Towards efficient and long-lasting EV chargers

Ecodesign requirements for electric vehicle chargers

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ecos

About ECOS

ECOS - Environmental Coalition on Standards is an international NGO with a network of members and experts advocating for environmentally friendly technical standards, policies and laws. We ensure the environmental voice is heard when they are developed and drive change by providing expertise to policymakers and industry players, leading to the implementation of strong environmental principles.

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Executive summary and key recommendations

Given the large amount of electric vehicle (EV) charging stations that will be built in the coming years, the European Commission should implement measures to reduce their environmental impact as soon (and as much!) as possible. Measures should tackle the energy and material use of EV chargers and ensure the adoption of future proof smart EV charging standards.

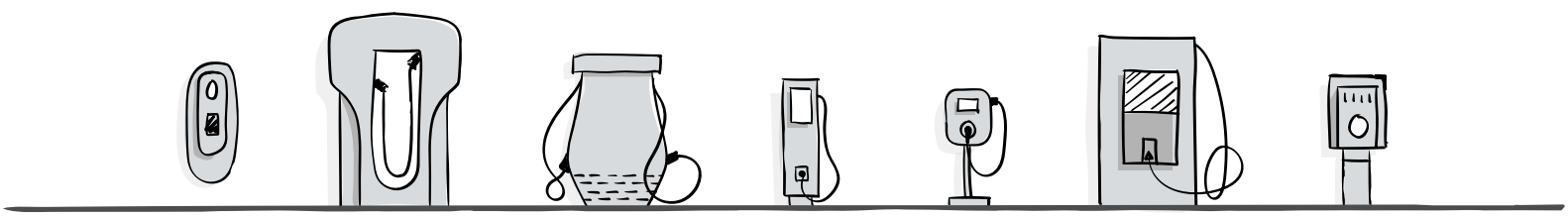
To decide which products to include in its Ecodesign and Energy Labelling Working Plan 2022-2024, the European Commission conducted a study[1] in 2021 to assess the potential for environmental savings from new product regulations. Among other products, it was found that regulating EV chargers could lead to significant energy savings. Therefore, the European Commission will soon investigate, by means of a preparatory study, whether ecodesign and energy labelling requirements are capable of significantly lowering the environmental impact of EV chargers. This new study will consider how to best regulate the chargers.

In this position paper, we underline the ecodesign measures identified by the initial study that are environmentally ambitious enough to transform the deployment of EV chargers. We also outline other measures that have been overlooked yet must be assessed due to their potential to improve the sustainability of EV chargers.

EV chargers are a highly relevant product to regulate under ecodesign, mainly because of the environmental savings in terms of energy and material efficiency that can be made due to the large number of EV charging points that will be built in the coming years. Ecodesign requirements could ensure less material is used to build EV chargers, while minimising the energy they use. As well as important material and energy savings, these measures would lower energy costs for consumers.

In its upcoming ecodesign preparatory study for EV chargers, we urge the European Commission to assess all possible measures to reduce the environmental impact of all types of e-mobility chargers through their entire lifecycle, as well as adopting future proof smart charging standards.

A key element in the EU's energy transition, a large amount of charging stations will be built the coming years and decades[2]. Therefore, the sooner an ecodesign regulation is in place, the more sustainable charging stations will be designed to minimise their environmental impact, both regarding energy and material use.



Ecodesign requirements for EV chargers should:

- Apply to chargers of all types of e-mobility, not only light-duty vehicles.
- Minimise energy conversion losses, as well as energy use in stand-by mode.
- Enhance the durability of components so they can remain in place for as long as possible while allowing for technological innovation.
- Enhance repairability, upgradability, and reusability to minimise the environmental impacts of a young and fast evolving market.
- Facilitate the possibility to remanufacture, recycle or recover elements to avoid material going to waste, as much as possible.
- Ensure the use of recycled content and minimise the use of energy intensive materials.
- Ensure EV chargers implement the right technical standards to allow for smart charging, starting with the ISO 15118-20 standard, which improves charging and enables the vehicle-to-grid (V2G). Future standards should be anticipated and able to be implemented as soon as possible, by providing sufficient computing and memory capacity, as well as all technical documentation regarding the applied protocols.

