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The U.S.-China Electric Vehicles Initiative

James F. Miller[1] and David Howell[2]
[1]*Argonne National Laboratory, 955 L'Enfant Plaza, Washington, DC 20024 USA*
[2]*U.S. Department of Energy, 1000 Independence Ave, Washington, DC 20585 USA*

Abstract

The U.S.-China Electric Vehicles Initiative is an international collaboration initiated in 2009. President Hu Jintao and President Barack Obama announced the launch of a U.S.-China Electric Vehicles Initiative on November 17, 2009, during President Obama's visit to China. The collaboration is sponsored by China's Ministry of Science and Technology (MOST) and the U.S. Department of Energy (DOE). The goals of the initiative are to accelerate the deployment of electric vehicles in order to reduce oil dependence, cut greenhouse gas emissions, and promote economic growth. The collaboration has four focus areas, namely: standards development, electric vehicle demonstrations, technical roadmap, and public awareness and engagement. The initiative will explore joint standards development, share information on vehicle demonstration programs, create a joint technical roadmap to identify research and development needs in the area of electric vehicles, and promote public awareness and engagement through dissemination of information. Several meetings and workshops have been conducted to date, both in China and at the U.S. Department of Energy's Argonne National Laboratory.

Keywords: EV (electric vehicle), PHEV (plug-in hybrid electric vehicle), battery, charging, infrastructure

1 Introduction

The U.S.-China Electric Vehicles Initiative is an international collaboration initiated in 2009. The collaboration is sponsored by China's Ministry of Science and Technology (MOST) and the U.S. Department of Energy (DOE). The collaboration is focused on addressing major challenges to widespread deployment of electric drive vehicles [1].

The collaboration has four focus areas, namely: joint standards development, joint demonstrations, joint technical roadmap, and public awareness and engagement through vehicle demonstrations. The four areas were developed at a forum in Beijing in September 2009, organized by DOE and MOST.

President Hu Jintao and President Barack Obama announced the official launch of a U.S.-China Electric Vehicles Initiative on November 17, 2009, during President Obama's visit to China [2]. At the launch, the two leaders emphasized their countries' strong shared interest in accelerating the deployment of electric vehicles in order to reduce oil dependence, cut greenhouse gas emissions and promote economic growth. The initiative will explore joint standards development, share information on vehicle demonstration programs, create a joint technical roadmap to identify research and development needs in the area of electric vehicles, and promote public awareness and engagement through information dissemination.

The United States and China are the world's two largest automobile markets. In recent years, both countries have made unprecedented investments in electric vehicles.

In the United States, the American Recovery and Reinvestment Act expanded a $7,500 consumer tax credit for electric vehicles and included $2.4 billion to support battery manufacturing. The U.S. government has also provided more than $8.5 billion to help automakers retool their factories to produce electric vehicles. The US goal is to have one million PHEVs on the road by the end of 2015. [3]

China has also provided significant investments for electric vehicle research, with significant funding for electric vehicle demonstrations and charging infrastructure. According to the government planning for the new energy vehicle market, the number of EVs sold is expected to reach five million units per year by 2020. [4]

2 Collaboration Activities

Activities under the initiative include the following:

- Joint standards development. The two countries will explore development of joint product and testing standards for electric vehicles. This will include common design standards for plugs to be used in electric vehicles, as well as common test protocols for batteries and other devices. Each country currently has extensive literature and data on its own standards. Making this information mutually available and working towards common standards can help facilitate rapid deployment of electric vehicles in both countries.
- Joint demonstrations. The Initiative will link more than a dozen cities with electric vehicle demonstration programs in both countries. Paired cities will collect and share data on charging patterns, driving experiences, grid integration, consumer preferences and other topics. The demonstrations will help facilitate large-scale introduction of this technology.
- Joint technical roadmap. A U.S.-China task force will create a multi-year roadmap to identify R&D needs as well as issues related to the manufacture, introduction and use of electric vehicles. The roadmap will be made widely available to assist not just U.S. and Chinese developers, but also the global automotive industry. It will be updated regularly to reflect advances in technology and the evolution of the marketplace.
- Public awareness and engagement. The United States and China will develop and disseminate materials to improve public understanding of electric vehicle technologies.

