ERSC2020
4th Electric Road Systems Conference
12-13 May 2020 Lund, Sweden

Spreading the knowledge

ERSC2020 ABSTRACT BOOK

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Foreword

This book presents the abstracts of the 4th Electric Road Systems Conference (ERSC2020), sponsored by the Swedish Transport Administration. The conference was planned to take place in Lund (Sweden) from May 12th to May 13th, 2020. But the conference has been canceled and substituted by a webbinarium on 12th May 2020, due to the virus COVID-19 outbreak. The purpose of ERSC2020 was to bring together leading researchers, policy makers, developers, and transportation professionals to exchange and share their experiences about all aspects of Electric Road Systems (ERS) in an international setting. The conference also aimed to bridge theory and practice by providing a platform for presentation of ERS technologies, including demonstration along a public road and a technology exhibition. 52 extended abstracts were submitted to the conference from eight countries (Sweden, Germany, Austria, Finland, Japan, India, Iran, Italy). Each submission was evaluated, following a double-blind peer review method. Each abstract was reviewed by at least two internationally known experts from the ERSC2020 Referee Committee. Eventually 38 abstracts were accepted for oral presentation and 14 abstracts for posters presentation.

We would like to thank all the contributors, the members of the organizing, scientific and referee committee and most importantly the Innovation Skåne company for their support and engagement for this conference.

Steering, Organizing and Scientific Committees of ERSC2020

Jan Pettersson, Mohammed Hoseini and Björn Hasselgren

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Oral presentations

1. Technologies and systems

O1 - 450-kW Conductive Electric Road System by Honda (Takamitsu Tajima, Honda R&D Co., Ltd)

1. Technologies and systems

Takamitsu Tajima[1]
[1] Honda R&D Co., Ltd.

Summary: The spread of EVs is a key point for reducing CO2 emissions while driving. In order to achieve this, it is important to introduce an Electric Road System (ERS) that charges the electric vehicle directly from the power supply road. In this presentation, Honda describes the development of a 450kW ERS by conductive side method (Dynamic charging EVs and Electric roads) to achieve this. In addition, this ERS system makes it possible to charge while driving from passenger cars to heavy-duty truck.

Click here for extended abstract

O2 - Combining Electric Road Systems and Vehicle Automation (Hampus Alfredsson, RISE Research Institutes of Sweden)

1. Technologies and systems

Hampus Alfredsson[1]

[1] Division of Digital Systems, Department of Mobility and Systems, RISE Research Institutes of Sweden, Gothenburg, Sweden

Summary: To this date, self-driving vehicle technology and electric roads have been developed as separate solutions for a future sustainable and transport-efficient society, but without any major communication.

However, several areas are seen where the technologies can potentially meet and benefit from each other, why it is necessary that these are analyzed before we end up in a form of "technological lock-in" where we later realize that the technologies could enhance each other if they were implemented simultaneously.

Click here for extended abstract

O3 - eHighway system simulation for operational and technical design verification (Markus Werner, Technical University of Dresden)

1. Technologies and systems

Markus Werner[1]
Arnd Stephan[1]
[1] Technical University of Dresden

Summary: At the last ERS conference, the TU Dresden presented the essential principles for creating a simulation model for eHighway tracks. Since then, the development of a simulation model that combines the modelling of driving dynamics of eTrucks with an electrical network model was completed for the eHighway field trial FeSH in Germany. The developed tool has been validated against measurement data from real operation. Based on the simulation model, it is possible to generate new models for any eHighway tracks and to make detailed forecasts regarding the expected electrical parameters like energy consumption and power demand of the corresponding network.

Click here for extended abstract

O4 - Evaluation of the Swedish charging infrastructure needs for long-distance transport (F. J. Márquez-Fernández, Lund University)

1. Technologies and systems

Francisco J. Márquez-Fernández[1, 2]
Joschka Bischoff[3], Gabriel Domingues-Olavarría[1], Mats Alaküla[1, 2]
[1] Lund University
[2] Swedish Electromobility Centre
[3] Technical University Berlin

Summary: Electric Road Systems (ERS) offer a technical solution for long-distance transport electrification by allowing the vehicles to charge as they drive, reducing the size of the battery and the charging power at the cost of a more expensive infrastructure. Therefore, it is important to optimise the deployment of charging infrastructure, to make sure that all vehicles can reach their destination while minimising the cost as well as the charging and the eventual queuing time. This article uses a MATSim model to assess the needs for charging infrastructure in Sweden, with and without ERS deployed.

Click here for extended abstract

O5 - Evolution Road ERS test and demonstration site in Lund, Sweden

1. Technologies and systems

Per Löfberg[1]
[1] Innovation Skåne

Summary: The Swedish Transport Administration has procured several ERS test and demonstrations in Sweden with different technical solutions for heavy traffic. The project Evolution Road is one of these demonstrations, testing an ERS with an intelligent ground mounted technology in the city of Lund in Southern Sweden. The purpose is to provide advanced knowledge about electric roads as part of a future fossil-free transport system. This presentation is an overview of the project, its technology and points of research during the planned tests, as well as any results that have been obtained during the first phase of the project.

