



ANSI Workshop Report

Standards and Codes for Electric Drive Vehicles

April 5 – 6, 2011 ■ Bethesda, MD

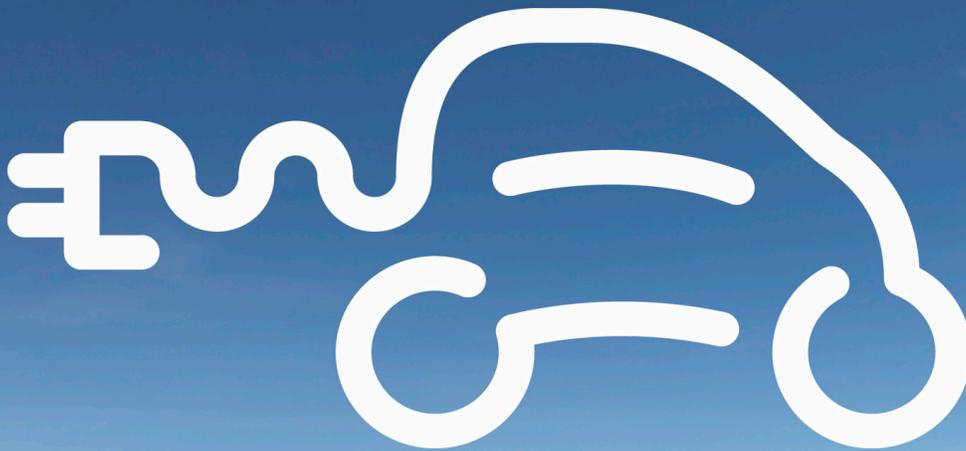


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¹ The workshop presentations and an audio recording of the general sessions are available at www.ansi.org/edv.

1.0 Executive Summary

On April 5-6, 2011, the American National Standards Institute (ANSI) convened a codes and standards needs assessment workshop on behalf of the U.S. Department of Energy (DOE) and the Idaho National Laboratory. The workshop explored what codes, standards, and conformity assessment programs are needed to facilitate the large-scale deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs), meaning vehicles that are recharged via connection to the electrical grid. The workshop format included presentations and panel discussions on day one focused on U.S. based standards activities (infrastructure and vehicle), international and regional standards activities, and code, conformance and training issues. Day two focused on gaps identification via breakout group discussions on the vehicle, associated infrastructure and related support services.

The Call to Action

The backdrop for convening a workshop on this topic was noted at the outset: the knowledge that EDVs will promote energy security by reducing our nation's dependence on foreign oil, they provide environmental benefits by reducing carbon emissions which contribute to climate change, and their widespread introduction into the marketplace will create jobs and promote economic growth. There is consumer interest to "go electric" but consumers are also uncertain about the range of the vehicles and whether the necessary charging station infrastructure is in place to meet their driving needs. In response to these market demands, both government and industry are responding with the necessary resources and innovations. In his January 2011 State of the Union address, President Barack Obama announced the goal of one million electric vehicles on U.S. roads by 2015. There is an enormous opportunity to grow this emerging industry.

It was acknowledged that the move to EDVs represents a major shift in our national automotive landscape. The standardization community has a critical job to do to facilitate the large scale introduction of EDVs into the market to ensure that the technologies and infrastructure are safe and effective. A public-private partnership is needed to move this work forward quickly and effectively. To address this emerging issue of national and global significance, ANSI has formed an Electric Vehicles Standards Panel (EVSP). The panel will offer a neutral forum where public and private sector stakeholders can work cooperatively toward solutions that will help build the market for EDVs.

Priority Area: Coordination and Harmonization

The overarching conclusion of the April workshop was a call for better coordination and harmonization of standardization efforts. There is no single umbrella organization coordinating all of this work. Instead, there is a proliferation of coordinating bodies and forums that stakeholders must participate in which strains resources. A standardization roadmap for North America would help to establish priorities for what needs to be done. A matrix of the various coordinating bodies and standards activities would also help stakeholders to navigate the various activities taking place and facilitate global harmonization.

The interoperability of electric cars with the charging infrastructure was identified as a key area for discussion with respect to harmonization, including the need for North America and Europe to quickly decide about moving forward in harmony. Coordination is also needed on such areas as residential applications, metering, preferential rates, time of use, and communications protocols. Work toward national consistency on permitting (“permit by notification”) would also be desirable, and could be extended to local jurisdictions.

Priority Area: Consumer Acceptance

It was recognized that consumer acceptance is key to the growth of the market for EDVs. The workshop identified as a priority the need to nurture consumer confidence. Primarily, this can be accomplished by providing more information about issues such as vehicle range, fuel efficiency, availability of charging locations, equivalencies between EDVs and traditional vehicles, and the customer’s experience over the long term. It was suggested that this could be achieved in part through a centralized, easy-to-use website, perhaps expanding fuelconomy.gov. And of course safety is paramount.

Priority Area: Conformance and Training

Conformity assessment and training programs that can increase consumer confidence in the products and people involved in the market for EDVs was identified as another priority area. There was a call for third-party, nationally-recognized certification and testing of electric vehicle supply equipment (EVSE) as a way to help ensure compatibility between the charging equipment and different vehicle types. Enhanced standards for labeling of vehicles and components would also be desirable. Conformity assessment is needed to ensure the authenticity of vehicle components, supply chain integrity, and battery safety.

In terms of assuring the availability of qualified personnel to address issues with EDVs, a number of training initiatives were discussed. Enhancements to efforts already underway could take the form of accredited certification programs and/or certificate training programs for multiple stakeholders. These would include: insurance adjusters, service technicians, emergency responders, authorities having jurisdiction for enforcement of local codes, and others. National training organizations and academic institutions should get involved in the development and dissemination of such training.

2.0 Workshop Overview

In his January 2011 State of the Union address, President Barack Obama announced the goal to have one million electric drive vehicles (EDVs) on U.S. roads by 2015. Consumers also have indicated their interest in EDVs, or vehicles that must be connected to the electric grid for recharging of their propulsion energy storage systems. According to a May 2011 survey by the Consumer Reports National Research Center, 73% of consumers are at least considering purchasing alternative fuel vehicles.² With an estimated 200 million licensed drivers currently on U.S. roads today, that equates to 146 million consumers who are potentially interested in going electric.

To help accommodate this major shift in our national automotive landscape, the American National Standards Institute (ANSI) convened a codes and standards needs assessment workshop on behalf of the U.S. Department of Energy (DOE) and the Idaho National Laboratory. The April 5-6, 2011, event brought together nearly 120 in-person attendees and another 30 webinar participants from a range of stakeholder groups. The workshop examined the codes, standards, conformity assessment, and training programs needed to facilitate the successful introduction and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road EDVs.

The first day of the workshop began with two panels on U.S.-based standards activities addressing infrastructure and vehicles. These were followed by a panel on international and regional standards activities. Day one closed with a panel on code, conformance, and training issues. From vehicle charging modes and connectors to battery safety standards to training for first responders, the wide-ranging challenges and priorities for successful EDV deployment were the focus of discussions.

The second day of the workshop consisted of three concurrent facilitated breakout sessions that provided attendees an opportunity for in-depth discussion of the standards, codes, and conformance issues related to electric vehicles, the associated infrastructure, and related support services. Participants identified areas of concern and made recommendations for additional standards programs that may be needed. The groups then reported back to the general session on their priority areas. Participants were given specific focus questions and worksheets to guide the discussions and they were encouraged to provide written responses to supplement what was said.

² Consumer Reports National Research Center. 2011. Auto Pulse #23: Car Buying: 5.

3.0 Summary of Presentations and Panel Discussions (April 5, 2011) ³

Day One: April 5, 2011

3.1 Welcome

In her opening remarks, ANSI senior vice president and chief operating officer Fran Schrotter highlighted the importance of collaboration in the standards and EDV communities to support this new technology:

“The demand is there – and growing. But the manufacturing, systems, and infrastructure all need to get up to speed to meet this demand. All of us in the standardization community have an absolutely critical job to do to facilitate the large-scale introduction of EDVs into the marketplace. We need to make sure that the technologies and infrastructure are effective, safe, and ready to accommodate what will truly be a major shift in our national automotive landscape.

“This is a terrific opportunity for the experts and leaders from the public and private sectors to join together and make concrete progress in streamlining the technological innovation that is going on in this emerging industry. And not a moment too soon here in the U.S., if we are to keep pace with other countries that are ramping up their EDV development.”

Ms. Schrotter noted that ANSI has formed an Electric Vehicles Standards Panel (EVSP)⁴ to foster the public-private partnership in this area. The output from this workshop will be a key input to the efforts of the standards panel.

3.2 Keynote Address — U.S. DOE Programs Related to EDVs

Patrick Davis, program manager for the Vehicle Technologies Program within the U.S. Department of Energy’s (DOE) Office of Energy Efficiency and Renewable Energy, provided the workshop’s keynote address, detailing DOE initiatives in the EDV arena.

Why Now?

Energy efficient and electric cars have been on the automobile landscape for decades – why will they succeed this time? Mr. Davis outlined several reasons why EDVs will now have a huge impact in the industry. First, environmental challenges are becoming more urgent. Second, battery technology has greatly improved, allowing for more convenient and effective EDV technology. Finally, Corporate Average Fuel Economy (CAFE) standards continue to become more stringent each year, and automobile makers must adapt technology to comply.

³ The workshop presentations and an audio recording of the discussions are available at www.ansi.org/edv.

⁴ For more information about the ANSI EVSP, see www.ansi.org/evsp.

Standards and Codes Support Consumer Acceptance

While technology for EDV is improving and expanding rapidly, no impact will be felt unless consumers embrace the new vehicles. Standards and codes play an important role in facilitating the public's trust, acceptance, and widespread use of new technology, and EDVs will be no exception.

Identification of Gaps

Mr. Davis underscored the importance of finding the gaps in the nation's path towards EDV development and use as one of the key purposes of the workshop. The U.S. uses petroleum for nearly 95% of its transportation needs, totaling one billion dollars spent per day on imported petroleum. A thorough assessment of how to facilitate the widespread use of EDVs is the first step in reducing American reliance on petroleum.

Better Batteries

The continual development in battery technology is a major factor in the success of EDVs. Mr. Davis outlined DOE battery innovation initiatives, which have brought about dramatic cost reduction and improved functionality.

Two billion dollars of the *American Recovery and Reinvestment Act of 2009* (ARRA) has been allocated towards EDVs, much of it related to battery technology. 1.5 billion dollars in funding is dedicated to accelerating the manufacturing and deployment of the next generation of U.S. batteries, and an additional 500 million dollars is dedicated to EDV components manufacturing.

With 20 battery projects underway currently, DOE continues to develop batteries that will meet the needs of next generation vehicles.

Ready? Set? Charge!

Mr. Davis emphasized the key role that efficient, effective, and inexpensive charging stations will play in EDV popularity across the nation. The first step is developing the home charging station infrastructure. Currently, cost and installation delays are significant barriers in this process.

Following home charging stations will be the implementation of retail and workplace stations, and finally public stations. These will be expensive if not fully utilized, and must be expensive in order to accommodate need. Ultimately, plug-in hybrid electric vehicles (PHEVs) are key to help initiate a pull for the development of a public infrastructure.

Transportation Electrification Demonstration Projects

One EDV initiative currently underway is the 400 million dollar Transportation Electrification Demonstration Project, a nationwide effort to mine data to assist in the widespread deployment of EDV charging stations.

The project includes the deployment of 13,000 electric vehicles, the installation of 22,000 charging stations, and funding of education programs, including two for service technicians and one for first responders on how to handle accidents involving EDVs.

Data collected in the project will include vehicle and charger performance, vehicle and charging utilization patterns and public charger use, the impact of various rate structures on charging habits, and the impact of vehicle charging on the electric grid.

Working with Cities to Install Charging Infrastructure

U.S. Vice President Joe Biden announced a new initiative in January 2011 to assist in establishing electric vehicle charging infrastructures within cities. The \$200 million program aims to establish a comprehensive infrastructure plan; encourage locally-based public- and private- sector collaboration; leverage federal resources; streamline building permit approval and installation procedures; and support the initial build-out of the infrastructure.

Clean Fleets Partnership

Mr. Davis also outlined the Clean Fleets Partnership, an initiative announced in Spring 2011 by President Obama in which the government works with national vehicle fleet operators to reduce petroleum consumption.

3.3 Panel — U.S.-Based Standards Activities (Part 1, Infrastructure)

Facilitated by Frank Hansen, Ph.D., program manager at Energetics, this session provided high-level overviews of the standards and codes landscape within the United States – what work is taking place and what remains to be done. The first panel addressed issues related to infrastructure; the second panel, vehicles.

Panelists included:

- Lee Slezak, Manager of Vehicle Systems, Vehicle Technologies Program, U.S. Department of Energy
- Thomas S. Basso, Senior Engineer, National Renewable Energy Laboratory
- Vishant Shah, Consultant, EnerNex Corp.
- Alan Manche P.E., Director, Industry Standards, Schneider Electric

Discussion topics:

- DOE perspective on the standards and codes landscape for electric drive vehicles
- IEEE P2030.1, *Guide for Electric-Sourced Transportation Infrastructure Working Group* and IEEE 1547, *Standard for Interconnecting Distributed Resources with Electric Power Systems*
- The Smart Grid Interoperability Panel Priority Action Plan 11 on Common Object Models for Electric Transportation, and V2G Domain Experts Working Group
- Knitting together the codes and standards for the electric vehicle infrastructure – an industry perspective

Who's on First?

Mr. Slezak noted that the development of standards and codes is a key initial step for the roll-out of EDVS to the public to be successful. Mr. Shah reported that the NIST Smart Grid Interoperability Panel (SGIP) Vehicle-to-grid (V2G) domain experts working group is slated to produce a roadmap related to EDV development by June. This roadmap aims to set a strategic direction and establish priorities.

The Roles of Standards and Codes

Mr. Slezak outlined the myriad roles that standards and codes play in the U.S., particularly their contributions to market penetration, safety, usability, and interoperability. Standards and codes can often contribute to lowering costs. He emphasized that consumer acceptance is highly important, and standards and codes play an important role in this as well.

Let's Work Together

Voluntary consensus standards, such as those developed by industry partnerships with balanced stakeholder participation, are an important element of EDV development. Building on that idea, Mr. Basso called for harmonization of national and international standards to facilitate the most efficient and effective development of this technology.

What Relevant Standards Exist?

