Agora Verkehrswende

Managed charging – A primer

The benefits of considering grid load and power availability when charging electric vehicles

FACT SHEET

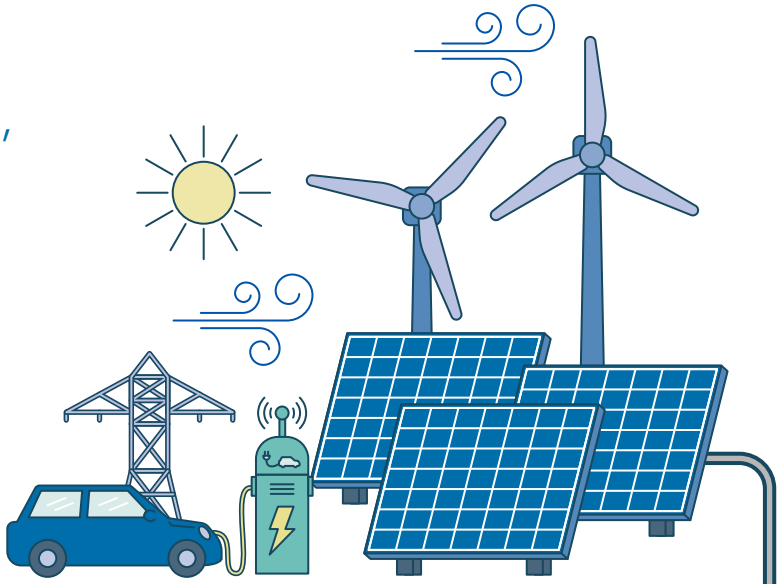
ellery studio

consentec

Flexible demand

How managed charging works, and why it is beneficial

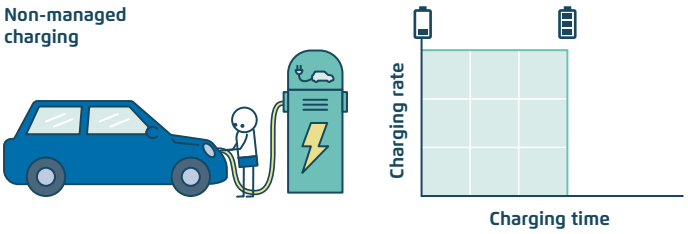
An electric vehicle (EV) is more than just a means of transport. Indeed, it is an element of the overall power system, which includes not only the power plants and grids that supply electrical energy, but also the appliances and machines run by end consumers. How and when EVs are charged has an influence on the power system as a whole – and, by extension, on the future of electromobility and the achievement of climate targets in transport.

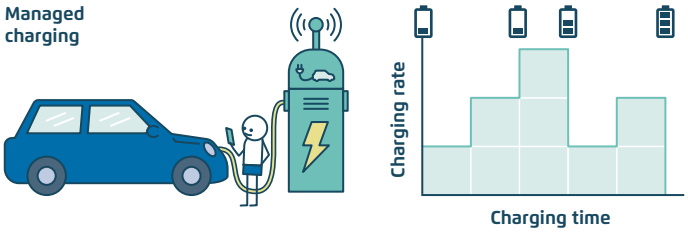


Adapting to user and power system needs

Normally, an EV charges to maximum capacity as soon as it is connected to a charging station. In managed charging, however, the status of the power system is taken into account. For example, the charging process may only start when there are large power surpluses, or the charging rate may be modulated depending on grid load.

Managed charging is ideal when a car is parked at a charging station for a long period of time – for example, at an owner's place of work or residence. When a vehicle is parked for an extended period, the charging speed becomes much less relevant. For EV owners, the main concern is that the battery is sufficiently charged when the vehicle is actually needed. In this regard, owners can set a minimum charge level that should always be reached.





Lower power costs and faster grid connection

Managed charging has two main advantages for consumers:

1. Lower power costs

When electricity is plentiful, power prices fall – for example, when demand is low, or when generation from the wind or sun is high. Users can benefit from lower power costs when aligning charging with power availability.

2. Faster grid connection

Permit approval for the installation of a charging station can be obtained more rapidly when the grid operator is granted the right to remotely control charging rates. However, such intervention by the grid operator is intended solely in exceptional circumstances, given acute grid bottlenecks (see blue info box).

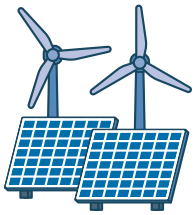
In Germany, work is still needed to establish the technical and regulatory conditions that will enable consumers to take advantage of both dimensions of managed charging – namely, market-oriented charging based on power availability, and grid-oriented charging based on current grid load.

