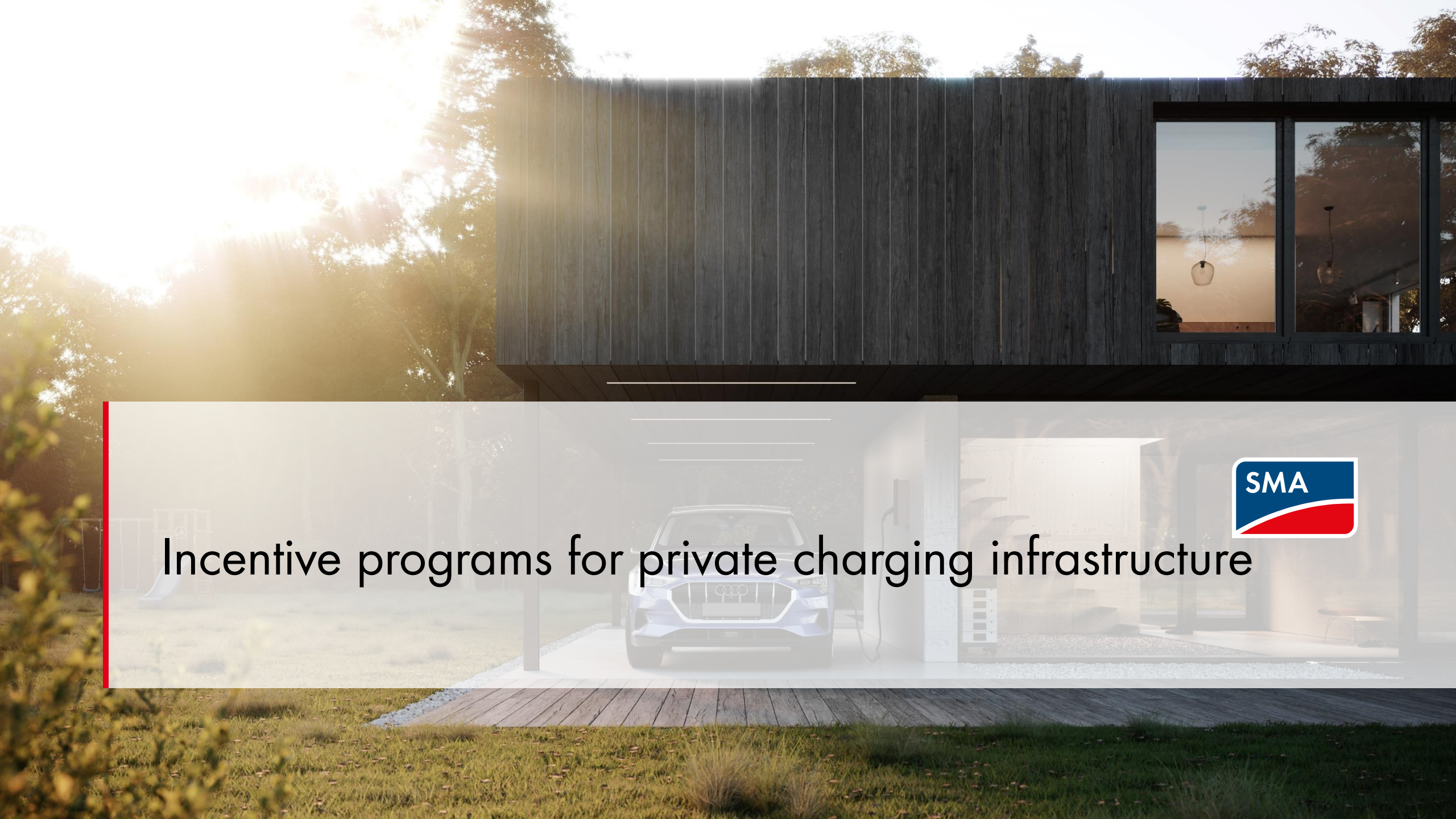
Source: Position paper, The German Association of the Automotive Industry

Installation regulations in Germany

- Installation by electrically qualified person
- Connection to a separate electric circuit (no other loads; simultaneity factor = 1.0)
- Dimensioning of the supply cable according to the max. charging power
- Connection of battery-storage system, generating system and charging station always on the same line conductor (VDE-AR-N 4100)
- Registration of the charging station ≤ 11 kVA with the responsible grid operator (NAV Section 19 No. 2)*
- Approval of the charging station > 11 kVA by the responsible grid operator (NAV Section 19 No. 2)
- Tests during commissioning according to DIN VDE 0105-100 by means of a test adapter (protection function, vehicle condition)

Charging station	Residual-current device	Circuit breaker	Additional costs**
Without integrated RCD or DC residual-current sensor (e.g., KEBA P20)	RCD type B RCD type A EV	Characteristic B/C	€550
With DC residual-current sensor (e.g., SMA EV Charger, KEBA P30)	RCD type A	Characteristic B/C	€55
With RCD type A and DC residual-current sensor (e.g., elexon A1)	-	Characteristic B/C	€0

