U.S. – China Electric Vehicle Initiative: A Win-Win or a Win-Lose?

presented at the University of Michigan

Inside China: Understanding China’s Current and Future Automotive Industry

November 16, 2011

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China’s remarkable growth in vehicle sales
中国车辆销售的惊人增长

- **Background**
  - In 1990, private car ownership was virtually non-existent
  - In 2006, 7 million vehicles were sold in China; nearly all manufactured there
  - In 2006, 16.5 million light-duty vehicles were sold in the U.S.
  - In 1992, China was a net exporter of oil
  - In 2006, China imported 45% of it’s oil

- **Argonne’s 2006 Forecast**
  - By 2020, China’s motor vehicle sales could equal current U.S. sales

- **Actual Result**
  - In 2009, China’s motor vehicle sales exceeded the U.S.
China’s motor vehicle stock is likely to grow dramatically

中国的机动车保有量可能大幅增长

**Vehicle Stock**

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<thead>
<tr>
<th>Year</th>
<th>U.S.</th>
<th>China</th>
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<tbody>
<tr>
<td>2009</td>
<td>245</td>
<td>160</td>
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<tr>
<td>2020</td>
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<td>58</td>
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<td>166</td>
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<tr>
<td>2020</td>
<td>208</td>
<td>263</td>
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**Vehicles / 1000 People**

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China became the world’s second largest net oil importer in 2009.


Source: 美国能源信息管理局，中国国家分析简报，2009-2011
Common problems provides a rationale for cooperation
共同的问题提供了合作的基础

- **Total energy use**
  - China 1\textsuperscript{st}: consumed 2,252 million tonnes of "oil equivalent" in 2009
  - U.S. 2\textsuperscript{nd}: used 2,170 tonnes; China topped the U.S. by roughly four per cent.
  - 10 years ago, China’s energy consumption was half that of the U.S.

- **Oil consumption**
  - U.S. 1\textsuperscript{st}: 19.1 million barrels per day, in 2010
  - China 2\textsuperscript{nd}: 9.1 million barrels per day

- **Greenhouse gas emissions**
  - China 1\textsuperscript{st}: 7.0 billion (23%)
  - U.S. 2\textsuperscript{nd}: 5.5 billion (18%)

- **Passenger car sales**
  - China 1\textsuperscript{st}: 13.6 million in 2009
  - U.S. 2\textsuperscript{nd}: 10.4 million
Presidents Barack Obama and Hu Jintao announced the launch of a U.S.-China Electric Vehicles Initiative – November 17, 2009

2009年11月17日，奥巴马总统和胡锦涛主席宣布了美中电动汽车合作草案

- **Shared interest in accelerating the deployment of electric vehicles**
  - To reduce oil dependence
  - Cut greenhouse gas emissions
  - Promote economic growth

- **Activities under the initiative will include:**
  - Joint standards development
  - Joint demonstrations
  - Joint technical roadmap
  - Public awareness and engagement
Argonne National Laboratory hosted the U.S.-China Workshop as a result of the Electric Vehicle Initiative in 2010 and again in 2011

在合作草案的带动下, 阿岗国家实验室于2010承办了第一届美国-中国电动汽车研讨论, 2011承办第二届

- **Sponsored by:**
  - U.S. Department of Energy
  - China’s Ministry of Science and Technology

- **Aug 4 – 5, 2011**

- **Three focus areas**
  - Battery Technology Roadmapping
  - Battery Test Procedures
  - Vehicle Demonstrations and Infrastructure
The workshop was organized to maximize information exchange and identify opportunities to work together.

Thursday Morning
Plenary Session

Welcome
US / China Perspectives
US / China Initiatives
CERC-CVC Updates

Thursday Afternoon
Roundtable Sessions

Battery Technology
Invited Presentations
Technical Discussions
Development of Action Plan

Battery Test Procedures
Invited Presentations
Technical Discussions
Development of Action Plan

Vehicle Demonstrations
Invited Presentations
Technical Discussions
Development of Action Plan

Friday Morning and Afternoon
Roundtable Sessions

Next Steps
Next Steps
Next Steps

Friday Afternoon
Closing Session
High level government officials provided perspectives from both countries

Henry Kelly, Principal Deputy Assistant Secretary Energy Efficiency and Renewable Energy Department of Energy

Zhang Zhihong, Deputy Director General Department of New and High Technology Ministry of Science and Technology
An overview of the technical progress in both countries was provided by senior research directors.

双边技术领导人分别简介相关科技发展

Dave Howell, Lead, Hybrid Electric Systems
Department of Energy

Wu Feng, Chief Scientist 973 Program
Beijing Institute of Technology
Breakout Sessions focused on Action Plans to accomplish the needed work

分组讨论著重于提出实践目标所需的行动方案

- Three breakout sessions
  - Battery Technology
  - Battery Testing
  - Vehicle Demonstrations and Standards Development

- Format of the Action Plans
  - Scope of the Collaboration
  - Goals / Objectives
  - Benefits
  - Desired Results
  - Coordination
  - Action Items
    - Steps already taken / accomplishments
    - Next steps
Battery Technology Action Plan: 电池技术发展规划：
Co-leaders (主席) Dave Howell – U.S. Department of Energy 美国能源部
WU Feng – Beijing Institute of Technology 北京理工大学

- **Scope of the Collaboration** 合作范畴
  - Conduct 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
  - Identify practical and cost-effective battery recycling processes