Background: The 2021 study

The European Commission's initial study from 2021 identified essential elements to improve the energy efficiency of charging stations, such as the potential to address energy convergence losses, which we strongly support. However, it overlooks other important aspects.

The study focuses on chargers of light-duty vehicles. Since the electrification of heavy-duty vehicles is expected to take off[3], using roughly the same charging technology (DC fast charging), ecodesign requirements should apply to chargers of all electrified road transport. Including chargers for other electrified modes such as e-bikes and e-scooters should also be assessed due to the large growth of these markets.

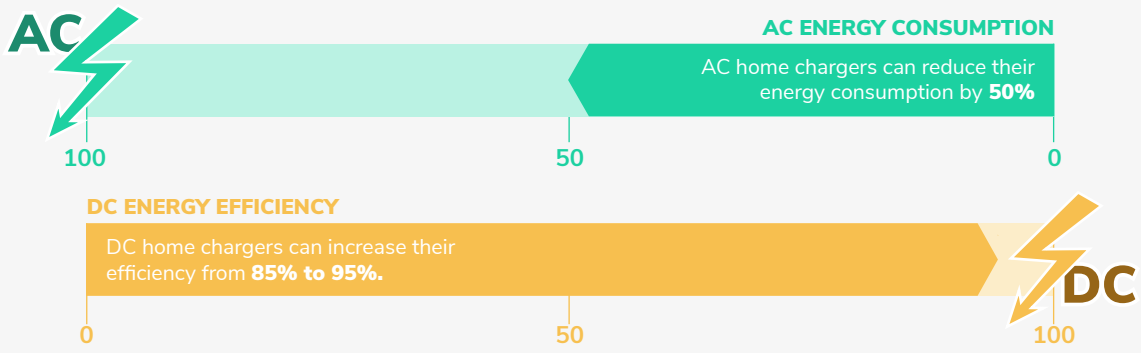
Furthermore, the study only assesses the use phase of an EV charger's lifecycle, without considering the extraction, manufacturing, transport, and end-of-life phases. Another missing element is the need to include smart charging standards in EV charging equipment, and ways to ensure developments of these standards do not render the infrastructure obsolete before the end of their expected lifetime.

Support for energy-saving measures

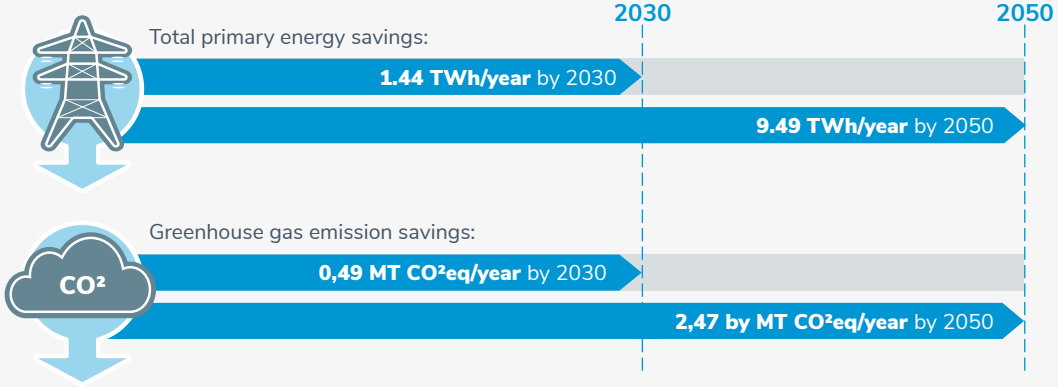
The Commission's initial study focuses on energy losses of EV chargers when energy is converted to the type (alternating or direct current) and voltage level suitable for EV batteries, as well as the (standby) energy consumption of the EV charger's control systems. It is assumed that AC home chargers can reduce their energy consumption by 50%. DC chargers can increase their efficiency from 85% to 95%. This would lead to an estimated total primary energy saving of 1.44 TWh/year by 2030 and 9.49 TWh/year by 2050. This would be 0,49 MT CO^2eq/year of greenhouse gas emission savings by 2030 and 2.47 MT CO2/year by 2050. While these numbers are estimates based on assumptions regarding future market and technical developments, the recently adopted Alternative Fuels Infrastructure Regulation (AFIR) sets legal requirements for Member States to deploy more EV charging infrastructure. Furthermore, the projections of EV sales made in the Commission's 2021 study are expected to be an underestimation due to the rapid electrification of the road transport sector. When taking these trends into account, and including the charging stations of heavy-duty transport and buses, the energy savings potential is even larger than anticipated.