Mr. Basso provided an overview of IEEE standards currently existing or in development that can contribute to EDV development. These include IEEE 1547, a series of standards on interconnection, as well as IEEE P2030, a series of standards that addresses Smart Grid interoperability.

New Standards and Codes Issues for EDVs

Developing EDV technology and its increasing popularity in the marketplace has led to unique standards and codes issues. These include refueling and charging, connectivity with the grid, and interoperability of systems. How can our current standards and codes systems expand to facilitate these new elements?

EDV Standards Will Be Interrelated

Mr. Manche offered an industry perspective on the types of standards and codes that will be needed, and how their close relationship to one another requires frequent communication and collaboration. Addressing everything from safety standards to building codes to interoperability requirements, standards and codes must work cohesively together to ensure a well-rounded, effective system. Gaps found in one area may also be found in another; similarly, changes in one area may have an impact in another.

Information for Local Governments

States looking for information on how to ensure that building codes and standards can accommodate electric vehicles will be guided by the DOE, which is utilizing its Clean Cities Program of 87 partnerships nationwide to assist local jurisdictions with this transition.

Green Consumers

Electric vehicles appeal to many consumers looking to reduce their environmental footprint. The Environmental Protection Agency (EPA) is working on a proposal to establish how electric vehicles can be labeled to inform consumers of their environmental impact.

Education for Industry Consumers

As EDVs become more prevalent nationwide, the electrical industry and consumers alike will have many questions on this new technology. Panelists agreed that comprehensive education plans are critical to EDV success. Some education plans are already in place for the electrical industry, and the DOE is working with industry partners to develop several educational guidebooks directed at different audiences.

Privacy, Please!

Several attendees expressed concerns about privacy issues related to EDVs. Panelists agreed that privacy issues must be addressed; work is taking place within the SGIP to further explore this topic.

Where Does the DOE Come in?

The DOE's role, outlined by Mr. Slezak, will include supporting the development and validation of several elements of EDV technology: the utility/grid operator, Home Energy Management/Home Area Network (HAN), Electric Vehicle Supply Equipment (EVSE), and the Plug-In Electric/Hybrid Vehicle (PEV). Mr. Slezak emphasized that the DOE is a strong supporter of industry and standards developing organizations (SDO) efforts, as well as global harmonization efforts.

Smart Grid Interoperability Panel and Vehicle-to-Grid

Led by the National Institute of Standards and Technology (NIST), the SGIP is a public-private partnership that aims to speed the development of interoperability and cybersecurity standards that will support a nationwide smart electric power grid.

V2G Smart Grid technology is one element of the SGIP's work. V2G refers to the system by which EDVs interact with the power grid, allowing electricity to flow from cars to the electricity grid.

NIST's Role in Smart Grid

Mr. Shah told attendees that NIST has the primary responsibility to coordinate development of a Smart Grid framework that includes protocols and model standards for information management to achieve interoperability of Smart Grid devices and systems. Some examples of standards that apply include those for vehicle batteries and communication inside the home.

Within the SGIP, there are:

- *Domain expert working groups*, which provide an analysis of the cross-functional area of applications requiring coordination between one or more technologies beyond the original scope of the technology itself. One such working group addresses V2G technology.
- *Priority action plans*, which facilitate coordination between any and all groups that must complement each other on the resolution of a gap or overlap in Smart Grid technologies. Two priority action plans include common object models and V2G implementation.

3.4 Panel — U.S.-Based Standards Activities (Part 2, Vehicle)

Panelists included:

- Jack Pokrzywa, Director, Ground Vehicle Standards, SAE International
- Kenneth Boyce, P.E., PDE Manager, Energy, Underwriters Laboratories, Inc. (UL)
- Christian Dubay, P.E., Vice President and Chief Engineer, National Fire Protection Association (NFPA)
- Rich Byczek, Site Manager, Intertek

Discussion topics:

- SAE International standards work, including communication protocols and connectors, fast charge, batteries
- UL standards activity including charging equipment; batteries
- Report of SAE / NFPA electric vehicles safety standards summit including vehicle charging

infrastructure; battery hazards identification and fire protection; training for emergency first responders and enforcement officials

- Battery abuse fire testing within SAE J2464

Equation for Success

How can we best find success in introducing EDVs to the market? Mr. Pokrzywa offered this equation:

$$\frac{\text{Policy} + (\text{Infrastructure} + \text{Reliability} + \text{Affordability})}{(\text{Standardization})} = \text{Customer Acceptance} + \text{Market Demand}$$

Work Underway in SAE

Mr. Pokrzywa outlined SAE International's work in the EDV arena. With 24 active committees dealing with electric vehicles, SAE is highly involved in EDV efforts. Mr. Pokrzywa noted that work with electric vehicles can be dated back to the early 1900s; efforts were renewed in the 1970s and 1980s.

Regional Differences Require Harmonization

Mr. Pokrzywa explained the configurations for EDV charging and the connectors used in different regions. For example, Japan and Korea use the SAE J1772 connector as well as the CHAdeMO, China has a unique version, Europe uses IEC 62196, and the U.S. uses SAE J1772. Opportunities for collaboration and harmonization are being pursued. If harmonization doesn't occur, it will mean higher costs for manufacturers and consumers and there will be limitations on the ability to share the infrastructure.

UL Makes a Plug for Safety

Mr. Boyce told attendees that UL has been conducting standards activities related to electric vehicles since the 1990s, with many recent developments and publications. The organization is focused on EDV safety, especially in regards to minimizing the risk of electric shock, fire, and injury.

Going forward, UL will look to support new technologies and innovations for the EDV market through new standards development. Ultimately, collaboration with key stakeholders will result in the best set of cohesive EDV standards and codes to support safe deployment.

U.S. National Electric Vehicle Safety Standards Summit

Mr. Dubai reported that the goal of the October 2010 U.S. National Electric Vehicle Safety Standards Summit was to provide an action plan to ensure the safe roll out of EDVs. Interested stakeholders can learn more in the Summit Report,⁵ which offers final action plan considerations for: vehicle charging infrastructure; battery hazards identification and protection; and training for emergency responders and enforcement officials. NFPA has a training program for first responders under a DOE grant. A follow-up summit will be held in Detroit on September 27-28, 2011.

Battery Abuse Fire Testing

Mr. Byczek informed attendees of battery abuse fire testing to SAE J2464, a high temperature hazard test that simulates exposure temperatures experienced in fuel fire – for example, a hybrid electric vehicle crash involving a gasoline fire. This test reveals the explosion risk of a battery pack – key information in evaluating and improving the safety of electric vehicles.

3.5 Panel — International Standards Landscape

Led by Frank Kitzantides, past vice president of the International Electrotechnical Commission (IEC), and IEC senior technology consultant, this panel provided high-level overviews of current and future standards development initiatives in the International Organization for Standardization (ISO); in the IEC, including the IEC-e8 strategic roundtable on electric vehicles; and in the European and Asia-Pacific markets.

Panelists included:

- John Ketchell, Director, Innovation, CEN / CENELEC Management Centre
- Keith Hardy, Senior Technical Advisor, Argonne National Laboratory
- Gregory C. Nieminski, LLC, Chair, IEC Subcommittee (SC) 23H, *Industrial Plugs and Socket Outlets*
- Kathryn Hauser, U.S. Executive Director, TransAtlantic Business Dialogue (TABD)

Discussion topics:

- IEC-e8 strategic roundtable on electric vehicles
- The CEN-CENELEC Focus Group on European Electro Mobility
- EDV standards activity in China and Japan
- IEC/SC 23H on electrical connectors and IEC/TC 69 on charging equipment
- TABD initiative on electric cars and smart grid

⁵ <http://www.nfpa.org/assets/files/PDF/Research/RFUSNEVSSSummit.pdf>

Business Crosses Borders

According to Ms. Hauser, positive, dramatic changes have been seen in transatlantic relations since 1995, with industries becoming more collaborative and less combative. CEOs no longer make distinctions based on borders – business is instead focused on transatlantic trade. And with pressures from international business partners including China, India, and Russia, we have to focus on the transatlantic economy and work with technology that will drive collaboration and leverage overall strength.

U.S. and EU — Different Approaches

Mr. Ketchell outlined the different approaches that the U.S. and EU take in standardization and new technologies. In the EU, standards are often linked to legislation, and early standards work was already required to remove internal trade barriers within the EU. Electric vehicle standards work thus far in the EU has been limited to vehicle pollution requirements (in support of EU regulations) and intelligent transport standards, among others.

EU Pushes for EV Standards in Multiple Areas

A mandate from the EU Commission is now pushing investigation of EDV standards in a number of arenas, including the interoperability of charging, connectivity, charger to battery, smart charging, safety risks, and electromagnetic compatibility.

Help Wanted

Mr. Ketchell noted that stakeholders in the EU view the electric vehicles industry as a huge employment generator for the coming years. Ms. Hauser echoed this theme, noting that the market for EDVs can create jobs and economic growth.

Challenges

Panelists noted many challenges that must be addressed in the development of EDVs. These include: a lack of standards that deters rollout; maturity of technology issues; moving too fast too soon; vehicle communication issues; battery issues; and safety issues, particularly in regards to e-mobility (electromobility).

Connectivity and Communication

Mr. Hardy's presentation stressed that there is a common global need for connectivity and communication. The physical configuration of the plug is not the sole concern; the wiring and communications protocols within the vehicle are equally critical and must be addressed. Collaboration is needed, whether through joint development of standards or the implementation of tools to verify or refine connectivity standards.

A Focus on Interoperability

Interoperability is imperative between key elements of an electric vehicle's charging structure. Mr. Hardy emphasized that we must find out the specific challenges to interoperability so that suppliers and industry can focus on these points. Then industry can work towards a commercial solution that will be beneficial for all parties.

Keep in Touch

Mr. Ketchell stated that European stakeholders and those at CEN/CENELEC are looking to set up a dialogue with ANSI to further explore these issues. The report from the CEN/CENELEC Focus Group on their work in EDVs is expected to be ready in mid-May 2011.

IEC and e8 Roundtable

Mr. Kitzantides reported that, in January 2011, IEC and e8 held an international roundtable on EDV rollout. Stakeholders aimed to determine priorities and ultimately accelerate the broad adoption of EDV technologies. Overall, participants of the roundtable agreed that global solutions are needed, and that IEC standards for EDV charging satisfy global needs at this time. A follow-up meeting is planned for the fall.

IEC TC 69 and Electric Vehicle Charging

Mr. Nieminski introduced the work of IEC Technical Committee (TC) 69 which has taken the lead in electric vehicle charging, including technology for automobiles, trucks, and buses. One standard developed by this TC is IEC 61851-1, *Electric vehicle conductive charging system - Part 1: General requirements*. This standard, most recently revised in 2010, is regularly updated to keep pace with technological developments. The related parts of this series of standards dealing with issues of A/C and D/C charging were also noted.

IEC TC 23 and Plugs and Sockets

Mr. Nieminski also described the work of IEC TC 23H and the various connectors that exist for A/C and D/C charging.

TransAtlantic Business Dialogue (TABD) Recommendations

Ms. Hauser reported that the TABD has made a recommendation to the EU Commission to take up the issue of electric cars, helping to drive the communication that is urgently needed in this initiative. TABD has also agreed to submit a formal paper on their recommendations for electric vehicles to the Transatlantic Economic Council (TEC).

3.6 Panel — Code, Conformance, and Training Issues

This panel, facilitated by Dr. Hansen of Energetics, provided high-level overviews and discussion of code, conformance, and training issues.

Panelists included:

- Mark Earley, P.E., Chief Electrical Engineer, National Fire Protection Association
- Andrew Kriegman, Vice President, Business Development, Leviton Manufacturing Co., NEMA Electric Vehicle Supply Equipment Section
- Bruce E. Johnson, Director of Fire Service Activities, International Code Council
- Al Ebron, Executive Director, National Alternative Fuels Training Consortium

Discussion topics:

- National Electrical Code (NEC) installation issues
- Potential NEC article 625 issues: listing and minimum enclosure rating requirements; electric vehicle supply equipment (EVSE) to building power connectivity for Level 2 and up; EVSE portability; branch protection and building wiring minimum sizing; EVSE charging cord topics; safety of chargers, plug-in connection, EVSE's personnel protection, and equipment
- International Code Council (ICC) building, residential, fire and green construction codes; training of code officials
- Advanced Electric Drive Vehicle Education Program

Is the Electric Industry Ready for Electric Vehicles?

Mr. Earley said yes, the industry is ready. However, requirements in the NEC are built on experience, so as more experience is gained, revisions will be necessary.

Electric Vehicles and the National Electric Code

The NEC addresses EDV charging and ventilation requirements in Article 625, *Electric Vehicles*. An NEC electric vehicles task group has been formed to further explore related issues. According to Mr. Earley, the NEC is also working to combat heat – the enemy of electrical systems and equipment. Heat issues can have a profound effect on electric vehicles, and many NEC publications guide the management of these issues.

Cracking the Codes

Mr. Johnson described the process for the development and revision of codes of the International Code Council (ICC). These codes reference consensus standards and dictate when and where standards should apply. The majority of the 15 ICC codes are intended to work together as companion documents.

Can Codes Keep up with Technology?

Basic safety procedures are in place, and codes and standards have been written. But technology changes rapidly, making it a challenge to predict what may need to be changed in the codes. Task groups have been formed to address this, and stakeholder participation in these groups remains critically important.

Challenges to EDV Success

Mr. Kriegman offered attendees a list of the challenges that may arise with respect to EVSE. These include: listing and minimum enclosure rating requirements; building power connectivity; overcurrent protection; and safety of chargers, among others.

Safety First

Mr. Johnson outlined a number of safety issues that may arise with the development of electric vehicles. These include: system safety including operation and maintenance, hazard identification and labeling, useful life of products, and how to best address new technologies.

Education and Training Needed

Getting information to code officials will be very important, said Mr. Johnson. Firefighters, too, will need training – not just on the electric vehicles themselves, but also the support systems such as charging stations that will be found in buildings and parking garages.

NEMA's Electric Vehicle Supply Equipment (EVSE) Section

Mr. Kriegman outlined the initiative of NEMA's EVSE Section, whose purpose is to support the development of the EVSE market, educate the market on the features and value of the EVSE infrastructure around the world, and develop the technology and application and product standards.