3 Progress

DOE and China's Ministry of Science and Technology have a five-year agreement to promote large-scale deployment of next-generation vehicle technologies. This collaboration includes research to advance clean, energy-efficient transportation, a cleaner environment, energy security and sustained economic growth.

Scientists and engineers at Argonne National Laboratory (ANL) often work with Chinese colleagues to conduct basic scientific research and to help solve energy and environmental challenges facing the people of China and the United States.

In July 2010, Wan Gang, Minister of Science and Technology of the People's Republic of China, visited Argonne to learn about the laboratory's alternative energy research. Since 2003, Argonne has worked with the China Automotive Technology and Research Center (CATARC) to promote energy-efficient vehicle technologies and clean transportation fuels in China. CATARC uses two of Argonne's software packages – Powertrain System Analysis Toolkit (PSAT), and Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) – to evaluate China's existing vehicles; to understand the interrelationships among performance, fuel economy and emissions; and to design new, advanced-technology vehicles.

A team of researchers from Argonne and Tongji University are using the Advanced Photon Source (APS) at Argonne to study the plume from a biodiesel fuel injector. This research is helping improve combustion efficiency and reduce emissions for biodiesel-fueled engines.

Building on the success of the first-ever U.S.-China Electric Vehicles Forum in September 2009, the United States and China regularly meetings, alternating between the two countries. The Forum brings together key stakeholders in both countries to share information on best practices and identify new areas for collaboration.

For the US-China Electric Vehicles Initiative, several workshops under the initiative have been

conducted to date, both in China and at DOE's Argonne National Laboratory in the United States.

Workshops were held at Argonne National Laboratory in September 2010 and again in August 2011. Another workshop is planned to be held at Argonne in August 2012.

3.1 2010 Workshop

From August 30 to September 1, 2010, researchers from China and the United States gathered together at Argonne National Laboratory for the first US-China Electric Vehicle and Battery Technology Workshop [5].

The workshop endeavored to create opportunities for discussion on initiatives between the two countries in order to make electric vehicles a reality. Plenary speakers at the workshop included officials and directors from both countries, including David Sandalow, U.S. DOE Assistant Secretary for Policy and International Affairs; Du Zhanyuan, Vice Minister, China Ministry of Science and Technology; and others.

Attendees participated in three roundtable sessions covering battery technology roadmapping, battery test procedures, and vehicle demonstrations and infrastructure. Wrap-up sessions on the last day of the conference documented the workshop's findings.

3.2 2011 Workshop

A second US-China Electric Vehicle and Battery Technology Workshop was held at Argonne National Laboratory on Aug 4-5, 2011 [6]. High-level government officials provided perspectives from both countries. Zhang Zhihong, Deputy Director General, Department of New and High Technology, Ministry of Science and Technology, provided the China perspective. Dr. Henry Kelly, acting DOE Assistant Secretary for Energy Efficiency and Renewable Energy, provided the U.S. perspective. An overview of the technical progress in both countries was provided by senior research directors: Wu Feng, Chief Scientist of the 973 Program, Beijing Institute of Technology, and by David Howell, Leader, Hybrid Electric Systems, U.S DOE.

The workshop had three focus areas, namely:

- Battery Technology Roadmapping
- Battery Test Procedures
- Vehicle Demonstrations and Infrastructure

The workshop was organized to maximize information exchange and identify opportunities to work together. Breakout sessions focused on Action Plans to accomplish the needed work.

3.2.1 Battery Technology

The scope of activities under battery technology in the collaboration includes conducting pre-competitive research on advanced battery technologies; advanced characterization and diagnostic techniques to understand failure mechanisms; in situ techniques to characterize materials and electrodes; developing modeling capabilities to predict battery life; and identification of practical and cost-effective battery recycling processes.

The goals and objectives are to enhance the appeal of electric vehicles by accelerating the progress in the very early stages of advanced battery technologies. Targeted battery technologies include lithium metal, lithium/air, and lithium/sulfur.

The desired results include characterization of next-generation of lithium-ion batteries; identification of relevant, advanced facilities in the U.S. and China; evaluation of existing diagnostic tools; design and conduct experiments to achieve the goals for various battery chemistries; specific to advanced batteries (Li/air, Li/S, Li metal), including fundamental studies, development of in situ characterization tools, advances in the mitigation of dendrite growth, and applicability of nanotechnology; and assessment of most promising recycling approaches.