* After consultation with several distribution grid operators, the power parameterized in the device by the installer is applicable for the registration (e.g., parameterization of a 22 kW device to a 11 kW device)
** Source: Hager



Incentive programs for private charging infrastructure

Charging options

A comparison of charging options

Household socket (230 V, 16 A)

- No additional investments
- Safety risk due to constant load (overheating, cable fire)
- Max. 2.3 kW (limitation by electric vehicle)
- Long charging time (up to 41 hours)
- No communication with the vehicle

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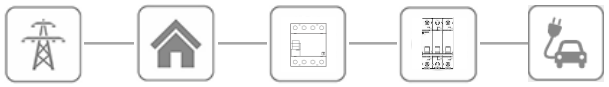
Standard wallbox (230 V, 32 A)

- Faster charging times
- 4.6 kW to 22 kW



A comparison of charging options

Household socket single-phase, 16 A, 2.3 kW		Wallbox three-phase, 32 A, 22 kW
 7 h 45 min	**Smart EQ**  17.6 kWh	 50 min
 17 h 50 min	**Renault Zoe**  41 kWh	 1 h 55 min
 41 h 20 min	**Audi e-tron**  95 kWh	 4 h 20 min

Wallbox – up to ten times faster charging

A comparison of charging options

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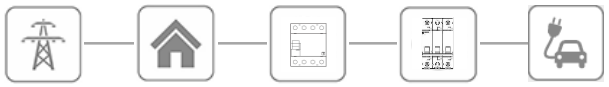
- Lower safety risk
- Reduced charging losses
- Random use of solar energy
- No cost-optimized charging
- Additional investments



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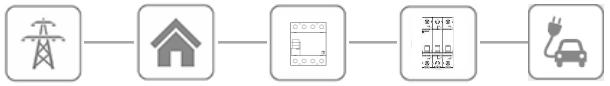


Intelligent wallbox (230 V, 32 A)

- Use of solar energy
- Cost optimization thanks to time-of-use tariffs
- Dynamic load control
- Faster charging times
- Reduced charging losses
- Lower safety risk
- Additional investments

SMA EV Charger
Fast, green, cost-effective

SMA EV Charger in combination with Sunny Home Manager 2.0

Functions
Intelligent charging modes (fast, PV-optimized, forecast-based)
Boost function
Power outage protection
Automatic phase-switching*
Grid operator interface
Charging mode selected via rotary switch or app
Monitoring via SMA Energy app
SMA Smart Connected

* Only applies to EVC22-3AC-10

Technical data

- AC charging station 7.4/22 kW
- Compatible energy manager: SHM 2.0
- One/three-phase
- Type 2 charging cable
- Integrated 6 mA DC residual-current monitoring
- Communication: Ethernet, Wi-Fi

Fast, green, cost-effective
Intelligent charging modes

Fast charging

When you are in a hurry, EV Charger enables charging with the maximum available charging power up to ten times faster than on a conventional household socket * - whether from the utility grid or PV electricity.

PV-optimized charging

If you have time to spare, EV Charger enables cost-effective, CO2-neutral charging with PV current for zero-emissions driving at minimum cost.

