Feasibility Study
Electric Mobility: Sino-German Cooperation on Certification

Sino-German Cooperation for Increased Alignment in
Certification, Testing, Licensing, and Homologation for Electric Mobility

Beijing, 16 October 2012

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on behalf of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

The information presented in this report reflects the discussions between Chinese and European experts and the material presented by the experts during this project. This report is the sole responsibility of its authors and cannot be construed as an official statement of Chinese or German governments or of any of the project partners involved.
# Table of Content

Table of Content ........................................................................................................... 2  
List of Abbreviations ...................................................................................................... 4  
Executive Summary ....................................................................................................... 6  

1. Introduction .................................................................................................................... 12  
   1.1. Background and Objectives of the Study ............................................................... 12  
   1.2. Approach and Methodology ................................................................................ 14  
   1.3. Basic Terminology ............................................................................................... 16  
   1.4. Description of Activities in Detail ....................................................................... 17  
      1.4.1. Phase 1 ........................................................................................................ 18  
      1.4.2. Phase 2 ........................................................................................................ 21  
      1.4.3. Phase 3 ........................................................................................................ 22  
   1.5. Project Results ..................................................................................................... 25  

2. National Approaches towards Electric Mobility and Standards ..................................... 26  
   2.1. The European Approach towards Electric Mobility ............................................. 26  
   2.2. The Chinese Approach towards Electric Mobility ............................................. 26  
   2.3. Strategy for Standardization in Germany ............................................................ 28  
   2.4. Strategy for Standardization in China ................................................................. 30  

3. Overall Car Safety ........................................................................................................ 33  
   3.1. Global Regulatory Approach ............................................................................. 34  
   3.2. Standardization .................................................................................................. 38  
      3.2.1. Ongoing Work on International Level ......................................................... 38  
      3.2.2. Ongoing Work in China .............................................................................. 38  
      3.2.3. Comparison Tables ..................................................................................... 39  
   3.3. Conformity Assessment ....................................................................................... 40  
   3.4. Homologation ..................................................................................................... 42  
      3.4.1. Homologation in Europe .............................................................................. 42  
      3.4.2. Homologation in China .............................................................................. 44  
      3.4.3. Comparison Tables ..................................................................................... 47  
   3.5. Next Steps ........................................................................................................... 49  

4. Battery Safety .............................................................................................................. 50  
   4.1. Standardization ................................................................................................... 50  
      4.1.1. Regulations and Standards in Europe ............................................................ 52  
      4.1.2. Regulations and Standards in China .............................................................. 54  
   4.2. Conformity Assessment ....................................................................................... 56
4.3. Homologation ..................................................................................................................57
4.4. Next Steps .......................................................................................................................57
5. Charging Infrastructure .................................................................................................58
  5.1. Standardization .............................................................................................................58
      5.1.1. International Level .................................................................................................59
      5.1.2. Comparison Tables ..............................................................................................60
  5.2. Conformity Assessment ...............................................................................................62
  5.3. Homologation ...............................................................................................................63
  5.4. Next Steps .....................................................................................................................64
6. Conclusions .......................................................................................................................65
Project 1: Sino-German Information Platform and Training Center on Conformity Assessment ....67
Project 2: Electric Vehicle Post-crash Compliance Testing ......................................................69
Project 3: Electrical and Mechanical Safety of Battery Systems .........................................71
Project 4: Alignment of Testing Methods and Equipment for AC and DC Power Supply ........73
Project 5: Sino-German Research Cooperation for Testing Specifications for Charging Cables ......75
Project 6: Comparative Testing of “Overall Car Safety” According to ECE-R 100.01 ...............77
List of Tables .........................................................................................................................79
List of Figures .........................................................................................................................79
Technical Appendix ...............................................................................................................80
# List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ACEA</td>
<td>European Automobile Manufacturers’ Association</td>
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<tr>
<td>AQSIQ</td>
<td>General Administration of Quality Supervision, Inspection and Quarantine of the People’s Republic of China</td>
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<tr>
<td>AWI</td>
<td>Approved Work Item</td>
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<tr>
<td>BAM</td>
<td>German Federal Institute for Materials Research and Testing (Bundesanstalt für Materialforschung und -prüfung)</td>
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<tr>
<td>BEV</td>
<td>Battery Electric Vehicle</td>
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<tr>
<td>BMBF</td>
<td>German Federal Ministry of Education and Research</td>
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<td>BMU</td>
<td>German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety</td>
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<tr>
<td>BMVBS</td>
<td>German Federal Ministry of Transport, Building and Urban Development</td>
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<tr>
<td>BMWi</td>
<td>German Federal Ministry of Economics and Technology</td>
</tr>
<tr>
<td>CATARC</td>
<td>China Automotive Technology and Research Center</td>
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<tr>
<td>CCC</td>
<td>China Compulsory Certification</td>
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<tr>
<td>CD</td>
<td>Committed Draft</td>
</tr>
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<td>CEC</td>
<td>China Electricity Council</td>
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<tr>
<td>CEN</td>
<td>European Committee for Standardization</td>
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<tr>
<td>CENELEC</td>
<td>European Committee for Electrotechnical Standardization</td>
</tr>
<tr>
<td>CNCA</td>
<td>Certification and Accreditation Administration of the People’s Republic of China</td>
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<tr>
<td>CPPS</td>
<td>GIZ Consumer Protection and Product Safety Programme</td>
</tr>
<tr>
<td>COC</td>
<td>China Quality Certification Center</td>
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<tr>
<td>DIS</td>
<td>Draft International Standard</td>
</tr>
<tr>
<td>DL/T</td>
<td>Professional Standard for Electric Power Industry/Recommended Standard</td>
</tr>
<tr>
<td>ECE-R</td>
<td>Economic Commission for Europe-Regulation</td>
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<tr>
<td>EEA</td>
<td>European Economic Area</td>
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<tr>
<td>EEC</td>
<td>European Economic Community</td>
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<tr>
<td>EMC</td>
<td>Electromagnetic Compatibility</td>
</tr>
<tr>
<td>EN</td>
<td>European Norm</td>
</tr>
<tr>
<td>EN/IEC</td>
<td>European Norm/International Electrotechnical Commission</td>
</tr>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
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<tr>
<td>EU-WVTA</td>
<td>EU – Whole Vehicle Type Approval</td>
</tr>
<tr>
<td>EUROBAT</td>
<td>Association of European Automotive and Industrial Battery Manufacturers</td>
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<tr>
<td>EV</td>
<td>Electric Vehicle</td>
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<tr>
<td>EVS-GTR</td>
<td>Electric Vehicle Safety Global Technical Regulation</td>
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<tr>
<td>FCEV</td>
<td>Fuel Cell Electric Vehicle</td>
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<tr>
<td>FDIS</td>
<td>Final Draft International Standard</td>
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<tr>
<td>GB</td>
<td>Chinese National Standard</td>
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<tr>
<td>GB/T</td>
<td>Chinese National Standard/Recommended Standard</td>
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<tr>
<td>GB/Z</td>
<td>Chinese National Standard/Guiding Technical Documents</td>
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<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH</td>
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<tr>
<td>GTR</td>
<td>Global Technical Regulation</td>
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<tr>
<td>HEV</td>
<td>Hybrid Electric Vehicle</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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</table>
IDT
IEC
IEC/CDV
IEC/TRF
IECEE
INS
IS
ISO
ISO/DIS
ISO/NP
ITU-T
KBA
LVD
MEP
MIIT
MoF
MoST
MPS
NDRC
NEA
NEQ
NEV
NHTSA
OEM
PLC
QC/T
RE
RESS
SAC
SAC/TC
SAE
SME
StVZo
UNECE
UNECE WP.29
VDA
VDE
VGC
WLTP
WP.29

Identical
International Electrotechnical Commission
International Electrotechnical Commission/Committee Draft for Vote
International Electrotechnical Commission/Test Report Form
IEC System for Conformity testing and Certification of Electrotechnical Equipment and Components
Innovation with Norms and Standards
International Standard
International Organization for Standardization
International Organization for Standardization/Draft International Standard
International Organization for Standardization/New Proposal
International Telecommunication Union-Telecommunication Standardization Sector
German Federal Motor Transport Authority (Kraftfahrt-Bundesamt)
Low Voltage Directive
Ministry for Environmental Protection of the People’s Republic of China
Ministry of Industry and Information Technology of the People’s Republic of China
Ministry of Finance of the People’s Republic of China
Ministry of Science and Technology of the People’s Republic of China
Ministry of Public Security of the People’s Republic of China
National Development and Reform Commission of the People’s Republic of China
National Energy Administration of the People’s Republic of China
Non-Equivalent, a term used to describe standards which are of similar origin but feature major technical differences
New Energy Vehicles
National Highway Traffic Safety Administration
Original Equipment Manufacturer
Power-Line Communication
Chinese Professional Standard for Automotive/Recommended Standard
Range Extender
Rechargeable Energy Storage Systems
Standard Administration of China
Standardization Administration of China/Technical Committee
Society of Automotive Engineers
Small and Medium Enterprises
German Road Traffic Licensing Registration (Straßenverkehrs-Zulassungs-Ordnung)
United Nations Economic Commission for Europe
World Forum for Harmonization of Vehicle Regulations (UNECE Working Party 29)
German Association of the Automotive Industry (Verband der Automobilindustrie)
German Association for Electrical, Electronic, and Information Technologies (Verband der Elektrotechnik Elektronik Informationstechnik e.V.)
Volkswagen Group China
World Wide Light Vehicles Test Procedure
see: UNECE WP.29
Executive Summary

China and Germany share the same interest in making Electric Vehicles a success. Within China's 12th Five-Year Plan, Electric Vehicles are included as one of the seven strategic industries. In parallel, with the national research fund ‘863’ and the ‘Energy Saving and New Energy Vehicle Industry Development Plan’, China has committed itself to invest large amounts of money to make Energy Saving in general and Electric Vehicles in particular a success. This applies also to Germany: here too, major investments were made in the development of Electric Vehicles: Germany's government attempt to provide the right framework for Electric Mobility, thus supporting the already advanced automotive, electrical engineering and energy technology sectors in research and development as well as in delivering a high level of quality and safety in integral parts of their products.

For both countries, standardization and conformity assessment are positioned high on the Electric Vehicle agenda. China is being active in Electric Vehicle standardization for more than a decade and developed a framework of national standards in support of this emerging industry. Based on these national standards, China also implemented a comprehensive testing system for Electric Vehicles.

Germany has been a driving force for many years in the standardization work for Electric Vehicles both on a European and international level. In 2010 Germany’s government launched the national platform for Electric Mobility “Nationale Plattform Elektromobilität” in order to include and involve all stakeholders from the public and private sector. As part of this platform Germany also published its own roadmap for standardization “German Standardization Roadmap”. It aimed to involve all stakeholders interested in achieving interoperability for this sector.

In order to foster the development and market introduction of Electric Vehicles, Germany and China decided to increase cooperation on various levels. This cooperation includes both well known tools like collaboration in standardization but also entirely new elements: Since certification and homologation are crucial hurdles for the market introduction of any new vehicles, both sides agreed that better cooperation in this field would greatly benefit this nascent industry. A first outcome of this cooperation is this feasibility study: It includes an outline of the current situation in conformity assessment in both countries, delves into the standardization and homologation environment, and ends with proposals for further collaboration in this field based on proposals made by both Chinese and European experts.
The study should contribute to the following objectives:

- Facilitate policy and technical dialogue between China and Germany;
- Compare regulations and certification systems for Electric Mobility on a worldwide basis;
- Identify necessary bilateral cooperation in policy, technology and science;
- Foster cost-effectiveness in certification both in China and in Germany;
- Support German manufacturers to access the Chinese market;
- Support Chinese manufacturers to access the European market;
- Improve the regulatory environment to foster bilateral trade in the field of e-mobility.

Project partners on Government-level in Germany were the Federal Ministry of Economics and Technology (BMWi) and on the Chinese side the Certification and Accreditation Administration of the People’s Republic of China (CNCA); on ministerial level, the Chinese partner is the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ). As executing parties the German side contracted the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH whilst the Chinese side appointed the China Quality Certification Center (CQC). The reporting was entrusted to Klaus Ziegler and Dr. Martina Gerst, operating under the coordinating function of GIZ.

The study is based on the contribution of German and Chinese experts from government and industry. Chinese experts represented the following organisations: Changchun Automotive Test Center, China Automotive Technology and Research Center (CATARC), China North Vehicle Quality Supervision, CNCA, CQC, Inspection and Authentication Institute, National Automobile Quality Supervision Test Center Xiang Fan, Shanghai Automotive Test Center, and Tianjin Automobile Test Center. The German Industry partners contributing to the study and the related study tour to Europe were Audi, BMW, Daimler, Phoenix Contact, TÜV Nord, TÜV Rheinland, TÜV Süd, Siemens, VW Group, as well as industry associations such as ACEA, EuropElectro, VDA and VDE.

The feasibility study was structured in three phases: (1) fact finding and structuring, (2) prioritization of topics and preparation of activities, and (3) detailing and project recommendations. As part of the first two phases, between November 2011 and March 2012, Expert Circles in the areas of “Overall Car Safety”, “Battery Safety” and “Charging Infrastructure” were set up and Expert Workshops were conducted. As part of the third phase a study tour to Europe took place where Chinese experts were visiting their European counterparts at their work places. The results can be summarized as follows:

- Regulations and standards for homologation are understood to be extremely important for setting up the framework for Electric Mobility in China. The standardization process for Overall Car Safety is much further developed, both in China and in Europe, whilst the standardization for infrastructure is in progress. Many of the relevant safety standards and regulations are at
least partly identical. As for the fundamental safety Regulation ECE-R 100, revisions addressing the needs of Electric Vehicles are almost finalized, completing the framework to ensure the desired and currently feasible safety level. These changes in standards and regulations will have to be followed by similar adjustments in testing methods and type approval processes both in Europe and in China.

- It is a major concern that certification and approval requirements for infrastructure are still incomplete and consequently hamper the market entry of this new technology. Missing is especially an agreed harmonized set of standards and technical instructions for compliance with infrastructure requirements, whilst for batteries the testing and approval processes remain to be completed. This situation might change gradually, starting with completion of standardization for infrastructure in China and with final approval of the globally relevant amendments to ECE-R 100 in the end of 2012.

- Batteries are the least defined part of the Electric Vehicle. Despite numerous standards on international, European, and Chinese level, there is still no commonly agreed set of rules for testing and certification of battery cells and battery modules. The ongoing amendment of ECE-R 100.02 regarding Battery Safety is deemed the most important effort for global harmonization of certification and homologation regulations. This amendment may very likely also find its way into the Electric Vehicle Safety Global Technical Regulation (EVS-GTR). Currently, the work on the ECE-R 100.02 amendment has been completed and entered the voting stage; it is expected that the members of WP.29 will approve this regulation toward the end of 2012.

- Whilst testing of batteries is considered a crucial part of ensuring safety of Electric Vehicles, it is equally important that regulations do not unnecessarily restrict design and technology for this still evolving sector.

- There seems to be a fundamental difference in standardization and legislation for Battery Safety: the European side understands that to ensure appropriate Battery Safety, the highest system level – the battery system as part of the whole vehicle – has to be considered; the Chinese side prefers to define specific standards addressing batteries as stand-alone components, regardless of the way the battery system is integrated in the vehicle. The resulting differences in testing standards also lead to considerable differences in the homologation process. Nevertheless, there is much common ground in the concrete mechanical and electrical testing of batteries – and a common understanding that existing testing processes both in Europe and in China do not suffice to guarantee an adequate level of battery safety.