The National Alternative Fuels Training Consortium

Mr. Ebron introduced the work of the National Alternative Fuels Training Consortium (NAFTC), a program of West Virginia University that focuses on curricula development and training programs on alternative fuels and advanced technology vehicles. NAFTC has educated thousands of students through their workshops and technical courses, giving them advanced EDV skills and making them more employable and marketable.

Advanced Electric Drive Vehicle Education Program

This NAFTC program, funded by DOE and the ARRA legislation, focuses on curricula development and outreach. Training topics include: first responder safety; career and technology education; advanced electric drive vehicle technician; and electric infrastructure. Upon completion, over 20,000 students will have been trained.

4.0 Summary of Breakout Group Discussions⁶

Day Two: April 6, 2011

4.1 Introduction

On the second day of the workshop, attendees participated in one of three concurrent breakout sessions: **vehicle**, **infrastructure**, and **support services/other**. Participants were able to pre-select their preference of breakout group, but in some cases were assigned to a group if no preference was indicated or if there was a need to balance the groups.

Each breakout group was provided three worksheets with specific focus questions to respond to as described below.

Worksheet 1: Standards Issues

Worksheet 1 posed the following questions:

- What are the standards issues of concern for the identified stakeholders?
- Are there any standards issues of concern that are different for medium- and heavy- duty vehicles?

For purposes of this worksheet, the following definitions were provided:

An “**issue**” was defined as a barrier or impediment to the successful introduction and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric-drive vehicles (EDVs).

A “**standards issue**” was defined as an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Participants were asked to describe the issues of concern from the perspective of specific stakeholders. Accordingly, there were three versions of worksheet 1 corresponding to the three breakout groups, each containing a different listing of stakeholder groups.

⁶ An audio recording of the breakout group reports to the general session is available at www.ansi.org/edv.

Worksheet 2: Standards and Codes, Conformance, Education Actions

In Worksheet 2, the focus shifted from issues to actions, with the following questions asked:

- What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues?
- What are the biggest gaps / needs for action?
- Do you know of any group or organization planning actions that may help address these gaps/needs (who, what & when)?
- Are there opportunities / a role for DOE to address the gaps / needs for action?

The assumption was that different standards issues require different types of action. New standards may be needed to address some issues, but for others, standards may exist and the solution lies in better conformance programs. Still others may require education or a combination of different types of actions.

Worksheet 3: Key Messages for DOE

Worksheet 3 provided the opportunity to highlight key points or ideas that participants thought DOE needs to hear, attend to, or take into consideration when setting priorities and planning actions. It asked:

- What are the 2-3 most important take-aways regarding standards issues and/or actions?

At the conclusion of the breakout sessions, a spokesperson from each group gave a report back to the general session. These reports highlighted particular issues or actions that the group determined were priorities. These are summarized below. The complete breakout reports providing further details are included in Appendix 1.

4.2 Vehicle Breakout Group

4.2.1 Stakeholder Issues

Vehicle Manufacturers

- **Priority:** Is there a roadmap of standards that DOE or some other organization can set forth?
- **Priority:** Who in the U.S. will take the lead with respect to harmonization? U.S., European, and other regulations come into play.
- **Priority:** A matrix of coordinating bodies and standards activities to harmonize where possible would be helpful.
- **Priority:** Identify vehicle charging requirements for home, office – need to communicate this to the customer via the dealer.
- **Priority:** Cybersecurity (vehicle hooked up to network) and supply chain integrity.
- Ensure longevity of standards for communications between vehicle and grid
- Look at both technical and market issues
- Interoperability between EVSE plug and vehicle
- Fuel economy – how is it characterized?
- Procedure for emergency shutdown of EDV
- Permitting – DOE already working on national consistency in “permit by notification”; extend to local jurisdictions
- Consider user operational needs to determine what needs to be standardized

Battery Manufacturers

- **Priority:** Battery hazards classification – including storage
- **Priority:** Battery transport – currently transported separate from vehicles and “married” later at point of sale
- **Priority:** Standards for re-purposing / second-life of batteries. Utilities also interested in this.

Vehicle Component Manufacturers

- **Priority:** Supply chain integrity. Conformity assessment critical to help ensure components in the network are not malicious / counterfeit
- **Priority:** Roadmap would help at component level in terms of what’s out there, what’s coming next

Issues for Medium- and Heavy- Duty Vehicles

- **Priority:** On-board diagnostics requirements for commercial hybrid vehicle manufacturers
- **Priority:** Crash testing of commercial vehicles as relates to batteries

4.2.2 Biggest Gaps / Needed Actions

Standards / Codes

- **Priority:** Need better coordination, not *more* coordination. Proliferation of coordinating bodies, but no single umbrella organization. Need to understand the relationships and get related activities under one umbrella where possible. NIST and IEC have set up processes to coordinate smart grid. Who has authority to coordinate?
- **Priority:** Interoperability of cars and charging infrastructure
- Roaming issues – are there agreements between utilities across states?

Conformance Programs

- **Priority:** As the supply of EDVs into the market grows, so will certification programs

Education Programs

- **Priority:** Mechanics need training to safely repair EDVs; they are not electricians
- **Priority:** Need to understand what's in each standard beyond its document number
- **Priority:** Permitting officials (some 40,000 of them)
- Safe battery recycling
- General consumer education

Opportunities for DOE to Address Gaps

- **Priority:** Dedicated, practical projects or research by DOE to support standards development
- **Priority:** Promote understanding and coordination of battery hazard information. Work with battery suppliers to get this information out into the market. DOE has expertise through battery R&D efforts at national laboratories.
- Advanced vehicle test activity – collect information on EDVs' power usage in relation to smart grid infrastructure. DOE already working on these tests.

4.2.3 Most Important Take-aways

- **Priority:** Harmonization and coordination of standards worldwide
- **Priority:** Interoperability – make sure all cars work with all chargers
- **Priority:** Leadership role that DOE can play for permitting authorities

4.3 Infrastructure Breakout Group

4.3.1 Stakeholder Issues

Utility Companies

- Need for standards relating to integration between IT systems and EDV service providers
- Notification with respect to original equipment manufacturers (OEMs) and where vehicles will be rolled out
- Enhancements to standards for telematics relating to the vehicle and infrastructure
- Possible enhancement to standards for connecting fast chargers to the system
- Standards related to voltage and frequency of electricity to the grid

Providers of EDV Charging Stations

- Payment systems and roaming
- Plug and cord issues, especially public safety issues with respect to cords and charging stations
- Need to assure compatibility of EVSE equipment with all vehicles via standards (SAE J1772) and certification / compliance testing
- Metering inside the EVSE – Clarification needed in re: ANSI C12. Definitions of utility grade meters vary. Standard needed for removable meters in time, but will not stop market for EDVs
- Site planning for EDV charging stations

Battery Switching Station Operators

- Interoperability for the battery – vehicle interface
- Communication between vehicle and battery switching station especially when battery is removed from vehicle
- Portfolio of standards needed for battery swapping stations on issues relating to the equipment, battery storage, etc.

Code Officials / Electrical Inspectors

- Code implementation takes place at local level – nationwide model may be beneficial
- How diversity factors with EVSE are dealt with in the NEC

Issues for Medium- and Heavy- Duty Vehicles

- Ability of light EDVs to recharge at truck stops?

4.3.2 Biggest Gaps / Needed Actions

Standards / Codes

- **Priority:** Compatibility of connector standards for DC fast charging (JARI CHAdeMO and SAE J1772)
- **Priority:** Certification of compatibility of EVSEs with different vehicles
- **Priority:** Lack of consumer information. Good activities underway e.g. NREL GEO EVSE database and reservation system
- Cord management
- Wireless charging
- Battery switching stations
- V2G standards
- Brick and mortar safety requirements

Conformance Programs

- Enclosures for chargers
- Cradle to grave lifecycle – recycling responsibility
- Recyclers
- Carbon reduction initiatives
- Energy efficiency of EDVs
- Crash worthiness
- Permit by notification
- Training for installers
- IT training (network certification)

Education Programs

- Training for installers
- IT training – mobile certified technicians?
- First responder training
- Services-based workshops and models
- Brick and mortar safety requirements
- Urban planning for station deployment

Opportunities for DOE to Address Gaps

- None specifically identified

4.3.3 Most Important Take-aways

EDVs are a leading edge technology which affects many stakeholders. There are a number of standards developing organizations (SDOs) involved. How can we improve coordination so that we know “who’s got the ball?”

- Certification of EVSE equipment/compatibility with vehicles
- Standards to facilitate consumer acceptance, usability, and confidence
 - Responsibility for customer experience
 - Responsibility for charging problems over long term
- EDVs are a major enabler for the Smart Grid (V2G)
- Who’s got the ball? Policy, Governance, Coordination Requirements, SDO Coordination
 - Residential applications
 - Metering
 - Preferential rates
 - Time of use
 - Standards for communications protocols

4.4 Support Services/Other Breakout Group

4.4.1 Stakeholder Issues

Service Technicians

- **Priority:** Getting the consistent and correct information into the hands of service technicians and individual owners. Large after-market population that will not be trained. Home retrofit / do-it-yourself owners who will work on EDVs themselves.
- **Priority:** Need for accredited certification of credentials of service technicians. This will enable transferability of qualifications / credentials of trained technicians across states / regions.
- **Priority:** Need for effective and standard diagnostics systems including work practices
- Safe transport by salvage / tow operators
- Need to consistently update automotive training programs
- Privacy and right of use issues of service technicians

First Responders

- **Priority:** Identification of hazards and measures to deal with them
- **Priority:** Emergency disconnects on EDVs - how to “turn off” the vehicle, how to know if it’s off, and how to discharge / ground the energy (standard location of shutoff)
- **Priority:** Standards / guidelines to keep emergency responders safe while performing rescue from EDVs
- Batteries, storage, and transport
- Need to expand professional qualifications for first responders to include EDVs
- Standards for telematics accessed by first responders; ICE (“in case of emergency”) numbers on cell phones
- Standardized color and labeling of wires and cables within and under the vehicle. Standardized terminology and symbols.

Insurance Companies

- **Priority:** Built-in fire protection measures in battery manufacturing / storage facilities
- Manual firefighting techniques in these facilities
- Accurate risk assessment of vehicle and home to fairly price houses and policies
- Ability to collect information without violating personal privacy rights

Regulators

- **Priority:** State and local officials' knowledge of built-in fire protection of buildings
- **Priority:** Clearer definition of what is "re-selling electricity" in re: EDV charging
- Coordination / facilitation of permitting
- Installation and charging EDVs at home
- What can / can't be done by consumers vs. trained installers / operators
- Jurisdictional regulation of taxes on electricity during en route charging

Consumers

- **Priority:** Availability and signage of charging stations
- **Priority:** Consumer confidence that codes and standards are protecting them
- Education!
- Compliance with *Americans with Disabilities Act*
- Consumer input into regulations, codes, and standards
- Validation of range claims
- Roadside assistance for breakdowns

Standards Developers

- **Priority:** Consistent terminology e.g., spinning reserve / non-spinning reserve
- **Priority:** Need for enhanced data collection on EDVs (usage, loss, how to access, etc.) and dissemination of such information
- **Priority:** Participation, coordination and harmonization internationally. Everyone says they want international harmonization but everyone wants “their way.” In some cases, we may need to agree to disagree to get standards that move things forward.
- Need for U.S. to develop a roadmap of standards for EDVs. NIST has published a standards roadmap 1.0 for smart grid not for EDVs per se; it is under revision / open for comment now. Ultimately, roadmap will be market defined.
- Need for a global roadmap rather than a collection of different national roadmaps

Issues for Medium- and Heavy- Duty Vehicles

- None identified

4.4.2 Biggest Gaps / Needed Actions

Standards / Codes

- **Priority:** Development of a North American standards roadmap to facilitate global harmonization (a template for coordination of SDO responsibility and international standardization). Challenges include standards for the DC connector and communications.
- **Priority:** Enhancement of standards for labeling of vehicles and components
- As close as possible to a global standard for the charging coupler
- Draw on SAE and other international dialogues to inform U.S. TAGs and develop a North American position
- Global standard for communication and message protocols between vehicles and the grid
- Increased participation of the utilities
- Development of a comprehensive lifecycle picture of maintenance, disposal, safety, storage, etc.
- Updating of vehicle safety and emissions testing to include EDVs
- Standards / safety inspections for retrofit and conversions involving EDVs

Conformance Programs

- **Priority:** Certification and testing of equipment that references the standard – third party, nationally recognized
- **Priority:** Personnel credentialing including certification and training/education certificate programs
- Need for safety validation system / third party testing
- Charging systems in building codes – permitting process
- Update FMVSS/CMVSS to apply to PEVs
- Utilize market forces, i.e. certification, to maximize compliance with standards

Education Programs

- **Priority:** Accredited certification and training programs for multiple stakeholders (insurance adjusters, emergency responders, service technicians, roadside assistance, authorities having jurisdiction, etc.)
- **Priority:** Centralized, easy-to-use website and other information tools for consumers to understand efficiency and range of their EDV (expansion of fueleconomy.gov)
- **Priority:** Truth in advertising / labeling initiative about energy cycle including usage and emissions

- Hazards education programs
- Consumer safe use and maintenance education
- Driver education updated for EDVs
- Update automotive education programs at state education departments and career and technology programs
- Communication / information sharing across federal agencies

Opportunities for DOE to Address Gaps

- Support the development of a template for coordination of SDOs for North America
- Support the development of a North American roadmap. ANSI can help but ability to participate in more meetings is a challenge.
- Understand and promote the fundamental difference that EDVs have for their traditional focus
- Facilitate reselling electric power to charge EDVs
- Fund validation of testing requirements and standards
- Support international collaboration and dialogue
- Support information sharing between SDOs, national training organizations and academic institutions
- More active involvement in the technical advisory groups that are writing international standards (becoming members of those groups)
- Develop practices and mechanisms to gain more timely information about opportunities to participate in the various technical groups writing the standards

4.4.3 Most Important Take-aways

- Encourage harmonization in North America by prioritizing what needs to be done.
- North America and Europe need to, in the near term, come together about moving forward in harmony. Will help advance global markets. China likely to do its own thing on a lot of standards because of the size of its market.
- Consumer understanding and confidence has to be nurtured in the near term, which involves highlighting equivalencies between EDVs and traditional vehicles. More education.
- Develop and disseminate training on EDVs to national training organizations and academic institutions.

5.0 Summary of Priorities in Written Responses to Focus Questions

To augment the breakout group discussions, participants were encouraged to record their answers to the worksheet focus questions in writing. A summary of priorities identified in these supplemental written responses follows below. The transcribed responses to the focus questions appear in Appendix 2.