Power system flexibility

Electric vehicles and managed charging are important building blocks of the energy transition

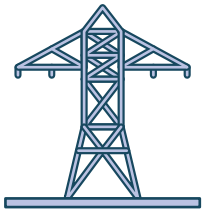
Managed charging is not only beneficial for EV owners. It is also advantageous for the power system, helping to reduce costs. Accordingly, it can be financially rewarded – for example, with lower power prices and grid usage fees. This is valuable because it facilitates the integration of renewable energy and the expansion of electric vehicles.

Better coordination



The amount of electricity generated by wind and solar systems varies based on the weather and time of day. When electric vehicle charging is managed in a market-oriented manner, demand is brought in closer alignment with supply. EV charging is prioritised when renewable energy is abundant.

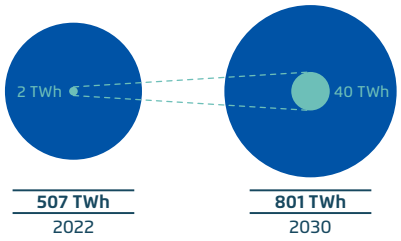
Reduced need for grid expansion



The level of grid expansion that will be necessary to accommodate the transition to renewables depends first and foremost on the volume of power to be transported at peak times. With grid-oriented charging, electric vehicles are primarily charged when grid load levels are low. This reduces peak loads and, as a result, lowers grid expansion needs.

Power generation is sufficient

Gross electricity generation in Germany (■) compared to the electricity demand of EVs (■)



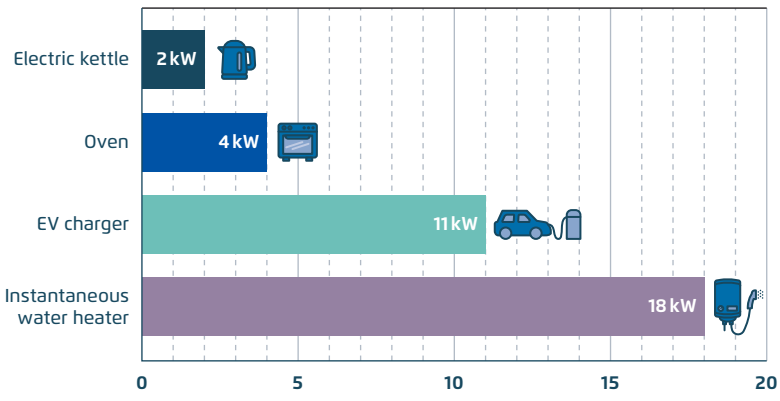
As the electric vehicle fleet expands, more electricity needs to be available for electromobility. This growing demand can be easily planned for and covered, as generation capacities will be further expanded, especially wind and solar. In 2022, EVs consumed 2 terawatt hours (TWh) of electricity, which corresponds to 0.4 per cent of gross generation in Germany. By 2030, EV power demand is expected to increase to some 40 TWh. This would represent 5 per cent of German power generation.

Grid capacities are sufficient

Power grids will need to be expanded to accommodate higher supply and demand levels. Grid operators are continually reviewing the need for infrastructure expansion while also taking the demand needs of electric vehicles into account.

The maximum output of a household charging station is typically 11 kilowatts. While this is higher than most household appliances, it is lower than that of an instantaneous water heater (18 kilowatts).