Click here for extended abstract

O6 - FAZEL1 Dynamic Charging Platoon Technology:

1. Technologies and systems

Fazel Pavand[1]
[1] Fazel Pavand

Summary:
FAZEL1's Dynamic Charging Platoon Technology solves EV fleet range anxiety on highways. Vehicles platooned with FAZEL1 technology receive an electrical charge from a vehicle energy source in-motion.
This dynamic charging platoon technology provides an opportunity for unlimited range extension, increased driving distance, increased battery life, reduced battery size and decreased charging-related waiting time, without the need for costly deployment of charging lanes.

Click here for extended abstract

O7 - Maturity of ERS power transfer technologies

1. Technologies and systems

Martin Gustavsson[1]
Magnus Lindgren[2]
[1] RISE Research Institutes of Sweden
[2] Swedish Transport Administration

Summary: There are numerous promising Electric Road System (ERS) development and demonstration projects globally since several years. However, the investment cost for large-scale deployment of ERS is considerable and decision-makers will require knowledge about how mature different solutions are compared to other transportation solutions. Drawing on the method associated with Technology Readiness Levels (TRLs) and previous efforts, this abstract provides a maturity assessment of several electric road system (ERS) technologies with a focus on the power transfer technology subsystem.

Click here for extended abstract

O8 - Real-world experiences of ERS – Best practices from demonstration projects in Sweden and Germany

1. Technologies and systems

Magnus Lindgren[1]
Hinrich Helms[2], Moritz Mottschall[3], Martin Gustavsson[4]
[1] Swedish Transport Administration
[2] ifeu – Institut für Energie- und Umweltforschung Heidelberg
[3] Öko-Institut e.V.
[4] RISE Research Institutes of Sweden

Summary: Demonstration projects currently underway will test Electric Road Systems (ERS) along public roads and in real-life environments, addressing various legal, political, economic, and efficiency aspects of ERS. Public road tests provide decision-makers and investors with a foundation for further investments that would bring ERS to commercial operation. At the time of writing, Sweden and Germany have together the largest collection of real-world experiences from demonstrations along public roads. Best practices have been collected from demonstrations of ERS technologies along public roads in Sweden, and procurement and the start of ERS field test projects in Germany.

Click here for extended abstract

O9 - Standards for electric road systems

1. Technologies and systems

Thomas Borglin[1]
[1] www.elstandard.se

Summary: At present, International and European standards for pantographs for overhead lines are being updated to possibly suit also vehicles for electric roads. Work on dedicated standards for such pantographs is foreseen, as is work on standards for electric rails for electric roads. These issues are the first to come to mind, and they are necessary for initial interoperability and safety. However, there are more issues that probably would require technical standards. In the following, these areas are identified and comprehensive motivation is given.

Click here for extended abstract

O10 - Visions for the introduction phase of electric roads

1. Technologies and systems

Mikael Hellgren[1, 2, 3]
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[3] Henrik Dahlström, Elways AB, henric.dahlstrom@elways.se

Summary: The introduction of electric road systems (ERS) will be a crucial part for the acceptance of them. If a big system is built up but few vehicles will use it the acceptance to use the system will go down. At the time of introduction there will be a lot of electric cars on the roads. Be giving them the possibility to use the electric road and stationary charger it will possibly be a lot of vehicles using the ERS. Another option is to build low speed stretches that would enable battery charging with only short sections implemented of ERS.

Click here for extended abstract

2. Operations and maintenance

O11 - Experiences in Road Maintenance Operations on the ELISA pilot site / eHighway Hessen

2. Operations and maintenance

Dominik Gurske[1]
[1] Hessen Mobil

Summary: After the construction of the catenary-based ERS “ELISA- eHighway Hessen” was finished in 2018, a six-month period of 8/5-Operation followed from Mai 2019 to December 2019, and is in regular 24/7 operation since January 2020. This was the first operation of an ERS on a highway in Germany. The operation of such a system presents challenges for road maintenance operators but also offers opportunities for innovation in their task of incorporating ERS into their working environment. Close Cooperation with road maintenance operators is crucial for the implementation of new technologies on today's roads.

Click here for extended abstract

O12 - Insights into the Operation of Overhead Line Hybrid Trucks on the ELISA Test Track

2. Operations and maintenance
Manfred Boltze[1]
Regina Linke, Ferdinand Schöpp[1], Jürgen K. Wilke[1], Özgür Öztürk[1], Danny Wauri[1]
[1] Technische Universität Darmstadt

Summary: The awareness for fuel usage of heavy-duty vehicles and its consequences for environment and transport costs are getting into focus of stakeholders. Therefore, the ELISA project has equipped a five kilometre section of the motorway A5 in the German Federal State of Hessen with the eHighway system in both directions. It's of particular interest to analyse the practical operation of "Overhead line Hybrid trucks" (OH truck) using a catenary system for electric energy supply. Based on results from dedicated research drives, different truck operation modes were identified, and a driver-vehicle-environment model was adapted to the specific conditions of OH trucks.