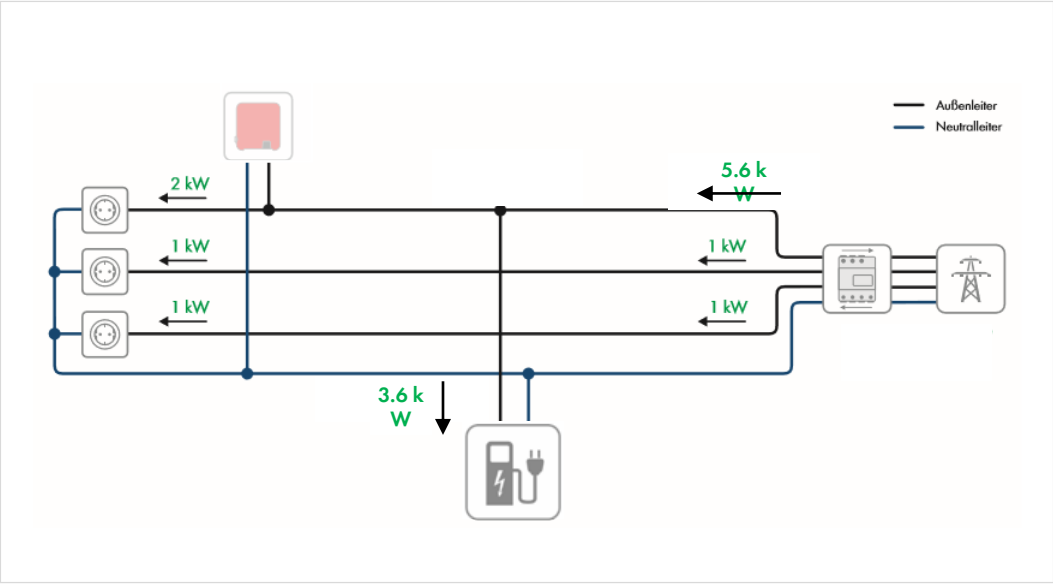
Forecast-based charging

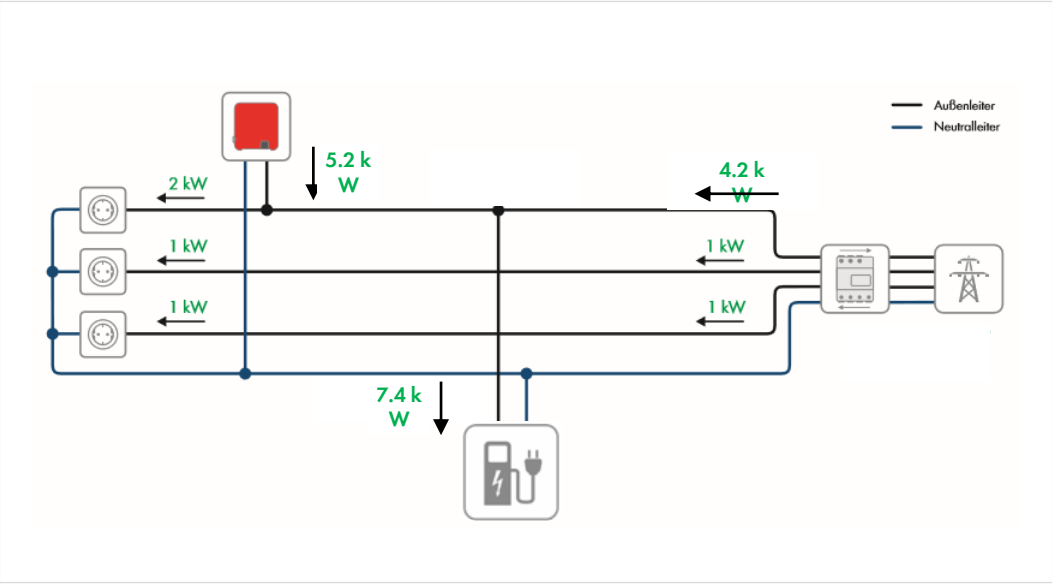
When you enter the charging target (departure time, amount of electricity to be charged) in the SMA Energy app, the Sunny Home Manager intelligently schedules charging and performs it at minimum cost while ensuring that your car will be ready when you need it.

Boost function for fast charging

Grid-compatible charging with 7.4 kW thanks to integrated balancing device

Conventional wallboxes charge single-phase with 3.7 or 4.6 kW due to the maximum permissible unbalanced load limits at the point of interconnection. By combining utility grid and PV current, EV Charger can charge single-phase up to 7.4 kW and thus is almost twice as fast as conventional wallboxes.

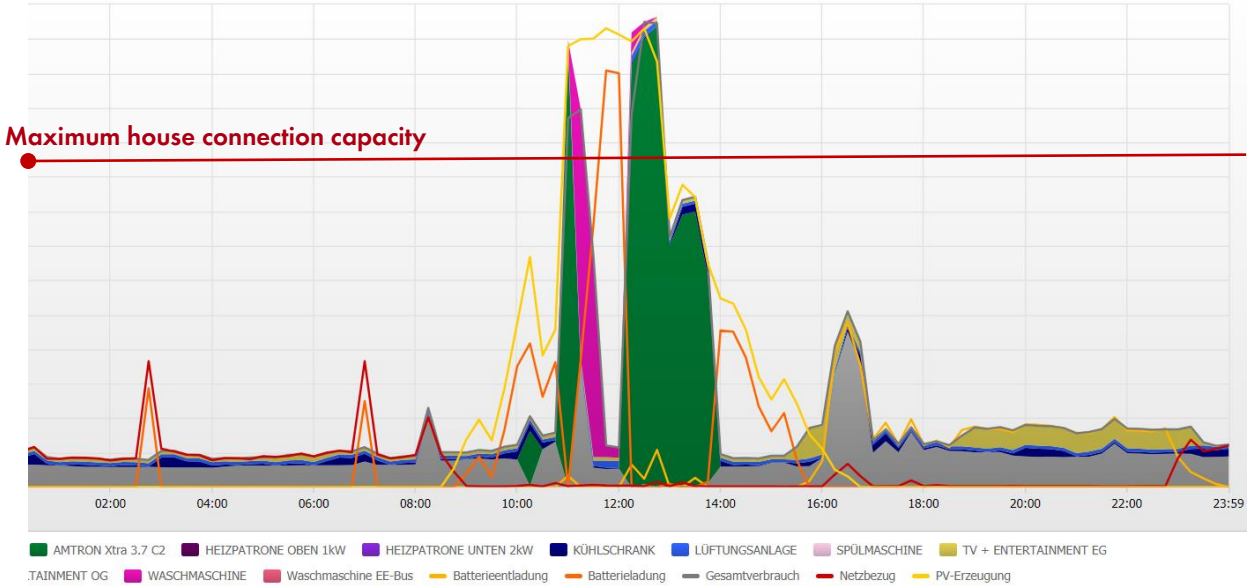




Safe thanks to power outage protection

Dynamic adjustment of the charging power

- Simple system design without extension of the house connection.
- Optimal utilization of the available connection capacity through the dynamic reduction of charging power when multiple loads are operated in parallel