- Car manufacturers both in Europe and China fear that homologation processes will restrict not only their global reach, but also their ability to design new cars and to further develop battery
technology. They insist that all regulations in this field have to be made in a bottom-up approach, where industry and testing houses define the key elements for any homologation process and not the regulators themselves. They recommend that when defining approval requirements extra care shall be taken that the design of battery elements and battery systems remain as open as possible. Figure 1 illustrates the number of different safety regulations in Electric Mobility in each country or global region.

Figure 1: Safety Regulations Electric Mobility (Source: VW Wolfsburg, June 2012)

- Whilst a global alignment of standards for the Charging Infrastructure of Electric Vehicles is in the making, this cannot be said for testing and homologation processes. It is thus imperative that cooperation on conformity assessment is taken seriously, and that such work has to be undertaken in close cooperation between governments and industry. A joint Sino-German project focussing on testing needs for Charging Infrastructure would be highly beneficial to accelerate such processes. However, since the current basis on the standard side is not sufficient, such a cooperation project should not start before the ongoing standardization work is completed. For the German side questions of charging infrastructure and communication systems are crucial since battery-swapping for private customers is not considered an option. China seems more open with regard to this issue.

- In the area of communication systems we are still far away from reaching a consensus for global interoperability. The European car manufacturers are focusing on a system based on power-line communication by using international standards, whilst the Chinese solution seems to be geared towards separate communication channels. These differences are relevant and make the infrastructure in Europe and China not compatible. Therefore, both European and Chinese car manufacturers are concerned that such testing rules will become a major obstacle
for the commercialization of Electric Vehicles if not handled properly: current markets are largely segmented by different rules for infrastructure and related testing processes. Whilst integration of processes within Europe and within China is foreseeable, an alignment of testing processes in Europe and China would need a clear political will on both sides.

• The participants of the study expressed their concern regarding the large number of initiatives and programmes currently ongoing, not only in Germany and China but also on a global scale that require a better coordination.

Six concrete bi-lateral cooperation projects have been identified by Chinese and European experts based on the findings above. Two projects are related to “Overall Car Safety”, one project to “Battery Safety”, two projects in “Charging Infrastructure”, and one overarching project to compare effectiveness of testing based on ECE-R 100.01 requirements.

Overall Car Safety

Project 1: Sino-German Information Platform and Training Center on Conformity Assessment
Project 2: Electric Vehicle Post-crash Compliance Testing

Battery Safety

Project 3: Electric and Mechanical Safety of Battery Systems

Charging Infrastructure

Project 4: Alignment of Testing Methods and Equipment for AC and DC Power Supply
Project 5: Sino-German Research Cooperation for Testing Specifications for Charging Cables

General Certification for Electric Vehicles

Project 6: Comparative Testing of “Overall Car Safety” according to ECE-R 100.01

In Figure 2 the proposed time-lines of the bi-lateral cooperation projects are illustrated: Project proposals No. 2, 3, 4, 6 should be started right now to achieve the best effect, whilst project proposal No. 5 can be started in the first half of 2013. Project proposal No. 1 can be started anytime; the experts recommend launching this platform in the second half of this year.
Figure 2: Bi-Lateral Cooperation Project Overview
1. Introduction

1.1. Background and Objectives of the Study

Low carbon industries and environmental sustainability are critical objectives at the top of both the Chinese and European agenda. While progress towards CO₂ reduction may be achieved through further improved internal combustion engines, alternative propulsion technologies and the development of other alternative energy sources, Electric Mobility is regarded as a key strategic tool to foster more sustainable ways of transportation, both in Europe and in China.

A fast and deep market penetration with new energy vehicles is desired by public authorities in China and the EU. However, the speed and success of the intake of the new technology in both societies will depend on a variety of complex and intertwined factors. Amongst others, those factors are: the readiness of a reliable and customer friendly Charging Infrastructure; the capacity of the automobile industry to tackle technical challenges such as cruising range, battery durability and reliability, trust in Overall Car Safety; the ability of industry and governments to agree on a globally harmonized approach towards standards, common interfaces, vehicle topologies and architecture, homologation and certification processes.

While global harmonization is recognised as a key element for a successful development of the industry by all parties, varying attitudes can be identified in local approaches, especially also in standardization and legislation. A key difference in homologation processes is based on the preference for embedded concepts in a complete vehicle system in the west, as opposed to an approach focusing on assessment of single components in the east. A good example for this duality of concepts are the differences between the disconnect scenario in case of a vehicle crash applied to batteries through the United Nations Economic Commission for Europe (UNECE) regulations 94 and 95 in Europe and the crash safety requirements of the battery itself applied in China according to GB 18384, GB/T 19751, and QC/T 743.

The Feasibility Study for a joint Sino-German Project for Conformity Assessment in Electric Mobility was initiated in October 2011 to identify areas where these differences can be addressed and hopefully also reduced. The study should help to develop concrete projects where cooperation is deemed promising despite the varying approaches and gaps in methodologies. These projects should allow – in joint Sino-German research – to realize the potentials for harmonization of certification and homologation processes. The overall objective is to strengthen the dialogue between the relevant partners and to support this dialogue with concrete actions on the ground, yielding benefits for the industry both in Europe and China.
The study has the following objectives:

- Facilitate policy and technical dialogue between China and Germany;
- Compare regulations and certification systems for e-mobility on a worldwide basis;
- Identify necessary bilateral cooperation in policy, technology and science;
- Foster cost-effectiveness in certification both in China and in Germany;
- Support German manufacturers to access the Chinese market;
- Support Chinese manufacturers to access the European market;
- Improve the regulatory environment to foster bilateral trade in the field of e-mobility.

Project partners on Government-level in Germany were BMWi and on the Chinese side CNCA; on ministerial level, the Chinese partner is AQSIQ. As executing parties the German side contracted the CPPS Programme of GIZ whilst the Chinese side appointed CQC. The reporting was entrusted to Klaus Ziegler and Dr. Martina Gerst, operating under the coordinating function of GIZ.

The study was based on the contribution of German and Chinese experts from government and industry. Chinese experts were delegated by the following organisations: CNCA, CQC, China Automotive Technology and Research Center (CATARC), Shanghai Automotive Test Center, Changchun Automotive Test Center, National Automobile Quality Supervision Test Center Xiang Fan, China North Vehicle Quality Supervision, Inspection and Authentication Institute and Tianjin Automobile Test Center. The German industry partners contributing to the study and the related study tour to Europe were Daimler, BMW, VW Group, Audi, Phoenix Contact, TÜV Rheinland, TÜV Süd, TÜV Nord, Siemens, as well as industry associations such as ACEA, VDA, VDE and EuropElectro.

The feasibility study has to be understood as a part of the overall Sino-German cooperation on Electric Mobility which includes various ministries both on Chinese and on German side. The setup of this “Strategic Partnership Electric Mobility” is described in Figure 3.
1.2. Approach and Methodology

A project kick-off meeting was held on 26 October 2011 at the premises of CNCA. All participating stakeholders agreed in the following principles: The feasibility study shall be based on a multi-stakeholder approach, achieved by including experts from industry, research, testing, and homologation both in Germany and in China. This resulted in the involvement of approximately 40 experts in this study, half of which represented the Chinese and half the German side. Both sides understood that close cooperation between industry and government is a key element in the study and also a target in itself.

During the kick-off meeting it was also decided that the work on the study shall be undertaken in Expert Circles which have to be defined during the first phase of work. These circles shall be defined in a way to cover the key issues related to Conformity Assessment for Electric Vehicles, especially those where experts from both sides identified major differences in practice between Europe and China. During a first Expert Workshop in November 2011 it was eventually decided to conduct the study with three Expert Circles covering a) Overall Car Safety, specifically aspects for Electric Vehicles, b) Safety of batteries and battery systems, c) requirements for a compatible and safe Charging Infrastructure. Whilst the experts agreed that this selection does not cover all aspects related to testing and certification of
Electric Vehicles, they agreed that these three circles will be able to cover the most prevalent and urgent issues to be addressed.

The experts concurred that the core element of the study shall be a comparison of Chinese and German practice in homologation and certification of Electric Vehicles. This comparison will allow the partners to identify areas in which future cooperation is needed and to make recommendations in this regard. However, it was commonly understood that it was not possible to investigate the differences between Conformity Assessment schemes without a comparison of the underlying standards and regulations in Europe and China, and an examination of the impact of the identified differences on Conformity Assessment. The experts also concurred that the basic principles of the homologation process in Europe and China shall be included in the investigations.

**Three-step approach**

A three-step approach was chosen for this study: The first step included the fact finding phase where a number of companies and industry associations were contacted and interviewed. The involvement of industry associations was recommended, because they are not only aware of current industry trends but also of members’ issues and requirements. In addition, industry associations have a large knowledge base available which they have gained through questionnaires and position papers regarding “hot topics” in their respective industries. The expert interviews included German OEM manufacturers, automotive bodies (e.g. ACEA), and certification bodies in China.

In a second step, Expert Workshops with German and Chinese participants from different fields were organised and performed. During these workshops three Expert Circles were established in areas conserved relevant for the outcome of the study. Based on the contributions during the workshops and in the Expert Circles a draft report was compiled. Both sides contributed equally to this workshop both in preparation and in execution. A compilation of the material provided by German and Chinese experts can be found in the annexes to this report.

In a final step, a draft report was compiled and submitted to all experts for comments. In parallel, Chinese experts made an expert mission to Germany where they visited the German industry partners and certification bodies participating in the project. During this trip the study was also presented to a broader public using the Hanover Technology Fair as a stage. Based on feedback received from experts and interested parties, a final version of the report will be compiled and is to be completed by end of September 2012.
1.3. Basic Terminology

This report is using some basic terminology related to the formal control of compliance, which should be understood as follows:

**Conformity Assessment:** This is a term commonly used to describe all efforts to assess and control compliance (=conformity) with a given set of instructions. These instructions can include regulations, standards, specifications, quality procedures, good practices, and a combination thereof. Conformity Assessment is a core element of every quality control system, its main tools are: audits, inspections, testing, type approvals, certification, and licensing. Homologation is based on a defined set of Conformity Assessment processes.

**Certification:** Certification describes a process where a certificate is issued based on a combination of quality control measures such as testing, inspection, and document review. The certificate is issued if the requirements outlined in the respective certification requirements are met; these can be standards, specifications, or other quality control related definitions. Certificates are in general issued by third party bodies appointed either by the applicant or by government bodies. Certificates can be part of a compulsory market access scheme such as China Compulsory Certification (CCC), or are issued on a voluntary basis such as ISO 9001 certificates. Good practice in certification is defined in respective guidance documents issued by ISO. A special form of certification used by authorities is called Licensing. Licenses may or may not be accompanied by certificates.

**Compulsory Standards:** China makes also use of compulsory standards, an additional level of legally binding documents between formal regulations and voluntary standards/norms. Compulsory standards are used in areas considered relevant for safety, security, and environmental soundness; compliance with these compulsory standards is pre-condition for market access in China.

**Homologation:** This is a commonly used description of the government approval system required for market access of products and services; in case of this study the process for approval and registration of electric and hybrid-electric vehicles. Homologation is based on regulations (see below), and compulsory standards in China or voluntary harmonized standards in Europe, which themselves may refer to standards and technical specifications as means of how to comply with the regulations. Homologation processes may include some or all of the following elements: approval of documentation, type testing, factory and production inspections, certification, registration and licensing, post-registration surveillance. Homologation rules may include a description of processes, applicable standards, and of the testing methodology to be used.
**Regulations:** These define minimum legal requirements, issued by governments or supranational bodies. Regulations may or may not refer to standards as a way to achieve compliance. Relevant in the automotive sector are:

- the vehicle regulations issued by UNECE, namely its Working Party 29 (WP.29);
- the relevant Chinese legislation, regulations, compulsory standards and administrative rules.

**Standards and Norms:** These are understood as official international, European, Chinese, or German standards; developed in formal standardization bodies on international level (ISO, IEC, ITU-T), in Europe (CEN, CENELEC, ETSI), and in China (SAC, CATARC, and others). Standards are in general voluntary; nevertheless compliance with applicable standards will in many cases allow presumption of conformity with applicable regulations. This is especially the case for the “new approach” directives in Europe such as the Low Voltage or EMC Directives.

**Technical Specifications:** These are non-normative elements of licensing and homologation processes. They usually explain how regulations shall be implemented or refer to specific testing methodologies. Technical specifications should give the user a better understanding of the underlying processes; however, they do not enjoy the authority of standards. They might be compulsory for the authorities issuing them and for users implementing the rules of such authorities.

**Type Testing and Type Approval:** Type testing – also called type approval – is generally part of a homologation process: It describes the testing of samples before they enter mass production. Basis for testing are usually standards and specifications, or in absence of such internal rules adopted by the testing body in charge.

### 1.4. Description of Activities in Detail

This feasibility study was set up to be more than a mere research project but also a pilot on new forms of collaboration on an innovative topic of joint interest. Hence, the study was accompanied by a series of events, activities and a continuous exchange of the experts that will be illustrated in the following.

The official opening ceremony of this project took place on 26 October 2011 in Beijing, followed by the kick-off of the project in an open circle of experts with the objective to:

- Introduce the project leaders and the project approach;
- Get to know project participant experts and their background;
- Collect expectations with regard to the outcome of the study.
At the end of the kick-off Expert meeting, the participants’ expectations were clustered into the four different areas standards, testing and certification, type approval and coordination of different e-mobility activities, consequently supplementing the basis for further proceeding in Phase 1, for example the drafting of interview guidelines.

The project timeline has been set from November 2011 to May 2012; the three project phases are shown in Figure 4:

![Figure 4: Phases of the Study and Activities (GIZ Nov 2012)](image)

### 1.4.1. Phase 1

During the kick-off meeting, the experts decided that the Chinese and the German team should work separately but exchange their findings in regular meetings. A first such coordination meeting, called “Expert Workshop” took place on 16 November 2011 in Beijing.³ In preparation of this first Expert Workshop the participants undertook following work:

**Chinese Experts**

The Chinese experts met several times to collect relevant material to be presented at the workshop in order to give the audience an overview of the existing Electric Vehicle Standards in China. First, the Chinese experts prepared an overview of existing Chinese Electric Vehicle Standards in Chinese and English, then an overview of power battery standards in China and abroad and finally a presentation

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³ The proceedings of these Expert Circles and the material collated in preparation can be found in the technical annexes.
about the conductive charging system for Electric Vehicles. The work on these presentations was distributed among the various experts of relevant organizations across China.

**German Experts**
In preparation of the first workshop, the German side agreed on the workshop’s participants whilst TÜV Rheinland volunteered to prepare a presentation about regulations and standardization for Electric Vehicles in Europe/Germany as well as about charging systems. Interviews with stakeholders have been conducted based on the information collected in the kick-off workshop.\(^2\)

**First Expert Workshop**
The Expert Workshop consisted of 30 experts from the German industry and their industrial and administrative counterparts in China gathering on the premises of CQC; organisers of the first Expert Workshop were CQC and the CPPS Programme of GIZ. Based on the initially collected material, the experts decided to focus work on three key areas of certification of Electric Vehicles – which led to the establishment of three “Expert Circles” with both Chinese and German participation. The topics were identified to provide clarity, structure, and relevance to the study. The experts also agreed that with these three Circles most of the relevant certification topics can be covered:

- **Expert Circle 1**: “Overall Car Safety”, covering overall vehicle safety aspects specifically for Electric Vehicles, including: electromagnetic compatibility and environmental issues
- **Expert Circle 2**: “Battery Safety”, covering mechanical and electrical safety of batteries and battery systems, including also recycling aspects of batteries
- **Expert Circle 3**: “Charging Infrastructure”, covering key elements of the infrastructure such as: cables, plugs, charger stations, and communication protocols

A fourth Expert Circle was considered at a later stage of the project on general homologation issues but was not pursued due to overlaps with the other three groups.\(^3\)

The topics and their respective Expert Circles became the basis for the structure of the study and of the underlying research: During the research in some cases the Chinese and German experts further split into sub-groups, each of them focusing on a sub-topic with the aim of identifying the state of the art in Conformity Assessment in China and Europe/Germany before comparing findings and agreeing on subsequent potential cooperation initiatives and projects. The sub-topics are shown in Figure 5.