Connected loads: A comparison of common consumers

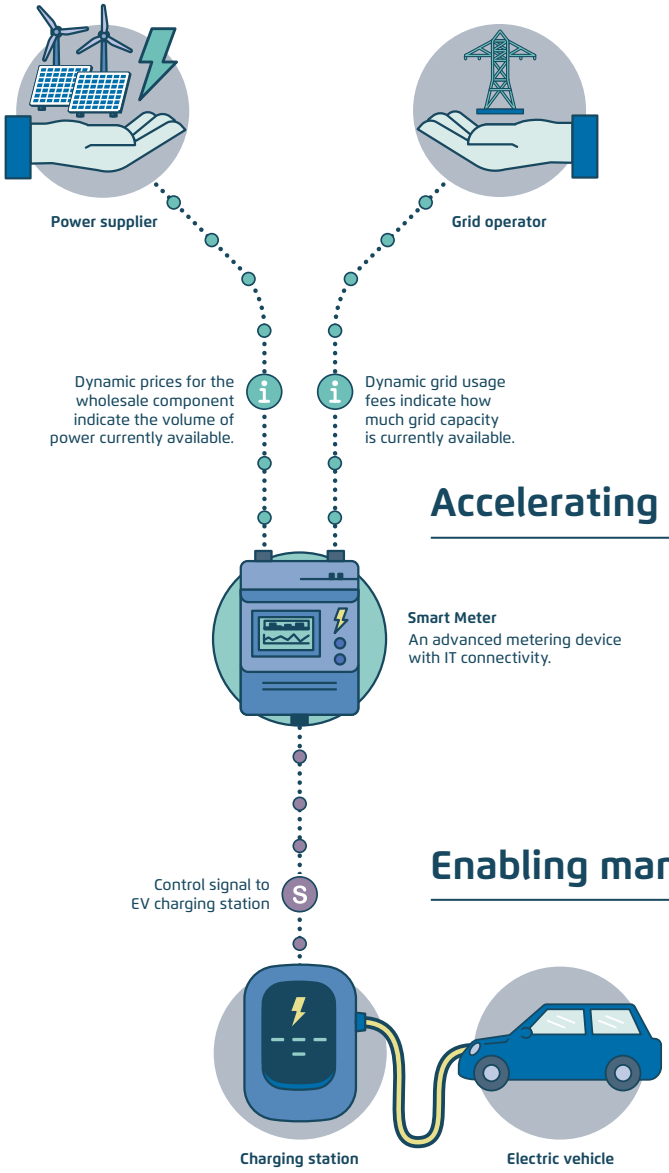


The advantages of managed charging for the power system cannot always be exploited simultaneously. For example, if a large number of EV owners schedule charging when electricity is cheap (market-oriented charging), this can only take place insofar as grid capacity allows it (grid-oriented charging). In this way, it is necessary to reconcile the occasionally countervailing needs of market- and grid-oriented charging.

Providing technical infrastructure

The power system must fulfil new requirements as part of the rise of managed charging and the broader flexibilisation of power demand

For managed charging to work, it is necessary to gather, share and process real-time information about power prices and the current status of the grid. New technical infrastructure is required to make this a reality. The power system will need to be outfitted with a variety of new measurement, communication and control systems.



Making monitoring of power grids mandatory

Private charging stations are usually connected to local low-voltage grids. However, grid operators currently lack the ability to effectively monitor loads at this grid level. While variable grid usage fees would send an effective price signal for grid-oriented managed charging, current technical capacities would limit their calculation to rough estimates. With a view to enabling an effective system of dynamic grid usage fees, grid operators should thus be required to install additional load monitoring infrastructure, as envisioned by the Federal Network Agency's proposal for Section 14a of the Energy Industry Act. As an added benefit, such infrastructure would enable grid operators to better determine when EV charging needs to be limited in the interest of grid stability.

Accelerating the adoption of smart meters

Consumers must be able to receive price signals regarding power availability and network utilisation and pass along control signals to their charging point. In the future, this can be done automatically using smart meters. However, smart meter adoption has been slow in Germany. A newly passed law designed to accelerate the digital transformation as it relates to the energy transition aims to remedy this deficit.

Enabling managed charging

For managed charging to work, charging points must be capable of receiving control signals from smart meters and adjusting the charging process accordingly. To this end, charging points must be outfitted with communication and control functions. Only charging points that have such functionality and are therefore controllable should continue to receive government subsidies, if such subsidies are granted at all.

Paving the way for bidirectional charging

Bidirectional charging provides the power system with valuable flexible storage capacity. EVs can also feed electricity into the grid when this is desired and advantageous. An ever-greater number of electric vehicles will be factory equipped to accommodate bidirectional charging. How the full potential of bidirectional charging can be exploited remains to be determined, however. The federal government should collaborate with stakeholders to study this issue.

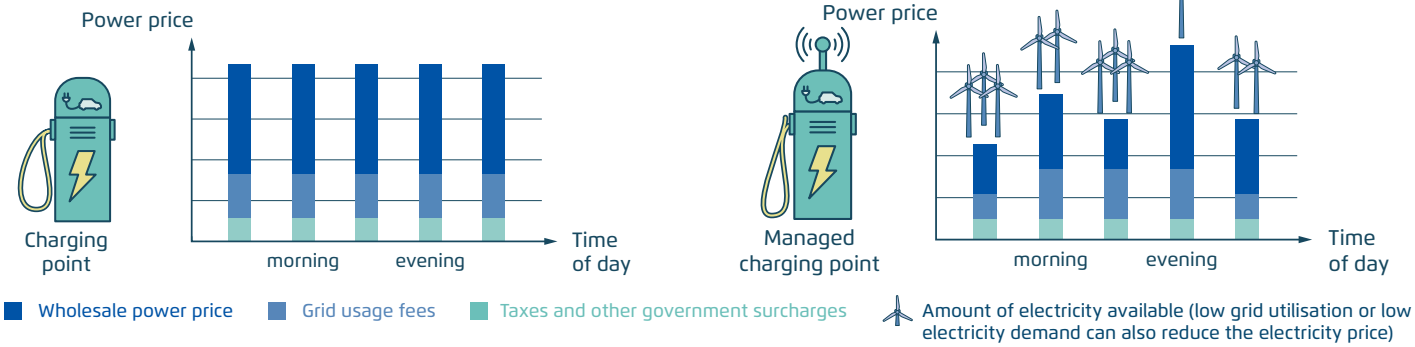
Harnessing market incentives

Variable prices help to coordinate electric vehicles, power generation and the power grid

Dynamic and fixed electricity prices in comparison

The electricity price paid by end consumers in Germany has several components. The two biggest determinants of power prices are the wholesale price and the grid usage fee. For household customers, the electricity price is usually the same from day to day and week to week, regardless of the time of day, as customers pay an annual average price. In general, short-term fluctuations in the wholesale market price are not directly passed along to end customers.