5.1 Stakeholder Issues

Not surprisingly, the written contributions tended to echo key areas of concern for the different stakeholders that were identified during the breakout group discussions. Most of the input related to the concerns presented by vehicle or support services stakeholders; very few written contributions were received on issues of concern for utility companies, EVSE providers, battery switching station operators, or code officials / electrical inspectors.

Education and Training – Service Technicians

A high priority is training for EDV service technicians. The addition of certification to existing programs is worth considering. For example, technicians could be certified in distinct areas for electric drive components and systems, like Automotive Service Excellence does for conventional vehicles. UL has a certificate program that focuses on safety. Training would be desirable in areas such as service disconnect; DC high voltage; and maintenance, inspection, and testing of charging stations. NAFTC is developing a training program with an emphasis on vehicles, infrastructure, and safety. Procedures for salvage and towing operators would also be helpful.

Standard Disconnects and Rescue Procedures – Emergency First Responders

The biggest concern for emergency responders is the need for a standard emergency disconnect / shut down location and device to know that a vehicle is off. Standard procedures for emergency rescue and extrication from an electric vehicle are also needed. Common labeling for wiring, symbols, and disconnects is a priority, as are consistent definitions, for example, on voltage.

Battery Storage – Insurance Companies

The handling and storage of batteries outside of the vehicle is a concern, especially in bulk situations and under extreme conditions of heat, cold, wet, or proximity to flammable gases.

Battery Re-purposing – Battery Manufacturers

Standards and codes for secondary / re-purposed batteries for non-vehicular applications (e.g., community energy storage) is an area of concern. Other issues of concern include battery safety, transport and storage, swapping, and end of life / recycling issues.

Training and Information - Regulators

Issues include the need to educate local fire and code officials on permitting, installation, and inspection, as well as training on both built-in fire protection measures (sprinklers, alarms) and manual fire fighting techniques. The need for a central, easy-to-use website with all of the applicable EDV standards, test methods, and training would be useful. Regulators also need to provide consumers with realistic ratings and information on vehicle range, charging times, mileage, and energy use and resale.

Information – Consumers

Consumers need simple, clear information on how and when to charge a vehicle; how to get a charging station installed; what are the vehicle life-cycle costs; how to deal with safety and maintenance issues, i.e., they need an "owner's manual." How much will it cost to re-wire a home to charge a car? How will this affect a homeowner's electric bill? Where do I find a licensed service technician? These are the types of questions that consumers have. A clearinghouse of this information and / or links to SDO sites might be useful.

Roadmap – Standards Developers and Vehicle Manufacturers

An issue identified for both standards developers and vehicle manufacturers is the need for one group to develop a roadmap for the U.S. / North American market. The purpose of such a roadmap would be to identify current standards projects, coordinate and prioritize codes and standards activities, designate responsible SDOs, and minimize overlap and gaps. It was suggested that perhaps a committee with participation by each SDO, regulators, and manufacturers could tackle this. The ANSI EVSP initiative was noted. Worldwide harmonization is also seen as desirable and is also an issue for regulators to be concerned about particularly where vehicles can easily cross borders.

5.2 Biggest Gaps / Needed Actions

The following gaps and related actions were among those mentioned:

Standards / Codes

Responses indicate that there are many overlapping standards and standards activities. A standards roadmap is needed to facilitate global harmonization and collaboration and to help stakeholders navigate who is doing what.

Standards participation also needs to be increased, particularly by OEMs in international standards development activity.

Safety must be addressed comprehensively through standards and codes. Issues that need to be addressed include safety of charging equipment in the home environment, high voltage labeling, emergency disconnects, and battery disposal.

Interoperability needs to be looked at, particularly in relation to the variety of connectors.

Regulators need to consider requirements related to reverse energy flow; rules related to homeowners reselling electricity; EVSE siting, construction, and usage; and safety and emissions testing for BEVs and PHEVs.

Conformance Programs

Conformity assessment aspects identified include testing, inspection, and third-party certification of EVSE and its components.

Conformance to assure safety battery manufacturing is also needed.

The possible introduction of personnel certification programs to enhance existing training programs could address the credentials of service technicians; those who install and maintain EVSE; towing operators and roadside assistance providers; emergency first responders; and insurance adjusters.

Education Programs

The need to provide consumers with comprehensive information is critical, especially on topics such as energy efficiency, vehicle range, safety, and residential usage.

Other audiences that need training include EVSE installers, emergency first responders, automotive technicians, insurance adjusters, and local code officials.

Opportunities for DOE to Address Gaps

Responses suggest a desire for DOE to take a leadership role in helping to foster collaboration among interested parties on a standardization roadmap for the U.S. and North America.

DOE can also help to coordinate information sharing between SDOs and national training organizations and academic institutions.

It is also suggested that DOE increase its participation on standards committees.

Finally, DOE might be able to help with the development of a central website with applicable information regarding standardization matters.

5.3 Most Important Take-Aways

In terms of the two or three most important take-aways (key messages for DOE), the following were notable:

Safety, training and education are key to EDV deployment. Consumers need information.

There are too many differing / overlapping standards that need consolidation. Greater consistency in standards for EDVs and the related infrastructure is needed.

A roadmap that explores coordination / harmonization issues for codes, standards and regulations should be looked at for the U.S. and North America. This should also be considered against other roadmaps in the context of the global market for EDVs. There should be active participation in harmonization efforts both domestically and internationally with a view toward global standards.

Greater coordination among U.S. federal government agencies is desirable and can be achieved through existing forums. Regulators have an important role to play and their actions can help to facilitate coordination in standards development. Issues also need to be considered at the federal, state and local government level, and from the vantage point of enforcement officials who have a different perspective than regulators.

6.0 Conclusions and Next Steps

Electric vehicles are posed to have a huge impact on numerous elements of industry and on the everyday lives of Americans across the nation. Overall, panelists and attendees agreed on several key issues as electric vehicle technology and popularity progresses:

Collaboration

Stakeholders from standards and code organizations, the electrotechnical industry, the automotive and utilities industries, representatives of the public sector, and consumers must come together to assure an efficient, effective, and safe transition to electric vehicles.

Interoperability

Interoperability between the connectors and charging stations is a top concern given the variety of vehicles on the road as well as the different charging modes that are available.

Safety

Safety for drivers and passengers nationwide is a top priority in electric vehicle development and roll-out. From standards and codes for safe charging stations, to battery hazards reduction, to training of users and emergency responders, many actions must be taken to assure that electric vehicles, their components, and the related infrastructure are safe.

Education and Training

Many different kinds of education and training are needed in relation to electric vehicles. Consumers, automobile technicians, and industry members alike have much to learn about EDVs, from their environmental benefits, to how to charge them, to how to service them. Equally important is training on the supporting infrastructure, including permitting, installation, usage, and maintenance of charging stations.

In his concluding remarks, Jim McCabe, senior director of standards facilitation at ANSI, noted that ANSI welcomes the input of all constituents as it continues to identify standards and conformance needs for this rapidly growing field through its new Electric Vehicles Standards Panel (EVSP).⁷ He emphasized that ANSI is well positioned to respond to the need for greater standards coordination around EDVs given the Institute's history of bringing diverse stakeholders together to develop consensus-based solutions for emerging priorities and new technologies. The EVSP will develop the roadmap that has been called for and in so doing will foster the coordination and collaboration on standardization issues that the workshop has confirmed is needed in order to grow the market for EDVs.

⁷ To participate in the EVSP, or to learn more, visit www.ansi.org/evsp.

VEHICLE GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?

Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Areas in blue text were cited as priorities.

Vehicle Manufacturers
<i>Consider standards issues of or relating to design of connectors, interoperability with charging stations, or any other concerns for vehicle manufacturers.</i>
<p>Is there a roadmap of existing standards that would apply specifically to all EVs, light, off-road, or medium or heavy-duty?</p> <p>Who in the U.S. is going to take the lead in harmonization regarding international standards? It would be easier if there was one worldwide standard to follow – U.S., Europe, and Asia</p> <p>Matrix of all coordinating bodies and standards activities to harmonize where possible – need for a scoping study</p> <p>Identify what the vehicle charging requirements are as they pertain to the homeowner/consumer for their charging location – home, office, etc. Help dealers / sales force communicate this information to consumers. OEMs and SDOs know this information, but it doesn't make it to the dealer level.</p> <p>Cybersecurity requirements and supply chain integrity: the vehicle and its sub-systems, individually and collectively, will need to satisfy requirements for interfaces and end-point equipment. Off-board communications from the vehicle to the grid</p> <p>The standards need to be “future proof” – right now, the standards in place for communications between the vehicle and the grid may inhibit future innovation</p> <ul style="list-style-type: none"> - But vehicle manufacturers assert that they made the choices they did because they were so advised by utilities to fit in with current infrastructure <p>Work together not just on technical issues but also on economic issues, outreach, and facilitation</p> <p>Interoperability between the plug EVSE and the charging port on the vehicle</p> <ul style="list-style-type: none"> - There is a committee starting to look at this issue <p>How do you characterize fuel economy for plug-in hybrid and electric vehicles? CARB is currently updating their 2011 procedure.</p>

In case of emergency, what is the procedure for an EV – shut down or slow down? Manufacturers may not wish for this issue to be standardized; it’s up to each OEM.

The permitting process is another issue for consumers. DOE is already working on national consistency in “permit by notification”

- can extend to local zoning requirements too

Examine user and operational needs to determine what needs to be standardized

Battery Manufacturers

Consider standards issues of or relating to safety, wiring, labeling, storage, secondary uses, recycling, or any other concerns for battery manufacturers.

Data that properly classifies the hazard of the battery from a fire/life safety perspective is needed; how do you deal with that hazard in the storage facilities.

Transportation of batteries and cars including batteries (so they don’t need to ship car and battery separately) – correlate the standards across the different agencies (FAA, DOT)

Repurposing / second-life standard for automotive batteries; utilities have an interest in this type of application

Technology look ahead on the attributes of batteries that will produce data object requirements (for example, what does the grid need to know about?)

Should there be sub-sets of standards for different battery technologies, or different standards? And even if there are battery standards, from the manufacturers’ perspective their customer is the OEM and they’ll meet their requirements.

Vehicle Component Manufacturers

Consider standards issues of or relating to component ratings, safety, interoperability, or any other concerns for vehicle component manufacturers.

Supply chain integrity – ensure that the component is not counterfeit

- Conformity assessment is critical

Roadmap would be helpful at a component level as well – what’s out there, what’s coming next

Are there any standards issues of concern that are different for medium- and heavy- duty vehicles?

For commercial hybrid vehicle manufacturers, what are the on-board diagnostics (OBD) requirements?

Crash testing for commercial vehicles as related to batteries (FMVSS 305 – light duty vehicles with lead acid batteries); which domestic agency is responsible; harmonize with international counterpart requirements

On a heavy-duty or commercial vehicle, there are particular issues with respect to the level of charge on the battery for regenerative braking capture

- EPRI Infrastructure Working Council is working on this

VEHICLE GROUP Worksheet 2: Standards and Codes, Conformance, Education Actions

What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues?

	Biggest Gaps/Needs for Action	Do you know of any group or organization planning actions that may help address these gaps/needs? <i>(Who, What, & When)</i>
Standards / Codes	<p>Better coordination needed, not <i>more</i> coordination</p> <ul style="list-style-type: none"> - Right now, there is a proliferation of coordinating bodies, but no single umbrella organization - We need to better understand the relationships and get related activities under a single umbrella wherever possible - Examples that need to be included: NIST and IEC have set up a formal coordination process re: smart grid. An informal example (due to cross membership): SGIP vehicle to grid (V2G) domain experts working group, IEEE P2030.1 - Who coordinates, who has the authority to coordinate, and how to coordinate in a way that each stakeholder’s needs/mandates are addressed <p>Interoperability of cars and charging infrastructure</p> <p>Roaming issues: are there agreements between utilities across states?</p>	<p>SAE J2953 is starting to address this point</p> <p>V2G and IEEE P2030.1 are trying to get a handle on it, but there are many models and it’s a huge issue. Lots of proposals but no solution yet.</p>

	Biggest Gaps/Needs for Action	(Who, What, & When)
Conformance Programs	<p>Certifiers are waiting for the rules to be set; once the standards are in place, certification bodies can develop a certification program that works for the manufacturers</p> <p>There’s a limited number of EVs produced right now. <i>As the supply chain grows, these activities will proliferate.</i> There’s not just one solution to develop an appropriately structured certification program, but we’ll need to be aware of this for the future to handle the volume of what’s coming to the marketplace.</p>	<p>UL (tests components, including on-board) CSA America</p>
Education Programs	<p><i>Mechanics are not trained electricians (NFPA 70 and 70E); how can they be trained to safely repair EVs</i></p> <p>Recycling batteries – what’s the safe procedure for dealing with a damaged battery?</p> <p><i>People need to better understand what’s in each standard beyond its document number.</i></p> <p>Education of permitting officials (International Association of Electrical Inspectors) - <i>don’t need to reinvent the wheel</i></p> <p>Need for consumer / general public education on EVs</p>	<p>SAE and the Truck Maintenance Council are defining orange cables to indicate high voltage West Virginia University activities from yesterday’s presentation NFPA 70E / OSHA requirements</p> <p>DOE award to Toxco</p> <p>NECA developed a training program for electrical inspectors, electricians, and contractors. NEC has an EV task group that can also look at permitting issues. IAEI has regional meetings often – training opportunities.</p> <p>UL University on EVSE Installation and regulatory approval</p> <p>DOE is doing an EV 101 video</p> <p>Vehicle OEMs have their own programs</p>

Opportunities/Role for DOE to Address Gaps/Needs for Action

Dedicated projects or research to support actual, practical, and relevant standards writing activities - 20k chargers and 9k EVs as part of the [DOE sponsored deployment project](#) – standards for useful purpose not just for standard sake

- But note that DOE has to be careful not to indicate any favoritism

Understanding and coordination of battery hazard information – getting the battery suppliers to share info and coordinate

- DOE has expertise through battery R&D efforts at National Laboratories

Advanced vehicle test activity: collect early information on how much power EVs use and when, to statistically characterize EVs vis-à-vis smart grid infrastructure needs

- DOE already working on these tests

VEHICLE GROUP Worksheet 3: Key Messages for DOE

What do you believe are the most important take-aways from the discussions in your breakout group?

