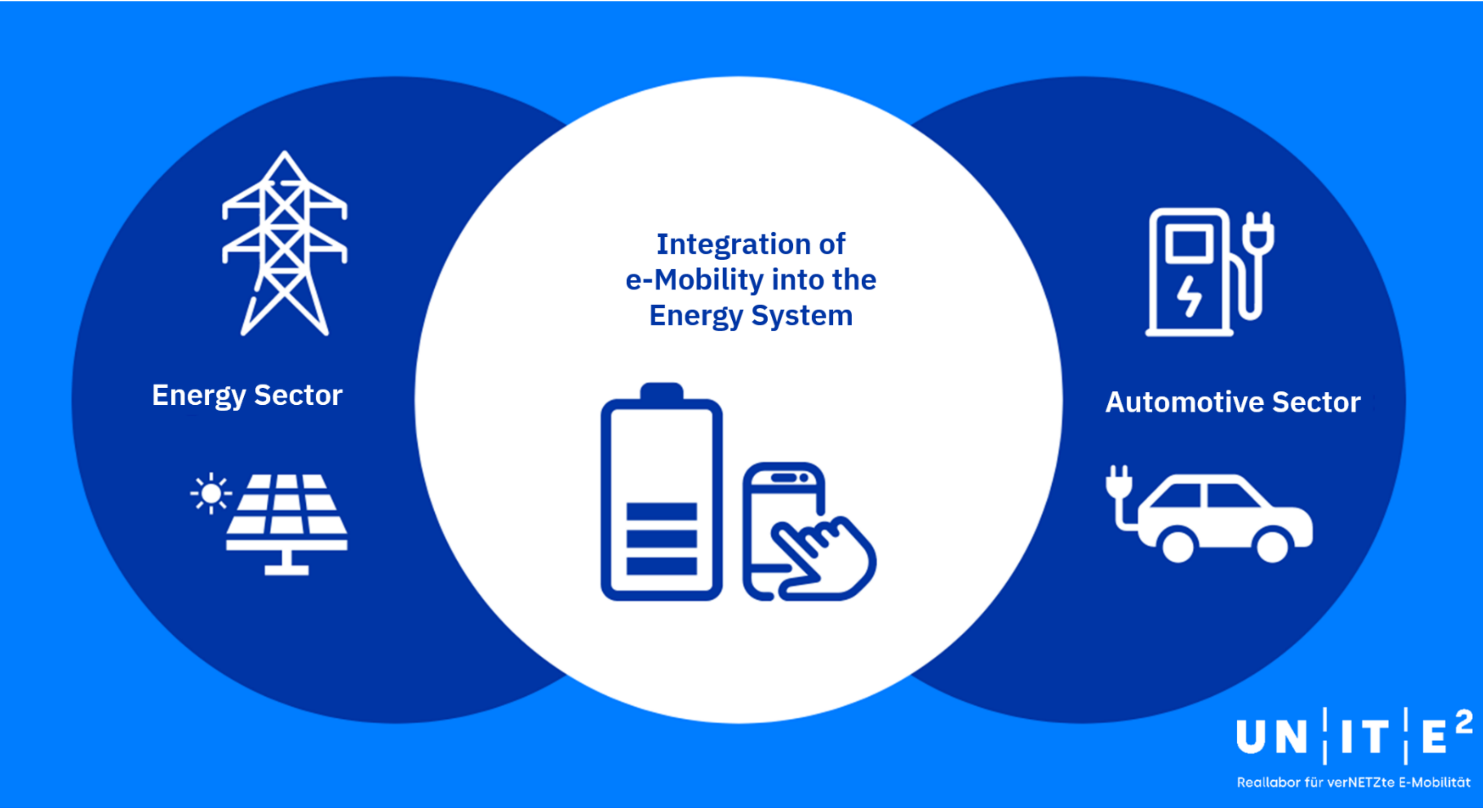

Incentives for grid-serving charging behavior in Europe

Other countries, same challenges

To integrate the significantly increasing number of electric vehicles into the electricity grid in the next few years, various approaches throughout Europe are being considered to encourage grid-serving charging behavior. Germany has barely used this option for specific customer groups. Therefore, it is worth looking at Europe when discussing possible incentive concepts because different approaches have already been applied in many neighboring countries.