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\(^2\) A collation of the material collected in these interviews can be found in the technical annexes.

\(^3\) Whilst such an Expert Circle was not established as part of this feasibility study, both sides agreed that cooperation in this field is necessary. In fact one of the proposed projects is addressing the overall effectiveness of testing requirements in China and Europe/Germany.
The research on each sub-topic was conducted simultaneously by Chinese experts on one side, led by an “Expert Circle leader” in the group, and experts representing the German industry on the other side, also led by an “Expert Circle Leader” in the group.

The study was further structured to reflect the following priorities of the project: background (context, technology and regulations), standards, testing and certification methods, type approval, homologation processes, and finally, recommendations for future cooperation projects. The outcome was a first draft-structure that had been translated and presented to the Chinese project partners who approved of proceeding with the project.

<table>
<thead>
<tr>
<th>Subtopics</th>
<th>Chinese Experts</th>
<th>German Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Car Safety</td>
<td>Huaqiang Wang (Shanghai Automotive Test Center), Guoqiang Li (CQC)*</td>
<td>Heiko Meier (Volkswagen AG), Michael Guse (Daimler), Wu Meng, Liu Meng, Zheng Rong, Albrecht Pfeiffer (BMW), Alexander Braun (TUV Rheinland)*</td>
</tr>
<tr>
<td>Environmental and safety issues</td>
<td>Changchun Automotive Test Center</td>
<td></td>
</tr>
<tr>
<td>Battery Safety</td>
<td>Mechanical Safety qi BYD, Auto Test, National Automotive Quality Supervision Test Center, Xiong Fan, Qiao Hongbo, China North Quality Supervision, Inspection and Certification Institute*</td>
<td>Markus Neiler, Michael Guse (Daimler), Liu Heng, Cynthia Zhang (BMW), Wu Jia (TUV Rheinland), Dr. Tobias Giebel, Zhao Yawei (VGC)*</td>
</tr>
<tr>
<td>Recycling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charging Infrastructure</td>
<td>Cables, Dep. 4 (CQC), Zhang Daquan (Dep. 1/CQC)*</td>
<td>Liu Heng, Albrecht Pfeiffer (BMW), Ralf Nohra (Daimler), Liu Weihai (TUV Rheinland), Liu Yuehe (Siemens), Du Flonzheng (Phoenix Contact)*</td>
</tr>
<tr>
<td></td>
<td>Plugs, Dep. 5 (CQC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chargers stations, Dep. 1 (CQC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication protocol, Tianjin Automotive Test Center</td>
<td></td>
</tr>
</tbody>
</table>

Contact Person for groups 1-3

Figure 5: Overview of the Three Expert Circles
The next Figure 6 exemplifies the structure for the work of the experts. Whilst not all of these elements were covered during the limited time available, this structure provided the basis for the reporting in the second Expert Workshop. Not all of these topics were included in the final report, since not all results were deemed sufficiently relevant for proceeding with the proposed projects.\

Example: Battery

- Mechanical Safety
  1. Background (context, technology, regulations,...)
  2. Standards/Specifications/Norms
    - List of Standards in Germany/EU and in China
    - Comparison of 1) and 2) and Differences
    - Open issues
  3. Testing and Certification methods
    - Testing/Certification in Germany/EU and in China
    - Comparison of 1) and 2) and Differences
    - Open issues
  4. Type approval
    - Type approval in Germany and in China
    - Comparison of 1) and 2) and Differences
    - Open issues
  5. Recommendation draft project

Figure 6: Structure for Reporting on Mechanical Safety of Batteries

1.4.2. Phase 2

The main work on the study took place between November 2011 and March 2012: During this period the experts had regular informal exchanges both on Chinese and German side. A second Expert Workshop took place towards the end of this period on 2 March 2012. To conclude this stage a first draft report was compiled in March 2012 and distributed among the experts for commenting and review.\

Chinese Experts

After the workshop, the Chinese experts met on a regular basis in order to compile, exchange, compare and discuss standards and certification procedures in China and Germany. Upcoming activities and tasks were distributed among the different Expert Circle sub-group participants. The different topics of the

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4 Detailed results of the research can be found in the technical annexes to the report.
5 A selection of the material prepared during this period can be found in the technical annexes.
analysis were prepared, discussed, and further developed with the help of input from the participants and had to be agreed on internally. As a result, the differences between German and Chinese regulations were defined and commented. All important material, such as tables and presentations, that were prioritized to be used in further proceedings and workshops were translated from Chinese into English and transferred to GIZ for further exchange with the German experts. Furthermore, first potential project ideas for cooperation projects were collected, developed, discussed and agreed upon before written down as a discussion basis with the German experts. The Chinese Expert Circle leaders kept regular contact among each other to keep everybody updated on new developments and changes. Also, communication with their German counterparts was established.

German Experts

In preparation of the Second Expert Workshop, a number of documents were collected and exchanged, and phone conferences were conducted with the German experts in order to get a sound information basis for the study as well as to collect in a very early stage first potential project ideas. Based on the input of the experts, a first technical draft document was outlined and circulated for further input and feedback prior to the workshop to all experts.

Second Expert Workshop

The second Expert Workshop allowed the three Expert Circles on “Overall Car Safety”, “Battery Safety” and “Charging Infrastructure” to exchange their concepts, ideas and proposals and to further develop their technical inputs. After a general introduction, the objective of each group was to work jointly in the different Expert Circle areas in separate break-out sessions, based on the technical fact finding document collected prior to the workshop.

As an example, in the Expert Circle on Overall Car Safety the break-out session had been structured as follows: define key areas to compare, compare standards, test/certification methods and type approval, and identify potential cooperation projects. The focus was on standards used for type approval (mandatory standards). A high-level overview of standards has been systematically compiled, using the Chinese mandatory standards for type approval for Electric Vehicles and finding the German/European equivalent. Also during the Expert Workshop, both sides exchanged their documents. The objective was to compare limits and test methods for respective standards using the developed template in order to identify potential areas of harmonisation.

1.4.3. Phase 3

The highlight of this phase was the presentation of preliminary results of the feasibility study during the Hanover Industry Fair with participation of German and Chinese experts. A first draft copy of the
feasibility study was handed over to BMWi on 23 April 2012 confirming the commitment of the participation organizations to continue cooperation on Conformity Assessment. After presentation the report went back to the experts for a second review. To conclude this phase a final draft was compiled end of May 2012. This final draft of the feasibility study was then sent to a larger audience for comment, including the participants in the Sino-German government dialogues involved in Electric Mobility issues.

Chinese Experts

After reviewing and commenting on the draft report, some of the Chinese experts embarked on a Study Tour to Germany: The main purpose of this study tour was to further detail the findings of the report and to prepare the ground for further collaboration on Conformity Assessment. The study tour took place from 23-28 April 2012. The Chinese team consisted of seven Chinese experts from CATARC, CNCA, CQC, and the China North Vehicle Research Institute.6

The study tour started on the Industry Fair in Hanover. On the first day the team visited the VW booth, the different Electric Mobility exhibitions, the TÜV Nord booth, and finally the booth of BMWi. In a short ceremony in the afternoon, the draft of the study was officially handed over to Mr. Arnold of BMWi, followed by a presentation on Chinese Conformity Assessment for Electric Mobility by the expert Xie Penghong from CQC. The following day the experts participated in the main Sino-German conference on Electric Mobility, also held at the Hanover Fair.

After the Hanover Fair, the team started to tour Germany with a visit at Phoenix Contact, where company representatives gave a detailed overview of their products and China activities and discussed Conformity Assessment issues related to automotive suppliers. The following day, TÜV Rheinland presented their organisation and existing co-operations with China, gave an overview of their global e-mobility activities, and explained the homologation process in Germany. In the afternoon of the same day, the study tour participants visited the offices of VDE in Offenbach where both sides made a number of presentations related to Electric Vehicles. Highlight was the visit of the testing facilities of VDE, leading to intensive discussions on effectiveness of different testing methods. On the last day of the study tour, the Chinese experts were invited to visit the new battery testing laboratories of TÜV Süd in Munich; whilst in the afternoon the study group toured the premises of BMW. In the ensuing discussions the experts confirmed again the importance of further collaboration in Conformity Assessment related issues. Both BMW and the Chinese experts were keen to discuss future projects as developed in the Expert Circles (see Chapter 6 of this report).

6 Participants were: Wang Kun, Wang Xin, CNCA; Xie Penghong, JiaGuoqiang, Wang Jiangdong, CQC; Hu Daozhong, China North Vehicle Research Institute; Li Mengliang, CATARC. The Chinese Expert Team was guided by Carl-Maria Bohny and Li Lei (GIZ) and attended by Dr. Martina Gerst.
All German organisations visited during the tour showed a high interest in the study, asked questions, and discussed with the Chinese experts all topics regarding Overall Car Safety, Battery Safety and Charging Infrastructure. They expressed their interest in Electric Vehicle harmonisation of certification and everyone emphasized that they would like to be involved in further cooperation projects.

German Experts

The German experts provided feedback as well as additional material to the first draft of the study. Based on detailed reviews from all three Expert Circles the entire report was revised and updated. Some of the German experts were also involved in the German study tour with their Chinese peers and contributed with additional presentations to an increased understanding of certification processes. The ensuing discussions proved to be highly valuable and much additional insight was gained both for the Chinese and the European testing environment.

Study Tour in China

In response to the study tour to Europe, the Chinese side extended an invitation to the German experts to visit several testing facilities in China from 6 to 10 August 2012. The institutions included the China Automotive Technology & Research Centre (CATARC), the State-Assigned Electric Vehicle Power Battery Testing Centre of the China North Vehicle Research Institute and the Shanghai Motor Vehicle Inspection Center (SMVIC) as well as Shenzhen BYD Auto Co., Ltd.

The expert group visited the testing facilities of CATARC, including the labs for battery, EMC and emission testing and discussed topics like the latest developments of relevant testing and certification issues, such as validation of charging cables, vehicle charging interfaces, and battery safety. During the second day visit to the State-Assigned Electric Vehicle Power Battery Testing Centre of the China North Vehicle Research Institute in Beijing, the leading test provider for power batteries with the most comprehensive testing range of battery items in China, the experts were informed about different requirements of China’s local standards and industry standards for batteries of electric vehicles and training and advisory services which the institute provides to manufacturers.

On 9 August 2012, the expert group visited the headquarters of BYD Auto Co. Ltd. in Shenzhen, which was established in 2003 and is a part of BYD Co Ltd, a producer of rechargeable batteries. Mr. Wang Kun, Certification and Supervision Department Director of CNCA, greeted all participants and introduced the background and framework of the Sino-German cooperation on electric mobility. In the following, experts from the Volkswagen Research Lab China presented state-of-the-art charging systems for new energy vehicles in the EU to the Chinese side. Both sides exchanged opinions about preferences for AC- or DC-charging of electric vehicles in China. Cases for private and public charging were separately discussed.
On the last day the expert group visited the Shanghai Motor Vehicle Inspection Center (SMVIC) and the National Center of Supervision and Inspection on Motor Vehicle Product Quality (Shanghai). SMVIC shared its experiences in EMC-testing for new energy vehicles, and showed great interest in the latest European EMC testing requirements and methods regarding new energy vehicles, the charging facilities for electric vehicles, and the level of human exposure to electromagnetic fields from charging facilities.

1.5. Project Results

During the review of the final draft both Chinese and European experts re-iterated their strong support for all six proposed cooperation projects. Whilst it was clear that a selection will have to be made, they all expressed their hope that such projects can be launched as soon as possible.

The feasibility study has raised expectations both with the involved authorities and with the industry: Continued cooperation on certification is considered highly important to support and accelerate the development and market introduction of Electric Vehicles both in China and in Europe.

In the following three sections, the results of the three Expert Circles on “Overall Car Safety”, “Battery Safety”, and “Charging Infrastructure” are outlined. Most of the results are based on technical material which can be found in the referenced annexe.
2. National Approaches towards Electric Mobility and Standards

This Chapter describes some of the basic policies underlying standardization, certification, and type approval for Electric Vehicles, both in Europe and in China. Without a general understanding of these principle strategies it might be difficult to understand why the systems in the two economies are so different and why major efforts are needed to align Conformity Assessment processes.

2.1. The European Approach towards Electric Mobility

The European strategy on clean and efficient vehicles has been adopted in May 2010 as part of the European response to the financial/economic crisis of 2008/2009. It provides a public policy framework to support the development of alternative technologies in the automotive sector with the main objective to stimulate the competitiveness of the European automobile industry and promote sustainable mobility.

The European strategy contributes to guide the European debate on measures to promote decarbonisation of transport and low emissions, but also takes the changing preferences of consumers (need for industry adaptation and innovation) into consideration. Green technologies play a central role in the sustainable development in Europe.

The strategy follows a two-track approach, assuring technology neutrality: Firstly, the promotion of technologically advanced and fuel efficient vehicles to be put on the market in the near future with a focus on the combustion engine (2020 perspective), increased use of sustainable bio-fuels, and gaseous fuels. Secondly, the European roadmap and the action plan for promoting and facilitating the emergence and proliferation of breakthrough technologies are mainly focused on Electric Vehicles (plug-in hybrids and fully electric) and Hydrogen-powered vehicles.\(^7\)

2.2. The Chinese Approach towards Electric Mobility

A main element preparing the Electric Vehicle market is the Chinese Approach towards Electric Mobility. The 12\(^{th}\) Five-Year Plan for the development of Electric Vehicle Technologies in China issued by the Ministry of Science and Technology (MoST) indicates that the Chinese Government is determined in developing the market for Energy Saving Vehicles and Electric Vehicles. One of the targets is the

\(^7\) See website of EU-Directorate General for Enterprise & Industry, Automotive Unit.
reduction of the average fuel consumption of energy-saving vehicles which is targeted at reaching 5.9 l/100 km by 2015 and at 5.0 l/100 km by 2020.

The key elements for the development of Electric Vehicles are the following:

- Mastering core technologies by the local OEMs / suppliers;
- Pure electric / range-extender / plug-in hybrid / fuel cell vehicles will all be treated as “New Energy Vehicles” (NEV) and fall under the Electric Mobility regulations. Normal hybrid vehicles will be treated as “Energy Saving Vehicles”;
- Before 2015, industrialization of normal hybrid cars will be encouraged, whilst small (mini) energy saving cars and large energy saving buses will be used as demonstration projects to prepare the industrialization of Electric Mobility after 2015;
- Current and future demonstration programs shall be continued and extended to about 30 cities and effective supporting measurements will be introduced aiming at NEV to achieve at least 1% market share in their respective sectors as soon as possible;
- The development of the infrastructure for battery charging and battery technology itself will be the focal point aiming at 400,000 charging poles and 2,000 battery fast charging / charging stations in demonstration cities and their surroundings.

The “Development Plan for Energy Saving and New Energy Vehicles in China” was issued in April 2012 by the Ministry of Industry and Information Technology (MIIT), covering the planning period from 2012 to 2020. It includes following objectives and actions:

**Objectives**

- Promote the industrialization of EV batteries and plug-in HEV. By 2015, the cumulative production and sales volume of the battery EV and Plug-in HEV should amount to 500,000 units, and cumulating up to more than 5,000,000 units by 2020;⁸
- Popularize the usage of normal hybrid vehicles and Energy Saving Vehicles;
- Define targets for fleet average fuel consumption of passenger cars;
- Achieve top rankings for NEV development globally in: vehicle technology, traction battery, and core components.