2-3 most important take-aways regarding standards issues and/or actions

Harmonization and coordination of standards worldwide

Interoperability - make sure that all cars work with all chargers

Leadership role that DOE can play for permitting authorities

INFRASTRUCTURE GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?

Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Areas in blue text were cited as priorities.

Utility Companies
<p><i>Consider standards issues of or relating to upgrades to deal with capacity issues, load management during peak/off-peak times, permitting, payment schemes, customer privacy, power outages, or any other concerns for utility companies.</i></p>
<p>1) Interface of EV service provider with other IT systems</p> <ul style="list-style-type: none"> ▪ Lack of standards vis-à-vis providers and utility requirements ▪ Need one common protocol for interface of ESI systems (currently ambiguous) ▪ Load aggregation ▪ Need common definition on rate plans
<p>2) Broader Issue: Notification to OEMs regarding where vehicles will be rolled out</p>
<p>3) Telematics (vehicle and infrastructure)</p> <ul style="list-style-type: none"> ▪ State of battery (J2847/1) – does not include telematics ▪ Location of chargers ▪ Non-control systems are a challenge to consumers. Need to provide common information (data format). ▪ Getting information to consumers (J2735) – addresses consumer side ▪ Harmonization amongst those standards
<p>4) Connecting fast chargers to the system (and associated load profiles to the network)</p> <ul style="list-style-type: none"> ▪ SAE J2894 Part 1 (may need additional parts)
<p>5) Support (voltage and frequency) of electricity to the grid – IEEE 1547, P1547.8 (should allow voltage ride through grid support)</p> <ul style="list-style-type: none"> ▪ SAE 2847-3 should be harmonized with IEEE 1547
<p>Standardized interoperability hub to bring these together is currently being considered in the EU.</p>
<p>Addressing payment schedule</p>
<p>Investigate smart energy alliance</p>

Broader Issue (not necessarily a standards issue): Power levels: High 10 kilowatt or greater multi-unit and residential dwellings

Providers of EDV Charging Stations

Consider standards issues of or relating to design of connectors/interoperability with vehicles, or any other concerns for providers of EDV charging stations.

- 1A) Issues of how payments will take place via roaming
- 1B) Plug and cord issues, especially with regard to residential applications. NEC 625 (ambiguity)
 - IEC 61851-1 (issues need to be addressed within this standard, especially Mode 3)
 - Cord handling issues and maintenance (public use of equipment, especially fast charging)
 - Public safety issues (cords that cross pathways)
- 2) Compatibility of EVSE equipment with all vehicles (current SAE J1772 signaling not adequate)
 - Related certification/ compliance test needed (Bluetooth example)
 - Harmonization of standards regionally and internationally
- 3) No meter within EVSE (clarification needed in ANSI C12)
 - UL 2735 defines smart meter – does not meet all utility requirements
 - Standard for removable meter needed
 - No show stopper – standard probably needed
- 4) Site planning for EV charging stations (i.e., how many per parking lot, how many hours can you charge, signage requirements, ADA compliance)
 - Design matrix for where to place public charging (technical reference, perhaps not standard)
 - Lack of equipment level standards (how payment systems talk to the charging station)
 - Probably have to standardize the machine

Need a standard for DC fast charging – Japanese protocol not accepted

What kind of information do charging station owners need to get out to consumers

- SAE J2847-2 for DC messaging (between vehicle and charger; not to consumer)

Standards to establish consumer reservations

Standardize mechanical bolt installation patterns

Battery Switching Station Operators
<i>Consider standards issues of or relating to interoperability, fire safety, warehousing, or any other concerns for battery switching station operators.</i>
<p>1) Interoperability for battery - vehicle interface (physical and electrical)</p> <ul style="list-style-type: none"> ▪ SAE J2929 touches on lithium ion batteries in general – more needed <p>2) Communication between vehicle and battery switching station (currently an outlier)</p> <ul style="list-style-type: none"> ▪ SAE J2735, SAE J1939 (strictly for communications with vehicle – not with battery switching operators) <p>3) Standards to cover the entire station or just components – heavy duty/ fleets Needed on health of battery, nature of battery (i.e., labeling system, state of charge)</p> <p>EOL standards needed for batteries</p> <p>Liability/ equipment failure – ownership of the assets not necessarily a standards issue</p> <p>Warehousing of batteries at switching stations – standards for storing, packaging, etc.</p> <p>Vehicle crash worthiness with battery swap NHTSA (FMVSS 305)</p> <p>Model conceptualization needed for battery switching stations – standards to asses switch out procedures</p> <ul style="list-style-type: none"> ▪ Vehicle interface

Code Officials/Electrical Inspectors
<i>Consider standards issues of or relating to fire safety, interoperability in residential/commercial settings, use of listed equipment, or any other concerns for code officials/electrical inspectors.</i>
<p>1) Implementation is at the local level – nationwide model may be beneficial</p> <ul style="list-style-type: none"> ▪ NEC 230.2D – additional services for rate schedules ▪ Variability of interpretation <p>2) Diversity factors (experiential issue)</p> <ul style="list-style-type: none"> ▪ Not enough user information available yet; hard to predict how things will be used <p>Continuous duty load – additional experiences needed to better clarify</p> <p>Permitting process for second meters</p> <ul style="list-style-type: none"> ▪ Branch capability – how to enroll sub meter <p>Clustering of loads (does permit process adjust for that?)</p>

Are there any standards issues of concern that are different for medium- and heavy- duty vehicles?

Can light EDV owners recharge at a truck stop?

Higher voltage DC / fast charging

Level 1 DC (up to 32 kilowatts)

INFRASTRUCTURE GROUP Worksheet 2: Standards and Codes, Conformance, Education Actions

What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues?

	Biggest Gaps/Needs for Action	Do you know of any group or organization planning actions that may help address these gaps/needs? <i>(Who, What, & When)</i>
Standards / Codes	<p>Cord management (expectations of public spaces)</p> <ul style="list-style-type: none"> - perhaps more germane to product standards - location of receptacle in vehicle - placement of pedestal <p>Wireless charging</p> <ul style="list-style-type: none"> - communication - safety aspects (UL) - hands-free conductive charging/anomaly (SAE) <p>Compatibility between fast charging / DC standards</p> <ul style="list-style-type: none"> - generation to generation reuse of assets <p>Battery switching stations recommendation for portfolio of relevant standards</p> <p>Certification of compatibility of EVSEs with different vehicles</p> <ul style="list-style-type: none"> - validation of protocols <p>Lack of Consumer Information (availability of recharging, location, reservation, etc.)</p>	<p>OSHA (in the workplace) NEMA (workstations) UL SAE International (recommended practice) [Ordinance issue subject to interpretation]</p> <p>SAE J2954 - now pooling stakeholders UL 2950 (safety) NEC 625 IEC committee</p> <p>JARI SAE IEC 61851, Parts 23 and 24 (currently) SGIP (DC ties to smart grid; messaging)</p> <p>UL (may consider) P2030.1? - may consider</p> <p>SAE J2953 (recommended practice) UL</p> <p>IEEE 1609 IEEE 802.11P SAE J2735 NREL GEO EVSE database (Google Maps)</p>

	Biggest Gaps/Needs for Action	(Who, What, & When)
Standards / Codes (continued)	V2G standards (electronics and communication)	SAE J2847 Part 3 (communications) IEEE P2030 (vehicle to grid) IEC 61850 SAE J2836-3 ISO/IEC 15118 (common data structures)
	Brick and mortar safety requirements/Insurance	ICC NEC
Conformance Programs	Enclosures for chargers	NEMA UL NEC 625, 110 28
	Cradle to grave lifecycle – recycling responsibility	EPA?
	Recyclers	EPA? SAE (for battery recycling)
	Carbon reduction initiatives	EPA? (determination of sourcing of electricity)
	Energy efficiency of EDVs	SAE J1634
	Crash worthiness (high powered batteries performance issues)	NHTSA
	Permit by notification <ul style="list-style-type: none"> - <i>safety issues</i> - local codes 	Clean Cities NECA Automotive OEM NREL
	Training for installers (quality standard needs)	UL NECA
IT training (network certification)	Tech schools Industry training programs	

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Education Programs	Training for installers	UL NECA
	IT training	Tech schools Industry training programs
	First responder training	NFPA NAFTC
	Services-based workshops and models (enhance communication)	Government NAFTC
	Brick and mortar safety requirements	Industrial engineers/architects
	Urban planning for station deployment	State or federal level

Opportunities/Role for DOE to Address Gaps/Needs for Action

INFRASTRUCTURE GROUP Worksheet 3: Key Messages for DOE

What do you believe are the most important take-aways from the discussions in your breakout group?

2-3 most important take-aways regarding standards issues and/or actions

Certification of EVSE equipment/compatibility with vehicles

Standards to facilitate consumer acceptance, usability, and confidence

- Responsibility for customer experience
- Responsibility for charging problems over long term

EVs are a major enabler for the Smart Grid (V2G)

Who’s Got the Ball? Policy, Governance, Coordination Requirements, SDO Coordination

- Residential applications
- Metering
- Preferential rates
- Time of use
- Standards for communications protocols

SUPPORT SERVICES / OTHER GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?

Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Areas in blue text were cited as priorities.

Service Technicians
<p><i>Consider standards issues of or relating to safety, qualifications, certificate programs/certification, or any other concerns for service technicians.</i></p> <ul style="list-style-type: none"> - Salvage/Tow Operators (can be considered First Responders) – the safe handoff of the vehicle from other first responders and how to transport and to mobilize the vehicle safely - The garage or body shop – how to work on the vehicle safely; access of information and certified technicians - Need a standard diagnostic system including work practices - Need to consistently update automotive training programs - Still lacking a critical mass of EV ownership (1 million by 2015) - Transferability of qualifications/credentials of trained technicians to service the EVs across states/regions - Home retrofit/Do-it-yourself individual owners who will work on their EVs themselves - Lack of standards around what you need to know to work on these vehicles - Privacy and right of use issues of service technicians - Update standards that apply to non-emission vehicles specifically around diagnostic information from OEMs <p>THEME</p> <ul style="list-style-type: none"> - Getting the consistent and correct information into the hands of these people - Large after-market population that will not be trained - Need for accredited certification of credentials of service technicians and need for effective diagnostics

First Responders

Consider standards issues of or relating to fire safety, wiring, labeling, consistent emergency shut-off procedure / location, extrication, telematics, or any other concerns for first responders.

- Emergency disconnect on EVs – how to “turn off” the vehicles and how to know if it’s off, and how to discharge/ground the energy (standard location of shutoff)
- Disconnection of these vehicles that are plugged into the grid by first responders, including battery storage systems when there is an emergency on site
- Need to expand professional qualifications for first responders to include EVs
- Lithium batteries burn at a much higher temperature and more difficult to put out
- Need for a standard/guidelines to keep emergency responders safe while performing rescue from EVs (Emergency Response Guide)
- New battery technology may have new hazards including the release of toxic gases that need to be known
- Standardize telematics accessed by first responders, next generation 911 as well
- EVSE manufacturing sites which store potentially hazardous materials – need standards for safe transport of materials
- The charging stations may need emergency disconnects especially with multiple units
- Need for standardized coloring and labeling of the wires and cables especially within and under the vehicle; including standardized terminology and symbols; needs to be understood and clear to first responders

THEME

- Identification of hazards and measures to deal with them

Insurance Companies

Consider standards issues of or relating to safety of battery manufacturing / storage facilities, impact on home / auto insurance premiums, or any other concerns for insurance companies.

- Built in fire protection measures in battery manufacturing/storage facilities – are they adequate for new EV technology?
- Manual firefighting techniques that fully control the emergency handling within these facilities
- Accurate risk assessment of vehicle and home to fairly price houses and policies
- Ability to collect information without violating personal privacy rights

Regulators

Consider standards issues of or relating to fuel economy/labeling, greenhouse gas emissions, jurisdictional coordination issues, public EVSE pricing strategy, or any other concerns for regulators.

- State and local officials knowledge of built-in fire protection of buildings
- Need for coordination of facilitation of permitting – need adequate representation of EV dealers
- Complexity around Installation and usage of charging EVs at home
- Better definition of what can and can't be done by consumers as opposed to trained installers and operators
- Clearer definition of what is “reselling electricity” regarding the charging of EVs
- Jurisdictional regulation of taxes on electricity during en route charging

Consumers

Consider standards issues of or relating to fuel economy/labeling, affordability, impact on home/auto insurance premiums, installation of charging stations, permitting, charging times, payment schemes, power outages, service technicians, battery recycling, or any other concerns for consumers.

- Education!
- Availability and signage of charging stations
- Consumer input to regulation and codes and standards
- Consumer confidence that codes and standards are protecting them
- Validation of range claims including under what conditions
- Roadside assistance during breakdowns

Standards Developers

Consider standards issues of or relating to the need for cooperation / collaboration, terminology, or any other concerns for standards developers.

- Questions on terminology
- Need of the US to develop a roadmap of standards for EVs
- Need a global roadmap instead of a collection of different national roadmaps
- Maintenance and testing
- Need for enhanced data collection on EVs (usage, loss, how to access, etc.) and disseminating of such
- Participation, coordination and harmonization internationally

SUPPORT SERVICES / OTHER GROUP Worksheet 2:
Standards and Codes, Conformance, Education Actions

What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues?