In most areas Europe copes with their problems together. However, there is no consistent solution for integrating electromobility into the grid. Numerous methods are being pursued throughout Europe - also in Germany - yet, many questions regarding the design remain unanswered. In order to solve these, partners from the automotive and energy industries, IT and charging infrastructure, as well as the science community, have joined the project "unIT-e² - Reallabor für verNETZte E-Mobilität" (meaning "living lab for connected e-mobility"). It intensively deals with the holistic integration of electromobility into the energy system. A total of 29 partners are participating in the joint project to approach the complex topic from many different sides. The project is mainly focused on looking at other European countries for two reasons. New registrations of all-electric cars in Europe doubled to over 500,000 vehicles between January and October 2021 compared to the previous year [1]. While registration numbers vary significantly between countries, the general trend of rising numbers is across the boards. Other countries are thus facing challenges comparable to those in Germany. Furthermore, while grid operators are tied to national conditions, component and automotive manufacturers sell their products across Europe and worldwide. Standardization and unification beyond national borders seem necessary. At least knowledge of the regulations of other countries will bring crucial advantages, if this does not succeed.

Initial Situation

The increasing number of electric vehicles combined with additional loads (e. g., heat pumps or air conditioning systems) leads to different grid loads in the lower voltage levels. In particular, high power consumption and possibly increased simultaneity can strain the operating resources beyond the technical capacity [2]. The design of the grid charges offers the possibility to influence the charging behavior of the customers by employing appropriate price incentives. It can be assumed that, in the absence of stronger price signals from the market side, users will align their behavior with the grid operator's prices. Furthermore, the home energy management systems can consider those price signals as part of the optimization process. This offers the opportunity to integrate a more significant number of electric vehicles into the power grid with existing grid capacity. Curative interventions and grid expansion can thus be avoided or at least reduced.

However, it should be noted that in the case of natural monopolies, for instance with electricity grids, the determination of grid fees usually has to follow guidelines due to regulation. The grid operator has little freedom of design. Consequently, creating the grid charge system is a question of allocating costs to possible payers in a fair way to the originator. The responsible regulatory authority must usually implement any adjustments depending on the legal framework. In Sweden and Finland, grid operators can choose the grid charge system they prefer [3]. Norway plans to pursue an approach based more on fundamental considerations in the future. The focus will then be on allocating costs to different tariff elements rather than prescribing a single grid charge model [4]. Regardless of the responsibility for setting the grid charge system, the goal must be to ensure that the right incentives are set to achieve economic efficiency.

Pressure for action

A look at the European countries shows an increased discussion about adjustments, especially in those countries whose grid tariff system for household customers is mainly based on a basic and a work price (GP/AP system) without time differentiation. These include Austria, Norway, and Luxembourg. Even Germany is affected by this challenge. In its current form, a GP/AP system does not provide any incentives for grid-serving charging behavior. Grid-serving is achieved when charging processes reduce grid costs [5]. In addition to direct control by the grid operator, this can be achieved by incentives for equalizing the grid load.

Regarding the German discussion on the amendment of § 14a EnWG and when considering the approach of other European countries, a distinction can be made between capacity- or power-based grid charge designs and the application of time-variable grid charges to achieve a more even grid load (cf. Figure 1).

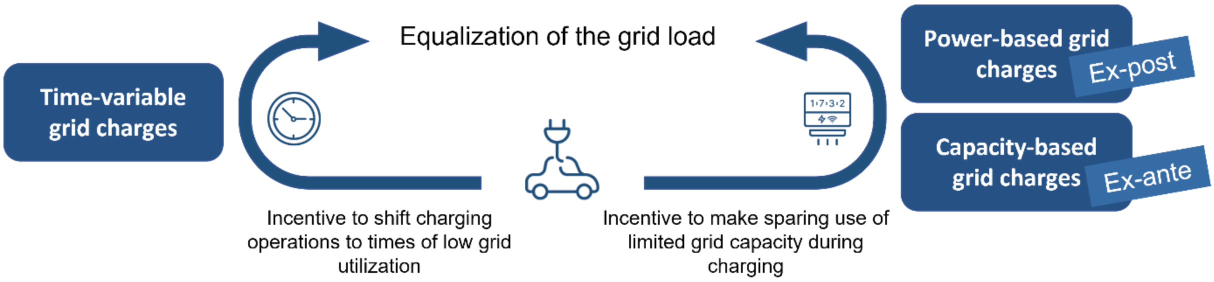

Figure 1 Options for the design of grid charges and related incentives.

In both cases, there are a large number of different variants. Both ideas are conclusive. Either the sparing use of limited grid capacity is encouraged, or incentives are provided to shift power consumption to times of low grid utilization. It can be stated that none of the approaches has yet gained acceptance in Europe. Figure 2 provides an overview of the currently applied grid charging schemes for residential customers in selected European countries. In the following, approaches to grid integration of electromobility pursued in three different countries or regions are presented.

