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International Cooperation under the Hybrid & Electric Vehicle Technology Collaboration Program

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Executive Summary

The International Energy Agency (IEA) established a Technology Collaboration Program (formerly called Implementing Agreement) on "Hybrid and Electric Vehicles" in 1993. Today 18 member countries participate in twelve working groups related to electric vehicles, components, deployment, infrastructure, and environmental/economic issues. Recent activities and key results from these working groups are described.

1 Introduction

The International Energy Agency (IEA) is made up of 31 member countries and has a network of 40 collaborative research programs, designated as the Technology Collaboration Programs (formerly called Implementing Agreements) as part of the IEA's Energy Technology Network. These programs foster the collaboration of government organizations, national laboratories, research institutes, universities and industrial companies. The aim is to speed up the technical and non-technical problem solving in the field of technologies for energy efficiency, more efficient use of resources, and the use of renewable energies. The goal is a broader and more stable energy supply and a limitation of CO_2 emissions. One of the key technologies is transport. It is one of the major sources of CO_2 emissions, it relies mainly on fossil fuels, and it is very energy-inefficient.

The IEA Implementing Agreement for co-operation on Hybrid and Electric Vehicle Technologies and Programmes (IA-HEV) was set up in 1993 as a basis for collaboration on pre-competitive research and the production and dissemination of information. In 2016 the name of the agreement changed to Hybrid and Electric Vehicles Technology Collaboration Programme (HEV TCP). Today, the HEV TCP has 18 participating member countries. The HEV TCP member countries are Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, South Korea, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

2 Activities

Every five years the Implementing Agreement prepares and delivers a new five-year work plan to the IEA headquarters. The work plan for 2020-2024 has been completed and approved. Under the new rules, participation of non-IEA countries is possible. This allows important countries in the production and the use of hybrid and electric cars to participate and to contribute to the international research activities.

The actual activities are carried out under working groups, or Tasks [1]. Countries join various Tasks depending upon their particular interests. An individual Task typically has about 3-10 participating countries.

Recently completed working groups focused on small electric vehicles [2], wireless charging [3], economic impacts of EVs [4], consumer adoption of EVs [5], and vehicle-to-systems integration (V2X) [6].

The fifteen current or recently completed working groups are:

Task 1: “Information exchange” - Activities include semi-annual meetings country experts, an annual report [1], a newsletter, and a web site (www.ieahev.org).

Task 23: “Light electric vehicle parking and charging infrastructure” -- Objectives are to document existing solutions for best practice, create turnkey guidelines for local governments, and conduct workshops for interested communities.

Task 37: “Extreme Fast Charging” -- Objective is to understand impacts, requirements, standards, and benefits for charging rates up to 1 MW. The Task investigates station siting factors, quantifies cost of installation, documents power supply and grid connection, understands implications of extreme fast charging on battery design and cost, understand pay structure, and study consumer education.

Task 38: “Marine Applications of Hybrid and Electric Systems (e-Ships)” – Objectives are to provide a leading platform on e-Ships, bridging “blue” maritime, “green” energy, e-mobility and automation perspectives; to characterize and showcase the technology, economics, energy and environmental aspects, applications and market potential of e-Ships; and to provide data and recommendations to policymakers to accelerate adoption and market acceptance of e-Ships.

Task 39: “Interoperability of e-Mobility Services” -- This Task focused on the charging infrastructure and more specifically on the interoperability aspects of e-mobility services like charging of passenger cars in the public and semi-public domain.

Task 40: “Critical Raw Materials for Electric Vehicles”. With mass deployment of EVs, attention is drawn to potential supply chain issues for several critical raw materials needed for EV and battery manufacturing.

Task 41: “Electric Freight Vehicles: The main objectives are to monitor progress and review relevant aspects for a successful introduction of electric freight vehicles (EFV) into the market.

Task 42: “Scaling Up EV Markets and EV City Casebook”. This task aims to collect learning and best practice from existing and planned large scale deployments of EVs around the world.

Task 43: “Vehicle/Grid Integration”. This task analyses the challenges identified on the integration of the electric vehicles into our electricity and transport system in order to improve economic and environmental performance.

Task 45: “Electrified Roadways (E-roads)” -- To develop a greater global understanding and awareness of electrified roadways (E-Roads), as well as related technologies developed and deployment activities in the participating countries.

Task 46: “Life-cycle Analysis of Electric Trucks , Buses , Two wheelers and Other Vehicles”.
Analyse, discuss, and document the environmental impacts based on life cycle assessment of electric buses, trucks, two-wheelers, and other vehicles (mining, agriculture, train, etc.)

Task 47: “Electrification of Ground Goods Movement in Ports”

Task 48: “Battery Swapping” focuses on creating stronger infrastructure for battery swapping technology and swapping of information.

Task 49: “EV Fire Safety” provides knowledge exchange on EV fire safety aspects through the sharing of experiences between country experts, increasing insights in EV fire safety risks and sharing best practices in preventing or mitigating EV fire incidents, from both the technological and regulatory perspective.