	Biggest Gaps/Needs for Action	Do you know of any group or organization planning actions that may help address these gaps/needs? <i>(Who, What, & When)</i>
Standards / Codes	<ol style="list-style-type: none"> 1. As close as possible to a global standard for the charging coupler 2. Development of a North American Standards Roadmap to facilitate global harmonization (coordination of SDO responsibility and international standardization – a template) 3. Draw on SAE and other international dialogues to inform the US TAGs and develop a North American position 4. Global standard for communication and message protocols between vehicles and infrastructure (the grid) 5. Increased participation of the utilities 6. Development of a comprehensive lifecycle picture of maintenance, disposal, safety, storage, etc. 7. Enhancement of standards for labeling of vehicles and components (involves multiple documents) 8. Updating of the vehicle safety and emissions testing to include EVs 9. Creating standards and safety inspections for retrofit and conversions involving EVs 10. Codes and standards for imported EVs (FMVSS) 	<ol style="list-style-type: none"> 1. SAE 2. ANSI with support from DOE

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
<p>Conformance Programs</p>	<ol style="list-style-type: none"> 1. Need for a safety validation system (process, people and product) for the purpose of insuring that it is working as intended; including independent third party testing 2. Charging systems in building codes – the permitting process 3. Update FMVSS/CMVSS to apply to PEVs 4. Certification and testing of equipment that references the standard – third party, nationally-recognized 5. Utilize market forces to maximize compliance with standards (i.e. UL/CSA certification) 6. Personnel credentialing including certification and training and education certificates 	
<p>Education Programs</p>	<ol style="list-style-type: none"> 1. Accredited certification and training programs for multiple stakeholders (insurance adjustors, emergency responders, service technicians, roadside assistance, AHJ, etc.) 2. Hazards education programs 3. Consumer safe use and maintenance education 4. Driver education updated for EVs 5. Update automotive education programs at state education departments and career and technology education programs 6. Centralized, easy-to-use website and other information tools for consumers to understand efficiency and range of their EV (*expansion of fueleconomy.gov) 7. Truth in advertising/labeling initiative about energy cycle including usage and emissions 8. Development of a mechanism that enables communication and information sharing across federal agencies 	

Opportunities/Role for DOE to Address Gaps/Needs for Action

1. Support the development of template for coordination of SDOs for North America
2. Support the development of a North American roadmap
3. Understand and promote the fundamental difference that EVs have for their traditional focus
4. Facilitate reselling electric power to charge EVs
5. Fund validation of testing requirements and standards
6. Support international collaboration and dialogue
7. Support information sharing between SDOs, national training organizations, and academic institutions
8. More active involvement in the technical advisory groups that are writing international standards (becoming members of those groups)
9. Develop practices and mechanisms to gain more timely information about opportunities to participate in the various technical groups writing the standards

SUPPORT SERVICES / OTHER GROUP Worksheet 3: Key Messages for DOE

What do you believe are the most important take-aways from the discussions in your breakout group?

2-3 most important take-aways regarding standards issues and/or actions

1. Encourage harmonization in North America by prioritizing what needs to be done
2. North America and Europe need to, in the near term, come together about moving forward in harmony – need to make a decision
3. Consumer understanding and confidence has to be nurtured in the near term, which involves highlighting equivalencies between EVs and traditional vehicles
4. Develop and disseminate training for EDVs to national training organizations and academic institutions

Focus Questions – Written Responses

VEHICLE GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?

Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Vehicle Manufacturers

Consider standards issues of or relating to design of connectors, interoperability with charging stations, or any other concerns for vehicle manufacturers.

1. Has a roadmap been published for applicable codes and standards to bring an EV to market in USA for now – road use?
2. Standard is needed for reverse flow of energy
3. Safety of EV electrical systems as EVs are operated in charge mode is necessary
4. Numbers in increasing locations
5. There must be a harmonization within the worldwide standards (one standards body)
6. The process of the IEC/ISO standardization takes too long and can't reach the vehicle production
7. The regulation of electric car transportation (by air) needs improvement
8. There must be a way / process to make sure that all PHEV can be charged on all charging stations (support SAE J2953)
9. The DOE could help to take out the financial interest of the different standards bodies
10. Need to make different connectors for DC charging as most as backward compatible
11. The standard / some organization need to think of backward compatibility or upcoming connectors to existing one to ease the reuse of existing charge spot. The same applies to the systems.
12. Need to make a joint standard on AC charging between SAE and IEC (SAE J1772 and IEC 61851-1)
13. Need to precise the way of implementation to reduce the non-interoperability between [charging] spots and cars
14. Need to have a common (worldwide) way to test the cars (charger) and to give a label which ensures the interoperability and the quality of chargers → conformity
15. Roll-out of vehicles with DC fast charge capability (e.g., Nissan Leaf with CHAdeMO connector) prior to standardization is a problem. The standard development process needs to be fast-tracked.
16. Who in U.S. going to take lead on international with overlapping objectives / deliverables?
17. Too many players – need central forum with clear charter & timetable

18. Global standards being addressed regionally / nationally (unique opportunity for global approach)
19. Customer use studies / facilitate marketing entry, penetration
20. Economics (full consideration set) needs to be included in standard decisions
21. Standards setting processes too slow – standards should stay voluntary, not regulatory
22. Connectors within the US (North America) should at a minimum, be the same
23. Residential EV chargers – permitting should be quick and easy
24. With inductive charging coming online, will there be a national code that standardizes that process?
25. Is there a national, coordinated standards roadmap for the U.S., similar to those overseas? If not, why? If so, who should have authority to establish the roadmap and coordinate the work of all the different groups (local vs. state vs. federal). Who should be invited to participate?
26. The ownership experience should be seamless. Standards, or lack thereof, should support development of the market.
27. Are there too many SDO's? For example what is the difference between UL battery standards and SAE battery standards?
28. One of the speakers said EV charger installation was biggest hurdle to consumers buying an EV at the dealership. So need to address this priority issue – should have a model permitting process / application that all permitting authorities should be incentivized to adopt. The Federal Government could assist with incentives (e.g., DOE could give \$250 rebate to permitting authorities for each installation that was permitted through the model streamlined process). This would help avoid the “not invented here” syndrome with the permitting authorities.

Battery Manufacturers

Consider standards issues of or relating to safety, wiring, labeling, storage, secondary uses, recycling, or any other concerns for battery manufacturers.

1. Hazardous MSDS information for the mechanics / first responders
2. Education of consumer is needed, especially in terms of how to act if issue arises in terms of first responders
3. Wireless charging standards available?
4. Adequate, comprehensive, ANSI requirements for safety of batteries (all technologies) for vehicular use
5. Suitable conformity assessment scheme for battery safety
6. Standard and code requirements to address secondary / repurposed battery use in non-vehicular applications (e.g., community energy storage)
7. Safety of potential market practices such as battery swap-outs, after-market replacements etc. in the future
8. Is there a reason to have a set of standardized battery cell / module / pack formats? (Would there be any benefit to the vehicle OEMs or the battery secondary use market?) In addition to standardized formats, should there be safety and performance standards for secondary use?
9. Need a standard for storing and transporting batteries

10. Re-purposed batteries
11. Partnerships for end of life issues / recycling of batteries between OEMs and recycling associations should be initiated, to prepare now for the eventual large increase in EV scrappage volumes.

Vehicle Component Manufacturers

Consider standards issues of or relating to component ratings, safety, interoperability, or any other concerns for vehicle component manufacturers.

1. Standardized the plug, but what about charging station itself, or does this fall under general IEC, more building codes, etc?
2. Suitable conformity assessment scheme for safety
3. Integrity of products – authentication of quality
4. With respect to charging connectors, we currently produce J1772 level 1 and 2 interconnects and are designing IEC (Europe) and GB (China) interconnects. Ratings = No standard current ratings / vary by region therefore wire sizes vary and rating of wire size also varies (current carrying). Specs = J1772 qualified to UL 2251 which is different than IEC 62196 which is different than GB – same basic tests but severity differs → could consolidate. Function / circuitry differs as well. To sell J1772 connectors in Europe requires CE marking which requires qual. to IEC 62196. One common standard would eliminate this hassle / added expense.
5. Voltage range and bus transients for accessories
 - HV version of J 1113
 - HV isolation and testing. What voltage levels?
 - HV distribution. How to interconnect several devices (a la HV fuse box)

Are there any standards issues of concern that are different for medium- and heavy- duty vehicles?

1. When will DC charging standards be compatible for higher amperage charge rates?
2. Which connector decision will work for high amperage DC charging?
3. Will inducting charging be applicable for heavy duty vehicle charging?
4. Voltage ranges (higher voltage, more power, higher current)
5. Accessories interfacing to EV drive systems. How?
6. Amount of battery (more). Any issues due to larger stored energy
7. Mounting (outside frame rail). Divided packs (left/right side rail)
8. Mostly outside, not parked in garages. Harsher environment
9. Level 2 / level 3 chargers, not L1
 - Higher power chargers
 - Larger connectors than auto

Focus Questions – Written Responses

INFRASTRUCTURE GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?

Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Utility Companies

Consider standards issues of or relating to design of connectors, interoperability with charging stations, or any other concerns for vehicle manufacturers.

Providers of EDV Charging Stations

Consider standards issues of or relating to safety, wiring, labeling, storage, secondary uses, recycling, or any other concerns for battery manufacturers.

1. Need to have a final DC configuration of plugs for EV
2. Nice to have a single solution
3. Detachable cord from EVSE unit to car

Battery Switching Station Operators

Consider standards issues of or relating to component ratings, safety, interoperability, or any other concerns for vehicle component manufacturers.

Code Officials / Electrical Inspectors

Consider standards issues of or relating to fire safety, interoperability in residential/commercial settings, use of listed equipment, or any other concerns for code officials/electrical inspectors.

Are there any standards issues of concern that are different for medium- and heavy-duty vehicles?

Focus Questions – Written Responses

SUPPORT SERVICES / OTHER GROUP Worksheet 1: Standards Issues

What are the standards issues of concern for the identified stakeholders?
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Issue = barrier or impediment to the successful introduction, and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs)

Standards Issue = an issue that is related to deficiencies and/or inconsistencies in current codes, standards, or conformity assessment programs.

Service Technicians
<p><i>Consider standards issues of or relating to safety, qualifications, certificate programs/certification, or any other concerns for service technicians.</i></p> <ol style="list-style-type: none"> 1. Ambiguous, inconsistent, level of competence. Criteria 2. Uncertain equivalence of credentials between geographical markets 3. Need safety procedures that non-dealership (OEM-trained) technicians can follow 4. Need simple procedures on vehicle (under hood?) that towing personnel can follow 5. No comment other than safety is not to be compromised 6. Auto dealer and manufacturers – work collectively with regulators at national / state / local level to develop programs to facilitate permitting / qualified installation 7. Include salvage and tow operators 8. Handling of “after-market” vehicles 9. Standardized diagnostics and work packages 10. These people are certified in most states through national and regional programs. Not aware of any standards issues. But training and / or certification for EVs needs to be added to the existing programs 11. Need to include towing and salvage 12. Technicians not knowing what they have to deal with 13. UL has certificate program / training program for technicians – focus on safety 14. Garage or body shop → how to work on vehicle safely, access of information, and certified technicians 15. How do service technicians get diagnostic information from EVs? Current OBDII SAE standards are based on emissions control, so it’s not clear whether manufactures are bound to or have guidance on diagnostic procedures for zero emission vehicles. They may make tools for their dealer technicians, but the laws requiring them to make certain information electronically available to independent service technicians / the public may not be well defined for EVs 16. How does the consumer know if a service technician is competent? Currently, groups like ASE certify technicians in distinct areas (brakes, suspension alignment, etc.). Will they do the same for electric drive components / systems?

17. What are the requirements for state safety inspections for EDVs? What are state emissions test requirements for PHEVs?
18. What does a roadside assistant technician do to re-start electric vehicles with depleted battery?
19. Service disconnect, high voltage DC training, electric motor training, continuing education on the technology
20. Maintenance, inspections, testing charging station
21. There needs to be one place where all codes and standards are listed that affect servicing auto technicians – that apply to their needs only
22. There needs to be a training program that includes standards and codes relating to EDVs for technicians. NAFTC WVU is developing such a training program – standards organizations should reach out and partner with them. Emphasis of training – vehicles, infrastructure, safety
23. Retrofit / field conversions of vehicles – coverage in standards is lacking / requirements
24. Training / certification programs for servicing vehicles
25. Towing – special consideration for differences in salvage and tow operator hand off – what do I do with vehicle?
26. Preventing service technician from being exposed to HV
 - Lockouts No cut / splice of HV cables
 - Verifying voltage is discharged Orange cables = HV = no cutting?
 - Towing (disabling drive & HV) diagnostics Diagnostics tools and embedded

First Responders

Consider standards issues of or relating to fire safety, wiring, labeling, consistent emergency shut-off procedure / location, extrication, telematics, or any other concerns for first responders.

1. Ambiguous, inconsistent level of competence
2. Uncertain equivalence of credentials between jurisdictions (transferability)
3. Need a standard disconnect / power down device regardless of whether vehicle is on-road, stationary (parked), or on-charge
4. Awareness of external battery storage (power) systems in home, office buildings, etc. to supply EVs as alternative to grid
5. No comment other than safety is not to be compromised
6. Common labeling – symbols – location – required information – database
7. Clarify terminology: Focus on “emergency first responders” (EFRs)
8. Address technology to support “size-up”, most notably telematics
9. Promote consistent vehicle approaches to support EFRs, such as similar wiring labels, definitions of “hi-voltage” vs. mid/low voltage, shutdown procedures, etc...
10. Manual firefighting of battery fires
11. Professional qualifications standards exist for fire / emergency rescue personnel.
It is based on general knowledge of vehicle incidents. Training should include EV issues – no major charges regional to NFPA professional qualification standard for rescue technicians.

- Vehicle manufacturers should look at standardized / consistent master shut off devices and locations
12. Guideline, how to handle a car in case of emergency (already exists for non-EV → need to extend to EVs (rescue guide)
 13. Safe transport of batteries after accident
 14. First responders not knowing what they have to deal with
 15. Need ability to know vehicle is “OFF”
 16. Need clear instructions available to be able to verify status and safely extricate → differ vehicle to vehicle but need general, consistent overall plans
 17. SAE standards recommended practice – not routinely applied
 18. How to shut off vehicle
 19. How to know where they can cut into vehicle
 20. Need to know what is in vehicle – fire suppression
 21. Need code and laws (local jurisdictions) specifying electricity cut-off and fire suppression at fast charging sites
 22. Emergency disconnect, charging stations – vehicle, indicator – in drive mode, clear labeling on locations of wiring, batteries, disconnects
 23. Information on battery materials, basic fire fighting procedures / rescue
 24. Limits on storage of batteries
 25. Signage for charging stations, high voltage, residential / commercial
 26. By products of charging, tie in disconnect with SRS system
 27. Need to have standardized labels on vehicle from OEMS
 28. Need to have consistent training programs. Codes and standards organizations need to work with universities, community colleges, and technical schools.
 29. Retrofit / field conversions of vehicles – what to do
 30. Emergency disconnect – standardize
 31. What to do with damaged battery? Can they use water?
 32. How to identify hybrid vehicle as hybrid
 33. How to shut off HEV (different for each manufacturer)

Insurance Companies

Consider standards issues of or relating to safety of battery manufacturing / storage facilities, impact on home / auto insurance premiums, or any other concerns for insurance companies.

