

# Standardisation of Electric Road Systems

## An Inventory of Standards for Vehicles, Electric Power Supply, and Infrastructure

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### Introduction

Sweden intends to become one of the world's first fossil-free welfare states and plans to have net-zero greenhouse gas emissions by the year 2045. Electric Road Systems (ERS) is one way forward towards this goal.

Interoperability within the European road transport system requires standardised solutions for ERS, since different technologies for ERS are developing simultaneously. Standardisation therefore plays an important role for further development of ERS. So far, there are no dedicated published standards covering ERS, but in 2018 standardisation work within the area was started.

The main objective of this study [1] was to analyse and point out areas where standards are missing, or identify if there is need for adaptation of existing standards to ERS.

### Methods and Materials

This study was mainly built on qualitative data gathered via document analysis and e-mail correspondence with experts.

A first mapping of standards, with subjects related to electric vehicles, infrastructure of electric roads, and electric power supply was done by experts at the Swedish Standards Institute (SIS). Then, a review of this mapping was done by a reference group of experts working more practically with standards that could be relevant for ERS.

An analysis was performed by SIS based on the initial mapping of standards and the feedback from the experts in the reference group.

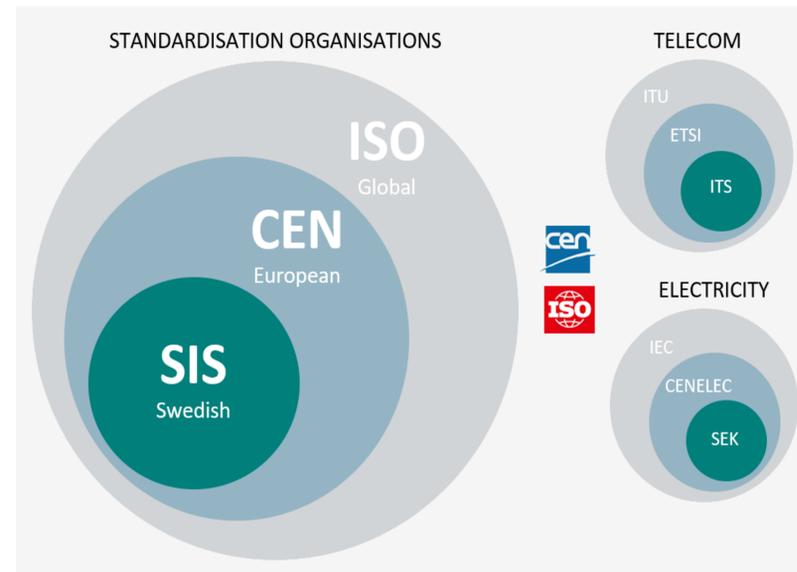


Fig. 1: Left - Hierarchy of global to national standardisation organisations. Right - Hierarchies of specialised standardisation organisations (Telecom and Electricity)

### Results

This study's main result is an inventory of 240 published standards and draft standards, that have a relationship to ERS. The standards are presented in an Excel file, categorized under vehicle, electric power supply and infrastructure.

These categories were used to examine standards in view of ERS as a system of systems [2]. The standards were also mapped and examined according to four different applications: general application, conductive transmission by rail in road, conductive transmission overhead, and inductive power transmission.

An initial analysis of the Excel file pointed out more than 80 standards (international, European and Swedish) as potentially applicable to ERS.

### Conclusions

The inventory list of standards resulting from this study is a useful tool for further examination of relevant standards, as well as for identification of missing standards for ERS.

Information from the standard list could also be used to recommend new important areas for standardisation and for prioritising future standardisation work in the developing field of ERS. For instance, two work items which are dedicated to ERS have recently been added within CENELEC TC9X ('Current Collectors for ground-level feeding system on Commercial Road Vehicles' and 'Current collectors on commercial road vehicles for overhead contact line operation').

The list of standards is a starting point and a work in progress, subsequently to be updated and refined. For instance, further expertise from standardisation organisations within the electrotechnical area and continued stakeholder dialogue, could add on to this study's results.

Additionally, examining further aspects of and links within ERS as a system of systems could be relevant. For example, the potential role of telecommunication standards for payment technologies in ERS and for other foreseen 'megatrends', besides electrification of transport, such as autonomous/automated and shared vehicles [3].

### References

- [1] Claeson, P., Casselbrant, L., Kadoura, Y., Almqvist, A., *Research and Innovation Platform for Electric Roads: WP 8 – Laws, regulatory system, and standardization – Standardization*, SIS Swedish Standards Institute, VTI rapport xxx, 2019 (The study was carried out by the Swedish Standards Institute (SIS) under a contract with VTI, in close collaboration with VTI and RISE).
- [2] Tongur, S., Sundelin, H., *The electric road system: transition from a system to a system-of-systems in Energy, Power and Transportation Electrification (ACEPT)*, Asian Conference on (pp. 1-8), IEEE, 2016
- [3] Sperling, D., *Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future*, 2<sup>nd</sup> Edition, 2018

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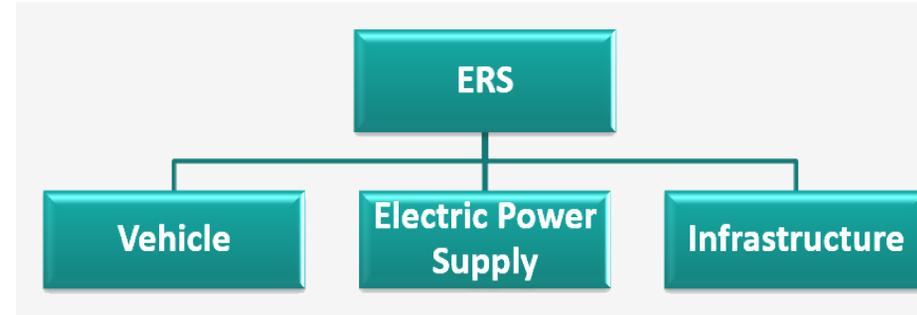


Fig. 2: A simplified system architecture of ERS used as a tool for identifying and sorting standards potentially applicable to ERS.