Cost-effective through maximum utilization of solar energy

Standardized minimum charging power of electric vehicles with type 2 plug (EN 62196)

- 1.3 kW single-phase
- 4.3 kW three-phase

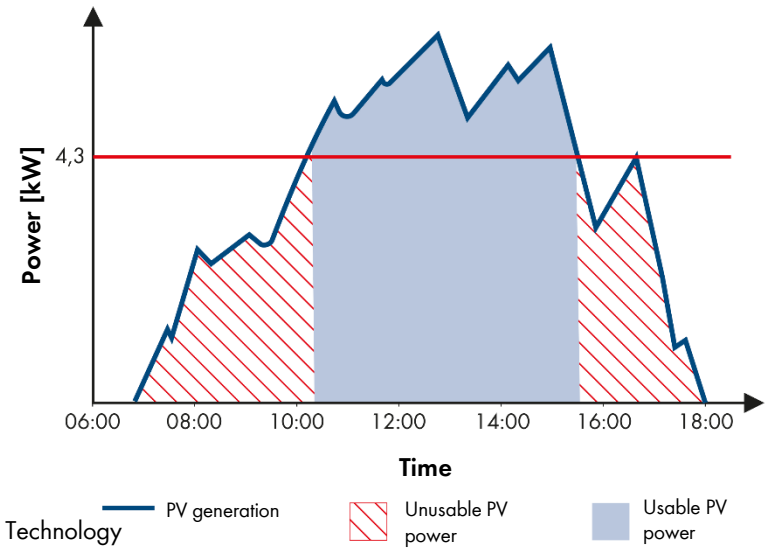
Challenge

- Low levels of PV power (in the morning and evening hours) cannot be utilized by conventional three-phase charging stations.

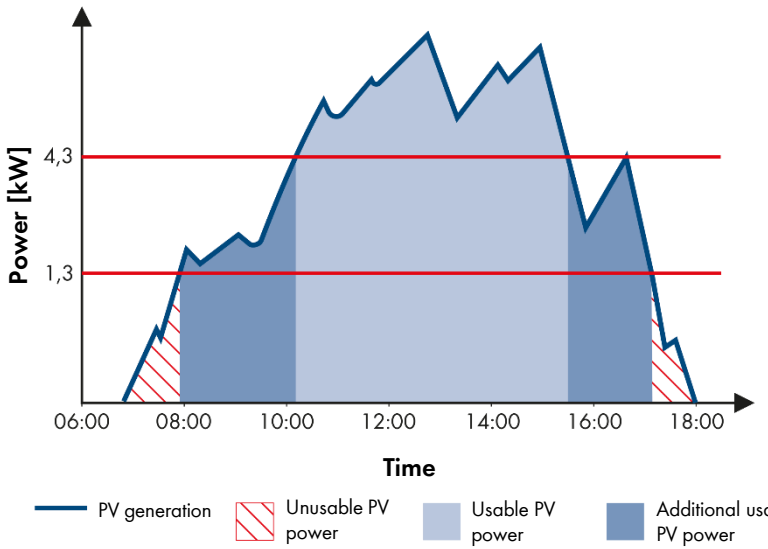
Solution:

- Automatic phase-switching for start of charging from 1.3 kW → maximum utilization of the PV energy

Conventional intelligent Wallbox



SMA EV Charger



SMA Smart Connected: We secure your mobility

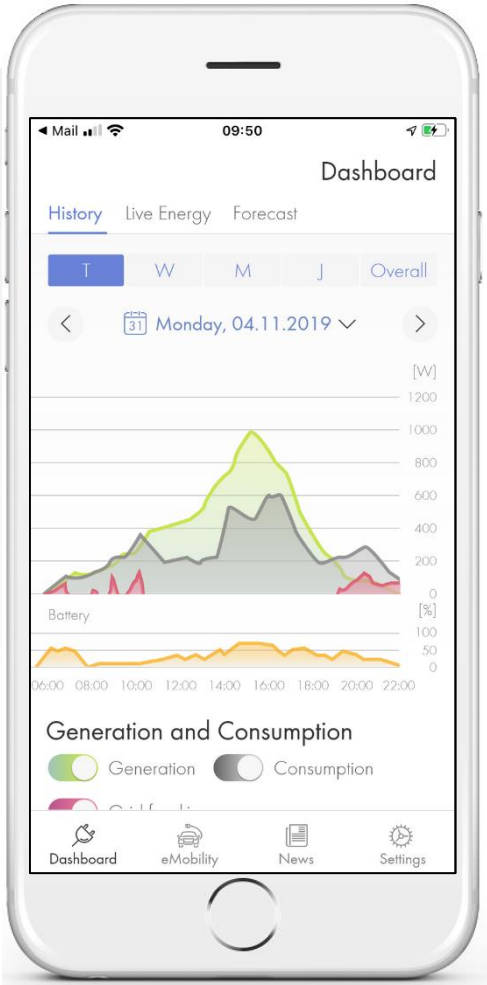
Five-year warranty + SMA Smart Connected