1. Inadequate methods to define and determine risks and assess abilities of principals to mitigate them
2. Educational materials for insurance companies so they do not adjust rates based on misconceptions
3. What information (e.g., certification of electrician installing EVSE) do insurers need?

4. Are insurance companies charging more for EV insurance premiums?
5. Concerns for: 1. Built-in fire protection measures (e.g., sprinkler, fire alarm, etc.), and 2. Manual fire fighting techniques
6. Focus on bulk storage concerns
7. Auto insurance for consumers will be impacted by EV cost, repair cost etc. – no standards issue. The fire protection community is concerned about handling and storage of EV batteries out of the vehicles. NFPA 13 committee looking at storage fire protection issues now.
8. Possibly insurance companies could get involved in the standards writing level
9. Standards to consider safe storage in varied conditions – extreme cold, heat, wet conditions – plus storage near flammable gases in garage
10. Increased liability due to shock?
11. Inspection, testing, maintenance of charging station
12. Hazards!
13. Need to know that high voltage can remain in batteries for months – storage location
14. EV rates not over rated in price
15. Battery warranty

Regulators

Consider standards issues of or relating to fuel economy/labeling, greenhouse gas emissions, jurisdictional coordination issues, public EVSE pricing strategy, or any other concerns for regulators.

1. Inadequate or duplicative protocols for validating and verifying GHG emissions claims, as well as recognized programs to assess conformance
2. There needs to be one well-organized, easy-to-navigate website that has all the applicable (EDV and support equipment) specific standards, test methods and available training. Think ENERGY STAR.gov - like
3. Realistic ratings provided to consumer on vehicle range / charging times based upon EVSE equipment.
4. Permitting, code compliant installation, inspection is not a barrier. Strict permitting codes and standards, inspections for gasoline dispensing stations. They are a barrier to unsafe installations.
5. Regulators need to work together to develop plans to educate – facilitate ? / installation / inspection / NFPA / ICC
6. For fire officials, same concerns as insurance
7. Provide training for local regulators (e.g., blgg and fire officials)
8. Electrical and fire inspectors are also regulators. The NEC requirements for EVSE and requirements for battery storage (NFPA 13) are standards issues NFPA is addressing
9. Testing methodology for assessing performance and efficiency of EVSE?
10. Utility “back office” interfaces for vehicle cross-charges
11. Rather than being above the process, can the regulators get involved in the standards development level?

12. Consistent labeling needed to help consumers make informed decision with respect to mileage and energy used
13. Confidence in installation of charging stations
14. Better definition of what consumer and trained operator can do
15. State vehicle safety and emissions testing needs to be defined – what does the service guy do when an EV tries to get certified?
16. Who can re-sell energy? Each state utility commission needs to define how / if EVSE owners can charge money to people who use their EVSE
17. Need requirements for EVSE accessibility defined in Americans with Disabilities Act
18. What codes, laws govern homologation (e.g., functional requirements for imported vehicles) of EDVs?
19. Inspection, testing, maintenance of charging stations
20. Hazards vs. protection
21. Occupant safety
22. Training needed for local government officials, code officials
23. Awareness workshops needed for government officials
24. Standardized regulations at state / local areas across country
25. Education and awareness of codes, standards and requirements
26. Harmonized requirements between communities and countries where vehicles can easily migrate cross borders
27. Retrofit vehicles

Consumers
<p><i>Consider standards issues of or relating to fuel economy/labeling, affordability, impact on home/auto insurance premiums, installation of charging stations, permitting, charging times, payment schemes, power outages, service technicians, battery recycling, or any other concerns for consumers.</i></p>
<ol style="list-style-type: none"> 1. Lack of consumer confidence 2. Is EPA considering an ENERGY STAR product category for EDV's? Consumers need source for equivalent energy efficiency information / education. What's behind the label? 3. Consumers need simple, clear information on how to charge a vehicle, get EVSE installed, understand life-cycle costs, etc. A clearinghouse of this information and / or links to SDO sites might be useful. 4. How much will it cost to re-wire my home to charge my car? How much will my electric bill go up? 5. Federal and State taxes on EV power consumption. How will the equivalent of gasoline taxes be allocated to owners of EVs / electric billing? 6. What happens when you are on the road and you run out of juice? Responders to road calls

7. Provide focused safety information to address consumer concerns and make available to auto dealers and similar groups
8. Methods for presenting “life cycle” vehicle cost comparisons
9. As often as possible, consumers should be integrated in standards writing committees
10. Rather than standards, consumers appear to need comprehensive owner’s manual
11. Simplicity → in charging, vehicle maintenance
12. Clear instruction / direction
13. Ability to maintain car easily → with confidence, certified personnel
14. Payment, reservation, and timing for charging
15. Definition of who pays for blown transformer because of introduction of EVs in residential areas
16. CEO education on stations and installer
17. Safety
18. Consumer confidence
19. Awareness workshops, events, activities needed to educate consumers on EDVs and that they are safe (vehicles, home charging, recycling, etc.)
20. Work with US DOE Clean Cities program and NAFTC program (nationwide programs) to get information to consumers on EDVs
21. Need consistent labeling of vehicles (EV, Hybrid, etc.) and labeling of components for safety purposes
22. Lighting of charging stations
23. Awareness of plugs / requirements for home charging
24. Availability of trained electricians - how do I find someone qualified for this?
- 25.** Where do I find a licensed service technician qualified to work on my vehicle besides the dealer?

Standards Developers

Consider standards issues of or relating to the need for cooperation / collaboration, terminology, or any other concerns for standards developers.

1. Conflict and duplication between standards
2. There is no one group or entity that helps coordinate PEV codes and standards work, prioritizes activities, ensures minimal overlap and minimizes gaps. Perhaps a committee comprised of a member from each SDO could tackle this (maybe include regulators, governments, and manufacturers)
3. Terminology (questions on)
4. Need of the U.S. to develop roadmap

5. Greater participation by charging system, vehicle connector and related accessory manufacturers to include all technologies, not limit standards to one design based on limited participation
6. Timely completion communications needs for system implementation including V2G.
7. Prioritize needs. Standards development: Develop information from data to allow “demand” factors to be identified in: home, office, commercial parking, fleets, street. So everything not (required to be) sized electrically at 100%.
8. DC charging must be settled quickly – configuration of plug
9. Should consider driving patterns – multiple fast charges in one day
10. One global standard is not a reasonable short / mid term goal.
11. Development of a roadmap of EV standards for U.S. / North America. Identify needs, designate responsible SDO, facilitate two way communication etc. ANSI EVSP.
12. Clarify terminology. For example, hi-voltage on vehicles is different than hi-voltage in building
13. Enhancement of data collection methods
14. NFPA is currently coordinating standards activity through SAE collaboration, ANSI EV Steering Committee
15. Need for international cooperation: U.S. SDOs and ISO /IEC (avoid double work / decrease costs)
16. Comparison of different existing / new roadmaps on international level → figure out needs for cooperation / discussions / etc. (harmonization)
17. Minimum capabilities of EVSE, including diagnostics
18. With all the SDOs, the need for an overall roadmap is critical
19. A detailed inventory of current-standards projects would help build awareness
20. Many SDOs involved – need to eliminate duplication / overlap
21. ANSI standards helpful
22. Identify areas missing and not being addressed
23. Harmonization in North America
24. Inspection, testing, maintenance
25. Consistency
26. Bring all developers to get in to make sure of coordination
27. Lack of one place to get access to all these issues, standards and codes dealing with EDVs – big issue
28. Retrofit vehicles – conversions at the component and vehicle level
29. Harmonization – North America and internationally
- 30. Interoperability between EV and EVSE**

Are there any standards issues of concern that are different for medium- and heavy- duty vehicles?

1. Anticipate higher power levels for buses, trucks
2. Clarifying manual fire fighting techniques for large capacity battery fires
3. Address inspection, testing and maintenance for all issues
4. Higher voltages involved in charging
5. Higher voltages
6. Connectors for charging. If the charging requirements vary for heavy duty vehicles (similar to other vehicle fuels), the plugs / receptacles need to ensure the vehicle will not charge if it will result in a safety hazard e.g., low voltage plug will not fit / will not charge in a high voltage [plug] or it won't charge safely.

Focus Questions – Written Responses

ALL GROUPS Worksheet 2: Standards and Codes, Conformance, Education Actions

What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues?

	Biggest Gaps/Needs for Action	Do you know of any group or organization planning actions that may help address these gaps/needs? <i>(Who, What, & When)</i>
Standards / Codes	<p>Too many overlapping standards → need consolidation. For instance IEC 62196-1 vs. UL 2251 – same basic connector tests with different requirements?</p> <p>China, GB specs, written around IEC but different?</p> <p>A standards roadmap to include a list of well defined use needs which will help create a more defined list of standards and prevent scope creep</p> <p>Unified system that publishes in real time all the changes and updates and code enforcement changes. And online forum that collects the consensus from both consumer and manufacturers</p> <p>Need to understand who’s doing what. We can’t identify gaps because the codes and standards landscape is so broad and complex; no one entity is aware of everything that’s going on.</p> <p>Comprehensive safety requirements – preferably ANSI, balanced consensus – process based</p> <p>Code requirements to address safe use of EVs as power consumer / power source, especially within residences</p>	<p>U.S. (local, state, federal); Europe (countries, EC); China; Japan; local regional, worldwide SDOs</p> <p>UL standards / outlines published (see UL presentation from 4/5). Some ANSI – others will be introduced to ANSI consensus process.</p> <p>NEC task group 2014 NEC code cycle starts Nov 2011 ICC code cycle 2012</p>

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Standards / Codes (continued)	Interoperability codes	
	Roadmap of codes to bring EVs to market	DOE / ?
	Reverse flow of energy regulations	DOE and smart grid applications
	Charging equipment / cord sets / receptacles harmonized North America	CSA has an EV resource task group that has involvement from North American manufacturers that has developed a list of priorities for standards development and harmonization and gaps
	Battery technology standards usage disposal	
	Consistent code requirements for equipment installation / signage / connector standards	
	Utilities need to coordinate with rest of industry so technology is compatible	
	Comprehensive life cycle for EVs	
	Consistent standards, especially in North America	
	Labeling of vehicles / coloring of high voltage cables / labeling of components	OEMs, codes and standards organizations
	Develop, update	
	Commercial, residential, charging stations	
	Uniformity of vehicle service / emergency disconnects	
	Each state needs to define whether EVSE owners can “sell” electricity	Each state public utility commission and/or energy commission has to make ruling on this
ADA needs to include guidance for EVSE siting, construction, usage		

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Standards / Codes (continued)	Need OBDII (or other standard) updated to address service diagnostics requirements for BEVs / zero-emission vehicles	May already be addressed in SAE standards, I don't know
	State requirements for emissions testing need to make provision for exempting BEVs and establish test procedure for PHEVs	May be addressed in some, all, or none of state requirements / regs. I don't know
	State requirements for safety testing of BEVs, PHEVs need to be established	
	Multiple SDOs with overlap / plus limited resources	ANSI EVSP – and plans to develop roadmap
	ID of standards that exist / in development	
	Update of NEC to address EV more fully	NEC TF
	Cooperating international standards (IEC / ISO impact)	
	Variety in connectors	
	Roadmap	ANSI Federation
	Inventory of current standards projects	ANSI Federation
	International cooperation / harmonization based on identified needs in different roadmaps	ANSI, SAE, CEN / CENELEC (EU), DIN (German Inst. for Standardization)
	Terminology standard for EVs	NFPA, SAE, others?
	Professional qualifications for service technicians	??
	High voltage charging procedures – general public? Trained techs?	NFPA? IEEE? EEI?
	Rules for reselling electric power to charge EVs – utility, state and local rules vary	Federal regulation?
Lack of US / NA coordination of standards roadmap	ANSI	

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Standards / Codes (continued)	<p>Need for development of NA roadmap of standards, coordination of SDOs, coordination of international representation & participation</p> <p>Need a strategy “road map” for standards showing what exists, what’s needed, who is doing the work</p> <p>Collaboration of stakeholders</p> <p>Coordinate to a global roadmap for EV implementation</p> <p>No significant gaps in standards development but inconsistent / lack of participation by US / Canadian manufacturers, OEMs to develop complete US positions in international standards area. Reasons: lack of time, lack of \$ to participate. Key people have restraints to participate while other countries complete standards activities.</p> <p>Identify overlapping requirements, harmonize efforts domestically and internationally</p>	<p>ANSI NA E8 from IEC EV manufacturers, EVSE suppliers, utilities, and standards orgs.</p> <p>U.S. TAGs for IEC / ISO EV related work (hardware, charging equipment, communications) not well attended, meet infrequently, minimal input / comment to develop standards. No financial support from individual OEMs</p>
Conformance Programs	<p>Should there be a certification procedure for EVSEs / cars? (Beyond J 1772 compliance)</p> <p>Adequately addressing conformance for increasing global supply chain. This will become more critical as more EVs are introduced and more supply chain manufactures become involved. As more after-market solutions are introduced, proper use (or restrictions) and conformance will be important.</p> <p>Battery manufacturers conformance program needs</p>	<p>UL presently offers certification for this equipment. Other solutions may also address this.</p>

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Conformance Programs (continued)	How do you ensure battery is manufactured to spec for safety reasons? Right now most regulations come solely from vehicle manufacturers' requirements.	
	Towing operator / roadside assistance / training PC (personnel certification) program	CSA personnel certification programs address some areas of PC for alt. energy vehicles
	Service technician training	
	First responder training	
	Permitting process for infrastructure systems	
	Service emergency disconnects	
	Labeling signage	
	North American standard connector	
	Who will test, maintain, and inspect public EVSE (in the same way that states inspect gas pumps)?	
	Technicians?	
	Installation of charging stations	
	Maintenance	
	Third party on charging components	UL safety testing
	Safety system → on-board, off-board, communication, functional safety	
	Conformity assessment program to address highest priority areas	
International cooperation / harmonization based on identified needs in different roadmaps		
Comparison of various programs (internationally)		