**Action plans**

- Build up more research and development capacity; breakthrough in the core technologies; reduce fuel consumption; improve safety and reliability of traction batteries; reduce weight of traction battery systems;

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⁸ Presentation Dai Hong, SAC, 2012.
• Speed-up popularization and demonstration programs: Continue to implement incentive policies for private customers purchasing and using energy saving vehicles including financial subsidies;
• Consider full localization when establishing charging poles and public battery fast charging / changing infrastructure. Relevant policies for traction battery recycling will be introduced;
• Improve and strengthen the technical standard system and the production permission administration system; actively conduct international cooperation.

2.3. Strategy for Standardization in Germany

The German national approach to Electric Mobility standardization is in line with the European strategy and the respective roadmap outlined above which can be found in the German Standardization Roadmap (2010). Although the market introduction of Electric Vehicles is understood as a challenge for Germany, it also offers market opportunities for the automotive, electrical engineering and energy technology sectors that have already established a high level of quality, safety and availability, particularly regarding the effort of standardization to ensure interoperability.

Figure 7 below demonstrates how German regulations and standardization are integrated in the European and global regulatory and standardization framework. This system has proven to be very effective in ensuring that there are no differences between the three levels Germany / Europe / International.

Figure 7: Standardization Organisations and Regulatory Bodies (Various Sources)

9 Nationale Plattform Elektromobilität, the German Standardization Roadmap, Version 1.0.1, 2010.
The benefits for the stakeholders of contributing to Electric Vehicle standardization are manifold: First, standards take a pioneering role in preparing the market, and in this regard particularly where for example user safety has to be ensured through testing methods and Conformity Assessment. Second, standards support innovation securing investments made for development and research. Finally, standardization is accelerating the further development of the Electric Vehicle sector by acting as an enabling framework.

Electric Vehicle standardization is characterized by several features distinguishing it from previous standardization. In the Electric Mobility context, the challenge can be found in coordinating and integrating diverse activities in different sectors in order to effectively fulfil requirements. Electric Vehicles are a breakthrough innovation requiring a new, cross-sector system thinking. Up to now, standards in electrical engineering, energy saving, communication, and automotive technology have been viewed as separate fields. Little attempt has been made for an integrated approach for Electric Vehicle standardization; although this would be an important aspect, particularly because these domains are converging, resulting in new interfaces.

There are a number of pilot and model projects being carried out in Germany. The main objective of these activities is to gain experience using existing standards, and/or revised ones and identify where new standards are needed. Several of these projects have a clear relationship to standardization.

These are:

- The “ICT for Electric Mobility” programme initiated by BMWi in conjunction with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Information and Communication Technology (ICT) aspects of Electric Mobility are being investigated and tested in seven “pilot regions” within Germany, which are closely connected to the six “e-energy” pilot regions.

- The funding programme announced by the Federal Ministry of Education and Research (BMBF) called “Schlüsseltechnologien für die Elektromobilität - STROM” (Key technologies for Electric Mobility), which expressly refers to the fundability of standardization and specification work.

- The long-term “Innovation with Norms and Standards” (INS) programme supported by BMWi in which innovative standardization projects carried out by German companies are being funded, particularly to help them uphold their interests at international level. The INS programme not only covers Electric Mobility but also “cutting-edge fields” identified in the Federal Government’s “High-Tech Strategy”, and is especially geared towards the needs of small and medium enterprises.
The aforementioned pilot regions are also cooperating in a joint “Taskforce: Interoperability” headed by a research team in the form of a consortium commissioned by BMWi to support work in the “ICT for Electric Mobility” funded projects. One aim of the task force activities is to ensure interoperability of the pilot solutions developed in the model regions while taking into consideration current international standardization efforts.

### 2.4. Strategy for Standardization in China

According to the 12th Five-Year Plan, the goal of the Chinese Standardization Strategy is to establish a scientific, systematic, open, orderly and adjustable renewable energy vehicle standard system which fully meets research, industrialization, commercialization and management requirements and becomes an important technical support for the Electric Vehicle industry. The idea behind this is to transform a large number of latest achievements and advanced experiences into these standards and subsequently publish these standards and get involved in international standard activities.\(^\text{10}\)

China’s standards development attempts to transform itself from a standard follower to a standard setter. The technical route of standards development will be transformed from research to a combination of joint research and industrialization. The emphasis of the standards development will be on the coordination of a key framework of national standards with standards developed for the industry sector and company specific standards. Chinese organisations involved in Electric Vehicles standardization are explained in Figure 8.

Since the first standards of Electric Vehicle have been released in 2001, they became the basis and the technical support for project application and evaluation, such as the State ‘863’ program as well as technically supported the Electric Vehicle technology innovations. The “Renewable energy automotive manufacture and product access management” released in June 2009 by MIIT describes that Electric Vehicles must meet the existing conventional test items and specific standards. Electric Vehicle Standards play an important role in the Electric Vehicle industry, manufacturing, or product access.

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\(^{10}\) Wu Zhixin, CATARC.
The work plan of standardization during the 12th Five-Year Plan includes three phases:\[12\]

- **Phase 1:** Establish a standard system scheme and develop urgently needed standards (September 2010 – December 2011). Key tasks are to establish a standards system scheme by concentrating all forces, to develop certain urgently needed standards (32 important standards) in order to ensure cooperation with research facilities, industry, demonstration projects, and to develop schemes for subsidies accelerating private purchase of new energy vehicles.

- **Phase 2:** Implement the standards developing plan (January 2012 – December 2013). Key tasks are to fully implement the standards developing plan and to develop standards rapidly (26 important standards), basically rebalancing the asynchronous development of standards and industry.

- **Phase 3:** Optimize standards (January 2014 – December 2015). Key tasks are to optimize the standards plan for renewable energy vehicles and complete the planned standards (20~30 standards), and to meet the requirements of research, industrialization, commercialization and management.

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11 Presentation Dai Hong, SAC, 2012.
12 Presentation Wu Zhixin, CATARC, 2012.
The next Figure explains the milestones of China’s standardization roadmap – including the three phases as described above, whilst the following Table 1 identifies the actual standardization work:

![Figure 9: China’s Standardization Milestones (Source: CATARC, SAC)](image)

<table>
<thead>
<tr>
<th>Existing Standards</th>
<th>Electric Vehicles</th>
<th>12</th>
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<tbody>
<tr>
<td></td>
<td>HEV</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FCEV</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>E-motorcycles</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Energy Storage</td>
<td>8</td>
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<tr>
<td></td>
<td>Electric Motors</td>
<td>5</td>
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<tr>
<td></td>
<td>Infrastructure</td>
<td>11</td>
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<table>
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<tr>
<th>Under Development</th>
<th>Final voting stage</th>
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<td></td>
<td>Development stage</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Preliminary Research</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 1: Chinese Standardization Work for Electric Vehicles
3. Overall Car Safety

The Chapter on “Overall Car Safety” is reflecting the results of the respective Expert Circle. The experts spent much time on defining the commonalities and differences in standards – since these are paramount for the homologation processes in Europe and China. Most of these standards are already in place of being completed in the near future.

There was a general understanding that existing testing and monitoring rules related to the Overall Car Safety will have to be adjusted in the near future based on the updated framework of standards. Testing in Europe and China is currently a combination of routine testing of Overall Car Safety applicable for all vehicles, combined with requirements specific to electric and hybrid-Electric Vehicles. It has proven to be difficult to show the differences in Conformity Assessment since the testing processes are not yet fully described.

Due to the different certification procedures and consequences, clarification is needed on whether a norm/standard or a regulation is addressed, as described in Figure 10.

![Figure 10: Norms and Regulations – Germany (Source: VW Wolfsburg, 2012)](image)

Norms can be bypassed and are…

- established by Industry
- "state-of-art"
- voluntary
- handled by verification
- conducted by manufactures and if appropriate by technical service
- relevant for product liability, misuse, design, transport, cost benefits, supply chain

Regulations can not be bypassed and are…

- established by Governments
- minimum legal requirements
- mandatory
- handled by homologation
- conducted by technical service and approved by governments
- relevant for free trade
From an European industry perspective, standards can be characterised as being established by the industry on a voluntary basis to take advantage of newest technology and to realize cost benefits, for example in procurement and logistics; whereas regulations are understood to set a minimum level of requirements which have to be fulfilled.

3.1. Global Regulatory Approach

Regulations for vehicle safety have been harmonized between EU, US, Japan, and many other countries based on the UNECE 1958 agreement. In fact this agreement led to a global alignment of testing and homologation requirements which is unique for most industry sectors – with one major exception: China. China – whilst adopting many of its deliverables – did not accede to the UNECE 1958 agreement and decided to have its own specific regulations for the automotive industry.

The UNECE 1958 Agreement operates on the principles of unified type approval and reciprocal recognition. Any country that accedes to the UNECE 1958 Agreement has the authority to test and approve any manufacturer’s design of a regulated product, regardless of the country in which that component was produced. Each individual design from each individual manufacturer is counted as one individual type. Once any acceding country grants a type approval, every other acceding country is obliged to honour that type approval and regard that vehicle or item of motor vehicle equipment as legal for import, sale and use. Items approved as meeting an ECE Regulation under this agreement are marked with an E and a number in a circle. The number indicates which country approved the item, and other surrounding letters and digits indicate the precise version of the regulation met and the type approval number, respectively.

For Electric Vehicles the same approach applies – whilst the detailed process of testing and type-approval is still under revision: Close cooperation in the before-mentioned two informal working groups under the UNECE 1998 agreement between the European Commission, the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) in the United States, the Ministry of Land, Infrastructure, Transport and Tourism of Japan, and the Ministry of Industry, Infrastructure and Technology in China will ensure that current mutual recognition of approval systems will also apply for this sector.

China did so far not accede to the UNECE 1958 agreement. Nevertheless, many of the respective regulations have been implemented in the Chinese standardization system. For a detailed description of current testing methods for Overall Car Safety in Electric Vehicles in Europe and China is included in the technical annexes to this report.
The updating of the global regulatory framework including the rules for the safety of Electric Vehicles is coordinated by the UNECE Working Party 29 (= World Forum for Harmonization of Vehicle Regulations). Its regulations and all current and future amendments are automatically adopted by the European Union. Notably this applies for the UNECE-Regulation 100 (ECE-R100), which has been amended to address the needs for NEV. Under the UNECE 1998 Agreement, specific safety requirements for batteries in electric and hybrid-electric vehicles have been established and should be adopted later this year. Two informal working groups under UNECE 1998 Agreement were created in November 2011; one addressing safety aspects of Electric Vehicles and their components including batteries (safety of occupants against electric shocks in use, during charging, and after an accident), and one addressing environmental aspects specific to Electric Vehicles. The European industry would welcome an even larger commitment of China to these initiatives like in the WP.29 of the UNECE.

Electric Vehicles are still produced in relatively small volumes, thus there is a need for global cooperation to enable and accelerate their market acceptance. Furthermore; re-enforcing safety of Electric Vehicles is considered an essential element to build consumer confidence in this new technology. Regulatory convergence can play a major role as it helps to enhance competitiveness and to control costs for market implementation.
The main objective of the work in WP.29 is indeed convergence of regulatory obligations related to Electric Vehicles in the global context. The two informal working groups mentioned before will facilitate the exchange information on current and future regulatory initiatives and shall result in a system that avoids unnecessary differences between regulatory approaches are avoided. As recently pointed out by representatives of the European Commission\textsuperscript{13}, common requirements in the form of Global Technical Regulations (GTR) shall be developed wherever possible.

Most of the planned activities refer to the regulatory framework for Electric Vehicles with a clear focus on ensuring the safety of the entire vehicle and of the battery system. The preferred approach is to achieve international standardization in order to create a level international playing field for Electric Vehicles, to provide clarity for vehicle and components manufacturers, and to gain the confidence of consumers. In this regard, the European Union invites China to become even more active in international legislative activities.\textsuperscript{14}

The experts consider it as very important that any new or amended regulation allows a suitable lead time before enforcement, in order to enable a) authorities and technical services to prepare for the new legislation, and b) to allow industry to change production and to acquire new testing equipment. This is also one of the key principles for CARS21, a joint initiative between the European car industry and the European regulators with the goal to implement an integrated policy approach, including improved implementation of new and amended regulations.

As shown in Figure 12, the development phase for implementation of new products in the car industry takes between 5 and 7 years. Due to high investments and efforts put into acquiring engineering and production capacities on the manufacturer and on the supplier side, both require regulatory institutions to be able to adequately adapt the timeframe for enforcing new or amended regulations.

\textsuperscript{13}EU-China joint seminars on Electric Mobility, February 2012 in Beijing.

\textsuperscript{14}China holds a Vice Chairmanship in the WP.29.
• Development phase about 5-7 years → additional requirements (durability, mileage, etc.) require longer test times & more engineering work
• Investments in platforms higher thus longer pay-back time
• Engineering and production capacities already allocated at manufacturer and supplier level

Figure 12: Lead Time for New or Amended Regulations (Source: VW Wolfsburg, 2012)

An example of such a well planned amendment and enforcement strategy can be seen in the process of the development of ECE-R100.01, as demonstrated in Figure 13 below.

Figure 13: Lead time – Amendment of ECE-R100.01 (Source: VW Wolfsburg, 2012)
3.2. Standardization

Whilst regulations on international level are almost completed, the standardization process for Overall Car Safety in China is also coming to an end. The experts in the Expert Circles on “Overall Car Safety” compared the requirements in Europe/Germany and in China. The resulting comparison tables demonstrate that – despite continuous efforts for harmonization – major differences between international regulations and the requirements applicable in China are still pertinent. Nevertheless, both European and Chinese experts agree that there is sufficient similarity to create the space for an intensified cooperation in testing and certification.

3.2.1. Ongoing Work on International Level

Updating and completion of the regulatory approach to Electric Vehicles under the UNECE agreement shall be finished by the end of 2012:

- Overall safety: Regulation ECE-R100 on electric powertrain vehicles;
- Electric safety: Amendment of the Regulation ECE-R100 with the .01 series to cover electric safety requirements for vehicles of categories M & N\(^{15}\);
- Crash Safety: Existing Regulations ECE-R12, R94,R95 have been amended to cover electric and hybrid-electric vehicles ;
- Braking systems: Adaptation of Regulation ECE-R13H;
- Batteries: Amendment of Regulation ECE-R100 under development, to become the .02 series. Requirements include e.g.: vibration, thermal shock, mechanical integrity\(^{16}\).

The amendment ECE-R100.02 covers also Rechargeable Energy Storage Systems (RESS) as individually approvable units. This approach allows a component based approval as preferred by the Chinese homologation system.

3.2.2. Ongoing Work in China

The Chinese standards are mostly corresponding to the international regulations, they do, however, include major modifications. Currently, the standard series GB/T 18384.1/2/3-2001 is under revision, the standards GB/T 19751-2005 and GB/T 24549-2009 are already published in an updated version.

\(^{15}\) Compliance with this amendment is required: a) for new types end of 2012, b) for all new vehicles in 2014.

\(^{16}\) The requirements cover also RESS as individually approvable units. This approach is supporting a component based approval as e.g. preferred by the Chinese homologation system.
Research on safety specifications for Electric Vehicle post-crash safety is ongoing; the objective is to develop crash test standards suitable to the Chinese traffic environment. The research is based on crash data from Electric Vehicles collected in China. The standard will contain detailed operational requirements such as precautions against explosion or fire. A respective standardization project (project number: 20110008-T-339) has been established. Experts from Japan and Germany are included in the development. A preliminary draft is available; the final standards shall be published in not more than two years.17

### 3.2.3. Comparison Tables

An extract of the findings of the experts is included in the Table 2. More details can be found in the technical annexes to this report.