Planned action items are to identify specific technology barriers and diagnostic tools for collaboration; develop joint research plans; identify technical leads for each task; and to meet at least twice a year for information exchange, additionally as necessary.

3.2.2 Battery Testing

The scope of activities under battery testing in the collaboration include direct experimental comparison of battery testing protocols from China and the U.S.; complete failure analysis of cells; mapping of failure modes; development of hazard identification and environmental mitigation; and develop glossary of terms and definitions in a share-able database.

The goals and objectives for performance and life testing are to identify similarities/differences in test philosophy, requirements, methods, etc.; to compare test results on the same batteries for data quality/reproducibility; and the comparison and improvement of battery life models.

The goals and objectives safety testing are to identify potential hazards of the products of battery failure under given conditions; to identify potential sensors; to identify potential extinguishing materials; and to identify promising internal short circuits for safety standards.

The desired results from performance and life testing are a joint publication comparing test procedures and results; a share-able database; and development of common testing protocols.

The desired results from safety testing are a database of products produced during a battery failure/breech; development of standards for testing internal short circuits; and development of testing standards for other battery issues

The next steps for performance and life testing are for Tsinghua, Tianjin, and Argonne to meet again to further discuss joint experiment; to write a test plan; and to conduct joint experiment.

The next steps for safety testing are for ICD and UL to meet again to further discuss joint experiment; agree on safety issue to test; write test plan; and conduct joint experiment.

3.2.3 EV Demonstrations and Standards

The United States and China have ambitious plans for EV demonstrations in Los Angeles and Shanghai. These cities will share field test data, best practices, and lessons learned from their demonstration projects.

The goals and objectives of the demonstration and standards activities are:

- Demonstrations: understanding use patterns of electric vehicles and the charging infrastructure to guide vehicle technology development and deployment of electric vehicle supply equipment (EVSE).
- Codes and Standards: harmonization of grid connectivity standards.
- Vehicle Testing: harmonize benchmarking and test procedures where possible.

The scope of the collaboration includes:

- Learning together how to deploy EVs that meet the needs of the public and the auto industry while minimizing the impact on national grids and the environment.
- Share technical information and experience from vehicle/infrastructure learning demonstrations [share data from Shanghai and Los Angeles vehicle demonstrations].
- Harmonize global codes and standards (vehicles, connectors, and communication) (share data and experience: map U.S. and Chinese standards; understand differences].
- Harmonize vehicle benchmarking, evaluating, and testing procedures (exchange information on vehicle test procedures; harmonize if possible).

The desired result from vehicle demonstrations is an extensive database on vehicle and infrastructure usage in selected markets. For codes and standards, harmonized or compatible standards where feasible are desired. For vehicle testing, common methodologies for vehicle benchmarking, testing and evaluation are desired.

The planned action items for vehicle demonstrations are to develop common data parameters and data analysis procedures. For codes and standards, the plan is to initiate joint mapping effort and to share draft standards. For vehicle testing and evaluation, the plan is for China Automotive Engineering Research Institute (CAERI), Argonne National Laboratory, and Idaho National Laboratory to exchange data and methodologies.

4 Conclusions

This U.S.-China Electric Vehicles Initiative is a collaboration designed to be a "win-win" partnership. Both countries share the common goals of reducing petroleum consumption and reducing greenhouse gas emissions, and promoting economic growth. The focus of the collaboration is research that does not involve intellectual property. Examples of this include the development of common battery and vehicle test protocols; lifecycle analysis; diagnostics, modeling, failure analysis for advanced batteries; and increased public awareness through vehicle demonstrations.

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Authors

James F. Miller
Argonne National Laboratory
955 L'Enfant Plaza, SW
Washington, DC 20024 (USA)
Tel: 202-488-2433
Email: james.miller@anl.gov

Dr. James Miller is a Senior Technical Advisor currently on assignment at DOE Headquarters in Washington, DC. He received a Ph.D. in Physics from the University of Illinois, and MBA from the University of Chicago.

David Howell
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585 (USA)
Tel: 202-586-3148
Fax: 202- 586-2476
Email: David.Howell@ee.doe.gov

David Howell is the Team Leader for Hybrid Electric Systems Team at the DOE Vehicle Technologies Program Office. He received his B.S. degree in Aerospace Engineering from the University of Tennessee in Knoxville, Tennessee.