Click here for extended abstract

O13 - IT Solutions for ERS operations

2. Operations and maintenance

Dan Zethraeus[1]
Kim Svedmark[1]
[1] Elonroad

Summary: Elonroad develop hardware and software and have several ongoing projects for both research purposes and to gain operational experience. Our goal is not only to create a working technology for secure and efficient energy transfer between the power grid and electric vehicles via highly segmented electrified roads, but also to develop IT based solutions to support all stakeholders. We take a look into our current solution and other related emerging solutions to try and find out what is required to successfully implement and support an ERS from a comprehensive perspective.

Click here for extended abstract

O14 - Learnings from Smartroad Gotland: the world's first public wireless ERS for buses and trucks

2. Operations and maintenance

Håkan Sundelin[1]
Stefan Tongur[1]
[1] ElectReon

Summary: Smartroad Gotland is the world´s first public wireless electric road system (ERS) for buses and trucks. The Smartroad concept by ElectReon is based on inductive technology for wireless charging of all types of vehicles and has a real time communication system with vehicles, ensuring safety, energy metering, and smart energy balancing. Given that ERS is a complex infrastructure project, the purpose of the project is to create knowledge to decision makers about wireless ERS and develop the technology so that it is ready for large-scale deployment. This paper describes the learning developed from Smartroad Gotland so far.

Click here for extended abstract

O15 - Optimizing the Installation of ERS by Knowing the Road

2. Operations and maintenance

Lina Nordin[1]

[1] Swedish National Road and Transport Research Institute VTI, VTI / Box 8072 / SE-417 55 Gothenburg / Sweden, lina.nordin@vti.se

Summary: Information based on reports from the ERS demonstration sites in Sweden and discussions with project leaders, and contractors of the demonstration project, was used to understand how the implementation of ERS might be affected by characteristics of the road and its sublayers. The demonstration projects in Sweden all seemed to lack knowledge of the sublayers of the roads, where the technology should be installed. This was mentioned as a cause of delay in the installation process. Suggestions are made for how to optimize as well as what else needs to be sorted out before a large-scale implementation of ERS.

Click here for extended abstract

O16 - Rotating test rig for testing of current collector material for Electric Road System applications

2. Operations and maintenance

Philip Abrahamsson[1]
David Wenander[1], Mats Alaküla[1], Francisco J. Márquez-Fernández[1]
[1] Lund University

Summary: The current collector is an essential piece of equipment for any vehicle charging from a conductive Electric Road System (ERS). The contact material is the material on the vehicle side that interfaces the ERS, and needs to be chosen for the application. Important parameters to consider are contact resistance, coefficient of friction, noise, durability, cost and more. In this paper a new type of test equipment is developed to be able to test different contact materials under conditions similar to the real application.

Click here for extended abstract

O17 - WINNER 1 – First public test of a dedicated DWPT system in Central Europa

2. Operations and maintenance

Maximilian Arnold[1]
[1] EnBW Energie Baden-Württemberg AG

Summary: In the past, Dynamic Wireless Power Transfer (DWPT) systems were not available for commercial operation of electric roads. With WINNER 1, EnBW will test a dedicated DWPT system on a test track of some 600 m with an EnBW shuttle bus, starting in 2020 and lasting for 2 years. EnBW wants to examine the technology maturity, the installation and operational processes, and the public reactions on this new technology.

Click here for extended abstract

3. Transportation network

O18 - Battery electric vehicles' contribution to the viability of charging from below electric road system based on individual driving patterns

3. Transportation network

Wasim Shoman[1]
Sten Karlsson[1], Sonia Yeh[1]
[1] Department of Space, Earth and Environment Chalmers University of Technology, 412 96 Gothenburg, Sweden

Summary: This study uses detailed driving patterns to model the benefits of implementing an ERS in Sweden with charging from below technology that is usable by passenger BEVs. This technology would increase the utilization of ERS infrastructure and possibly lead to significant cost savings in BEVs by enabling smaller batteries. Results show that the required average battery capacity could drop up to 76 % and the expected savings of using smaller batteries range between 0.17 -6.5 M€/ERS km for a total of 2900-9300 M€. The economic net benefit is heavily dependent on the percentage of cars switching to BEV and ERS placement.

Click here for extended abstract

O19 - ERS for the German climate protection strategy for freight transport? A review and synthesis of market diffusion and electrification studies

3. Transportation network

Florian Hacker[1]
Patrick Plötz[2], Julius Jöhrens[3]
[1] Oeko-Institut, Berlin
[2] Fraunhofer ISI, Karlsruhe
[3] ifeu, Heidelberg

Summary: The contribution of overhead catenary-based (OC) trucks to the reduction of transport-related greenhouse gas emissions depends largely on the speed of market ramp-up and the achievable electric driving performance as well as the carbon intensity of the energy used. This contribution discusses and compares the methodological approaches and the results of three comprehensive studies on modelling the market ramp-up for Germany. It compares possible market ramp-up scenarios and their greenhouse gas (GHG) reduction potential, identifies key influencing variables and formulates recommendations for action for the market success of the technology, which can be derived from the study comparison.

Click here for extended abstract

O20 - Feasibility Study of Swedish-German ERS Corridor

3. Transportation network

Julius Jöhrens[1]
Hinrich Helms[1], Gregor Nebauer[2], Darijan Jelica[3]
[1] Institute for Energy and Environmental Research, Heidelberg / Germany
[2] Intraplan Consult GmbH, München / Germany
[3] RISE Research Institutes of Sweden, Gothenburg, Sweden

Summary: This study examines a potential international ERS corridor between Sweden and Germany in the form of a case study. The study aims to illustrate the challenges of a transnational ERS and to discuss potential implementation strategies. For this purpose, we first define relevant criteria to assess the usefulness of establishing an ERS corridor. Technical, economic, environmental, but also political-strategic criteria play a role here. Based on these criteria, we evaluate the ERS corridor using traffic flow analyses and derive recommendations as to what needs to be considered when designing a Swedish-German ERS corridor.

Click here for extended abstract

O21 - Overhead catenary vehicles in south-west Germany? A regional catenary vehicle network and its implications for electricity demand.

3. Transportation network

John Fritz[1]
Daniel Speth[1], Patrick Plötz[1]
[1] Fraunhofer Institute for Systems and Innovation Research ISI

Summary: The introduction of heavy-duty overhead catenary vehicles in Baden-Württemberg (south-west Germany) could have a noteworthy impact on the energy system. We elaborate when, where and how much additional energy is required, based on four levels of market diffusion. Roads to be electrified are selected based on the traffic volume. Hourly resolved traffic flows allow electric load analysis. In an ambitious market diffusion scenario, there is an 8% increase of the electricity demand. In two counties, the total electricity demand increases by more than 30%. The average load increases by 650 MW, the highest hourly peak is even 3.5 times higher.

Click here for extended abstract

O22 - Selecting the most suitable road for electric road infrastructure – optimising for geometry and road design

3. Transportation network

Peter Ekdahl[1]
Christian Nilsson[1], Jonathan Jönsson[1]
[1] Ramboll Sweden AB

Summary: During 2019 and 2020 Ramboll has developed a digital tool that enable road engineers and strategic planners to calculate and compare energy consumption for transport over a finite set of road segments in a 3D perspective. The tool can be used both on existing roads and on virtual roads in the planning and design stage. In the context of electric road systems, the tool is directly applicable for prioritization of where the implementation of electric road systems would be most efficient in terms of saving carbon emissions.

Click here for extended abstract

O23 - Transport Demand Optimized Electric Road Placement

3. Transportation network

Gyözö Gidofalvi[1, 2]
Can Yang[2]
[1] KTH Royal Institute of Technology - Integrated Transportation Research Lab (ITRL)
[2] KTH Royal Institute of Technology - Geoinformatics

Summary: The large-scale deployment of Electric Road Systems (ERS) is a viable pathway for reaching the emission reduction targets in the road-bound heavy freight sector. However, the placement of the electric roads is crucial. In particular, corridor- and segment-statistics based placements are significantly inferior to Route Based Electrification Utility (RBEU) optimized placements. In particular, RBEU-optimized placements electrify up to 3.25 times as much transport work or eliminate the same amount of C02-emissions with 80% less infrastructure investment as corridor placements! These savings are estimated to be up to 0.89 Mt in CO2e-emissions or 1.2 B€ in infrastructure costs for Sweden.

Click here for extended abstract

Correction notice: *The following statement in the abstract is incorrect "These savings are estimated to be up to 300 Mt in CO2e-emissions or 1.2 B€ in infrastructure costs for Sweden.". The correct statement is "These savings are estimated to be up to 0.89 Mt in CO2e-emissions or 1.2 B€ in infrastructure costs for Sweden."*

O24 - Will real fleet operators opt to use electric roads? Case studies on possibility, practicality, profitability and preferability

3. Transportation network

Joakim Nyman[1]
Oscar Enerbäck[1], Stefan Tongur[2]
[1] RISE Research Institutes of Sweden
[2] Electreon AB

Summary: The purpose of this work is to analyse the implementation and use of an electrical road system (ERS) with regards to it being possible, practical and profitable to use the system from a user's point of view. With planned ERS installations as a starting point, the analysis includes studying whether the electric road alternative meets the requirements to be the preferred technology for the user. This study is intended as an interesting complement to higher-level work on business models and national economic aspects to help understand where, when and how to install ERS.

Click here for extended abstract

4. Business and economics

O25 - A Multidimensional Approach for Assessing Technological Development Projects – The Example of Electric Road Systems

4. Business and economics

Mike Danilovic[1, 2]
Tomas Müllern[3], Arne Nåbo[4], Philip Almestrand Linné[4], Jasmine Lihua Liu[2]
[1] Halmstad University, Sweden
[2] Shanghai Dianji University, China
[3] Jönköping International Business School, Sweden
[4] Swedish National Road and Transport Research Institute (VTI, Statens väg- och transportforskningsinstitut), Sweden

Summary: Technology Readiness Levels has become a standard approach to assessment technological development. The origin of TRL is the US moon rocket programs. However, to develop and put into practice advanced technology projects, other aspects are important to evaluate in a systematic way.

This paper provides a tentative model of four main perspectives to analyze readiness levels of technology projects; Technology Readiness Level (TRL), Political Readiness Level (PRL), Social and Societal Readiness Level (SRL), and Commercial Readiness Level (CRL).

To be successful we need to understand the process, interconnectivities and the impact based on all those aspects in an integrated way.

Click here for extended abstract

O26 - Balancing fleet, route and service range for a profitable large-scale implementation of ERS

4. Business and economics

Tobias Bernecker[1]
Jonas Speiser[1]
[1] Hochschule Heilbronn

Summary: The paper gives insight into latest developments in business modelling for ERS as a first outcome of the current evaluation of the ERS testing site “FESH” in Germany. It focuses on interdependencies between ERS roads, ERS fleet, carriers’ service ranges, and consequences for ERS profitability by presenting first results out of the “FESH” accompanying research. Preliminary key findings are five hypothesis, indicating that successful ERS market penetration will need more focus on the basics of commercial truck operations and carriers’ service ranges in order to successfully establish development paths for ERS fleet and infrastructure build up

Click here for extended abstract

O27 - Comparing the cost-efficiency of policy measures promoting ERS

4. Business and economics

Michel Allekotte[1]
Hinrich Helms[1], Julius Jöhrens[1]
[1] ifeu - Institute for Energy and Environmental Research

Summary: High initial infrastructure costs of ERS bear the risk of a financial "valley of death" until sufficient financial revenues can be generated from operators to finance this infrastructure. Promoting ERS by choosing a suitable policy measure might speed up market uptake and reduce this risk. Thus, a major task is the identification of cost efficient policy measures from a government point of view. In order to evaluate this cost efficiency a linear optimisation model is used. The aim of the policy measures is the increase of the vehicle stock and electrical mileage of OC trucks at minimal fiscal cost.

Click here for extended abstract

O28 - Concessions and auctions as models for deployment of electrified road systems

4. Business and economics

Björn Hasselgren[1]
[1] Swedish Transport Administration and Uppsala University

Summary: Electrification of the (heavy) road transportation system based on the deployment of ERS-technology, possibly in combination with batteries and charging infrastructure, promises to be a measure, which can reduce CO2-emssions while also fulfilling requirements of both positive C/B-ratios and financial surpluses for the involved actors. The major challenge of the transition to an electrified structure is how to organise the distribution of electricity to the vehicles (technology) and how to organise the overall system. Here inspiration from models used in other infrastructure areas can be sought. Concession-like structures could be an alternative to government ownership and offer efficiency gains.

Click here for extended abstract

O29 - Financial profitability in an electric road system – a calculation model

4. Business and economics

Björn Hasselgren[1]
Elin Nässtrom[1], Per Skallefell[2], Hanna Sandqvist Wong[2], Sara Erskérs[2]
[1] Trafikverket
[2] EY

Summary: This calculation model analyses financial consequences for various actors in an electric road system and can help to give further understanding of the financial implications of an ERS-system. A set of scenarios with different variables such as traffic flow and length of electric road are analysed, while consideration to other forms of electrification of road transport through e.g. batteries is elaborated on as well. The analysis shows that ERS-systems could be financially viable in a longer-term perspective, as electrified vehicles are introduced on a large scale, also taking the investment cost in the entire system into consideration.

Click here for extended abstract

O30 - Making wireless ERS ready beyond demonstration projects

4. Business and economics

Oren Ezer[1]
Stefan Tongur[1]
[1] Electreon

Summary: Wireless electric road systems (ERS) are based on inductive technology that transmit energy to vehicles that are in motion. While multiple projects have shown that there are many advantages for wireless ERS there has to date been limited commercial success for this technology. Based on Electreon's world leading demonstration projects, this paper addresses the following question: *When is wireless ERS ready to move beyond demonstration project.* The paper defines steps beyond demonstration projects and discusses identified challenges of technologies related to scalability. The conclusion is that wireless ERS will be ready to move beyond the demonstration project phase in 2021.

Click here for extended abstract

O31 - Market Creation: Studying the Business Case of Potential ERS Users

4. Business and economics

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Summary: The implementation of ERS faces challenges regarding creating a market that is attractive for end users to enter. Therefore, this study explores barriers and opportunities of ERS from a user perspective. The pilot of road 73 is studied from a perspective of market creation. In order to get insights from actual cases, three identified end users are leading the research: Coca Cola, Norvik Hamn and Flygbussarna. The results include describing business opportunities and barriers that are expected for end users from a commercial ERS launch. Additional results explain business model implications from a system with static and dynamic charging.

Click here for extended abstract

O32 - Regulative framework for overhead contact lines for trucks on motorways: a European approach for interoperable ERS infrastructure, financing, billing

4. Business and economics

Matthias Hartwig[1]
Markus Staub[2], Werner Pfliegl[2]
[1] Institut für Klimaschutz, Energie und Mobilität e.V.
[2] Siemens Mobility GmbH

Summary: In order to establish a feasible system of financing and billing Electric Road Systems (ERS), it should not be classified as part of the electricity distribution grid. Suggested is a two-step system of financing and billing ERS which will facilitate the development of the infrastructure and ensure the acceptance and conversion of the market within already existing billing systems. The transition between the steps and each necessary regulation in order to implement the steps need to be as concrete and politically and regulatory reliable as possible.

Different techniques in different countries might still be interoperable in usage and billing.

Click here for extended abstract

O33 - When can batteries and stationary charging be cheaper than electric road systems?

4. Business and economics

Anders Grauers[1]
[1] Swedish Electromobility Centre / Chalmers

Summary: A detailed analysis of the cost for battery electric vehicles and stationary charging infrastructure are compared with a simple cost estimate for ERS, and that indicates that several of the heavy trucks may prefer rather big batteries and stationary charging over ERS. It will also be shown how even long-haul trucks can be cost effective using batteries and stationary charging. The conclusion is that these results call for a more detailed comparisons to determine which trucks will prefer to use stationary charging despite driving on roads with ERS.

Click here for extended abstract

O34 - Work towards an interoperable pan-European payment system in electric road systems

4. Business and economics

Johan Hedin[1]
[1] Hybris Konsult AB

Summary: There is an urgent need to define the provisions for an interoperable pan-European payment system to be used in electric roads systems. This paper outlines the essentials for such work which comprises: Standardisation, defining the interoperable framework, system architecture, alignment with existing payment systems for road tolling, alignment with EU-directives (the EETS) and a roadmap for action and co-operation. An essential part of this analysis is to use the experiences and work from the road tolling sector and apply it to ERS.

Click here for extended abstract

5. Societal readiness

O35 - Actor networks around catenary hybrid trucks in central Europe: An analysis over time

5. Societal readiness

Aline Scherrer[1]
Uta Burghard[1], Iska Brunzema[1]
[1] Fraunhofer ISI

Summary: As one type of electric road system (ERS), catenary hybrid trucks (CHT) can contribute to the decarbonisation of heavy road transport. As a technological niche, CHT represent an alternative to the currently dominating regime technology of diesel-powered trucks. For the successful growth of this niche, growing actor networks are considered a key element in the multi-level perspective (MLP) and strategic niche management (SNM). This paper shows that the actor network around the technological niche of CHT in Germany and Europe has grown and become denser since the initiation of the field trials in Germany but that some network bottlenecks remain.

Click here for extended abstract

O36 - Carbon footprint of ERS in Germany

5. Societal readiness

Kirsten Biemann[1]
Hinrich Helms[1], Julius Jöhrens[1], Michel Allekotte[1]
[1] ifeu

Summary: This presentation compares the carbon footprint of different ERS trucks with a conventional diesel truck. Overall, greenhouse gas emission for the ERS truck are still dominated by the well-to-wheels emissions, especially due to the German electricity mix. Nevertheless, greenhouse gas savings of up to 20% can be achieved.

Click here for extended abstract

O37 - Challenges and progress in standardization of the interaction between pantograph and overhead contact lines on electrified roads

5. Societal readiness

Christian Saliger[1]
[1] Siemens Mobility Austria GmbH

Summary: In order to offer a cost-effective and potentially CO2 neutral alternative to today's methods of road transportation an interoperable access for properly equipped commercial road vehicles with suitable pantographs on overhead contact line equipped roads needs to be ensured. Clear regulations are essential to enable all involved parties alike to make informed decisions and offer sustainable solutions for a cleaner future. To achieve this CENELEC TC9X WG 27 project 70743 was initiated to standardize the interaction between pantograph and overhead contact lines on electrified roads with a clear-cut scope covering all necessary parameters such as interfaces, safety and testing.

Click here for extended abstract

O38 - How will we decarbonize heavy road transport? Role of electric road systems and hydrogen solutions from an energy system perspective.

5. Societal readiness

Anna Trendewicz[1]
Carsten Borchers[1], Dmitri Artemjew[1]
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Summary: Sustainability and decarbonization of our global energy system are the challenges for the 21st century. E.ON's purpose is to lead the energy transformation towards a connected and sustainable world. How could we contribute as energy networks operator? In this study we take a closer look at the decarbonization of heavy road transport. How could we use the key technological solutions: electric road systems (ERS), ultrafast charging and hydrogen? Will we see a dominant solution or a balanced portfolio? What will this mean financially? This short article summarizes our perspective on this topic from the energy system point of view.

Click here for extended abstract

Posters

1. Technologies and systems

P1 - Cutting-edge technologies for an ERS test track

1. Technologies and systems

Renato Mazzoncini[1]
Marco Francesco Bocciolone[1], Dario Zaninelli[1], Morris Brenna[1], Luca Zanzottera[1]
[1] Politecnico di Milano

Summary: Different supply systems for Electric Vehicles in Electric Road Systems (ERS) are investigated by Politecnico di Milano funded by BREBEMI S.p.A. (the A35 motorway concessionary) in the concession framework, considering: overhead catenary line, dynamic wireless power transfer and ground-level power supply. The paper deals with the investigation and design of the above-mentioned technologies applied to a test track nearby the A35 Milano-Brescia motorway in the north of Italy. This 1 km long test track represents a novelty among the test sites because allows real experimental applications of multiple ERS technologies in the same place with the same load conditions.

Click here for extended abstract

P2 - Prestudy of optimizing electrification of lightweight landfreight distribution using an Electric Road System

1. Technologies and systems

David Wenander[1]
Philip Abrahamsson[1], Mats Alaküla[1], Francisco J. Márquez-Fernández[1]
[1] Lund University

Summary: In order for the urban distribution sector to electrify their vehicle fleets, easy to use charging infrastructure
needed. There is not enough time for most drivers within the distribution sector to stop and connect their vehicles
for charging during their routes as managing time is essential to maximize profit. Consequently charging
to be automated to minimize the need for driver interaction. In this paper automatic charging with a conductive
Electric Road System (ERS) is compared with conventional AC charging for a city distribution truck.

Click here for extended abstract

P3 - Swedish Powertrain TEAD

1. Technologies and systems

Anders Göransson[1]
[1] ERSC2020

Summary: Swedish Powertrain offer a comprehensive and innovative range of systems and components for the Powertrain of vehicles. Production in 15 plants, Sweden, Germany, Hungary and Brazil. Since 2010 engaged in research and development of electric powertrains. Below focus on our product TEAD. TEAD is a twin motor system adapted for electric roads. By an intelligent switch system gives the opportunity to switch the motors function drive or charge or in combination. The product perfomance is based on the research project MFEA supported by the Swedish Energy agency in cooperation with the University of Lund and Volvo AB.

Click here for extended abstract

2. Operations and maintenance

P4 - eHighway Hessen / ELISA pilot site: first year of operation of the first German eHighway

2. Operations and maintenance

Igor Rudgartser[1]
[1] Hessen Mobil Road- and Traffic Management, Frankfurt/Main

Summary: For more than a year eHighway Hessen is in operation. Three phases have been run through. From operation on selected and announced days and times to 24/7 operation in which the system is operated until the end of the project. This approach was chosen because eHighway Hessen is located on a very heavy traffic section of the federal motorway. This paper explains the chosen approach, describes gained experience as well as outlines the lesson learned. As part of the presentation, a brief analysis of the 2-3 most important incidents by May 2020 is planned as a case study.

Click here for extended abstract

3. Transportation network

P5 - Electric Regional Bus based on City ERS

3. Transportation network

Mats Alaküla[1, 2]
Madeleine Rosicki[3]
[1] Professor, Lund University
[2] Senior Advisor, AB Volvo
[3] MSc EE

Summary: In this paper it is analysed how regional bus traffic operating to/from the city of Lund (Sweden) benefit from using an ERS designed for supplying the city bus traffic only. Lund city needs about 11% of the total city bus route length covered with ERS to provide the whole city bus network. It is shown that full electric regional bus lines, if they use the ERS charging in both route ends, make up about only 6 % of the total bus route length in Lund, corresponding to a proportional reduction of the ERS cost for the city bus traffic.

Click here for extended abstract

P6 - Potential Electric Road Network for Finland

3. Transportation network

Tapio Ojanen[1]
Taina Haapamäki[2]
[1] Finnish Transport Infrastructure Agency
[2] FLOU

Summary: The Finnish Transport Infrastructure Agency (FTIA) is preparing a report about the possibilities and challenges of implementing an electric road system (ERS) in Finland. This presentation will focus on the analysis of the potential electric road network from the perspectives of road traffic volumes, CO_2 emissions mitigation potential, investment costs and revenues.

Click here for extended abstract

P7 - RegionEl – a joint initiative to accelerate the adoption of light and heavy duty vehicles in West Sweden

3. Transportation network

Gunnar Ohlin[1]

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Summary: RegionEl is a joint initiative involving public and private actors with the overall purpose to facilitate and accelerate the adoption of light and heavy electric vehicles in order to meet the climate goals for the transport sector. One of the project aims is to create a consortium with participants from the automotive industry, hauliers, grid operators, real estate owners and other actors and in collaboration with local municipalities and the region of Västra Götaland produce a plan for the building of a robust charging infrastructure that can accelerate the transition to heavy electric vehicles.