Task 50: “Light Electric Vehicles”. This task builds on the earlier work of Task 32, further exploring the context of global developments in LEVs.

3 Key Results

Some key results from the various working groups include, among others, the following:

- *Critical Raw Materials for Electric Vehicles.* The availability and price of critical materials are important issues for the future adoption rate of electric vehicles. Materials of particular concern include cobalt, lithium, nickel, graphite, neodymium, dysprosium and copper. Recycling will be an important factor to help alleviate demand shortages, but recycling by itself will not solve the problem. Increases in battery manufacturing efficiencies or into alternative battery chemistries can also reduce the requirements of these critical minerals for EV production. [7]

- *Interoperability of e-Mobility Services*. Protocols and standards for interoperability of charging equipment and related payment systems are not yet fully established and much more work is needed for developing and implementing interoperability. This working group identified some best practices/recommendations to stimulate interoperability and a user-centric charging experience (find, access, transparent prices, payment). Most crucial basic requirement for the deployment of an interoperable and user-centric public charging infrastructure is to set-up a strong collaboration between public and private stakeholders, based on a long-term vision and strategy and ensuring broad multi-stakeholder buy-in. Public stakeholders should include all levels: from national to regional to municipalities and should also take into account cross-border cooperation at EU and global level. Electric mobility is bringing the mobility and energy sector very close together; a strong interaction between these previously disparate markets is now required. [8]

- *EV City Casebook and Policy Guide*. This updated 3rd report documents the results on sharing experiences for EV demonstration and deployment, identifying challenges and opportunities, and highlighting best practices for creating thriving EV ecosystems. Policies play a critical role. The EV City Casebook and Policy Guide presents informative case studies on city and regional EV deployment efforts around the world. These case studies are illustrative examples of how pioneering cities are preparing the ground for mass-market EV deployment. They offer both qualitative and quantitative information on cities’ EV goals, progress, policies, incentives, and lessons learned to date. These studies enhance the understanding of the most effective policy measures to foster the uptake of electric vehicles in urban areas. Measures such as increased fuel economy standards, incentives for zero- and low-emissions vehicles, and support for the deployment of charging infrastructure are successfully being employed. Private sector responses to public policy signals confirm that policy measures are effective in escalating the momentum for electrification of transport. [9]

- *Innovation Strategies and Funding Policies for Automated and Electric Road Mobility.* This book contains results from the HEV TCP task on electrified, connected, and automated vehicles. The book, part of the series on Lecture Notes in Mobility, describes the best ideas from the sharing economy and smart systems integration that could truly disrupt mobility. One of the major insights of the book is that truly disruptive innovation potential can be unlocked if technologies like electric cars and self-driving pods are combined with game-changing business and operational models like ride-sourcing and car-sharing. [10]

- *Extreme Fast Charging for Plug-in Electric Vehicles.* A report on the current status of extreme fast charging technology describes fast charging technology deployment developments and trends, discusses objectively how fast charging technology can contribute to the deployment of electric vehicles, and provides recommendations for setting up a roadmap for fast charging technology development and implementation. [11]

- *Electric Freight Vehicles.* In order to meet the Paris Climate Agreement targets, the global road freight sector will need to cut its CO2 emissions by 60% until 2050. Various technical and non-technical options exist for reducing the emissions of road freight transport, such as improving the efficiency of freight logistics, reducing the fuel consumption performance of conventional vehicles and introducing (near) zero tailpipe emission vehicles such as battery-electric vehicles (BEV) into the market that could result in the large-scale emission reduction. Although electrifying the fleet is the ideal option for the future and has been the subject of significant discussion, there is still a high degree of uncertainty regarding technology developments of electric powertrain options. Specifically, the challenge has been to introduce electrification whilst continuing to meet the user requirements. This has given rise to numerous activities in the different vehicle segments of the freight sector with some uncertainty as to which solutions will be adopted in the longer term. [12]
- *Life Cycle Assessment (LCA) of Electric Vehicles (EVs).* The working group identified how electric drivetrain vehicles should be designed for optimal recyclability and minimal resource consumption. It also identified the best available technologies and practices for managing the materials in EVs at the end of their useful life, when the vehicle is dismantled. Country-specific factsheets on the environmental impacts of hybrid and electric vehicle sales were quantified. The analysis takes into account the electricity generation mix specific for each country. Environmental effects depend strongly on the national electricity generation. For HEVTCP countries, the greenhouse gas emissions of electricity supply at the charging point ranges from a low of 50 g CO2eq/kWh in Sweden, to a high of about 700 g CO2eq/kWh in Ireland and the United States. The estimated reduction in greenhouse gas emissions per average EV/PHEV ranges from a 8-76% reduction, depending on the country-specific electricity generation mix. [13]

4 Conclusions

The Hybrid and Electric Vehicle Technology Collaboration Program (HEV TCP) enables member countries to discuss their respective needs, share key information, and learn from an ever-growing pool of experience from the development and deployment of hybrid and electric vehicles.

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