<table>
<thead>
<tr>
<th>Item</th>
<th>Chinese standard</th>
<th>UNECE Regulation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric safety I</td>
<td>GB/T18384.1-2001</td>
<td>ECE-R100.01</td>
<td>Identical</td>
</tr>
<tr>
<td>Electric safety II</td>
<td>GB/T18384.2-2001</td>
<td>ECE-R10</td>
<td>Chinese standard partly ECE-R10, partly ECE-R100.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECE-R100.01</td>
<td></td>
</tr>
<tr>
<td>Electric safety III</td>
<td>GB/T18384.3-2001</td>
<td>ECE-R 100.01</td>
<td>Identical</td>
</tr>
<tr>
<td>Battery</td>
<td>QC/T 741-744 (under revision)</td>
<td>ECE-R100.02 (draft)</td>
<td>Not identical</td>
</tr>
<tr>
<td>Battery dimensions</td>
<td>QC/T 840</td>
<td></td>
<td>Not existing in EU</td>
</tr>
<tr>
<td>Range &amp; Energy consumption</td>
<td>GB/T 18386-2005</td>
<td>ECE-R101</td>
<td>Partly Identical</td>
</tr>
<tr>
<td>EMC</td>
<td>GB/T 18387-2008</td>
<td></td>
<td>Not exiting in EU (Note: not to be compared with ECE-R10)</td>
</tr>
<tr>
<td>Safety spec HEV (hybrid)</td>
<td>GB/T 19751-2005</td>
<td>ECE-R100.01</td>
<td>Partly Identical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECE-R94</td>
<td>Partly Identical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECE-R95</td>
<td>Partly Identical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECE-R10</td>
<td>Partly Identical</td>
</tr>
<tr>
<td>Defrost &amp; Demist</td>
<td>GB/T 24552-2009</td>
<td>EC Regulation 672/2010</td>
<td>EC Regulation, no directive (system change from former 78/317 EEC)</td>
</tr>
</tbody>
</table>

17 Liu Guibin, CATARC.
### Table 2: Chinese Standards and UNECE Regulations relevant for Type Approval

<table>
<thead>
<tr>
<th>Standard Type</th>
<th>Chinese Standard</th>
<th>UNECE Regulation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel cell EV</td>
<td>GB/T 24549-2009</td>
<td>ECE-R100.01</td>
<td>Identical</td>
</tr>
<tr>
<td>Identification of controls</td>
<td>GB/T 4094.2-2005</td>
<td>ECE-R121</td>
<td>Identical; standard released in China but not adopted in CCC regulation</td>
</tr>
<tr>
<td>Fuel consumption of HEV</td>
<td>GB/T 19753-2005</td>
<td>ECE-R101</td>
<td>Identical</td>
</tr>
<tr>
<td>Emission of HEV</td>
<td>GB/T 19755-2005</td>
<td>ECE-R83.06</td>
<td>Identical</td>
</tr>
<tr>
<td>Brake</td>
<td>GB/T 21670-2008</td>
<td>ECE-R13H</td>
<td>Identical</td>
</tr>
<tr>
<td>Post-crash Behaviour</td>
<td>Draft standard</td>
<td>ECE-R94 and ECE-R12</td>
<td>Identical</td>
</tr>
<tr>
<td>Power performance HEV</td>
<td>GB/T 19752-2005</td>
<td></td>
<td>Not existing in EU</td>
</tr>
<tr>
<td>Engineering approval program</td>
<td>GB/T 18388-2005</td>
<td></td>
<td>Not existing in EU</td>
</tr>
<tr>
<td>Electric Machine</td>
<td>GB/T 18488-2006</td>
<td></td>
<td>Not existing in EU</td>
</tr>
</tbody>
</table>

3.3. Conformity Assessment

Processes for conformity assessment including certification and type approval are substantially different in China and Germany and reflect the vastly different approaches towards product safety in the two jurisdictions. Whereas in Europe/Germany the type approval is based on the UNECE 1958 agreement, which is enshrined in respective EU Directives, and adopted in national law and regulations, in China the type approval process includes CCC and a registration of types/models by the authorities in charge for the automotive sector. Both processes in China rely on national compulsory standards rather than UNECE regulations with which they only partially overlap (see also in Table 2).

Nevertheless, both sides see considerable potential for an alignment of the underlying testing procedures. As the international community is currently working on the implementation of the revision of the UNECE Regulation ECE-R100, the test methods will have to be adjusted subsequently: This opens

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18 Note: ECE-R 100.01 covers hybrid-electric and electric vehicles.

19 In Germany implemented through the “Straßenverkehrs-Zulassungs-Ordnung” (Road Traffic Licensing Registration, StVZO) and organized by the “Kraftfahrt-Bundesamt” (Federal Motor Transport Authority, KBA).
the door for joint Sino-German development of updated testing processes. In fact the European governments expressed repeatedly that they expect China to make contributions to this field. The bilateral projects outlined at the end of the feasibility study are part of this process – concrete proposals how such cooperation could materialize.

As part of this feasibility study a detailed comparison of testing processes in Europe and China have been made. The detailed results of this comparison are included in the technical appendices of this feasibility study; they also form the basis for the conclusions in Chapter 6.

The following collection of statements from European and Chinese industry experts should allow to further assessing the need for future collaboration in certification in the area of vehicle safety for Electric Vehicles:

- It seems that the German and the Chinese philosophy regarding product focus and technologies are different; this has to be taken into consideration when planning harmonization activities.

- The homologation framework is rather completed in the EU and it is a concern that Chinese standards, certifications, and approval requirements of Electric Vehicles are still incomplete and consequently hamper the market entry of this new technology.

- Recognition of UNECE regulations instead of CCC certification and vice versa would be a first step towards harmonization.

- In 2011, despite constant efforts, no progress has been made with regard to a number of Electric Mobility standards. Chinese standards are still not compatible with internationally accepted standards and regulations.

- Harmonization of customs rules regarding the access of imported vehicles would be an important first step for cooperation (e.g. establish free trade zones like in other countries).

- In addition, different approaches towards standardization in China (top-down) and Germany/Europe (bottom-up) affect the harmonization of standards and certification/type approval.

- Differences in standards and regulations are understood to be extremely important for setting up a proper framework for Electric Mobility in China.

- The international regulatory environment is highly dynamic, welcoming new stakeholders such as State Grid.
• The international standardization bodies would like to welcome and integrate more Chinese experts working on common standards.

• The automotive industry in general has expressed and addressed coordination requirements regarding the large number of different initiatives and programs currently going on not only in Germany and China but also on a global scale.

3.4. Homologation

Homologation processes in China are based on a national certification and registration system which includes several ministries, whilst in Europe homologation is supervised by the individual member states under the principle that registration in one single member state is respected throughout the European Economic Area.\(^{20}\)

3.4.1. Homologation in Europe

In Europe, homologation of vehicles has been unified with the implementation of the Framework Directive 2007/46/EC and its translation in national regulations. The Directive defines that one registration process in one member state is sufficient for the entire European Economic Area and that all related documents can be transferred to any other member state without need for further tests and checks. The process of initial approval is called EU-Whole Vehicle Type-Approval System (EU-WVTA). Additional simplifications of the homologation process are foreseen for 2014. The system assures that any manufacturer placing vehicles in Europe can enjoy the entire European market without need for adjustments or re-testing.

The Directive 2007/46/EC incorporates the entire framework of UNECE Regulations regarding safety of vehicles as part of the EC-type approval of vehicles, puts them on the same level as EU Directives, and declares equivalence between UNECE Regulations and the corresponding directives of the EU (Art 34 and 35 of Directive 2007/46/EC). The directive also addresses all future changes of the UNECE Regulations and stipulates an automatic update of respective EU regulations\(^ {21}\).

The details of the EU-WVTA process are outlined in the annexes to the Directive 2007/46/EC and include the following steps:

\(^{20}\)European Economic Area (EEA) = Member States of European Union plus Norway and Iceland.

\(^{21}\)The Directive 2007/46/EC explicitly mentions that “... amendments to UNECE Regulations to which the Community has already acceded should be incorporated within the Community type-approval procedure either as requirements for EC vehicle type-approval or as alternatives to existing Community law”.

42
• Before granting type-approval, the approval authority must verify that adequate arrangements for ensuring conformity of production have been taken by the manufacturer. In most cases, this is deemed to be achieved if the manufacturer demonstrates compliance with ISO 9001;

• After granting approval, the approval authority must verify that the production arrangements of the manufacturer continue to be adequate. This verification must be carried out in accordance with the procedures set out in the Directive, and, where appropriate, with the specific provisions of the relevant Regulatory Acts listed in Annex IV to that Directive;

• In addition to the separate EU type-approval directives, regulations are developed under the auspices of the revised UNECE - 1958 Agreement. There is a very strong correlation between EU legislation and UNECE Regulations, and regulations adhered to by the Community are considered to be equivalent to their corresponding, separate directives for the purpose of EU type-approval;

• A “technical service” is an organization or body designated to undertake testing, inspection, and certification work under the automotive directive. Technical services need to prove their ability to perform such services and are registered by the member state where the service is located (notification process). Such technical service can be an in-house testing body or a third party; there is no requirement for involvement of a third body as long the in-house testing infrastructure does allow reliable testing and obtained the required credentials;

• Mandatory safety regulations describing requirements directly related to Electric Vehicles are: ECE-R10, ECE-R12, ECE-R13H, draft ECE-R51 (minimum noise), ECE-R83, ECE-R94, ECE-R95, ECE-R100, and ECE-R101. Including all addressing sub-systems (components) which need special attention during the testing process;

• In addition to these car-specific requirements, conformity with the Low Voltage Directive (LVD) 2006/95/EC is required – this applies especially where no car-specific requirements have been established, as e.g. for charging cables for Electric Vehicles;

Although type approvals processes in all member states of the European Union are legally equivalent, there are real and perceived differences in the rigor with which the regulations and protocols are applied by different national type approval authorities. Some countries have their own national standards for granting type approvals, which may be more stringent than called for by the UNECE Regulations themselves. For example, within the auto parts industry, a German (E1) type approval is regarded as a measure of insurance against suspicion of poor quality or an undeserved type approval.
3.4.2. Homologation in China

In China, the homologation process of Electric Vehicles depends on whether a car is locally produced or imported.

Locally produced Electric Vehicles

Three ministries are involved in the registration of locally produced Electric Vehicles. MIIT in charge for the vehicle registration and leading the process, AQSIQ represented through CNCA for the CCC certification, and the Ministry for Environmental Protection (MEP) for emission controls. As shown in Figure 14, the homologation includes three components:

1) Registration in the MIIT Catalogue of approved vehicle models,
2) Certification under the CCC system,
3) Registration in the Catalogue of MEP.

The homologation process in China is based on Chinese national compulsory standards. The illustration in Figure 15 gives an overview of the different standards required for registration and certification of M1-type vehicles in China.

For locally produced Electric Vehicles currently 16 specific standards have to be taken into consideration, the standards are listed in Table 3. Additionally, locally produced NEV are requested to own all Intellectual Property Rights meaning in practice that a foreign supplier or manufacturer has to hand over all patents to the Chinese company.
Homologation overview of locally produced Electric Vehicle

MIT catalogue
- Tech. data
- Compulsory test
- Production permission

CCC certification
- Tech. data
- Compulsory test
- Factory audit

BJEPB catalogue

Local MPS office registration

Application for access
- Tech. Data

MIT: Ministry of Industry and Information Technology
MPS: Ministry of Public Security
BJEPB: Beijing Environmental Protection Bureau

Figure 14: Homologation of Locally Produced EVs (Source: VW China, May 2012)

Enforced China National Standards for M1 Vehicles (Up to Jan. 2012)

Figure 15: Standards for Registration and Certification of M1-Type Vehicles
### Existing additional standards specific for locally produced Electric Vehicle

<table>
<thead>
<tr>
<th>No.</th>
<th>Standards NO.</th>
<th>Standard Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>QC/T 741-2006</td>
<td>Ultra capacitors for vehicle</td>
<td>N.A</td>
</tr>
<tr>
<td>6</td>
<td>QC/T 742-2006</td>
<td>Lead-acid batteries for electric vehicles</td>
<td>N.A</td>
</tr>
<tr>
<td>7</td>
<td>QC/T 743-2006</td>
<td>Lithium-ion batteries for electric vehicles</td>
<td>N.A</td>
</tr>
<tr>
<td>8</td>
<td>QC/T 744-2006</td>
<td>Nickel-metal hydride batteries for electric vehicles</td>
<td>N.A</td>
</tr>
<tr>
<td>9</td>
<td>GB/Z 18333.2-2001</td>
<td>Zinc-air batteries for electric road vehicles</td>
<td>SAE J1797-1997</td>
</tr>
</tbody>
</table>

2012-5-16 Department: Homologisation/Technical Lobby

### Existing additional standards for specific locally produced Electric Vehicle

<table>
<thead>
<tr>
<th>No.</th>
<th>Standards NO.</th>
<th>Standard Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>GB/T 18387-2008</td>
<td>Performance levels and methods of measurement of magnetic and electric field strength from electric vehicles, broadband, 9kHz to 30MHz</td>
<td>SAE J551/5 JAN 2004</td>
</tr>
<tr>
<td>13</td>
<td>GB/T 18388-2005</td>
<td>Electric vehicles – Engineering approval evaluation program</td>
<td>N.A</td>
</tr>
<tr>
<td>15</td>
<td>GB/T 18488-2-2001</td>
<td>Test procedures of the electrical machines and controllers for electric vehicles</td>
<td>JEVS E701-1994</td>
</tr>
<tr>
<td>16</td>
<td>GB/T 19838-2005</td>
<td>Instrumentation for electric vehicles</td>
<td>IEC 784-198</td>
</tr>
</tbody>
</table>

2013-5-16 Department: Homologisation/Technical Lobby

Table 3: Standards for Homologation of Electric Vehicles in China (Source: VW China, May 2012)
Imported Electric Vehicles

AQSIQ is the responsible ministry for the approval of imported Electric Vehicles. The main system is the CCC certificate under control of CNCA and issued by CQC. Figure 16 shows the homologation schedule and the respective weeks needed to market a car in different countries and regions due to regulatory requirements. In the EU, authority tests can be done at the manufacturers facilities, therefore, homologation takes about 20 weeks. In other countries such as India and China, homologation can take up to twice as long. As a consequence, the automotive industry aims to market state-of-the-art technologies first in countries where the homologation time is fast and straightforward.

As shown in Figure 16, there are still some uncertainties about the importation process.

Figure 16: Homologation Schedule (Source: VW Wolfsburg, May 2012)

3.4.3. Comparison Tables

A comparison of homologation topics between Europe and China can be found in Table 4 based on a presentation made by TÜV Rheinland during the Expert Workshops:
<table>
<thead>
<tr>
<th>Topic</th>
<th>Europe</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration Unit</td>
<td>Vehicle Type</td>
<td>Variant of Vehicle Type</td>
</tr>
<tr>
<td>Requirements</td>
<td>EC Directives and UNECE Requirements</td>
<td>GB Standards (often derived from UNECE regulations with modifications)</td>
</tr>
<tr>
<td>Initial Inspection</td>
<td>Initial Assessment of Quality System (based on ISO 9001) and COP Procedures</td>
<td>Initial Assessment of Quality System and COP Procedures, onsite inspection required</td>
</tr>
<tr>
<td>Certificate of Conformity</td>
<td>One Certificate per Vehicle, in the language of country of delivery</td>
<td>One Certificate per Vehicle in Chinese; additional registration requirements by MIIT and MEP</td>
</tr>
<tr>
<td>Follow-up Inspections</td>
<td>Onsite inspection</td>
<td>Pre-check of documentation (quality control plan), onsite inspection</td>
</tr>
<tr>
<td>Authorized Testing Body</td>
<td>Notification needed, first or third party testing acceptable</td>
<td>Laboratories appointed by CNCA / MIIT / MEP</td>
</tr>
</tbody>
</table>

Table 4: Comparison of Homologation in Europe and China

**European Process:**

As outlined before, the responsibilities in the type approval process are distributed on different levels. The first level are the Member State governments, appointing the national approval authorities and notifying the technical services. The second level are the national approval authorities, responsible for all aspects of type approval, the communication with other approval authorities, the appointment of technical services, and the issuing of certificates. The third level are the testing and certification bodies, carrying out inspections and type approval tests and reporting to the approval authority. On the last level, the automotive manufacturers go through the type approval process by ensuring conformity of their production.