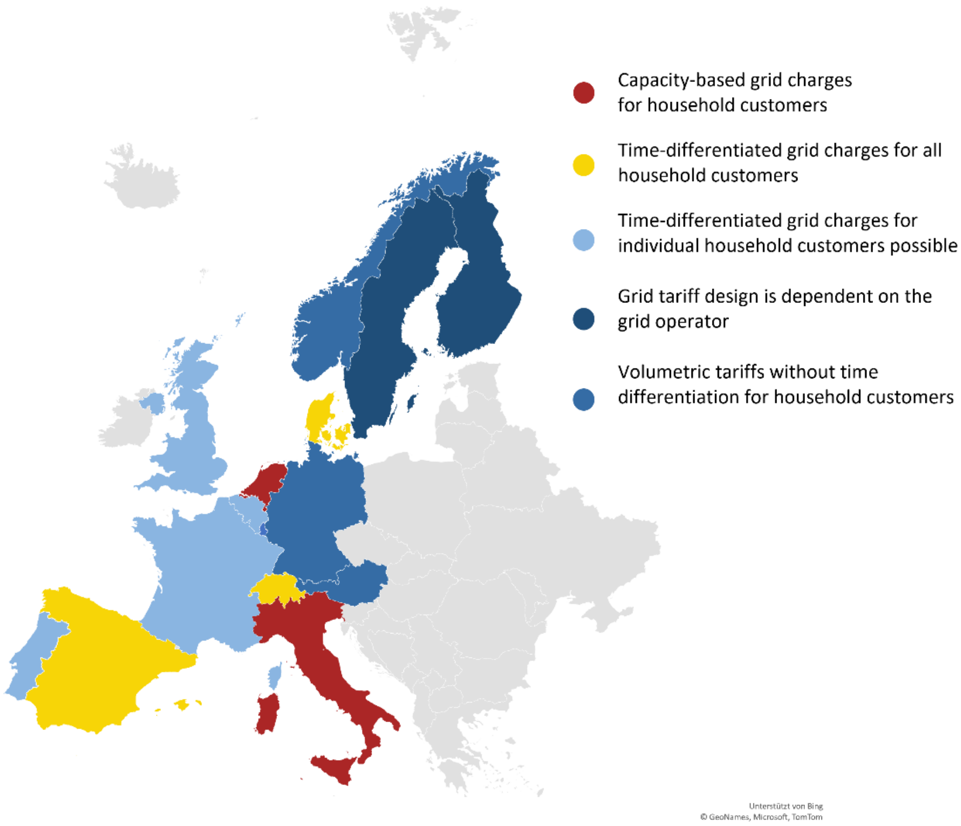

Figure 2 Grid charges for household customers in selected European countries Figure: Own illustration

Austria - Power must be priced

Austria is comparable to Germany in terms of the prerequisites, the progress of the smart meter rollout, and the current grid charge system. According to a position paper published in January 2021 by the Austrian regulatory authority E-Control, a charge based on work and power will be applied to all low-voltage customers once the smart meter rollout has been completed. The plan uses a power share of 40 % to 60 %, analogous to the higher grid levels.

According to E-Control, these adjustments should contribute to an adequate cost allocation for electromobility. However, the Austrian regulator is critical of dynamic grid charges because they are less predictable. [6]

Belgium (Flanders) - Smart meter rollout has significant impact

In Flanders, a region in Belgium, the grid charge structure will change significantly from 2022 on. In order to enable the grid integration of electric vehicles and in anticipation of the introduction of smart meters, there will be a shift from work-based prices to power-based grid charges. Grid charges for residential customers will then shift from fully work-based pricing to be based to 80 % on the average 12-month monthly peak load. The remaining 20 % of grid charges will continue to be work-based. In this context, power-based prices can only be applied to customers with a smart meter. This presents a challenge, as their rollout is not yet completed in Flanders. The full rollout is not expected to be finished until 2029. Due to this, customers with a conventional meter will pay a minimum flat rate for capacity, based on an assumed capacity of 2.5 kW. Unlike the current work-based grid charges, the power-based charges for the regulatory period from 2022 to 2024 will not be time-based. However, the VREG (Flemish regulator) has asked distribution system operators to consider the introduction of time-based grid charges and to report on this by the end of 2023. [7]

Italy - charging possible at night

For historical reasons, Italy has had a capacity-based system of grid charges for a long time. Most household customers are only entitled to a contractual grid connection capacity of 3 kW. This means a maximum technical capacity of 3.3 kW is available for permanent purchase. This regulation means that charging a (premium) electric vehicle with battery capacities of over 100 kWh, which have now been achieved, is not possible in a target-oriented manner. In addition, there is a unique feature in Italy that the smart meters there are typically equipped with a breaker. Therefore, exceeding the agreed power leads directly to a disconnection from the grid. A manual reset is necessary to restart the system. [4]

Italy has therefore introduced a special regulation for the integration of electric mobility into the grid as of the 1st of July 2021. This concept is valid until the 31st of December 2023. There is no adjustment of the contractually agreed power. But if the customer can prove the presence of an electric vehicle, the software’s available power increases by up to 6 kW during the night from 11:00 pm to 7:00 am and also on Sundays as well as on public holidays. The customer will not even have to pay any extra for this advantage [8]. The complete charging of an electric vehicle thus becomes possible within one night. This procedure is an example of extending a capacity-based system by a time-variable incentive.