We strongly support the Commission in setting minimum energy efficiency requirements for all types of EV chargers to deliver as much energy savings as possible.

Assumptions on energy saving when energy is converted to EV batteries (including standby energy consumption):



Estimated savings from energy conversion:



Material efficiency savings should be assessed

To enhance the overall sustainability of EV chargers, the European Commission must investigate the adoption of ecodesign requirements for different aspects.

The EN 4555X standard series can play a role because it sets out methodologies to assess common ecodesign requirements focusing on the efficiency of materials for energy-related products. These standards provide ecodesign guidelines that can be adapted to many different product groups – including EV chargers. The standards cover a range of topics that relate to sustainability across the entire lifespan of a product, including:

Requirements	Standard	Description
Durability	EN45552[4]	The ability to function as required, under defined conditions of use, maintenance, and repair, until a main function is no longer being delivered
Repair	EN 45554[5]	The process of returning a faulty product to a condition where it can fulfil its intended use
Upgrade	EN 45554	The process of enhancing the functionality, performance, capacity, or aesthetics of a product
Reuse	EN 45554	The process by which a product or its parts, having reached the end of their first use, are used for the same purpose for which they were conceived
Remanufacturing	EN 45553[6]	The industrial process which produces a product from used products or used parts where at least one change is made which influences the safety, original performance, purpose, or type of the product
Recycling	EN 45555[7]	A recovery operation of any kind, by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes excluding energy recovery
Recovery	EN45555	An operation of any kind, the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy

In addition to the requirements assessed by the EN 4555X series, an ecodesign requirement is needed on the use of recycled content.

Durability

When designing EV chargers, one of the main challenges is the relative immaturity of the market. The EV charger landscape is rapidly evolving, with an increasing number of industry players offering various solutions. This diversity, combined with the lack of standardisation, makes it difficult to predict the durability of products currently in operation. Given the dynamic nature of the EV charger market, we anticipate that products deployed today will likely be outdated and replaced before reaching their expected end-of-life. Indeed, subsystems like power transformation, communication, user interfaces or the connection to third-party services will likely take advantage of future technological improvements or market standardisation, requiring adaptations to designs.

To ensure material efficiency in such a fast-changing market, EV charger components must be as durable as possible. Since assembly is likely to evolve, ecodesign requirements should focus on upgradability, reusability, and remanufacturing of components, to ensure they can remain in place for as long as possible.

When EV charger spots are leased by municipalities and the service provider changes, the entire charger assembly should not be replaced solely for (re) branding purposes. Open technical documentation should be readily available to operate the chargers and facilitate the integration of various charger components, such as structural elements and power transformation, into the infrastructure of the next service provider.

To maximise the value transfer of outdated EV charger parts to other products at the end of their lifetime, it is crucial to prioritise designs that are easily upgradeable, reusable, remanufacturable, and recyclable.

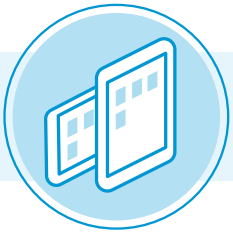
Following these design principles will contribute to the sustainability and longevity of EV charger systems and their components while adapting to rapidly changing market dynamics:

Ease of disassembly

Products should be designed for straightforward disassembly.

Documentation availability

Comprehensive documentation regarding materials, open software, and hardware interfaces should be accessible.



Standardised interfaces

The use of standardised interfaces should be encouraged to enhance the compatibility and interchangeability of components.