**Chinese Process:**

The reponsibilities for the homologation process are distributed among several ministries combining safety, environmental, and performance requirements. The system is built on a combination of Whole Vehicle Type Approval and certification of key components. Whilst the latter is defined in specifications to the compulsory CCC certification process, the whole vehicle needs to comply both with CCC requirements and the applicable processes for registration of the individual models. Finally, vehicles must also demonstrate compliance with the relevant environmental regulations and obtain the respective approvals.
3.5. Next Steps

The homologation processes between Europe and China are very different, both in certification requirements and in the amount of required testing and auditing. Nevertheless, there is a consensus between the experts in Europe and China that this does not prevent the establishment of similar testing requirements and methodologies for overall car safety. Achieving such alignment will require joint efforts and close cooperation of all parties involved, especially in the area of NEV. The rewards of such efforts would be a major simplification of both testing processes and testing documentation. It will further allow a harmonization of testing equipment, thus reducing overall testing cost for both Chinese and European car manufacturers.

Whilst opinions about the way forward are not fully compatible, it was still possible to define concrete areas for cooperation, mainly the project proposals No. 1, 2, and 6. Project No. 1 is addressing the mutual exchange and learning from each other’s experiences in testing and type approval. Project Number 6 suggests a comparison of test results based on the current testing processes in China and Germany, with the aim to better understand strong points and weaknesses of both testing systems. Finally, project No. 2 is addressing an urgent need for both sides to have clearer rules regarding post crash safety testing.
4. Battery Safety

This chapter describes the outcome of the Expert Circle dealing with Battery Safety: Due to different approaches in standardization and homologation between China and Europe/Germany, the emphasis of future cooperation must be put on alignment of testing methodology and processes. An extensive overview of applicable standards was made and it became evident that even on international level there is no clear answer what standards should be used for the homologation process. Testing and homologation of Battery Safety for Electric Vehicles is still in its infancy – currently there is no common understanding on how this should be done.

Batteries are the least defined part of the Electric Vehicle: Many different approaches by various car manufacturers in China and Europe lead to solutions which are difficult to compare. Numerous regulations and standards exist on international level, in Europe, and in China defining all levels of the battery from entire vehicle to individual cell and material used. The ongoing draft for amendment of UNECE-R100.02 regarding Battery Safety can be deemed as a global trend for certification and homologation of batteries that may find its way also in the EVS-GTR in progress.

Acknowledging the need for global alignment of standards, the European Commission’s DG Enterprise and Industry and the Chinese Ministry for Industry and Commerce recently agreed on a closer cooperation regarding battery standards. The agreement includes a commitment to establish a work plan for 2012-2015, following the objective “to exchange information and enhance cooperation in the area of safety requirements for the batteries used in Electric Vehicles.”

4.1. Standardization

There seems to be a fundamental difference in standardization and testing for Battery Safety as the European side understands that for appropriate Battery Safety the highest system level – the whole vehicle, including the battery system – has to be considered, whilst the Chinese side defines specific standards addressing batteries as a stand-alone component of the vehicle. This difference has its origin in the testing processes where China insists that it has to be ensured that vehicle batteries are safe the way they are being produced, regardless of the special vehicle environment. The European homologation system does not include any compulsory testing requirements for batteries on cell and cell pack levels.

Standardization of batteries can be undertaken on different levels; the European homologation system for batteries is focusing on the last two levels only; the Chinese standardization system is addressing the first four levels as Battery Safety, whilst the last level is addressed in Overall Car Safety regulations.
• materials used
• cell based approach
• battery modules / cell packs
• battery system
• overall car system including batteries

The basic regulation for safety of battery systems has been developed in the UNECE WP.29 as amendment .02 to the R100 regulation and shall be published by the end of 2012. For this task, an informal working group on electrical safety operating under the name RESS has been established. This working group is relying on two approaches, one vehicle based and one component based, whilst both approaches derive their requirements from the overall vehicle safety level. The proposals include among others new regulations on: vibration, thermal shock, mechanical impact, fire resistance, over-charge and –discharge protection, overheating protection, emissions (for open type traction batteries).

This regulation is composed of testing standards for lithium-ion batteries developed in parallel by ISO and standards on testing of all type of propulsion related batteries developed by IEC. To make things even more complicated both China and Europe developed additional standards for safety of batteries and battery installations. Finally, the UN published a section on lithium-metal and lithium-ion based batteries in its recommendations on the transport of dangerous goods, Manual of Tests and Criteria, item 38.3.

As per recycling of batteries, the Chinese side pointed out that the respective ISO standard on recycling of vehicles has been adopted and integrated in the Chinese standard GB/T 19515-2004, but that the original ISO standard does not sufficiently specify the requirements for battery recycling. The Chinese experts expressed their interest in operating some common research program in the future on the second life of batteries. Still, there seems to be a common understanding that it is too early to discuss specific recycling standards for car batteries, and that existing general requirements related to battery recycling are sufficient.

Noteworthy is also a fundamental disagreement on the business model to be used for battery systems for Electric Vehicles between car manufacturers and grid operators: The car industry insists that the battery system is an essential and inseparable part of the design of the vehicle. On the other hand, grid operators put pressure on all parties involved to also prepare for the introduction of battery swapping systems. It is obvious that any such swapping system would require serious restrictions on form and shape of battery packs – something the industry is vehemently opposing. Battery swapping will in China be addressed by a specific set of standards that is currently being developed; there is no such development in Europe.
Due to the complicated structure of the international system, the principal regulations and standards are listed separately. For all battery types a comparison of requirements is included in the technical annexes to this report.

**International / European Regulations:** These regulations form the basis for homologation in Europe:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU Framework Directive for the Approval of Motor Vehicles and their Trailers</td>
<td>Directive 2007/46/EC</td>
<td>Electric Vehicles as well as combustion vehicles are included</td>
</tr>
<tr>
<td>Safety of Electric Vehicles</td>
<td>UNECE-R100</td>
<td>Revised to include all electrically propelled systems</td>
</tr>
<tr>
<td></td>
<td>UNECE-R100.01</td>
<td></td>
</tr>
<tr>
<td>Requirements of a vehicle with regard to its electrical safety</td>
<td>UNECE-R100.02 Part I</td>
<td>Estimated year of enforcement: 2013</td>
</tr>
<tr>
<td>Requirements of a RESS with regard to its safety</td>
<td>UNECE-R100.02 Part II</td>
<td>Estimated year of enforcement: 2013</td>
</tr>
<tr>
<td>Transport of Dangerous Goods, Manual of Tests and Criteria</td>
<td>UN 38.3, revision 5</td>
<td>Specific instruction on lithium-ion batteries</td>
</tr>
</tbody>
</table>

Table 5: European and International Regulations used for Homologation in Europe
**International Standards for Testing of Battery Safety:** These standards are not part of the registration process in Europe; nevertheless they define the testing requirements for batteries:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrically propelled road vehicles -- Test specification for lithium-ion traction battery packs and systems -- Part 1: High-power applications</td>
<td>ISO 12405-1: 2011</td>
<td>Newest testing standard for lithium-ion batteries for EVs</td>
</tr>
<tr>
<td>Electrically propelled road vehicles -- Test specification for lithium-ion traction battery packs and systems -- Part 2: High energy application</td>
<td>Under development (ISO 12405-2: 2012)</td>
<td>Newest testing standard for lithium-ion batteries for EVs</td>
</tr>
<tr>
<td>Electrically propelled road vehicles - Test specification for Lithium-ion traction battery packs and systems -- Part 3: Safety performance requirements</td>
<td>Under development (ISO 12405-3: 2013)</td>
<td>Newest testing standard for lithium-ion batteries for EVs</td>
</tr>
<tr>
<td>Road vehicles – Recyclability and recoverability</td>
<td>ISO 22628: 2002</td>
<td>In China adopted as GB/T 19515-2004</td>
</tr>
</tbody>
</table>

Table 6: International Standards for Battery Testing
Other Standards used in Testing Specifications for Batteries: Table 7 shows a collection of other standards used to define safety of battery systems and batteries; these are generally not part of registration requirements in Europe:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety of primary and secondary lithium cells and batteries during transport</td>
<td>IEC 62281: 2004</td>
</tr>
<tr>
<td>Secondary batteries for the propulsion of electric road vehicles -- Part 1: Test parameters</td>
<td>IEC 61982-1: 2006</td>
</tr>
<tr>
<td>Secondary batteries for the propulsion of electric road vehicles -- Part 2: Dynamic discharge performance test and dynamic endurance test</td>
<td>IEC 61982-2: 2002</td>
</tr>
<tr>
<td>Secondary batteries (except lithium) for propulsion of electric road vehicles – Performance and endurance tests</td>
<td>Project IEC 61982: 2012</td>
</tr>
<tr>
<td>Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 1: Performance testing</td>
<td>IEC 62660-1: 2010</td>
</tr>
<tr>
<td>Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 2: Reliability and abuse testing</td>
<td>IEC 62660-2: 2010</td>
</tr>
<tr>
<td>VDA Test Specification for lithium-ion battery systems for hybrid electric vehicles</td>
<td>VDA Specification</td>
</tr>
<tr>
<td>Safety requirements for secondary batteries and battery installations - Part 1: General safety information</td>
<td>EN 50272-1: 2010</td>
</tr>
<tr>
<td>Safety requirements for secondary batteries and battery installations - Part 3: Traction batteries</td>
<td>EN 50272-3: 2002</td>
</tr>
</tbody>
</table>

Table 7: Other Standards for Batteries used in Europe

4.1.2. Regulations and Standards in China

The next table shows the standards applicable for batteries for Electric Vehicles in China. Note that these standards are currently all voluntary; the requirements for overall vehicle safety including battery systems are outlined in Chapter 3.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-acid batteries for electric road vehicles</td>
<td>GB/T 18332.1-2009</td>
<td>To be used in combination with QC/T 742-2006</td>
</tr>
<tr>
<td>Nickel-metal hydride batteries for electric road vehicles</td>
<td>GB/T 18332.2-2001</td>
<td>To be used in combination with QC/T 744-2006</td>
</tr>
<tr>
<td>Lithium-ion batteries for electric road vehicles</td>
<td>GB/Z 18333.1-2001</td>
<td>Guiding document, based on SAE J 1797: 1997</td>
</tr>
<tr>
<td>Zinc-air batteries for electric road vehicles</td>
<td>GB/Z 18333.2-2001</td>
<td>Guiding document</td>
</tr>
<tr>
<td>Safety specifications on hybrid electric vehicle</td>
<td>GB/T 19751-2005</td>
<td></td>
</tr>
<tr>
<td>Electrically propelled road vehicles -- Test specification for lithium-ion traction battery packs and systems -- Part 1: High-power applications</td>
<td>Under development (GB/T ...)</td>
<td>Adoption of ISO 12405-1</td>
</tr>
<tr>
<td>Electrically propelled road vehicles -- Test specification for lithium-ion traction battery packs and systems -- Part 2: High energy application</td>
<td>Under development (GB/T ...)</td>
<td>Adoption of ISO 12405-2</td>
</tr>
<tr>
<td>Electrically propelled road vehicles - Test specification for Lithium-ion traction battery packs and systems -- Part 3: Safety performance requirements</td>
<td>Under development (GB/T ...)</td>
<td>Adoption of ISO 12405-3</td>
</tr>
<tr>
<td>Ultra-capacitors for Electric Vehicles (cell level)</td>
<td>QC/T 741-2006</td>
<td>Automotive industry sector standard</td>
</tr>
<tr>
<td>Lead-acid batteries for Electric vehicles (cell level)</td>
<td>QC/T 742-2006</td>
<td>Automotive industry sector standard</td>
</tr>
<tr>
<td>Lithium-ion batteries for Electric vehicles (cell level)</td>
<td>QC/T 743-2006</td>
<td>The standard is currently being revised</td>
</tr>
<tr>
<td>Nickel-metal hydride batteries for Electric Vehicles (cell level)</td>
<td>QC/T 744-2006</td>
<td>Automotive industry sector standard</td>
</tr>
<tr>
<td>Specification and dimension of traction batteries for EV</td>
<td>QC/T 840-2010</td>
<td>Automotive industry sector standard</td>
</tr>
<tr>
<td>Technical specification for battery management system for EVs</td>
<td>QC/T 897-2011</td>
<td>Automotive industry sector standard</td>
</tr>
<tr>
<td>Cycle life test method and requirements for traction battery</td>
<td>Under development (GC/T ...)</td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Chinese Regulations and Standards for Electric Vehicles and Batteries
4.2. Conformity Assessment

Due to differing standards both on international and national level, it is difficult to identify a common approach for testing and homologation. As mentioned before, the ongoing draft for amendment of UNECE-R100.02 regarding Battery Safety can be deemed as a global trend for certification and homologation of batteries that may also find its way in the EVS-GTR in progress.

For the time being a mix of existing standards is used by testing bodies in Europe: In a recent presentation at an EU-China seminar on Electric Vehicles the Association of European Automotive and Industrial Battery Manufacturers (EUROBAT) pointed out that currently a combination of testing according to IEC 62133, IEC 62281, and UN 38.3 is most popular in Europe. This is also related to the existing battery certification scheme operated under the IECEE scheme for worldwide conformity of testing and certification.22

<table>
<thead>
<tr>
<th>Testing Required</th>
<th>QC/T 743</th>
<th>ECE-R100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Power</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Self-Discharge</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Overcharge</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Over Discharge</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Short Circuit</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Drop / Falling</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Penetration</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Crush</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Thermal Shock</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Vibration</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Cycle Life</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Exposure to simulated vehicle fire</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>High temperature</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 9: Comparison of Testing Requirements for Lithium-Ion Batteries

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22 A description of the regulatory and testing environment in Europe is included in the technical annexes to this feasibility study.
Whilst batteries do not fall under any compulsory market access scheme in China, they must comply with the applicable standards, mainly the GB/T 18333 and QC/T 741-744 series. These standards are not identical with the requirements in ECE-R100 and in the respective ISO and IEC standards, requiring adaptations for China markets.

4.3. Homologation

Since batteries reflect the heart of any Electric Vehicle – harmonization of homologation schemes related to the safety of rechargeable energy systems must become a top priority for all parties involved. Considering the high percentage of overall cost in Electric Vehicles related to batteries it is imperative that standards, testing procedures, and homologation processes become aligned on a global scale. Since there is indeed common ground with the new UNECE-R100.02 regulation this should be feasible in not too distant future. However, this requires better cooperation of all partners involved; both on national and international level.

Car manufacturers both in Europe and China fear that country specific homologation processes will restrict not only their global reach, but also their ability to design new cars and to develop battery technology further. They point out that ECE-R100.02 should remain the sole basis for testing and approval of battery systems. Any additional regulation in this field has – according to the industry – to be made in a bottom-up approach, where industry and testing houses define the key elements for any homologation process but not the regulators themselves. Based on this understanding, the industry is willing to engage and invest in activities leading to an improvement of testing processes – processes which will then be aligned with the need to ensure long term safety of rechargeable battery storage systems in NEV.