By contrast, dynamic electricity prices allow household customers to manage vehicle charging in line with the current status of the power system. Prices fall when power generation is plentiful or when the grid is underutilised. Conversely, prices rise when electricity is scarce or grid loads are high. Data supplied by the household's smart meter are used to automatically regulate the charging process.



Dynamic price variation as a prerequisite for managed charging

Managed charging works through dynamic wholesale prices and grid usage fees, because they...

...inform consumers about current power supply and grid capacity.

...motivate consumers to charge their vehicles when prices are low.

...reconcile market- and grid-oriented charging

Next steps for legislators and regulators

To enable real-time variation in power prices, two steps are required first and foremost by the federal government and Federal Network Agency:

1. Introduce dynamic grid usage fees so that grid operators can modify grid charges in line with grid usage. The Federal Network Agency must take the lead in proposing a model for this to occur.

2. Expand the current provisions for dynamic electricity prices: Legislation passed in May 2023 makes it obligatory for all power suppliers to offer dynamic prices for the energy procurement component of the power price, starting in 2025.

Interventions based on Section 14a of the Energy Industry Act should remain the exception

Variable electricity prices and grid usage fees will help to improve the coordination of supply and demand as well as avoid grid bottlenecks early on. This will increase efficiency, thus reducing overall costs. If a bottleneck nevertheless occurs, grid operators should be empowered to control the charging of flexible consumption units such as heat pumps and electric vehicles. Section 14a of the Energy Industry Act (EnWG) provides for such intervention to take place. However, the scope of intervention permissible is not precisely defined. The Federal Network Agency recently published a proposal for how such intervention could work.

It is crucial that interventions based on Section 14a remain the exception, because they make it more difficult to orient the charging process to the current supply situation. They also impair consumer autonomy and convenience. Accordingly, as a general rule, consumers should be empowered to react to market incentives and manage the charging process as they see fit.

This fact sheet explores the topic of managed charging for electric vehicles, including associated technologies, potentials and policy options. The management of the charging process in line with the current status of the power system can reduce charging costs for consumers and accelerate the grid connection of private charging stations. In addition, managed charging enables a higher share of renewables.

Given the right policies and regulations, managed charging will reap considerable benefits for electric vehicles and for the power system as a whole. While past discussions have focused on perspectives native to the energy sector, this fact sheet serves as a general primer for all interested parties. In addition to summarising current regulatory plans, it offers recommendations for the successful adoption of managed charging in Germany.

1st edition

100-2023-EN

Publisher
Agora Verkehrswende
Anna-Louisa-Karsch-Str. 2 | 10178 Berlin
T +49 (0)30 700 14 35000
F +49 (0)30 700 14 35129
www.agoraverkehrswende.de
info@agoraverkehrswende.de

Project managers
Fanny Tausendteufel, Project Manager, Industrial Policy
Marica Gehlfuß, Media Design and Communications Officer
Nikolas Linck, Communications Manager
Kerstin Meyer, Senior Associate, Green Vehicles
Dr. Philipp Prein, Head of Communications

Partners
Ellery Studio – Bernd Riedel, Andreas Lohner, David Ramirez Fernandez
Consentec GmbH – Wolfgang Fritz, Christian Linke

Publication date: August 2023

Please cite as:
Agora Verkehrswende (2023): *Managed charging – A primer. The benefits of considering grid load and power availability when charging electric vehicles*

www.agora-verkehrswende.de

Sources

COVER IMAGE: SimonSkafar

"Power capacities are sufficient": Only BEVs are considered. Current generation: smard.de; Generation in 2030: https://www.agora-energiewende.de/veroeffentlichungen/klimaneutrale-sstromsystem-2035/; EV power demand: https://www.agora-verkehrswende.de/veroeffentlichungen/gesteuertes-laden-1/

"Comparison of fixed and variable power prices": Based on a BDEW assessment: https://www.bdew.de/media/documents/221208_BDEW-Strompreisanalyse_Dez2022_08.12.2022_korr_vx5gByn.pdf

Agora Verkehrswende

Agora Verkehrswende is a joint initiative of Stiftung Mercator and the European Climate Foundation.