Importance of the smart meter rollout

The three examples presented clarify that the smart meter rollout is a prerequisite for successfully implementing the incentive concepts. Unless the grid connection capacity is billed based on the installed fuse of the house connection (cf. the Netherlands), smart meters are indispensable for capacity- or power-based grid charges. This also applies to a design of time-variable grid charges - which goes beyond a distinction between day and night. Some countries have already completed the smart meter rollout and are, in some cases, already installing the second generation of devices (cf. Italy and Sweden). However, the majority of countries are still in the rollout phase. The current status of the smart meter rollout in Europe is shown in Figure 3. The technical and functional scope of the installed devices differs significantly between the countries [9].

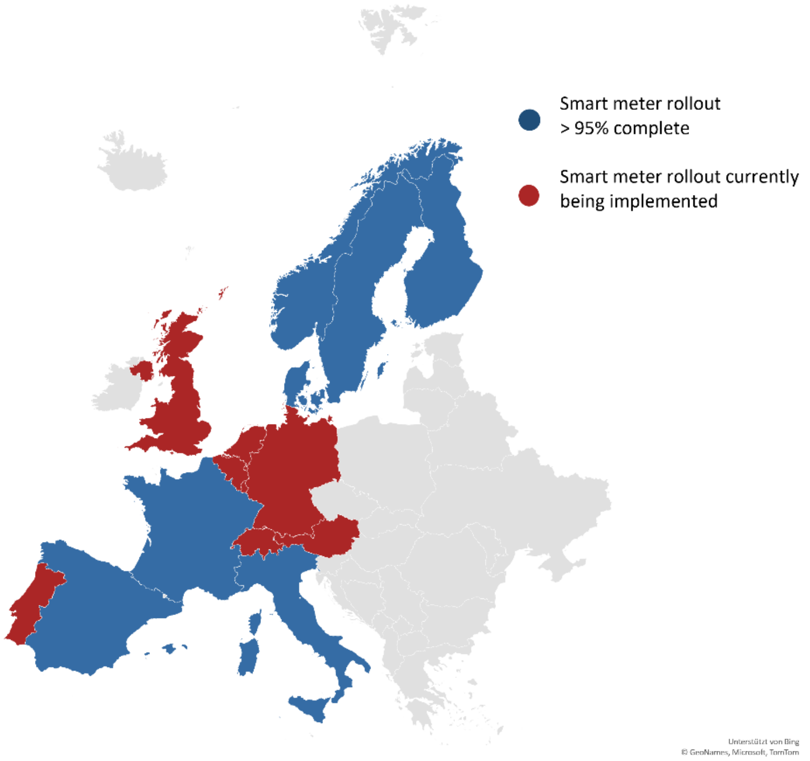

Figure 3 Status of the smart meter rollout in selected European countries Figure: Own illustration

In the individual countries, the heterogeneous approach to grid charges and smart meter rollout also poses a challenge for the unIT-e² project. Defined use cases may only work for Germany. In addition to the differences in grid integration shown here, this also applies to many other aspects of the electromobility ecosystem. The goal must be to increase European standardization of electromobility-related processes in the upcoming years. This also applies to the discussion of the future design of grid charges - in which the view of Europe should not be neglected. From the point of view of components and automobile manufacturers, the implementation of future business models should aim for further standardization of the grid charge system, at least within the European Union. This is because use cases in bidirectional charging depend not only on the technical requirements - in particular, ISO 15118-20 - but also on the regulatory framework for the (grid-) charges to be paid.

A closer look at the situation in other European countries shows that countries with a similar situation as Germany are currently discussing similar issues. In many countries with a need for adaptation, the discussion is developing in the direction of capacity and power-based grid charge systems. As a first step, this may mean introducing an ex-post power-based charge also for household customers (cf. Austria). Further development will thus be gradual and closely linked with the smart meter rollout. Ex-ante based capacity prices are also being discussed but have not been newly introduced in any European country. In principle, this appears to be a further development stage in perspective. A combination with different capacity levels over time (cf. Italy) is possible as a variant based on this. This evolutionary approach could also be a way forward for Germany. A fundamental adjustment of the grid charge system and an acceleration of the smart meter rollout for household customers would be urgently required against the sharp rise in the number of electromobility registrations in the coming legislative period.

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