Monitoring with SMA Smart Connected

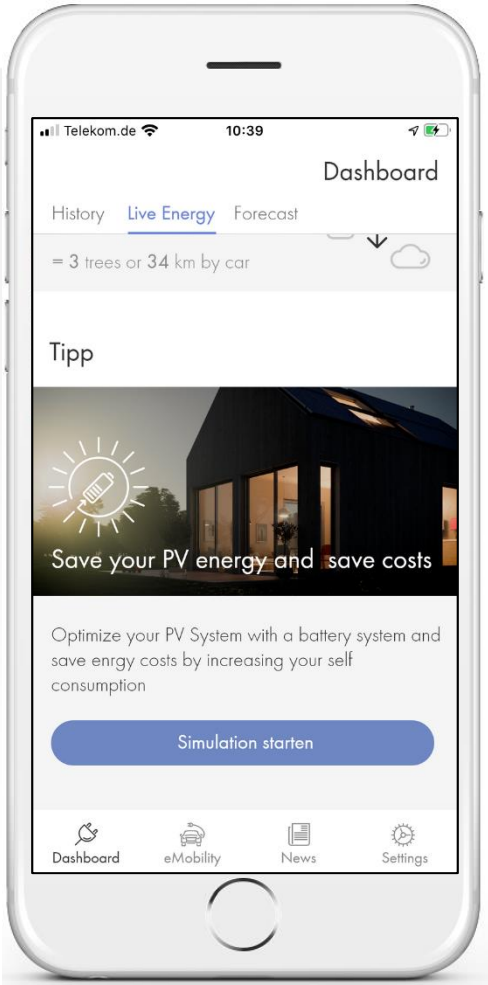
- Proactive monitoring and analysis
- Diagnosis by e-mail
- Automatic shipping of replacement device