Repairability

The ability to repair, upgrade, or reuse a product is tightly linked to its ease of disassembly. If product disassembly is complex, it will be harder to repair, upgrade, or reuse because parts can get damaged in the disassembly process, skills necessary for the disassembly can be unavailable, or tools required can be too specific or expensive. The availability and accessibility of spare parts must also be guaranteed to support the repair effort.

EV chargers are operated by companies which may not have been involved in designing the chargers, nor be responsible for their maintenance. With such a complex web of technical support, it is in the economic interest of all actors to ensure that EV charger disassembly and repairability is straightforward to maximise operational efficiency.

The position of EV chargers on or close to roads also implies a high risk of collisions. So, their design should take these risks into account to avoid serious damage to core structural and functional elements in case of collision. Replacement of exposed cover parts should be made simple and straightforward.

The EN 45554 standard proposes assessment methodologies covering disassembly, spare part availability, repairability, reuse, and upgrade potential. Applying this to EV chargers is in the interest of all market players and consumers.

Upgradeability

Sub-systems that are likely to evolve following technological improvements or changes in the market or user behaviour must have maximum upgradeability. By allowing the replacement of specific parts, the need to install an entirely new EV charger is removed, and as many components as possible will be able to remain in place until the end of their lifetime.

The following sub-systems should be prioritised in terms of upgradeability as they are the most likely to benefit from upgrades, such as a new communication system, a new user interface, and support for additional third-party services:

- Communication
- Power control
- Software
- Power transformation

Reuse

Many of the building blocks that make up an EV charger could be reused in other applications:

- Power transformation subsystems could be reused in stationary battery charging or home energy storage.
- Power control subsystems could be reused in another power transformation application with different power ranges.
- Communication subsystems could be reused in other Internet of

Things applications requiring similar communication capabilities, such as light mobility charging stations or environmental monitoring applications.

- Human-Machine Interfaces, such as touch screens or displays, could be reused in other applications that require a similar interface (e.g. vending machines, infotainment)

Many elements could be reused without adaptation if they are integrated in a modular way, their technical documentation is available, or open-source approaches are promoted. To make reuse possible, different components must be able to be easily disassembled without being damaged.

Remanufacturing

Contrary to reuse, remanufacturing entails modifying components to fit a new application. Certain structural elements of EV chargers can be repurposed for use in other EV chargers or outdoor appliances.

Likewise, digital processing and control elements can be integrated in a modular fashion, with well-documented procedures to simplify reprogramming and reintegration into new applications at a later stage.

Recyclability

All the structural and protective elements for EV chargers should be made of recyclable materials. Mono-materials should be favoured to simplify recyclability.

Recovery

When setting stringent ecodesign requirements covering all material efficiency aspects discussed above, there will be limited potential for recovery. All the parts included in an EV charger have the potential to be designed to be recyclable, apart from the concrete used to stabilise the EV charger. This concrete should instead be recovered without any transformation operation.

Use of material

To improve material efficiency, materials must be reused as much as possible. An ecodesign requirement that sets an ambitious minimum threshold of recycled content in EV chargers would ensure that chargers are partly built with recycled materials. The use of energy intensive materials like steel or glass should also be minimised and materials produced from fossil elements or transformed via petro-chemical processes, like conventional plastics, completely avoided.

Including smart charging standards

The breakthrough of EV sales is good news for the fight against climate change. EVs are much more energy efficient than combustion engine cars[8], and electricity is increasingly produced from renewable sources. However, the electrification of transport – and other sectors such as heating – generates challenges for local electricity grids, which need to provide electricity in much larger volumes.

It is essential to charge EVs in a smart way, at moments it is beneficial for the grid. Charging can be postponed, sped up, or slowed down in response to external signals to accommodate grid needs. Also, many car batteries will soon be capable of bidirectional power flow by means of vehicle-to-grid (V2G) technology.

This means that the battery can give power back to the grid or building. This essentially turns the car in a battery on wheels that can function as storage for renewable energy. When charging takes place during periods of low demand, consumers that make use of dynamic tariffs can save money by charging smartly.

Smart charging is only possible when the right technical standards are implemented. Such standards enable communication between the EV and the charging station, the charging station and the back-end system, the EV charging station and an energy management system. Smart charging communication standards are being developed by the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC), with active participation of ECOS[9].