- **Goals / Objectives** 目标与目的
  - 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 air
    - Lithium sulfur
    - Lithium metal
Battery Technology Session - Action Plan continued
电池技术发展 - 发展规划（续）

- **Desired Results** 预期结果
  - 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 /conduct experiments to achieve the goals for various battery chemistries
  - Specific to advanced batteries (Li-air, Li-S, Li-metal)
    - Fundamental studies
    - Development of in situ characterization tool
    - Advances in the mitigation of dendrite growth
    - Applicability of nanotechnology
  - Assessment of most promising recycling approaches

- **Action Items** 行动项目
  - Identify specific technology barriers and diagnostic tools for collaboration
  - Develop joint research plans
  - Identify technical leads for each task
  - Meet at least twice a year for information exchange, additionally as necessary
Evaluating battery recycling processes can identify preferable alternatives 评估电池回收过程可以确定更好的替代品

- **Reasons for recycling**
  - Material scarcity alleviated
  - Recycled materials cheaper
  - Production impacts avoided
    - Energy use
    - Emissions
    - Mining impacts
  - Legally required

- **But not all recycling processes are created equal**
  - Materials recovered at different stages
  - Suitable for different chemistries

- **Criteria for comparison**
  - Energy and environmental impacts
    - Determined by lifecycle analysis
  - Value of recovered materials
  - Regulatory or institutional issues
Battery Testing Action Plan: 电池测试程序:
Co-leaders (主席)  Ira Bloom – Argonne 阿岗国家实验室
QIU Xinping – Tsinghua University 清华大学

- **Scope of the Collaboration 合作范畴**
  - Direct experimental comparison of battery testing protocols from China & US
  - Complete failure analysis of cells; mapping of failure modes
  - Development of hazard identification and environmental mitigation
  - Develop glossary of terms and definitions in a share-able database

- **Goals / Objectives 目标与目的**
  - Performance and Life
    - Identify similarities/differences in test philosophy, requirements, methods, etc.
    - Comparison of test results on the same batteries for data quality / reproducibility
    - Comparison and improvement of life models
  - Safety
    - Identify potential hazards of the products of battery failure under given conditions
    - Identify potential sensors
    - Identify potential extinguishing materials
    - Identify promising internal short circuits for safety standards
Battery Testing Session – Action Plan continued

电池测试程序–发展规划(续)

- **Desired Results** 预期结果
  - Performance and Life:
    - Joint publication comparing test procedures and results
    - Share-able database
    - Development of common protocols
  - Safety
    - Database of products produced during a battery failure / breech
    - Development of standards for testing internal short circuits
    - Development of testing standards for other battery issues

- **Action Items** 行动项目
  - **Next steps: Performance and Life** (Tsinghua, Tianjin, and Argonne)
    - Meet again to further discuss joint experiment; agree on vehicle and battery
    - Write test plan; conduct joint experiment
  - **Next steps: Safety** (ICD and UL)
    - Meet again to further discuss joint experiment; agree on safety issue to test
    - Write test plan; conduct joint experiment
Demonstrations / Standards Action Plan: 示范与标准化：
Co-leaders (主席)  Keith Hardy – Argonne 美国能源部
Li Jianqiu – Tsinghua University 清华大学

- **Scope of the Collaboration**

  *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 demos]
  - 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]

- **Goals / Objectives**

  - Understanding use patterns of electric vehicles and the charging infrastructure to guide vehicle technology development and deployment of EVSEs
  - Codes and Standards: harmonization of grid connectivity standards
  - Vehicle Testing: harmonize benchmarking and test procedures where possible
Desired Results 预期结果
- Vehicle Demos: extensive database on vehicle and infrastructure usage in selected markets
- Codes and Standards: harmonized or compatible standards where feasible
- Vehicle Testing: common methodologies for vehicle benchmarking, testing and evaluation

Action Items 行动项目
- Vehicle Demos: develop common data parameters and data analysis procedures
- Codes and Standards: initiate joint mapping effort; share draft standards
- Vehicle Testing: ANL, INL, and CAERI to exchange data and methodology
U.S. and China have ambitious plans for EV demonstration sites – Shanghai and Los Angeles will share data

中国和美国关于电动汽车展示有着雄心勃勃的计划—上海和洛杉矶将共享数据

Jiading District
- 180 sq mi
- 2.3 million people
- Shanghai – 23 million

Los Angeles
- 470 sq mi
- 3.8 million people

Shanghai’s Jiading Automobile Industrial Zone
Can collaborating with China be a win-win partnership? 和中国的合作将会是双赢的互惠关系吗？

- **Share common goals**
  - Reduce petroleum consumption
  - Reduce greenhouse gas emissions

- **Focus on research that does not involve intellectual property**
  - Lifecycle analysis
  - Diagnostics, modeling, failure analysis for advanced batteries
  - Development of common battery and vehicle test protocols
  - Increased public awareness through vehicle demonstrations

- **Which country benefits the most:**
  - Not necessarily the one with the lowest labor costs, but rather...
  - The one that innovates the most: innovation will always be the key
  - Played correctly, collaboration means China and the U.S. are “jogging partners,” not racers.
    - We encourage and stimulate each other.
    - We both get (technologically and economically) healthier.
Workshop presentations, booklet, and photos are at: http://www.cse.anl.gov/us-china-workshop-2011/
or Google: argonne china workshop
Thank you for your attention
谢谢