4.4. Next Steps

Whilst the standardization environment remains to a certain degree incompatible, there is much common ground in the mechanical and electrical testing of batteries – and a common understanding that current testing processes both in Europe and in China do not suffice to guarantee safety of batteries. The need for improved testing methodology and measurement methods also opens the door for a future Sino-Chinese cooperation on development of testing. Both sides agreed that such work is urgently needed and that there is indeed such interest in a common project in this field (see project No. 3).
5. Charging Infrastructure

The Chapter on Charging Infrastructure reflects the findings and contributions of the respective expert circle. It shows that there is indeed a basic global understanding on some key elements of the Charging Infrastructure – nevertheless the standardization work is yet to be completed. It is thus pre-mature to compare testing requirements or to develop certification schemes.

All experts agreed that a common understanding of testing and homologation in this field is essential for the commercialization of Electric Vehicles – once standardization is completed.

5.1. Standardization

The basic idea of safety for conductive charging of Electric Vehicles has been enshrined in the respective IEC standards and is commonly accepted both in China and in Europe. The initial standardization process for infrastructure is in its final stage both in China and in Europe – completion is expected in the second half of 2012. On top of this, major revisions are ongoing on existing standards, most of which are to be finished by the end of this year. However, despite this basic understanding there are major differences in charging modes, in the charging infrastructure itself, and in communication systems.

In fall 2011, all European car manufacturers agreed on standards for charging modes and plugs for Electric Vehicles, related both to AC and DC infrastructure. This understanding is compounded by very advanced discussions with the US manufacturers on a common infrastructure, and supported by a dialogue with Japan on a common solution. The European agreement and the discussions with US and Japan shall lead to a unified set of standards fully implemented by 2017. There will be some backward compatibility for cars produced according to previous standards becoming defunct by the date.

This common agreement does not yet include the Chinese automotive industry: Whilst discussions have started, China is not part of the international understanding on preferred future charging modes. China developed its own standards for AC and DC connector types, which are based on international standards, but contain significant modifications: The Chinese standards for AC infrastructure seem to be fairly close to the future internationally agreed system; this cannot be said about the currently applicable DC standards. It is unclear whether China plans to further harmonize the standards for plugs and system architecture/topology with the international system. Some of the key differences are listed in the technical annexe to this feasibility study.

As some of the experts pointed out, the parallel use of two different but related standards in China and other major economies poses a significant safety risk: Current setup allows it to mix connector and plugs
compliant with IEC and GB requirements. Thus, it is of utmost importance that this problem is resolved before such parts enter the Chinese market.

Regarding communication it is still too early to discuss a globally aligned system: the European car manufacturers have agreed on a system based on power-line communication using internationally recognized standards such as “HomePlug Green PHY”, whilst the Chinese solution seems to be geared towards separate communication channels, though no final decision has been made. Both sides are aware that additional communication channels will be needed for full integration of batteries of Electric Vehicles into future Smart Grids.

A final remark regarding charging cables: There is currently no generic European or Chinese standard available. As a consequence, the respective minimum requirements for rubber insulated cables apply and are used as basis for testing processes, both in Germany and in China.

In order to fill this gap, TÜV Rheinland created testing specifications, whilst VDE developed a certification program that includes testing. The specifications of TÜV Rheinland are based on the applicable requirements of IEC 61851 and IEC 62196, considering also the higher voltage requirements. These testing schemes seem to be a good basis for the development of a joint Sino-German understanding on how security of charging cables can be assured. Such cooperation might even lead to joint testing specifications and new EN and GB standards, ideally even to a new IEC standard (see project proposal No. 5 in Chapter 6).

5.1.1. International Level

Figure 17 gives a good overview over the situation and the timeline for international standards, relevant both for Europe and the US:
5.1.2. Comparison Tables

Tables 10-12 compare the standards applicable in Europe and in China for Charging Infrastructure and for related communication, starting with the three most important IEC standards for plugs, sockets, inlets, and outlets.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Europe</th>
<th>China</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection set of EV conductive charging – AC charger coupler</td>
<td>IEC 62196-2: 2011</td>
<td>GB/T 20234.2-2011</td>
<td>The pilot circuit is identical whilst rest of standard is different from IEC (PWM duty cycle is not defined)</td>
</tr>
</tbody>
</table>
### Table 10: Standards for Plugs, Sockets, Inlets, and Outlets

<table>
<thead>
<tr>
<th>Topic</th>
<th>Europe</th>
<th>China</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road vehicles - Vehicle to grid communication interface</td>
<td>Standard under preparation (ISO/IEC 15118-1: 2013)</td>
<td></td>
<td>CN relies on CAN Communication</td>
</tr>
<tr>
<td>Communication networks and systems in substations</td>
<td>Standard under preparation</td>
<td>IEC 61850 Series DL/T 860</td>
<td>State Grid Company endorsed IEC 61850 Series for Smart Grid</td>
</tr>
<tr>
<td>Information technology: Power-line communication (PLC)</td>
<td>(ISO/IEC 15118-1: 2013)</td>
<td>Discussions on future CN standard for PLC</td>
<td>China is currently not relying on PLC for EVs</td>
</tr>
</tbody>
</table>

### Table 11: Standards for Communication related to Charging Infrastructure

<table>
<thead>
<tr>
<th>Topic</th>
<th>Europe</th>
<th>China</th>
<th>Comments</th>
</tr>
</thead>
</table>
Conductive charging system for EVs – DC Electric Vehicle charging station

Standard under preparation (IEC 61851-23: 2012)

GB/T 18487.3-2001

Chinese standard outdated

Conductive charging system for EVs – Control communication protocol: off-board DC charger and EV

Standard under preparation (IEC 61851-24: 2013)

GB/T 27930-2011 (published 1 March 2012)

Chinese standard built on IEC 61851-24 (draft version), not identical

Rubber insulated cables up to 450/750V Part 6: Arc welding electrode cables

IEC 60245-6: 1994

IEC/TRF 60245-6: 2010 (Test Report)

Chinese standard under discussion (not covered by GB/T 20234 series)

IEC 60245-6 is not fully applicable for EV needs

Table 12: Standards for Conductive Charging System

5.2. Conformity Assessment

All experts seem to agree that any coordinated approach towards a common infrastructure would need a harmonized set of testing requirements and related standards and instructions. Any homologation process should then take account of this common set of testing rules.

At present, all testing is based on existing specifications for the “low voltage” area. Since charging currents generally exceed the limits set for “low voltage”, it is understood, that such requirements need to be adjusted to the specific needs of Electric Vehicles in near future. Testing processes both in Europe and in China are a combination of various testing standards, most applicable for a power supply of 220/380V only. For power supply exceeding this value there seems to be no standardized testing process – leaving it to the individual testing laboratory to define specifications.23

In Europe market access for low voltage equipment is free: Testing by a notified body generally suffices to comply with regulations; this also applies to the Charging Infrastructure. The situation for charging powers exceeding the low voltage area remains unclear – though current practice is to leave also such equipment firmly in the area of self-declaration by the producer. Applicable EN/IEC standards define the required testing.

In China the Charging Infrastructure for Electric Vehicles is currently not part of the CCC catalogue, thus it might be exempt from the rules for compulsory market access licensing. However, several experts on

23 A listing of the testing requirements is included in the technical annexes to this study.
the Chinese side indicated that the Charging Infrastructure equipment might be added to the CCC catalogue in near future. In either case, it is understood that testing has to be undertaken according to the requirements outlined in applicable Chinese standards. In the latest development, China introduced a voluntary national certification scheme for Charging Infrastructure based on Chinese standards.

In a speech held at the EU-China workshop on standardization for Electric Vehicles in February 2012, Mr. Wu Zhixing explained that testing is to become one of the four pillars to support the creation of a complete infrastructure for Electric Vehicles, including its key components. It is thus understood that China is going to define a framework of Conformity Assessment rules which are dedicated to the needs of testing and homologation for Electric Vehicles; however no timeframe has been given for this.

This emphasis on Conformity Assessment is also reflected by the efforts of power distributing companies in Europe and China to have strict rules enforced regarding the quality of the Charging Infrastructure. Whilst these efforts are in general defining insular networks and often remain company specific, they underline the importance of high quality infrastructure for the stability of the power supply network.

5.3. Homologation

Both in China and in Europe, there are currently no specific homologation requirements for Charging Infrastructure in place: The basic principle is that this infrastructure must be safe for consumers, comply with low voltage regulations, and ensure EMC compatibility. The future ECE-R 100.02 regulation will probably influence homologation processes for Overall Car Safety, however, at the current stage it remains unclear what this will entail.

The uncertainty regarding the degree of global convergence of standards for infrastructure does not yet allow a substantial discussion on harmonization of testing and homologation processes. Nevertheless, both Chinese and German experts pointed out that such cooperation will be necessary in near future and that any support for such dialogue will be highly welcome.

Both European and Chinese car manufacturers expressed their fear, that testing rules will become a major obstacle for the commercialization of Electric Vehicles if not handled properly; current markets are already too segmented by different rules for infrastructure and related testing processes. An alignment of testing processes between Europe and China would need clear political will on both sides.

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24 Mr. Wu Zhixing is member of the EV subcommittee for EV standardization SAC/TC 114 SC 27 and works for CATARC, the China Automotive Testing and Research Institute.
No wonder that both European and Chinese car manufacturers voice their strong interest in close European-Chinese cooperation on testing processes.

5.4. Next Steps

Whilst a global alignment of standards for infrastructure of Electric Vehicles is in the making, this cannot be said for testing and homologation processes. Having said this, both sides agree that there is an urgent need for a common understanding in this field. Such common understanding would allow:

a) Simplifying market access in Europe and China,
b) Reducing the amount of testing equipment required, both in Germany and in China, and
c) Help moving towards a mutual acceptance of testing results in future.

It is thus imperative that cooperation on Conformity Assessment is taken seriously, and that such work has to be undertaken in close cooperation between governments and industry. A joint Sino-German project focussing on testing needs for Charging Infrastructure would be highly beneficial to accelerate such processes (see project No. 4).
6. Conclusions

Based on the statements made by the participants during the interviews, the questions and the information collected within the study, the information exchanges during the two Expert Workshops, as well as the results of the three Expert Circles, some general recommendations can be made and a number of bi-lateral projects are proposed accordingly.

- Standards and regulations are understood to be extremely important for setting up the proper framework for Electric Mobility in China. Whilst standardization work is to be completed soon, all three Expert Circles identified a lack of harmonized testing methods and certification schemes dedicated for Electric Vehicles. Experts on both sides, Germany and China, are concerned that this will become a major stumbling block for the commercialization of Electric Vehicles in Germany and China. Whilst integration of processes within Europe and China are foreseeable, an alignment of testing processes between Europe and China would need clear political endorsement – exemplified e.g. in concrete cooperation projects.

- Despite numerous standards on international and national level defining battery cells and battery modules there is still no commonly agreed process for testing and certification. There seems to be a fundamental difference in standardization and homologation for Battery Safety as the European side understands Battery Safety as a part of the overall safety of vehicles, whilst the Chinese side defines specific standards addressing batteries as a component of the vehicle. These different testing standards also lead to differences in testing and type approvals as part of the homologation of the entire vehicle. Car manufacturers both in Europe and China fear that homologation processes will restrict not only their global reach, but also their ability to design new cars and to innovate battery technology. Thus, they insist that regulation in this field has to be made in a bottom-up approach, where industry and testing houses define the key elements for testing processes, and not the regulators themselves.

- On a political level the dialogue between Germany and China should be strengthened in the area of Charging Infrastructure. Interoperability regarding the Charging Infrastructure has not been achieved; European and Chinese car manufacturers are concerned that standards and testing methods will become a major obstacle for the Charging Infrastructure of Electric Vehicles if not handled properly. Current markets are already too segmented by different rules for infrastructure and related testing processes. Whilst integration of processes within Europe and China is foreseeable, an alignment of testing processes between Europe and China would need clear political will on both sides.
• Experts on both sides pointed out that there is a need for clarification where additional certification requirements are needed and where this should be left to the industry to decide. Without a clear understanding on this point any cooperation work risks being interrupted by discussions over fundamental differences between the Chinese and European approaches of government approval versus self-declaration.

• An agreed roadmap for future regulations and homologation specifications is considered a precondition for any successful cooperation on certification. Without clear schedules for implementation of new standards and requirements both in Europe and China it might be difficult for the experts to find common ground. It is thus recommended that each proposed cooperation project will have to identify such markers at the beginning of the cooperation process.

It is to be understood, that all the following project proposals will achieve their goals only in close cooperation between regulators and industry. This applies to all levels: management, technical input, and financing of the initiatives. In line with this understanding, the projects will only take place if the majority of funds are made available by the beneficiating industrial players themselves.
7. Project Proposals

Project 1: Sino-German Information Platform and Training Center on Conformity Assessment

Background

Chinese and German representatives in the project have voiced the request to learn more from each other and to exchange knowledge and information about the respective type approval systems and related issues in Germany and China on a more systematic basis. Such exchanges will contribute to an increased understanding of Car Safety measures which is the pre-requisite to ensure consumer trust in the Electric Mobility market. This is an area which is considered highly beneficial for the participants because they may immediately increase their knowledge and experience in the areas of Conformity Assessment and subsequently can disseminate knowhow gained in their respective organisations.

Project Outline

The project shall focus on the set up of a common Information Platform and Training Center on Conformity Assessment covering the following two areas: 1) set up an information and collaboration platform which serves as an information centre of global initiatives in Conformity Assessment for Electric Vehicles, and 2) establish a Training Center that offers Conformity Assessment modules based on a modular training concept (including web-based trainings, face-to-face seminars, on-the-job training, etc.). The Information Platform and Training Center can be located both in Germany and in China. This project has the advantage that it can be launched very soon and requires only limited resources: The Training Center is based on a modular approach, the first events and trainings can take place with limited planning on a short notice. Potential training modules may include conformance testing services or homologation/type approval processes.

Project Partners

The Information Platform and Training Center should be jointly developed and operated by German and Chinese industry, research institutions, and governmental organisations: In order to streamline input by these stakeholders it is necessary to establish an umbrella organization led by a professional organization specialised in training services. It is recommended to also include industry associations such as ACEA, BDI, VDA, VDE and ZVEI on the German/European side in this project and organizations such as CATARC on the Chinese side.
Time Frame and Resources

The conceptual work of drafting the Information Platform and Training Center could start immediately. Once the size of the undertaking is clear, first events could start at the beginning of Q1/2013 and continue for three to five years, with a review after the first two years. The financing volume depends on the size of the Information Platform and Training Center and if for example potential marketing partners can be found.

Results

During the initial two years, a number of seminars and trainings will increase the knowledge base and experience of the participants on a short-term basis. This will contribute to Conformity Assessment schemes which again substantially contribute to improved car safety.

Following results are expected:

- Develop close personal relationships with cooperation partners involved
- Develop a better mutual understanding of Conformity Assessment processes
- Increase knowledge of individuals as well as organizations involved
- Contribute to a potential harmonised Sino-German voluntary certification scheme
- Extend the information base in a highly immature market through a better and easier communication and collaboration platform
Project 2: Electric Vehicle Post-crash Compliance Testing

Background

One area identified during the discussions in the “Overall Car Safety” Expert Circle is the electrical car safety in a post-crash situation. Safety of passengers and rescue working in post-crash situation is very high on the agenda both in Europe and in China. Recent accidents have shown that post-crash safety is crucial for consumer acceptance of this still young technology: If not handled properly the entire industry might suffer from the reputation of not being sufficiently prepared to ensure the safety of passengers and third parties. Vehicle crash tests have also shown that there is indeed a need to adapt safety measures especially related to severe accidents. One of the measures discussed is the automatic cutting of power in a crash in order to ensure the safety of rescue teams.