SMA Energy app
Highlights

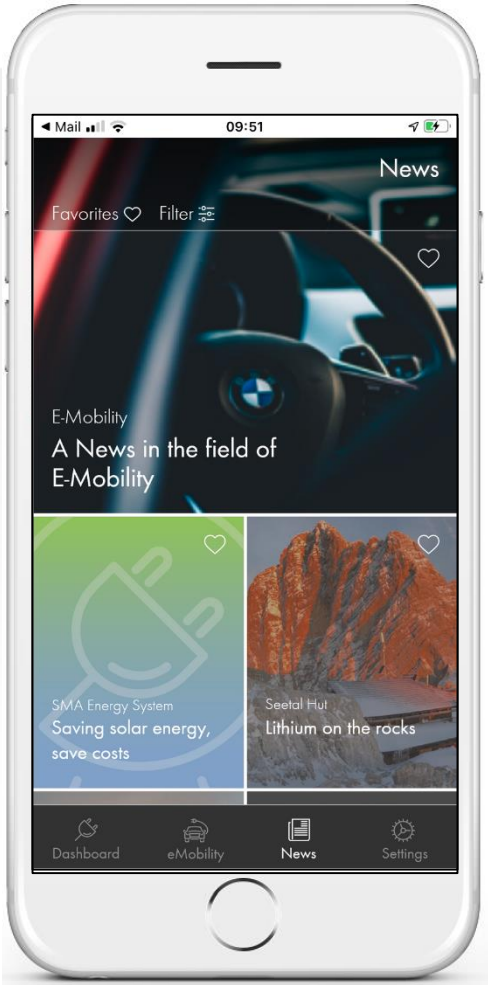
Energy balance



History and forecast

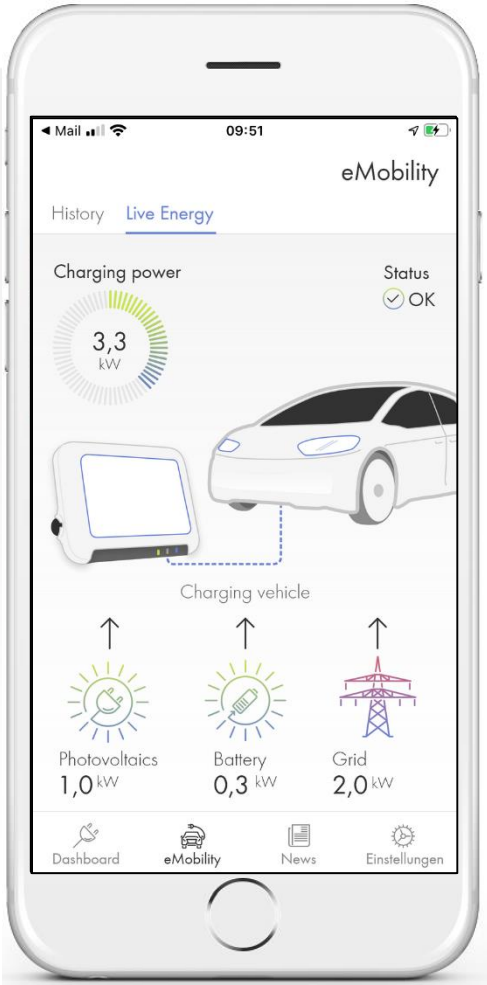


Simulation

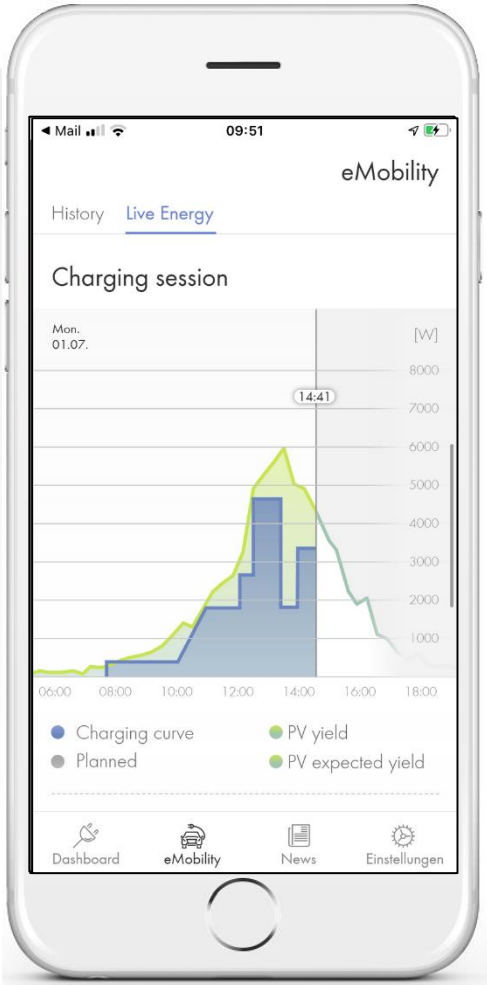


News

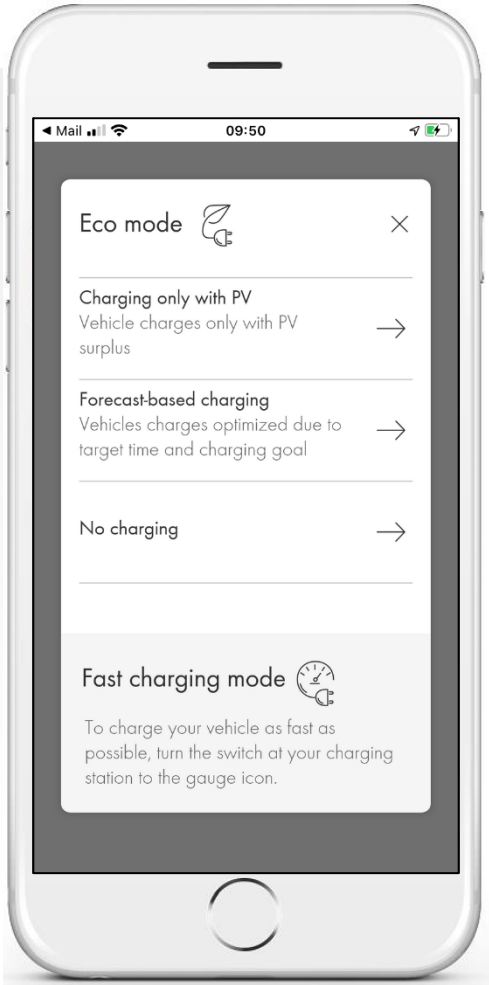
SMA Energy app
Highlights



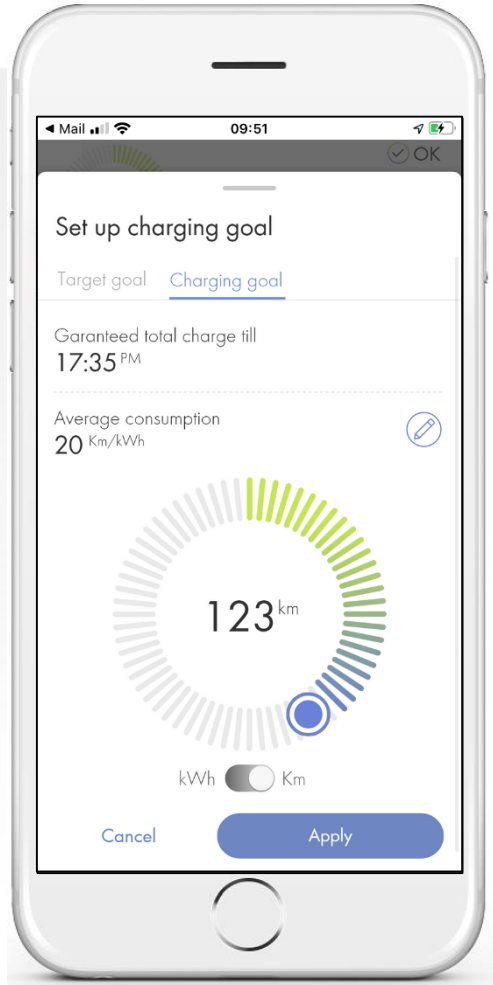
E-vehicle visualization



Current charging process



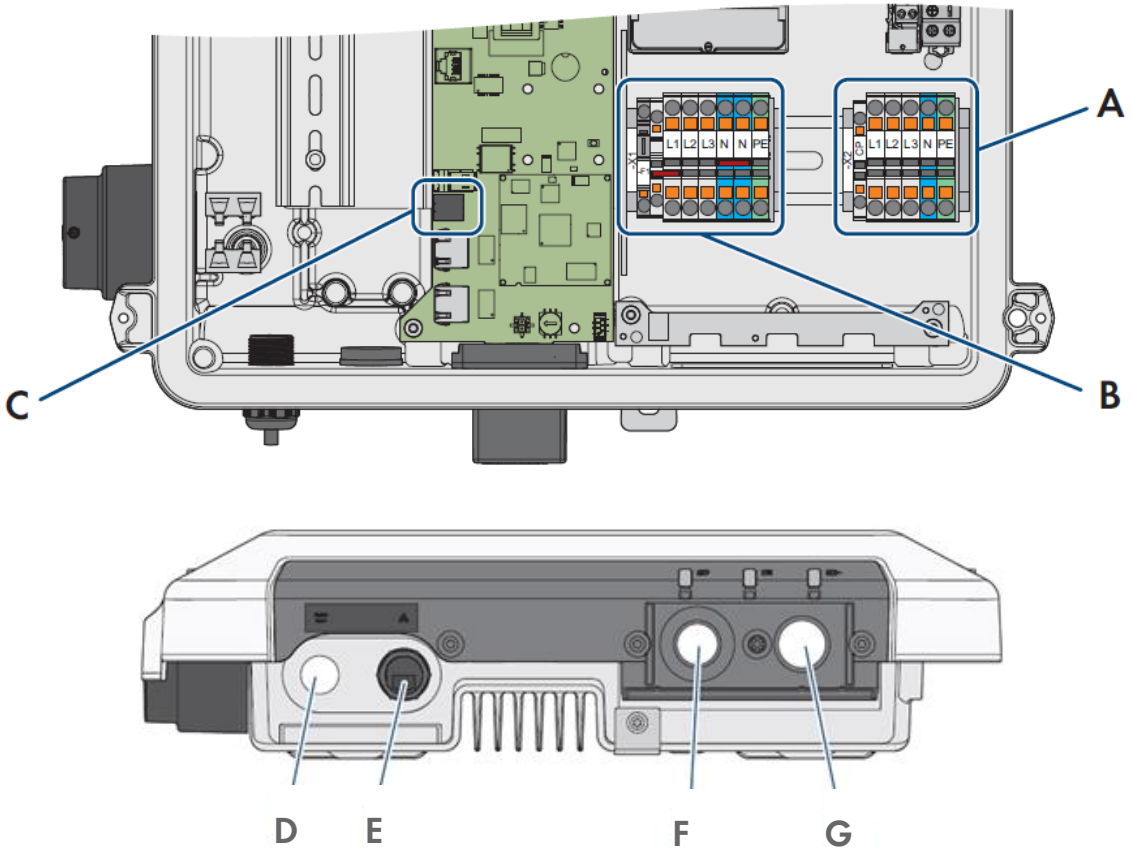
Charging mode selection



Active control

Connection overview

A	Charging cable terminal blocks
B	Utility grid terminal blocks
C	Digital signal source terminal
D	Enclosure opening for digital signal source
E	Network port
F	Enclosure opening for utility grid
G	Enclosure opening for charging cable



Benefits of SMA EV Charger

Solar power professional

- Universal application
  - New/existing system
  - (Almost) all electric vehicles
- One-stop shop – ONE contact person/warrantor
- Fast and reliable servicing support