Newly built infrastructure should implement the ISO 15118-20[10] standard as soon as possible. This standard supporting V2G technology is well advanced and will soon be available for widespread use. In addition to V2G, it also improves the charging experience significantly.

Operators of newly built infrastructure should be required to implement this standard as soon as it is commercially available. Market Surveillance Authorities should check whether the standard is effectively implemented.

The IEC 63110[11] and IEC 63119[12] standards are further from completion but nonetheless on the way. It remains unclear exactly how these standards will be compatible with standards that are currently in use, but efforts should be made to prepare for them to coexist with the new IEC standards, and eventually migrate towards them.

Since standards continue to evolve, their regular updates will improve smart charging and facilitate the integration of EVs into the grid. Manufacturers must remain informed about these developments and ensure their equipment supports the latest smart charging standards – by either replacing the old standard or ensuring that it functions in parallel with new standards. To technically enable future updates, sufficient computing and memory capacity must be provided and all technical documentation regarding the protocols applied must be available[13]. This will allow third parties to upgrade the infrastructure in case the manufacturer or operator ceases to exist.

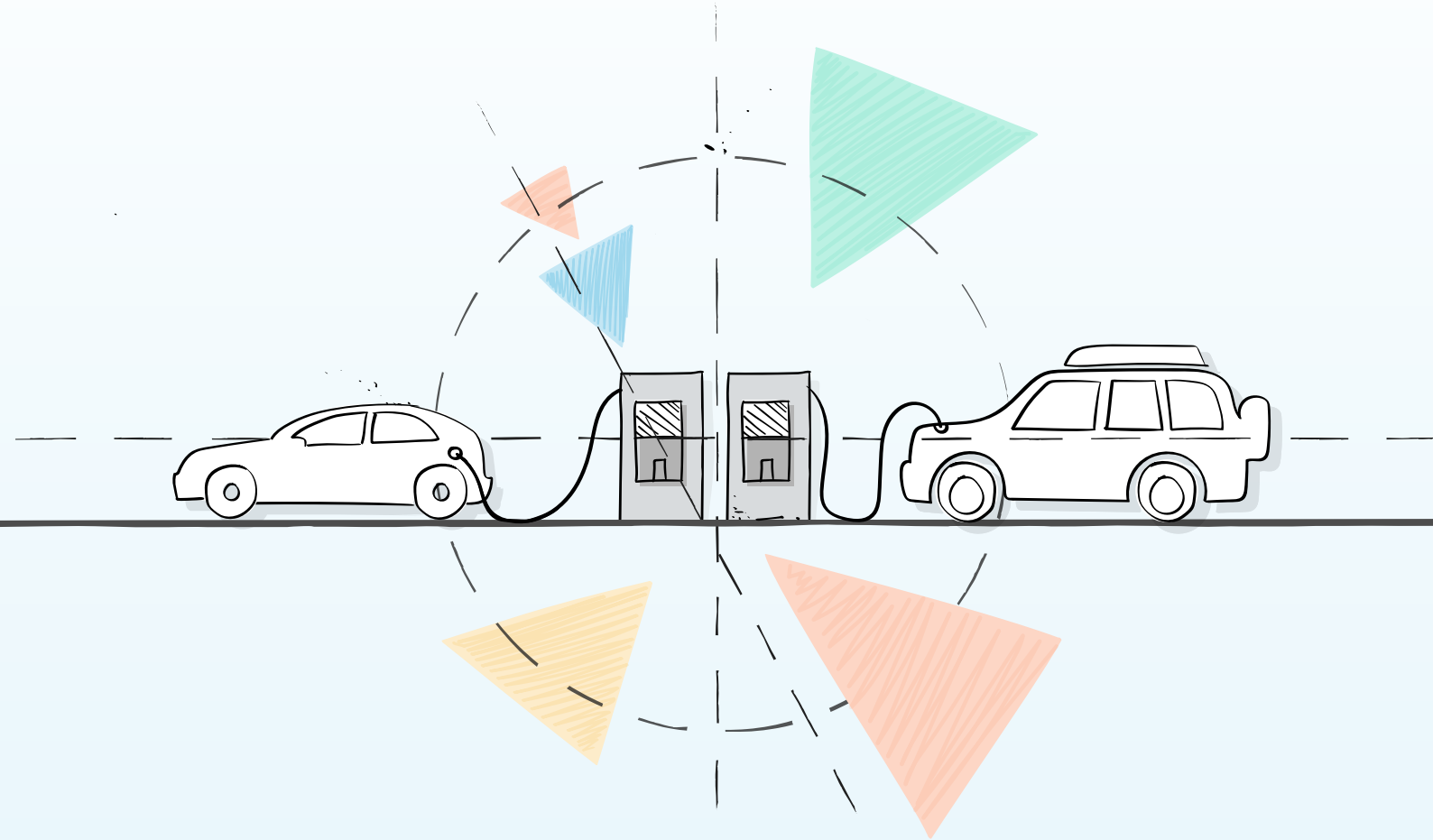
It is important that the latest standards are implemented in charging infrastructure to provide grid support and potential financial benefits to consumers. While some of the standards may be mandated under the European Alternative Fuels Infrastructure Regulation (AFIR), this legislation does not include compliance tests to be carried out by Market Surveillance Authorities.

