IEA Task 45 Electrified Roadways (E-roads) Webinar #1
September 17, 2020
Discussion Highlights

Attendees

Lee Slezak, DOE, VTO	Rosemarie Cramer, Ministry of Infrastructure & Water Mgmt	Magnus Lindgren, Swedish Transport Administration	Ingrid Sundvor, Institute of Transport Economics
PT Jones, ORNL	Veda Galigekere, ORNL	Burak Ozpineci, ORNL	Arjan van Vliet, Ministry of Infrastructure & Water Mgmt
Ellen Bourbon, AST/DOE	Alix Jiran, CATARC	David Smith, ORNL	Manish Mohanpurkar, INL
Sigve J. Aasebo, Norwegian Public Roads Administration	Stephane Laporte, VEDECOM	Hakan Sundelin, Electreon	

These discussion highlights are intended to condense the full notes of Task 45's first informational webinar and provide a summary of the discussion and background for the Task's scope and working methods. The full notes (transcription of the webinar) will be posted on the Task 45 website and are also available upon request.

Based on the discussions from this webinar a number of topics will be shared with the Task 45 member countries for consideration into the task scope and focus areas of interest. These topics include but are not limited to:

1. Appropriate power level requirements for various categories of vehicle E-roads systems
2. Considerations for E-roads system flexibility in terms of vehicle categories versus optimization of the system for specific vehicle categories
3. Requirements and applications
    a. Climatic and geographic considerations
    b. Connected and autonomous vehicle technologies
    c. Communications
4. E-roads and grid system resiliency
    a. Cyber security impacts
    b. Grid disruptions
5. Development of standards (including safety) with a process that does not impede technical progress in an immature technology area
6. Identification of a performance metric for electric road system evaluations

Introductory Remarks

A brief introduction to the task was provided by Lee Slezak of the U.S. Department of Energy which includes a webinar series to set the theme for the discussions on E-roads and related technologies. Some of his key points were:

- DOE invests in mobility electrification R&D and supporting electric grid R&D
- Task 45 is follow-on work to the IEA Task 26 – Wireless Power Transfer for EVs
- The reason for the task and the webinar series is information exchange

  "It's only through these connections and establishing collaborative activities and sharing information that we'll be able to advance (E-roads) technology" Lee Slezak

P.T. Jones led the introduction into Task 45's technologies of interest (TOI) areas, noting is was not a requirement of Task 45 to determine a superior technology – but to utilize, coordinate and collect information from work done or planned for each of the technology areas to advance E-roads in general. While some technologies might be good for a specific area/environment or use case, there may be subsystems of that technology which may be applied in other systems, which would yield a greater impact for E-mobility. This task is looking for commonalities and barriers so we can help people doing the research.

The four TOIs (Slides posted to the Task 45 webpage will have examples of the TOIs)

- Dynamic Wireless Power Transfer (DWPT)
  - High flexibility, enabling use by a variety of vehicle categories
  - Technology requirements level is high
- Non-road Conductive (Overhead)
  - Recent highlights with HD trucks on demonstration routes and use cases
  - Includes new bus architectures (with advanced energy storage systems) using legacy trolley infrastructure. New buses are capable of distances over 12 km without connecting to an overhead power line
  - Technology requirements level is medium

Sweden has actively been demonstrating this technology and answered questions as to the method to determine power levels for the systems as well as involvement from various project partners. Their effort is focused on HD vehicles and the vehicle systems typically operate in the 700V range.

- Non-road conductive (Side)
  - With speed and power levels established, the side connection point offers flexibility to move vehicles
  - Honda prototype examples, no other known deployments
  - SAE Technical Paper 2018-01-1343, T. Tajima, H. Tanaka
  - Technology requirements level is medium

- In-road conductive
  - Technology requirements level is low in the area of power exchange
  - How does the rail system work with materials in the roadway itself, and how does it mature with time and as the temperature changes?

There has been a 2 km project in operation on a public road in Sweden since 2018. Continued discussions on this deployment related to lane positioning and route selection for the demonstration.