End customer

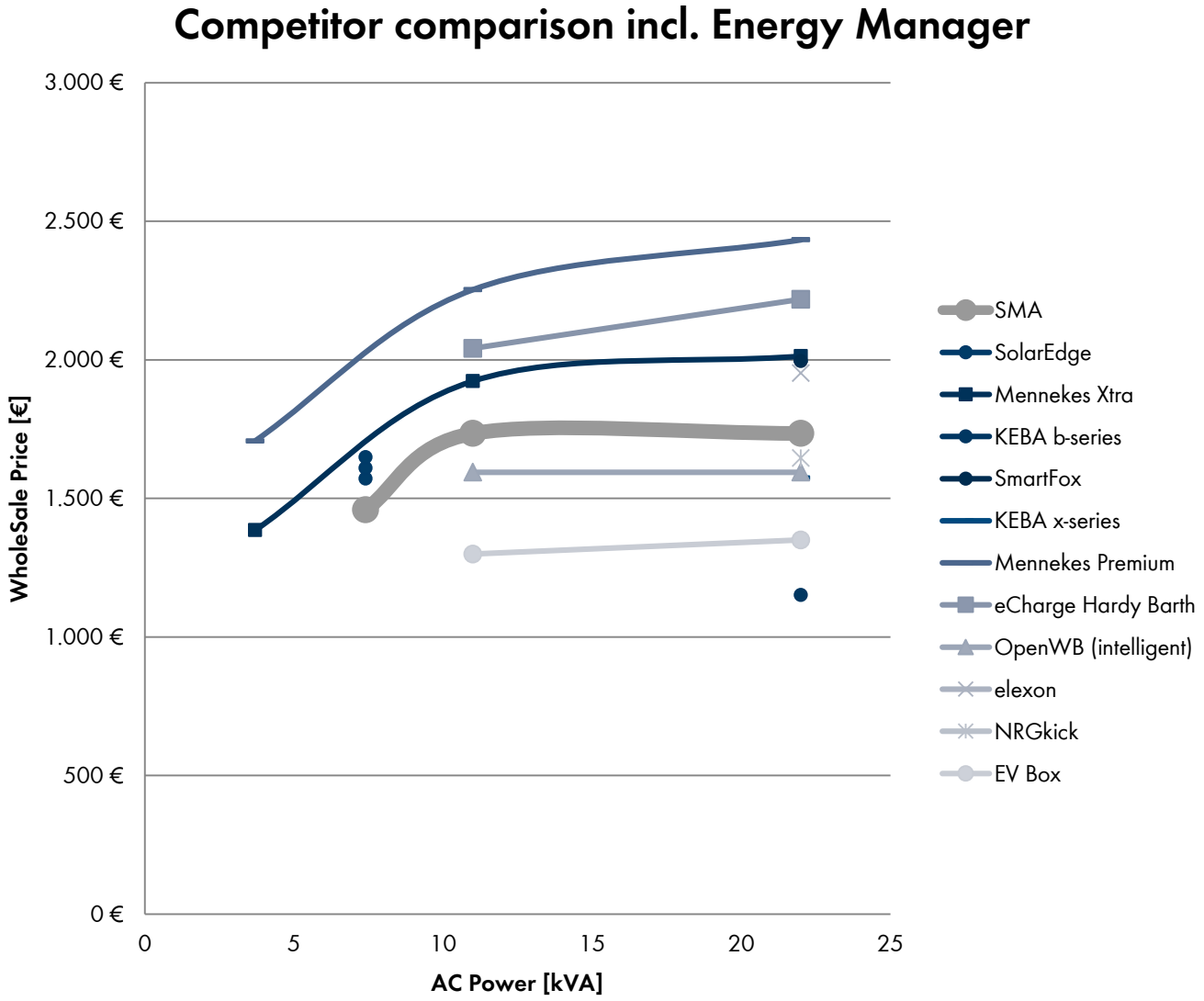
- Fast and safe charging of the electric vehicle
- Reduced mobility costs
- Zero-emissions mobility
- Fast and reliable service in the event of a fault

SMA Energy Systems Home

SMA EV Charger compared to the competition

	SMA EV Charger	Mennekes Amtron Xtra	Mennekes Amtron Premium	SmartFox Car Charger	KEBA P30 b-series	KEBA P30 x-series	SolarEdge 2in1 Inverter + EV Charger	Sonnen sonnenCharger	EV Box Elvi Smart Charging	eCharge Hardy Barth cPH1	OpenWB series 2	elexon A1
Charging cable included												
Calibrated energy meter												
Authentication (e.g. RFID)												
PV-optimized charging												
Time-controlled charging												
Boost function												
Automatic phase-switching												
Blackout protection												
SMA Smart Connected												
Warranty	5 years						12 years	3 years				

EV Charger offers outstanding price–performance ratio



SMA EV Charger: key differences

SMA EV Charger	Intelligent wallbox
• **Maximum utilization of solar energy** (through automatic phase switching & forecast-based operation) • **Cost-effective charging** (through intelligent charging modes: charging PV surplus and using time-variable tariffs) • **Reduced security risk** (through blackout protection) • **Fast charging times** (through boost function and dynamic adaptation to preset limits) • **Reduction of charging losses** (compared to charging at the household socket) • **Everything from one source** (all components perfectly matched, modularly expandable) • **Fast, automated service** (through integrated Service SMA Smart Connected) • **Monitoring and control of the entire system via app** • **Reduced additional investment** (integrated DC residual current sensor and charging cable)	• Utilization of solar energy • Lower safety risk • Faster charging times • Dynamic load control • Reduced charging losses • Additional investments

Outlook

- Internal field test already started
- Presentation at Regionaldialoge & E-World
- Information to wholesalers End of March/ Beginning of April
- Go-live product website End of April/ Beginning of May
- Start Beta-Test with SMA Partner installers in May
- Start (social) media campaign in May
- SOD End of June

> Datasheet, Flyer

Questions?

Thank you!

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