This is key to ensure manufacturers effectively implement these standards. Therefore, the Commission should include the implementation of smart charging standards as ecodesign requirements.

Conclusion

Regulating EV chargers through ecodesign could bring significant environmental benefits – benefits that are not limited to energy savings alone. The right ecodesign requirements could also deliver material efficiency improvements and clear market surveillance competencies to ensure that the right smart charging standards are implemented so that electric vehicle charging can contribute to a green and stable grid.

Regarding material efficiency, the rapidly evolving nature of the EV charger market requires a shift in perspective. For this product we need to move away from an exclusive focus on overall durability and instead prioritise upgradability, reusability, and remanufacturing. To achieve this, EV chargers must be designed with an emphasis on modularity, easy disassembly, standardisation, and the availability of comprehensive interface documentation to facilitate upgradability, component and software interchangeability, and reuse. This approach will maximise sustainability in the evolving EV charger market, as well as reducing the environmental impact of these essential products over their whole lifecycle.



Endnotes

1. European Commission, 2021, Preparatory study for the Ecodesign and Energy Labelling Working Plan 2020-2024 - Task 3 Preliminary Analysis of Product Groups and Horizontal Initiatives. This study is different from the EV charger specific preparatory study the Commission will start working on soon. It is broader in scope assessing a whole range of product groups and includes only a brief analysis of the EV charger energy efficiency potential.

2. In 2021 Europe would need to install over 3 million charging stations by 2030, according to the European Automobile Manufacturers' Association (ACEA). European EV Charging Infrastructure Masterplan, 2022. **ACEA Whitepaper: A European EV charging infrastructure masterplan**

3. The International Council on Clean Transportation, 2023. **Europes electric truck market surges aug 2023**

4. EN 45552:2020 General method for the assessment of the durability of energy-related products

5. EN 45554:2020 General methods for the assessment of the ability to repair, reuse and upgrade energy-related products

6. EN 45553 General method for the assessment of the ability to remanufacture energy-related products

7. EN 45555:2019 General methods for assessing the recyclability and recoverability of energy-related products

8. Transport & Environment, 2020. **EV life cycle analysis**

9. More information on all relevant smart charging standards can be found ECOS report: Standards for EV smart charging: A guide for local authorities https://ecostandard.org/news_events/read-the-new-ecos-rap-briefing-standards-for-ev-smart-charging-a-guide-for-local-authorities/

10. EN ISO 15118-20 Road vehicles - Vehicle to grid communication interface - Part 20: 2nd generation network layer and application layer requirements.

11. Providing communication between the charging station and charging station back-end.

12. Ensures the communication flows to allow for secure payment across borders, and charging station operators.

13. As proposed by the European Commission preparatory study on Building Automation and Control Systems (BACS), this could be done by means of escrow services, whereby a third party holds documentation on behalf of the involved parties. This way the availability of copies of documentation on the product hardware embedded software is available in case the manufacturer goes out of business. It allows other parties to ensure the product can still function.

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