Standards

Regardless of the chosen TOI, standards will be required for a number of systems, some focused solely on sub-systems for the transfer of power, communications or possible automation and others related to merging the road infrastructure with electricity infrastructure. Though it would be advantageous to unify the standards, there may be E-roads standards that are specific to personal vehicles and others for commercial vehicles (SAE J2954 and J2954/2 static wireless charging of EV guidelines are examples). Possible standards topics include:

- Power levels, connection, alignment, and component location
- Communications and automation
- Roadway technology integration

Meetings attendees recognized the need for standards but noted that standards placed on an immature technology might inhibit technology development. Lee Slezak noted the example set by the “CharIN” workgroup for high power conductive charging, where the group is building a reference document which will be submitted to a standards organization for adoption.

Standards are difficult to develop in an immature technology arena, sharing information and data collection efforts of demonstrations will be beneficial to the creation of standards.

<u>Interoperability</u>

How should this task quantify the importance of interoperability (between technologies or vehicle classes) and look at the various methods of vehicle connection to the E-Road for different vehicle categories? There was recognition that R&D needs to be conducted to quantify the impact of the various vehicle categories to prioritize connection methods and the impact of competing technologies to enable e-mobility through other methods (i.e. extreme fast charging (XFC)). The potential impact of dedicated lanes for technology deployment was also a topic of interest.

<u>Vehicle and Driver Requirements</u>

Certain E-Road technologies may require specific vehicle to grid interface equipment and possibly vehicle automation at some level to reduce driver workload. It was noted that a number of the E-Road technologies (i.e. Electreon and Siemens ‘E-Highway’) do not require additional lateral vehicle control other than the driver staying within their lane. Another topic was a vehicle’s diagnostic capability to identify if it could remain in operation in the event of a grid failure (i.e. would a vehicle have sufficient on-board charge to maintain operations and not interfere with traffic). This area will require additional development and will be in scope of Task 45.

Additional discussion topics were system resiliency and communications (including cyber security), safety and power electronics. As E-Roads would be a primary energy source for these electric vehicles, the integrity of the system and its ability to maintain point of connection (POC) to the grid is critical. If the system is damaged or inoperable, how will it communicate with vehicles to relay the required alternative plans for vehicle power? Similarly, the ability of the chosen system to be flexible in power delivery and selection of road infrastructure to be electrified are large tasks.

Road debris and vehicles which damage infrastructure need to be planned for as well as technology disruptors (hacks or sabotage attempts). Both roadways and the electric grid infrastructure are susceptible to outside interference, combining these systems increases the possibilities for disruption. Each TOI needs to be evaluated for their resiliency and robustness.

The inclusion of cyber security as focus area will be discussed in detail during the next webinar to understand the appropriateness of this subsystem to be within the scope of the task.

<u>Presentations</u>

The general discussion portion of the webinar was followed by two E-Roads demonstration project presentations. The slides will be posted on the Task 45 website. The first presentation by Veda Galigekere from ORNL outlined the progress and technical challenges for a high power dynamic wireless charging project to be deployed at the American Center for Mobility (ACM) in Michigan. The interim research results have led to the selection of demonstration power levels, required equipment and associated costs for a scaled deployment.

The second presentation by Stephane Laporte of Vedecom, briefly discussed the scope and results from the FABRIC E-Roads demonstration project in Europe and the transition to the new INCIT-EV E-Roads project. Each of these projects focused on multiple charging technologies and numerous partners at locations throughout Europe. The INCIT-EV project will have two dynamic wireless power transfer projects, one on the city streets of Paris and one on a test track at Satory in Versailles.

Closing Remarks

The webinar closed with a brief discussion of the scope and general timing for Task 45, discussions about the content for follow-on webinars, and the need for IEA HEV-TCP member countries to engage with the task. One topic of discussion related to the ability to evaluate the technologies through a developed performance metric. This would help policy and decisions makers compare and contrast the various technologies based on specific characteristics. These individuals could prioritize characteristics for their specific region or deployment scenario. This concept of a developed performance metric will be part of a focused discussion during the next webinar. Information about the task will be updated on the HEV-TCP website as soon as the Task 45 page is available.