Charging: Priorities for EV Users

Introduction

This paper mainly concentrates on the charging requirements of ***individual*** electric car owners – which are different than fleet users.

Two types of EVs will need charging: Battery Electric Vehicles (BEVs) and Plug-in Hybrids (PHEVs):

- Because of their limited range, BEV cars will essentially be used for commuting and short urban trips, mostly driven at slow speed (urban and congested traffic) with only one occupant. This usage represents about 80% of cars mileage. Small and ultra-small BEVs with small batteries packs (around 10kWh) and limited range (50-150km) are ideal for this usage and therefore have a wide potential market, especially in two-car families (25-30% in Europe).

  However, some other users will prefer larger BEVs with more driving range, using bigger batteries packs (up to 50kWh, maybe more when batteries become smaller and cheaper).

- For long trips and mixed usage, consumers will prefer PHEVs, which will tend to be bigger and faster cars, capable of transporting comfortably a family for week-end and holiday trips.

  Fuel Cell Vehicles (FCVs) and/or "quick"[1] charging BEVs (capable of charging in less than 10-15 minutes) are likely to be commercialised in the future and to replace PHEVs for this usage.

Normal-charging at or near home is a priority

Obviously, no-one will buy an Electric Vehicle (EV) if he cannot charge it. And no-one will drive miles away to a remote charging station and wait for his EV to charge.

Charging sockets at the workplace may be useful on weekdays, but they are useless during week-ends and holidays. So individuals need to charge at or near their home. While some people have a garage in which they can charge – especially in North-European countries, the majority will need to charge on public space next to their home – especially in South-Europe countries.

Also, in order to load-balance the grid, it is best that EVs charge at night, using off-peak electricity, which often is largely produced with CO2-free electricity (such as wind turbines and nuclear). This would allow charging a large number of EVs (about 20-30% of the total car market) without having to reinforce the grid, while optimizing EVs CO2 footprint. It requires charging where EVs are parked at night: at or near home.

Overnight normal charging on a single-phase domestic socket, at a limited charging power (for instance 2-3 kW), is more than sufficient for replenishing an EV for usual daily trips:

- Average daily usage 40km, consumption 10-25kWh/100km → charge need for 40km: 4-10kWh.
- Charging 8 hours (10pm to 6am) at 2-3kW → available energy: 16-24 kWh.

However, some EV users, such as those subject to "range anxiety" and owners of larger EVs covering longer daily distances, will want more charging power at or near home.

[1] See definition in annex

Charging on a domestic socket is a priority

So for many individual EV users, charging overnight on a standard single-phase domestic socket, at a safe power (probably around 2-3kW), is well sufficient. These EV owners will not want to go through the expense of installing an expensive high-power outlet in their garage: they want to use a domestic socket – with a timer or smart-socket allowing them to charge off-peak with cheap electricity.

Also, many EV drivers do appreciate to be able to get an additional charge wherever they are – they are quick to realise that there are about one million times more domestic sockets than petrol station! Many EV drivers always carry a charging-cable with a domestic plug and an extension cord so that they can get an additional charge when they need it – such as at friend's home, in a restaurant, at a meeting place…

Therefore, the first priority for many individual EV drivers is to be able to safely charge (at a safe, limited power) on a local domestic socket. It should be allowed in all countries where domestic socket's power rating is sufficient (most European countries).

The fact domestic sockets are different in each country is no problem for two reasons: First, it is unrealistic to believe that many BEVs will cross borders until "quick" charging (over 150 kW) and/or battery swapping are widely available on motorways – which may take well over a decade. Second, adequate adaptors (rated 16Amps) could be made available and used safely.

Faster charging needs

Faster charging will be required at home by some other individual EV users, such as those subject to "range anxiety" or those covering longer daily distances.

Also, as shown by the Japanese presentation shown at the first CEN-CENELEC meeting, charging stations on public space outside residential districts (such as in city centres and shopping districts) are necessary (mainly to address "range anxiety"). While normal charging power (around 2-3kW) is sufficient for pedelecs, scooters and some EV users (providing 10 to 25km additional range per hour), many EV users will prefer higher charging power ("accelerated" or "fast"). Public charging stations should also have a domestic socket for pedelecs, scooters and other vehicles that can only use normal charging.

Using BEVs for very long trips requires "quick" charging stations on freeways, capable of offering a 200km+ range in less than 10-15 minutes. This requires charging powers over 150 kW, as well as batteries capable of coping with "quick" charging without damage (as already available at lab scale).

It must be remembered that long trips (over 60km) only represent 20% of cars mileage – mostly during week-ends and holidays. Also, for long trips, FCVs and/or battery exchange stations may become a better option than "quick" charging.

Fleets have different requirements

BEVs are likely to become an option for most urban fleets, such as taxis, delivery trucks, maintenance vehicles, garbage collection…

Many of these vehicles will need to cover longer daily distances than individual car owners (up to 300km). They will need more batteries and/or faster charging powers (maybe up to around 50kW, which charges 10kWh in 12 minutes) and/or battery exchange stations.

While fleets may be the dominant EV market in the short term, the main market in the medium term (5-10 years) will most probably be individual cars.

Conclusions

There are therefore 3 types of charging needs to be addressed:

1. Normal charging on a single-phase domestic socket, at a safe power level (around 2-3kW), for most individual at or near home – as well as for charging some cars and most pedelecs, scooters motorcycles and light EVs on public space.
2. “Accelerated” to “fast” charging, for many fleets, for some individuals at home, and for additional charging on public space, on a connection system to be defined (capable of standing around 10-50kW).
3. In a more distant future, “quick” charging on a high-power socket (over 150kW), for freeway needs.

EV users will not want to carry along more than 2 connectors, and EVs should not have more than 2 or 3 inlets on the side. Since domestic sockets are already standardised for each country, only “accelerated” to “fast” and “quick” connectors require a standardisation at the European – and ideally worldwide – level.

From a consumer’s perspective, the CEN-CENELEC committee should therefore concentrate on a limited number of connection systems, for instance:

1. Ensure that EVs can safely be charged on a single-phase domestic socket.
2. Select a connection system for “accelerated” to “fast” charging, which urgently needs standardization.
3. For the longer term, prepare the path to “quick” charging, keeping in mind that it may be too early to define detailed standards.

Finally, to ensure free-market, open architecture is essential:

- No standard may require the use of proprietary equipment and/or technology.
- Customer authentication, access keys, and billing mechanisms must be made compatible at a European level, so that users can use any charging station without preregistration and pay with standard methods (such as credit card or SMS) and/or have their consumption invoiced by their utility company.

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Appendix: Terminology for Charging Powers

We use the words “normal”, “accelerated”, “fast” and “quick” starting from the definitions in the draft document “EV_N29 Terminology_2010_08_18.pdf” of the CEN-CENELEC PT1-Terminology subgroup: