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Electric Road System- Business Model

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ABSTRACT

Electric Road System (ERS) is a road that supplies electric power to the vehicles travelling on road. Common implementations are overhead power lines above the road and road-level power supply through conductive rails or inductive coils embedded in the road. In this study we elaborated the possible methods of electric supply though electric roads to the electric vehicles. We also describe a business model require to implement this technique into actual practice.

KEYWORDS: *Business model, dynamic charging, electric road, electric vehicles, energy network, ERS, maintenance, standardization*

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INTRODUCTION

Electric Road Systems (ERS) are principle electrified roads that are suitable for dynamic power transfer to the vehicles on the road. Commonly an electric engine receives power from an external power source which has been assimilated into the surface of the road. The transfer of the electrical power is made during the vehicles are in motion in a similar fashion as that for trolley buses, where the main difference is that ERS-vehicles can connect and dissociate from the power supply while in moving. Accordingly, the roads with ERS can be utilized by both vehicles with conventional fossil fuel as well as ERS-vehicles. To install ERS-vehicles more adaptable they are frequently fitted with batteries or lower internal combustion engines (ICE) so that they also can be operated on conventional roads.

ELECTRICITY SUPPLY TO EVS

There are basically three physical ways that a vehicle can be charged while driving on the road, i.e., from above, the side or from below. Unfortunately, charging from the side is too dangerous for pedestrians and bicyclists due to the fact that an arm apparatus would require to stick out from the side of the vehicle, this approach is not accounted as an option. So, the result is that, there are currently three technologies of ERS that are considered in the industry, i.e., conductive power transfer through overhead lines, conductive power transfer from rails in the road and inductive power transfer through the road pavement [6].

A. Overhead Conductive Transmission Technology

The overhead contact line power transfer technology has existed for many years and is conductive based technology; actually, it is the same technology that is used in present trains, trams and trolleybuses. In other words, electricity in such a system is continuously transferred from the overhead power lines to the vehicle through a so called pantograph. A pantograph is an element that connects the overhead power lines to the vehicle and it can transfer electricity between the overhead line and the vehicle. Across the roads there are electricity pylons that support the electricity cable. The systems applying overhead transmitting lines today are generally closed systems. They generally involve vehicles that journey along a preset path while continuously been attached to the overhead lines and in more cases also are connected to a rail in the ground.

Fig.1. Overhead Conductive Transmission Technology

B. Conductive Power Transfer from Road

The conductive power transfer from the road is a recent technology compared to that of overhead power transfer cable. The French company Alstom opened the first tramway system in Bordeaux (2003) with their conductive road transfer technology named Aesthetic Power Supply (APS). Not only did the APS technology prove that conductive road transfer is feasible, but also displayed that the technology was secure to utilize and more aesthetically pleasing corresponding to some then compared to conventional overhead contact lines. Since then, several cities around the world have integrated the APS system. In 2015 Alstom executed SRS, which is an innovatory ground-based static charging system for electrical motorcars based on the APS technology. Alstom has likewise been working in collaboration with Volvo on an ERS that allows nonstop conductive power transfer from road for trucks. The Swedish organization Elways has also evolved its own technology of conductive power transfer from road known as Elways. Unlike the ERS developed by Alstom and Volvo which is designed only for trucks, Elways has rather developed a system that can be used by all types of vehicles.

In short, Elways technology enables electricity transfer from the power grid to rails in the road. This means that there is a lack of a current collector or pickup arm to connect the rails in the road to the vehicles. To raise the overall safety for humans and animals, the power supply rails is segmented.

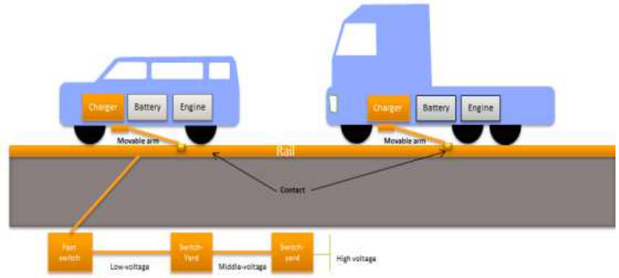

Fig.2. conductive power transfer from road

C. Conductive Power Transfer from Road

Before Inductive ERS use induction principles to transmit electricity wirelessly to vehicles in motion, which means that no mechanical contact is demanded. In other words, the inductive power transfer technology utilizes the AC transformer principle. Figure can be used to describe this principle. conventional AC transformers, which generally used in power distribution systems, have laminated iron core that conduct the magnetic flux from a first winding through a secondary winding with miniscule effectiveness loss due to loss and leaking. This is showed in figure A. still, to allow the inductive power transfer technology, the core is resolve into two different parts as shown in figure B. Accordingly, the inductive power transfer by road technology works by having the secondary winding of the transformer laid in the vehicle while the primary winding is stretched and installed into the road. This allows magnetic flux to be transmit between the road and the vehicle, therefore allowing nonstop power transfer as shown in figure C. To allow the transmission, likewise this solution requires a class of pick-up arm, which corresponds to another side of the transformer as shown in figure C.

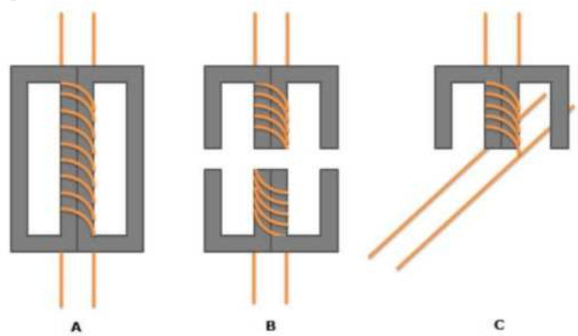

Fig.3. The principle behind the inductive power transfer from road technology.

BUSINESS MODELS

Electric road system would require interfaces between several players like the electricity supplier, the power grid company, the vehicle manufacturer, the road owner, the electric road technology operator, the metering and payment provider, and the user of the electric road.

A. Stakeholders

The automotive firms have to develop technical capability and a business model for vehicles that can be incorporated into the ERS, no matter which power transfer technology that becomes the standard.

Petroleum firms will continue to be significant but will require handling the fact that they will most likely become secondary fuel suppliers. Therefore, a requirement for reinvention and enforcing complementing new businesses, alike as fast charging and battery switching stations will most probably be needed.

The Construction firm's role will be to integrate the electric transfer technologies in the roads as well as the electric grid in a secure and durable manner. A new demand for public-private partnerships could be a possibility.

Government and agencies will probably have to play an important part in facilitating the investments in ERS. The main motivation for them will be to decrease the environmental impact, oil imports and raise the energy efficiency. New national and international policies will most likely be needed as loss in oil taxes and currency savings from oils imports will be removed. Also, export of ERS technologies could become a new demand of income.

Users could potentially decrease their fuel charge due to raising energy efficiency and the comparably low electricity charge (however, the electricity charge are expected to rise). Moreover, the user could use a system that is more environmental friendly

Road power technology firms could be firms delivering the different power transfer technologies. The main role in the ERS business model for these firms is yet to be identified.

Lastly, the Power companies producing electricity will become the primary energy supplier and must hence also develop and dimension the power grid to be suitable to handle the rise in the electricity consumption needed. Likewise, designing and delivering power stations connecting the electrified roads is a new potential business demand in combination with raising the sales of electricity for the power utility companies.

Fig.4. The major stakeholders in the ERS

B. ERS actor constellations

The introduction of electric roads influences a number of public and private actors. The association of actors in different ownership configurations and financing models (public-private partnerships [PPP]) has a major impact on the design of desirable value propositions and profit models. Road operators, transport operators, and energy firms must work together for ERS increment.

New roles and business models can also be developed when executed roles are disturbed by additional investment see Figure, The role of the 'Electric Road System Operator' (ERSO), the actor responsible for the operation of the road, is an example of a central actor who doesn't yet exist and whose possible identity is not yet established. We have specified feasible components of the ERSO role and bettered understanding around what is needed for such a role.