Click here for extended abstract

4. Business and economics

P8 - Fuel retailer business model adaptation to the vehicle electrification trend

4. Business and economics

Gustav Thorsell[1]

[1] Royal Institute of Technology (KTH) & The Swedish Transport Administration

Summary: Cars and heavy-duty vehicles have traditionally relied on the use of the internal combustion engine, with the inherent need of fossil fuels as propellants, normally supplied by fuel retailers. Today, we seen an increasing adoption of electric vehicles, which subsequently rely on electricity rather than fossil fuels as energy carriers. This shift in demand may create an external transformation pressure on fuel retailers to adapt accordingly. The aim of this study is to map suitable business models and the capabilities of fuel retailers to address the challenge.

Click here for extended abstract

P9 - Alternative organisational and business models in ERS

4. Business and economics

Per Skallefell[1]
Linda Andersson[1], Kristin Skjutar[1], Viktor Arfwidsson[1]
[1] EY

Summary: To create viable and sustainable business models for ERS, is it possible to use alternative organisational and business models? Can it be in collaboration between public and private parties? By involving private parties in public infrastructure projects, it's possible to share responsibilities and financing to create incentives that can increase efficiency and improve the solution. Previous research and experiences indicate that it can become more efficient than traditional models and as there are similar prerequisites for ERS, alternative models could be suitable in the further development. It's also important to aim for developing commercially viable business for all parties involved.

Click here for extended abstract

P10 - Benefits and effects of electric roads

4. Business and economics

Stefan Grudemo[1]
[1] Swedish Transport Administration

Summary: Knowledge of the benefits and effects of electric roads is limited. Effects like vehicle costs, road wear, road safety, emissions including carbon dioxide and also noise are possible to calculate in a socio economic calculation. Others like environmental and climate impact from a life cycle perspective, electromagnetic fields and effects on landscape, nature and cultural environment has to be analysed in other ways

Click here for extended abstract

P11 - Defining the eco-system for interoperable electric road systems in Europe

4. Business and economics

Johan Hedin[1]
[1] Hybris Konsult AB

Summary: If electric roads systems are implemented in several countries across Europe, there needs to be provisions in place to enable users to use the systems seamlessly in other countries without having to change equipment or enter new contracts. Hence the interoperable cross-border eco-system for ERS need to be defined to be able to tackle the challenges lying ahead of a pan-European deployment of interconnected ERS-schemes. This paper outlines the first steps towards defining an eco-system for interoperable ERS as a part of a staged approach for cross border implementation of ERS over Europe.

Click here for extended abstract

P12 - The benefit of ERS for the city buses in Lund

4. Business and economics

Joakim Ahlberg[1]
Emma Lindvall[1], Ola Olsson[1]
[1] Ramboll Sverige AB

Summary: What is the benefit of an electric road system for the buses in the city of Lund? In trying to answer that
question a socio-economic analysis is conducted. Both a societal and a business approach are used to answer
the following questions:

What the benefit:
· of society,
· of the infrastructure manager;
· to technology providers;
· for energy suppliers,
· to operators,
· of product owners,
will be if the bus network in Lund is fully electrified.

Click here for extended abstract

5. Societal readiness

P13 - A Study on In-Motion Charging for electric three-wheeler in India

5. Societal readiness

Suyash Singh
Smarajit Basu[1]
[1] BBS College of Engineering and Technology, Prayagraj

Summary: Detailed study on In-motion [1] charging concept for electric three-wheelers in Indian smart cities will be done. With huge market potential to make the business viable due to large volume of vehicles present and it will make smooth movement of three-wheelers in every city. The study will have different sections from finding the list of potential cities for setting up the In-motion charging tracks to viable business models, environmental impacts consumer acceptability etc. In this detailed study process a comparative analysis on different types of In-motion charging techniques will conclude the be best suitable for electric three-wheeler in India.

Click here for extended abstract

P14 - Electric Road Systems, Intelligent Transport Systems, and Electronic Fee Collection – An Inventory of Standards

5. Societal readiness

Philip Almestrand Linné[1]
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[1] VTI - Swedish National Road and Transport Research Institute
[2] SIS - Swedish Institute for Standards

Summary: The main objective of this study is to create an overview of, and to analyse, which standards that are directly or indirectly central for ERS in the area of intelligent transport systems (ITS) and electronic fee collection (EFC). The study employs a combination of qualitative and quantitative methods including literature studies, an interactive stakeholder workshop, and expert reviews of a tentative listing of ITS and EFC standards that are potentially applicable to ERS. The main result is a preliminary inventory of ITS and EFC standards, including 45 EFC standards, of which 33 have been marked as potentially applicable to ERS.

Click here for extended abstract

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