Project Outline

The project shall focus on the joint development of a safe and reliable testing scheme for Electric Vehicle post-crash safety. The scheme should take advantage of already existing post-crash testing data from both Chinese and German sides, and aim for the highest safety in the Electric Vehicle after a crash. The proposed testing schemes shall undergo a thorough validation by German and Chinese testing houses. A voluntary Sino-German certification scheme might be the result of such cooperation, ideally with mutual recognition of the certificates or at least the underlying test results. Finally, the result shall be enshrined in jointly adopted testing specifications.

Project Partners

The project shall be developed by German and Chinese car manufacturers in cooperation with German and Chinese testing houses and certification bodies. The project can be led by the industry itself, involving both German and Chinese testing facilities. It is highly recommended to include technical services such as Dekra or TÜV on the German side and CATARC or China North Vehicle Research Institute on the Chinese side. It might be helpful to include an independent consultant for the project management. Political partners on the German side might be – besides BMWi – also the Kraftfahrt-Bundesamt (KBA) and the Bundesanstalt für Materialforschung und –prüfung (BAM).

Time Frame and Resources

As this is a very urgent topic to be taken care of, the project is to be started as soon as possible: Both sides have already started to work on the post-crash safety issues and are in a position to substantially
contribute to project. The timeline for the project is estimated to be about 2 years; it requires substantial investments in testing facilities and vehicles.

Results

Following deliverables are expected:

- Common understanding on post-crash requirements for Electric Vehicles
- Common set of methodologies and requirements for post-crash testing
- Successful demonstration projects using these suggested set of requirements
- Integration of these sets of requirements into homologation schemes
- Joint Sino-German specifications for post-crash testing
- Accelerated global harmonization of post-crash standards
Project 3: Electrical and Mechanical Safety of Battery Systems

Background

Global alignment of battery standards, testing processes, and homologation is a key element to foster the development of a globally relevant industry for Electric Vehicles. This process has already started with the amendments of the UNECE-R 100 regulations in the .02 version and in newly developed testing standards on ISO level. Whilst major differences in standards for Battery Safety between China and Europe are still prevalent, this shall not deter from cooperation in testing and certification for batteries. Both Chinese and European experts believe that there is an urgent need for such harmonization of testing methodology and processes. Cooperation in this field is promising, since it is commonly understood that current testing processes do not suffice and need major revisions. If such cooperation is successful, this might lead to further harmonization of standards between China and UNECE regulations.

Project Outline

The project shall focus on the development of joint Sino-German methodologies and procedures for testing of rechargeable battery storage systems based on current and newly developed standards on international level and in China. The project should address battery related safety requirements for individual cells, for battery packs, battery systems or batteries as a component, and for the entire vehicle. The outcome of such cooperation should be a set of agreed principles as well as instructions for testing: these will probably not lead to a full harmonization of the process but it will allow an alignment which eventually could lead to acceptance of test results under an international scheme such as IECEE for cells and battery packs and UNECE for battery systems and overall car safety including battery systems.

Project Partners

Besides representatives of German and Chinese industry, this project must also include institutional stakeholders on both sides. For China these are namely CNCA, CQC, MIIT and the Standard Administration of China (SAC); for Europe the international standardization bodies UNECE and ISO, especially its Technical Committee ISO/TC 22 - SC21. Due to the political sensitivity of the undertaking, the project should be led by an independent consultant.
**Time Frame and Resources**

Most of the underlying standardization work is completed or in its final development stage, thus this project should start as soon as possible. The duration of the initial project should not exceed 3 years, and extension can be discussed at a later stage. The project must include demonstration cases to show the effectiveness of the newly developed procedures. This is important to convince authorities to include the newly developed processes into their homologations schemes. Finally, the project will have to include training of the laboratories involved in the process.

**Results of Project**

At current stage it is rather difficult to define its deliverables. If everything goes well we should end up with following outcomes:

- Common set of methodologies and requirements for battery testing
- Successful demonstration projects using this suggested set of requirements
- Integration of this defined set of requirements into homologation schemes
- Accelerated global harmonization of battery standards
- Partial or full mutual recognition of battery testing results under the IECEE and UNECE umbrellas
Project 4: Development of Testing Methods and Equipment for AC and DC Power Supply

Background

Both government representatives and industry in Europe and China agreed that an alignment of testing methods and related testing equipment for Charging Infrastructure will be a crucial element in the commercialization of Electric Vehicles in China and Europe: Without clear rules on testing and homologation, local and company specific rules will dominate market access and thus lead to unnecessary market segmentations. This is a highly sensitive area as too rigid testing requirements will impede the configuration of cars and thus hinder the development of the Electric Vehicle industry, whilst too little alignment will lead to incompatible solutions in Europe and China.

Project Outline

The project shall focus on the identification of a common set of testing processes and parameters covering both Chinese and International standards for Charging Infrastructure. One of the key criteria for these processes is the use of similar testing equipment. In a second step these procedures need to be tested both within the industry and in designated testing houses. If all sides agree, the project could eventually result in proposals for new or revised testing standards to be developed under IEC auspices.

Project Partners

The project should be developed jointly by German and Chinese car manufacturers with active support of relevant Chinese and international testing houses, as well as Chinese and German grid operators. Since this project is directly affecting competition between testing houses it is advisable to identify a third party consultant leading this project. We recommend including BMWi, VDE, RWE, TÜV, DEKRA on the German side and CNCA, CATARC, CQC, a relevant electro technical standardization organization, and Chinese 1-2 testing houses in the project team.

Time Frame and Resources

Since standardization work for Charging Infrastructure is not yet completed, it would be premature to start with the project right now. Whilst nobody questions the relevance of the project, its implementation is not urgent as long as wide scale commercialization of Electric Vehicles has not yet started. We thus recommend that this project is initialized in the first half of 2013 and lasts for at least
3-4 years. Definition and implementation of new joint testing processes is not an easy process and will need a lot of input by experts.

Results

Whilst the success of such efforts for international alignment of testing specifications cannot be predicted, we may assume following outcomes:

- An aligned framework of testing processes, based on existing standards
- New joint Sino-German testing specification
- New joint Sino-German voluntary certification scheme
- Proposal for new deliverable on IEC level, if possible
Project 5: Sino-German Research Cooperation on Testing Specifications for Charging Cables

Background

One of the gaps identified during the discussions between European and Chinese testing experts is the lack of adequate processes for testing of charging cables for Electric Vehicles. Current standards in China and Europe are based on cables in the low voltage area: This cannot satisfy since the power needed for fast-charging of Electric Vehicles goes beyond 220/380V, which is the basis for most standards in the low voltage area. Whilst some cable related standards are also applicable for higher Voltage ratings, this does certainly not apply for all parts and aspects of charging cables for Electric Vehicles. In such situations it is the task of testing bodies to define practical and reliable ways for testing: TÜV Rheinland defined a comprehensive testing specification for charging cables, whilst VDE defined a voluntary certification and testing scheme. These two schemes are probably unique globally and could serve as models for new global testing specifications or a future IEC standard.

Project Outline

The project shall focus on joint Sino-German research for the development of a safe and reliable testing scheme for charging cables on various power levels. The scheme shall based on existing and applicable Chinese, German, and international standards and reflect the ideas used for the TÜV Rheinland specification and the VDE certification and testing scheme. Based on such joint research a testing scheme shall be developed and thoroughly tested. A voluntary Sino-German certification scheme might be defined, ideally with mutual recognition of the certificates or at least the underlying test results. Finally, the result shall be enshrined in a testing specification, which might even become a new deliverable for IEC.

Project Partners

The project should be developed jointly by German and Chinese cable manufacturers in cooperation with German and Chinese testing houses and certification bodies. The project might be led either by TÜV Rheinland or by the testing institute of VDE on the German side and probably CQC and CATARC on the Chinese side. It is recommended to include all interested research bodies, industry associations, and testing institutes, both on German and Chinese side.
Time Frame and Resources

The task is straightforward and may start immediately: All relevant standards are already in place, and there is no intention to create a new international standard just for charging cables. The project will take 2-3 years.

Results of Project

Following deliverables are expected:

- Scientific data for future testing specifications
- Common understanding on testing rules compiled in a “rule book”
- Jointly agreed list of required testing equipment
- Draft of new / revised / combined testing specifications, as needed
- Recommendations for homologation in China and Europe
- Proposal for a new working item at IEC
Project 6: Comparative Testing of “Overall Car Safety”

According to ECE-R 100.01

Background

One of the activities of the Expert Circle “Overall Car Safety” was to compare Chinese and European/German regulations and standards in place for Overall Car Safety. Although there are quite some similarities in European and Chinese standards, procedures for type testing seem to be quite different both in the number of testing items and in the underlying organizational structure. In order to ensure customer safety and foster consumer trust it is important that testing processes are reliable and effective. Current testing in Europe and China is a combination of established testing processes for Overall Car Safety with requirements specific to electric and hybrid-electric vehicles. There seems to be a common understanding that these processes need to be adjusted in near future. In preparation of such changes, the experts propose to undertake a series of comparative testing in Europe and China, which will establish a scientific basis for recommendations for improvement of the systems in Europe and China.

Project Outline

The project shall focus on testing according to the ECE-R 100.01 regulations which have been partially adopted in China with the new standards GB/T18384.1-3 and GB/T24549. After a joint definition of the testing and monitoring requirements, both sides will organize and conduct cooperative testing in their own facilities. In a next step, the results shall be compared with the thorough analysis of differences in the testing outcomes. The conclusions from such a comparison shall be reported to the respective governmental organizations. The outcome might lead to an adjustment and eventual alignment of testing processes in Europe and China based on scientific evidence. Final objective of the project is to prepare the ground for a future mutual recognition of testing certificates. Ideally, the project will also lead to the development of joint Sino-German testing specifications.

Project Partners

The project should be developed jointly by German and Chinese car manufacturers in cooperation with German and Chinese testing houses and certification bodies, such as TÜV Rheinland, Dekra, TÜV Süd, CATARC, China North Vehicle Research Institute, and other Chinese testing houses involved in automotive testing. It is highly recommended to select partners who have the willingness and the capacity to cooperate in such comparative testing over a longer period. Since the project might lead to adjustments in the homologation processes it makes sense to have relevant governmental institutions
both in Europe and China involved in the project; this might include e.g. the Federal Ministry of Transport, Building and Urban Development (BMVBS) on German side, or CNCA and MIIT on Chinese side. A strong project management – probably led by an independent consultant – will be needed to coordinate this project.

**Time Frame and Resources**

The project may start as soon as both sides agree on common project objectives and a more detailed project approach. Both sides have already tested their standards respectively and can draw from this experience. The timeline for this project is estimated to be about 2 years; related project costs depend on the resources involved such as manpower, testing equipment and testing intensity.

**Results**

This project will relatively soon lead to substantial recommendations for improvements of testing and homologation processes, thus its impact might soon be highly visible. Following concrete outcomes are expected:

- Scientific data on reliability and efficiency of testing processes
- Comparison of testing results based on ECE-R 100.01 rules in China and Europe
- Recommendations for improvement of testing and homologation processes
- Development of testing specifications, where practical
- Start discussions for a future agreement on mutual recognition of testing results
# List of Tables

Table 1: Chinese Standardization Work for Electric Vehicles ................................................................... 32  
Table 2: Chinese Standards and UNECE Regulations relevant for Type Approval .............................................................................. 40  
Table 3: Standards for Homologation of Electric Vehicles in China (Source: VW China, May 2012) ............................................................................. 46  
Table 4: Comparison of Homologation in Europe and China ................................................................................................................. 48  
Table 5: European and International Regulations used for Homologation in Europe .................................................................................. 52  
Table 6: International Standards for Battery Testing ......................................................................................................................... 53  
Table 7: Other Standards for Batteries used in Europe .......................................................................................................................... 54  
Table 8: Chinese Regulations and Standards for Electric Vehicles and Batteries .......................................................................................... 55  
Table 9: Comparison of Testing Requirements for Lithium-Ion Batteries ................................................................................................. 56  
Table 10: Standards for Plugs, Sockets, Inlets, and Outlets ................................................................................................................... 61  
Table 11: Standards for Communication related to Charging Infrastructure ................................................................................................. 61  
Table 12: Standards for Conductive Charging System ...................................................................................................................... 62

# List of Figures

Figure 1: Safety Regulations Electric Mobility (Source: VW Wolfsburg, June 2012) .............................................................. 9  
Figure 2: Bi-Lateral Cooperation Project Overview ....................................................................................................................... 11  
Figure 3: Governmental Project Partners ........................................................................................................................................ 14  
Figure 4: Phases of the Study and Activities (GIZ Nov 2012) ........................................................................................................... 18  
Figure 5: Overview of the Three Expert Circles ........................................................................................................................................ 20  
Figure 6: Structure for Reporting on Mechanical Safety of Batteries.................................................................................................. 21  
Figure 7: Standardization Organisations and Regulatory Bodies (Various Sources) ........................................................................... 28  
Figure 8: Chinese Organizations involved in Electric Vehicle Standardization .................................................................................. 31  
Figure 9: China’s Standardization Milestones (Source: CATARC, SAC) ............................................................................................. 32  
Figure 10: Norms and Regulations – Germany (Source: VW Wolfsburg, 2012) .................................................................................... 33  
Figure 11: UNECE Working Structure for Electric Vehicles (Source: VW Wolfsburg, 2012) ............................................................. 35  
Figure 12: Lead Time for New or Amended Regulations (Source: VW Wolfsburg, 2012) .............................................................. 37  
Figure 13: Lead time – Amendment of ECE-R100.01 (Source: VW Wolfsburg, 2012) .............................................................. 37  
Figure 14: Homologation of Locally Produced EVs (Source: VW China, May 2012) .............................................................. 45  
Figure 15: Standards for Registration and Certification of M1-Type Vehicles ...................................................................................... 45  
Figure 16: Homologation Schedule (Source: VW Wolfsburg, May 2012) ...................................................................................... 47
Technical Appendix

Appendix A: First Expert Workshop

A1: Agenda, Participants, Meeting Minutes
A2: Presentations

Appendix B: Second Expert Workshop

B1: Agenda, Participants, Meeting Minutes
B2: Technical Input German Experts
B3: Technical Input Chinese Experts
B4: Presentations

Appendix C: Overall Car Safety

C1: List of Chinese Standards for New Energy Vehicle Safety
C2: Comparison of Standards and Regulations
C3: Testing Methods – Car Safety Testing in Europe
C4: Testing Methods – Car Safety Testing in China
C5: CCC Implementation Rules for Motor Vehicles
C6: Partial Translations of Chinese Standards for Car Safety

Appendix D: Battery Safety

D1: Comparison of Standards (Lithium-Ion Battery)
D2: Testing Methods – Battery Testing in China (QC/T 743)
D3: Testing Methods – Battery Testing in Europe
D4: Regulatory Environment for Battery Safety in Europe
D5: Harmonized Datasheet – Proposal TÜV Süd
D6: Comparison Table for Battery Standards / Excel (CATARC)

Appendix E: Charging Infrastructure

E1: Comparison of Standards (IEC – GB)
E2: Testing Methods – Charging Infrastructure in China
Appendix F: Additional Documents Phase 3

F1: Progress Report Feasibility Study (German), 5 March 2012
F2: Agenda Study Tour to Europe 23-27 April
F3: Homologation Requirements in Europe
F4: Homologation Requirements in China – Imported Cars
F5: Homologation Requirements in China – Locally Produced Cars
F6: Twelfth Five-Year Plan MoST and MIIT
F7: Chinese Standardization System for Electric Mobility
F8: CCC Certification System