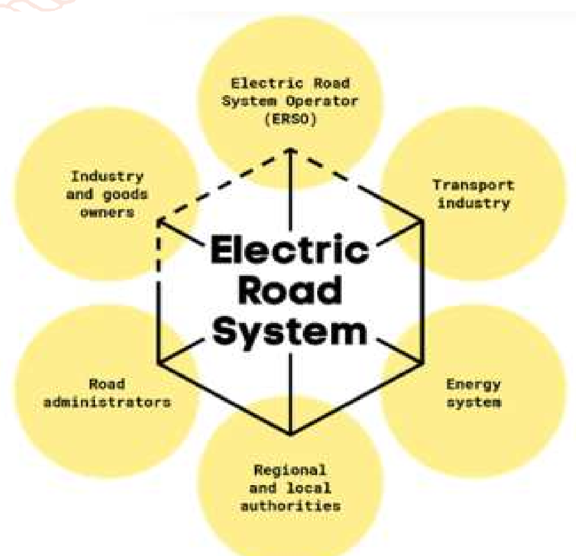

Fig.5. The Business ecosystem with various actors and new roles

C. Access control and payment

Access control is a critical part of the dealing between the ERS and the vehicles traveling on it. It will be important to check that every vehicle on an ERS is licensed to use it, and vehicle has the right technical capabilities to do so safely. A possible way forward is to integrate or base upcoming ERS access system solutions with existing fleet management and information systems.

Electric road users will have to pay both for electricity and use of charging infrastructure and payment may be divided into both fixed and variable charges. Payment systems will therefore be necessary and should be flexible and adaptable.

There are existing specialized solutions that could be applied to ERS. However, further explanation is needed around how a payment system should be divided into factors installed in vehicles and those executed on the road.

CONCLUSION

- There are many reasons to invest in electric roads. Among them is the capability of reducing our dependency on fossil fuels and decreasing noise levels in cities.
- When ready for the execution of electric roads, it is also required to research the effects of electromagnetic fields. The feasibility of using different protecting technologies should also be considered, to protect people and electrical appliances in the vicinity of electric roads.
- Introducing electric roads nationally and globally will involve major investment, so it is significant to examine the profitable effects and advantages to society.
- We have set up that the large-scale preface of electric roads would direct to important earning in terms of the costs of energy employed in the transport sector.
- The electricity industry emphasized the significance of understanding how electric roads will be connected to the electricity grid, so that they can make applicable investments in the already existed grid.

References

[1] Kreutzer, Dr. U. and Blocher, Dr. E. On the road – With electric power. From the trolleybus to the eHighway. [online]. 2021. Available: https://new.siemens.com/ global / en / company / about / history / stories / on - the - road - with - electric-power.html.

[2] Bateman D. Leal, et al. Electric Road Systems: A solution for the future? Tech. rep. 92055 La Défense CEDEX, France: The World Road Association (PIARC), 2018. Available: https://www.trafikverket.se/contentassets/2d8f4da1602a497b82ab6368e93baa6a/piarcelvag.pdf

[3] Etemandrezaei, M. and Rashid, M. "22 Wireless Power Transfer". In: Power Electronics Handbook (Fourth Edition). ISBN: 9780128114070. Butterworth Heinemann, 2018, pp. 711–722.

[4] Panchal, S. Stegen and Lu, J. "Review of static and dynamic wireless electric vehicle charging system [online]". In: Engineering Science and Technology, an International Journal (JESTECH) vol. 21, Issue 5 (2018). ISSN: 22150986.

[5] Thampim, P. and Poulose, T. "Status of The Technology for Electrical Road Focusing on Wireless Charging". PhD thesis. Halmstad, Sweden: Halmstad University, 2020. Available: https://www.diva-portal.org/smash/get/diva2:1453380/FULLTEXT02

[6] Sam Schaap. "Review of Electric Road Systems". M.Tech. thesis. Kth royal institute of technology: Stockholm, Sweden, 2021.