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Conformance Programs (continued)	<p>Certification of service techs for EVs</p> <p>Certification of electrical installers and maintainers of EVSE and EV batteries</p> <p>System for conformity assessment validation (safety system, interoperability)</p> <p>Development of a NA EV standards roadmap to facilitate global harmonization (coordinate SDO required, coordinate international participation)</p> <p>Road tax? Who is working on this, state or federal effort?</p>	<p>IBEW, IEC, NECA</p>
Education Programs	<p>Consumer education → automobile dealer networks are still unable to provide consumers the needed information about the electric-drive vehicles they sell</p> <p>Installation of EVSE</p> <p>Regulatory approval of EVSE installations</p> <p>Educating consumers on needs for residential charging units</p> <p>Educate consumer on hazards related to the battery and if it leaks. Safety.</p> <p>Training for automotive technicians including updated information on codes and standards (that are relevant)</p> <ul style="list-style-type: none"> ▪ Same for infrastructure training <p>Training and participation of government and code officials</p> <p>Awareness education of consumers</p>	<p>UL university training program / certification NECA training program</p> <p>UL university training program / certification</p> <p>NFPA</p> <p>UL and EPA need to make sure these large battery safety / EPA issues are addressed.</p> <p>NAFTC, WVU is working on this under the Advanced Electric Drive Vehicle Education Program – funded by US DOE</p> <p>NAFTC WVU</p>

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Education Programs (continued)	Update CTE secondary education in state departments of education	Other electrification awardees of DOE
	Training of first responders	NAFTC under DOE award; NFPA and other electrification awardees
	Training of automotive technicians	NAFTC WVU under US DOE Advanced Electric Drive Vehicle Education Program (National Training Center)
	Training of infrastructure (EDV) planning and installers	NAFTC
	Consumer awareness	National AFV Day Odyssey conference, etc.
	ASE	NFPA EV
	High voltage education – AC / DC	NC DOI OSFM www.ncdoi.com/OSFM emergency responder guides
	Hazards - battery materials	Hybrid vehicle guides
	Service technicians, roadside assistance, insurance adjusters, and emergency responders need official certification training programs for EDVs.	ASE?
	Local code officials, permitters, electricians need training on EDVs, test procedures, installation procedures, and record management	
	Consumers → maintenance charging	UL training and certificate program
	Technician	
First responder	NFPA program	
Consumer EV knowledge – basics or technology, do’s & don’ts, address DIY		

	Biggest Gaps/Needs for Action	<i>(Who, What, & When)</i>
Education Programs (continued)	Service techs First responders Mechanic training for EVs Producing meaningful equivalent energy efficiency and range estimate information aimed at the consumer	

Opportunities/Role for DOE to Address Gaps/Needs for Action
<ol style="list-style-type: none"> 1. Someone in US needs to take the lead to develop a coordinated (e.g., Local, State, Federal, International) roadmap for developing needs and standards. Is it DOE? If not then, who? How would they be authorized, and how could they control activities of other agencies, SDOs, and interested parties? Our goal is to provide sustainable and accepted transport for customers which is affordable, safe, and efficient. How to get there? 2. Templates – similar to hydrogen program 3. Roadmap – US 4. Foster collaboration of North American – particularly US / Canada (DOE / NRCAN) 5. Have DOE get codes and standards organizations to work with training organizations – big gap (other than just their own training of their own members) 6. Help coordinate information sharing between SDOs and national training organizations and academic institutions 7. Increased participation on standard committees (not just SAE and IEEE) 8. DOE needs to get more actively involved in the USNC and the IEC standards development at the Technical Advisory Group (TAG) level 9. Governmental support in order to achieve international harmonization 10. Create one well-organized, easy-to-navigate website that has all the applicable (EDV and support equipment) specific standards, test methods and available training. Think ENERGYSTAR.gov like. A “jumping-off point” full of categorized links.

Focus Questions – Written Responses
ALL GROUPS Worksheet 3: Key Messages for DOE

**What do you believe are the most important take-aways
from the discussions in your breakout group?**

2-3 most important take-aways regarding standards issues and/or actions

1. Assessing conformity to standards is just as important as defining their requirements
2. Worksheet #1 – Regulator category – consider separation of issues by Federal, State, and Local governments. Perhaps more importantly, consider regulators and enforcement officials separately – they have different needs
3. Charging stations – regulated similar to gas pumps?
4. Raise issues relevant to USG agencies in interagency forums such as the Interagency Committee on Standards Policy (ICSP), ANSI Government Member Forum, etc. Coordination between agencies is needed – several have roles and responsibilities with regard to EVs – NIST, DOE, EPA, DOT RITA Joint Program Office, NHTSA, etc.
5. Safety for responders, consumers, identification of hazards
6. Training of automotive instructors and technicians for EDVs. Updated training needs to be developed and disseminated across the country
7. Consistent standards across the spectrum of EDVs from vehicle, to infrastructure, to home installation
8. Consumer awareness and EDVs – about safety, home installation, where to get information, how to work with local code officials
9. Coordination / harmonization of codes standards regulations (U.S. – Canada and Mexico; International)
10. Templates to coordinate SDO activity
 - U.S. roadmap
 - North American roadmap
 - Interface with global roadmap
11. Training / education – validation of personnel knowledge (personnel certification)
12. Forum helped expand depth / width of interest found
13. Lack of global standardization
14. Too many differing / overlapping standards that need consolidation
15. Actively participate in harmonization efforts domestically and internationally
16. There are lots of discussions on an umbrella coordination group to take the lead. This is starting to sound like a regulation agency, not a standards agency, might be what is needed? Keep in mind though standards are voluntary, regulations are not. Until it becomes a regulation, you cannot force an SDO to follow it and each will continue to do its own thing (i.e., no coordination)
17. Safety is key to sustainable deployment





ANSI Workshop
Standards and Codes for Electric Drive Vehicles

AGENDA

Tuesday – Wednesday, April 5 – 6, 2011
9:00 a.m. – 5:00 p.m.

Bethesda North Marriott
5701 Marinelli Road, Bethesda, MD 20852

This two-day workshop will consider the codes, standards, and related conformity assessment programs needed to facilitate the successful introduction and widespread acceptance and deployment of light-, medium-, and heavy-duty on-road electric drive vehicles (EDVs) – vehicles that must be connected to the electric grid for recharging of their propulsion energy storage systems, which in most cases will be batteries. The workshop is being convened on behalf of the U.S. Department of Energy (DOE) and the Idaho National Laboratory (INL).

Participants will work collaboratively through presentations, Q&A, and breakout discussions to identify the issues, determine where there are gaps, and make recommendations for additional standards and programs that may be needed. This input will inform a report to be prepared after the workshop.

Day One: April 5, 2011

Time	Topic	
8:00 am	Registration / Continental Breakfast	
9:00 am – 9:15 am	Welcome and Opening Remarks The speaker will discuss the need for a public-private partnership to help drive the market for EDVs.	Fran Schrotter Senior Vice President and COO American National Standards Institute
9:15 am – 9:30 am	Keynote Address The speaker will highlight U.S. Department of Energy (DOE) programs related to electric drive vehicles.	Patrick Davis Program Manager, Vehicle Technologies Energy Efficiency and Renewable Energy U.S. Department of Energy
9:30 am – 9:35 am	Introduction of Workshop Facilitator	Jim McCabe Senior Director, Standards Facilitation American National Standards Institute

<p>9:35 am – 10:55 am</p>	<p>Panel: U.S.-Based Standards Activities (Part 1 - Infrastructure)</p> <p>Panelists in this two-part session will provide high-level overviews of the standards and codes landscape within the United States – what work is taking place and what remains to be done.</p> <p>With audience Q&A. Topics will include:</p> <ul style="list-style-type: none"> ▪ DOE perspective on the standards and codes landscape for electric drive vehicles ▪ IEEE P2030.1, <i>Guide for Electric-Sourced Transportation Infrastructure Working Group</i> and IEEE 1547, <i>Standard for Interconnecting Distributed Resources with Electric Power Systems</i> ▪ The Smart Grid Interoperability Panel Priority Action Plan 11 and V2G Domain Experts Working Group ▪ Knitting together the codes and standards for the electric vehicle infrastructure – an industry perspective 	<p>Facilitator: Fred Hansen, Ph.D. Program Manager Energetics</p> <p>Panelists: Lee Slezak Manager, Vehicle Systems Vehicle Technologies Program U.S. Department of Energy</p> <p>Thomas S. Basso Senior Engineer National Renewable Energy Laboratory</p> <p>Vishant Shah Consultant EnerNex Corp.</p> <p>Alan Manche, P.E. Director, Industry Standards Schneider Electric</p>
<p>10:55 am – 11:10 am</p>	<p>Networking Break</p>	
<p>11:10 am – 12:30 pm</p>	<p>Panel: U.S.-Based Standards Activities (Part 2 - Vehicle)</p> <p>With audience Q&A. Topics will include:</p> <ul style="list-style-type: none"> ▪ SAE International standards work, including communication protocols and connectors, fast charge, batteries ▪ UL standards activity including charging equipment; batteries ▪ Report of SAE / NFPA electric vehicles safety standards summit including vehicle charging infrastructure; battery hazards identification and fire protection; training for emergency first responders and enforcement officials ▪ Battery abuse fire testing within SAE J2464 	<p>Facilitator: Fred Hansen</p> <p>Panelists: Jack Pokrzywa Director, Ground Vehicle Standards SAE International</p> <p>Kenneth Boyce, P.E. PDE Manager – Energy Underwriters Laboratories, Inc.</p> <p>Christian Dubay, P.E. Vice President and Chief Engineer National Fire Protection Association</p> <p>Rich Byczek Site Manager Intertek</p>
<p>12:30 pm – 1:30 pm</p>	<p>Lunch</p>	

1:30 pm – 3:00 pm	<p>Panel: International Standards Landscape</p> <p>Panelists will provide high-level overviews of current and future standards development initiatives in the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) including the IEC-e8 strategic roundtable on electric vehicles, and in the European and Asia-Pacific markets.</p> <p>With audience Q&A. Topics will include:</p> <ul style="list-style-type: none"> ▪ IEC-e8 strategic roundtable on electric vehicles ▪ The CEN-CENELEC Focus Group on European Electro Mobility ▪ EDV standards activity in China and Japan ▪ IEC/SC 23H on electrical connectors and IEC/TC 69 on charging equipment ▪ TABD initiative on electric cars and smart grid 	<p>Facilitator: Frank Kitzantides Past Vice President, IEC IEC Senior Technology Consultant</p> <p>Panelists: John Ketchell Director , Innovation CEN / CENELEC Management Centre</p> <p>Keith Hardy Senior Technical Advisor Argonne National Laboratory</p> <p>Gregory C. Nieminski, LLC Chair, IEC/SC 23H</p> <p>Kathryn Hauser U.S. Executive Director TransAtlantic Business Dialogue</p>
3:00 pm – 3:15 pm	Networking Break	
3:15 pm – 4:40 pm	<p>Panel: Code, Conformance, and Training Issues</p> <p>Panelists will provide high-level overviews of code, conformance, and training issues.</p> <p>With audience Q&A. Topics will include:</p> <ul style="list-style-type: none"> ▪ National Electrical Code (NEC) installation issues ▪ Potential NEC article 625 issues: listing and minimum enclosure rating requirements; electric vehicle supply equipment (EVSE) to building power connectivity for Level 2 and up; EVSE portability; branch protection and building wiring minimum sizing; EVSE charging cord topics; safety of chargers, plug-in connection, EVSE's personnel protection, and equipment ▪ International Code Council (ICC) building, residential, fire and green construction codes; training of code officials ▪ Advanced Electric Drive Vehicle Education Program 	<p>Facilitator: Fred Hansen</p> <p>Panelists: Mark Earley, P.E. Chief Electrical Engineer National Fire Protection Association</p> <p>Andrew Kriegman Vice President, Business Development Leviton Manufacturing Co. NEMA Electric Vehicle Supply Equipment Section</p> <p>Bruce E. Johnson Director of Fire Service Activities International Code Council</p> <p>Al Ebron Executive Director National Alternative Fuels Training Consortium</p>
4:40 pm – 5:00 pm	Wrap-Up Day One / Day Two Preparation	Jim McCabe / Fred Hansen
5:00 pm – 6:00 pm	Networking Reception	

Day Two: April 6, 2011

Time	Topic	
8:00 am	Registration / Continental Breakfast	
9:00 am – 9:15 am	Overview of Day / Breakout Group Assignments (General Session)	Fred Hansen
9:15 am – 10:45 am	<p>Concurrent Breakout Sessions</p> <p>Attendees will select one of three breakout groups to participate in:</p> <ul style="list-style-type: none"> ▪ Vehicle ▪ Infrastructure ▪ Support services / other <p>Each group will discuss / answer focus questions on:</p> <ol style="list-style-type: none"> 1. What are the standards issues of concern for the identified stakeholders? 2. What standards and codes, conformance programs, and/or education programs are needed to address the key standards issues? 3. What are the most important take-aways or messages for DOE? <p>To augment the discussions, worksheets will be provided online and at registration so that participants may also record their answers in writing. Participants should think about which breakout group they want to participate in and consider writing down some of their answers to the questions ahead of time.</p>	<p>Vehicle Group Facilitator:</p> <p>Ziga Ivanic, P.E. Heavy Truck Team Leader Energetics</p> <p>Infrastructure Group Facilitator:</p> <p>Fred Wagner Program Director Energetics</p> <p>Support Services / Other Group Facilitator:</p> <p>Fred Hansen</p>
10:45 am – 11:00 am	Networking Break	
11:00 am – 12:30 pm	Concurrent Breakout Sessions (continued)	
12:30 pm – 1:30 pm	Lunch	
1:30 pm – 3:00 pm	Breakout Group Reports (General Session)	Fred Hansen et al.
3:00 pm – 3:30 pm	Next Steps and Closing Comments	Jim McCabe

April 5-6, 2011
ANSI EDV Workshop Participants

Last Name	First Name	Organization	Participation
Ahdieh	Navid	NREL	In-person
Ambrozaitis	Giedrius	Alliance of Automobile Manufacturers	In-person
Amette	Pamela	Motorcycle Industry Council	In-person
Anderson	David	U.S. Department of Energy	In-person
Austin	Dan	NC Office of the State Fire Marshal	In-person
Ayvaz	Turan	American National Standards Institute	In-person
Baker	Scott	PJM Interconnection, LLC	In-person
Basso	Thomas	National Renewable Energy Laboratory	In-person
Beier	Mario	DIN German Institute for Standardization e. V.	In-person
Bentley	Julian	LMI	In-person
Bird	Sonya	Underwriters Laboratories Inc.	In-person
Bohn	Theodore	Argonne National Lab	In-person
Bomeke	Falk	Embassy of the Federal Republic of Germany	In-person
Boot	John	General Electric Co	In-person
Boyce	Kenneth	Underwriters Laboratories Inc.	In-person
Burke	William	National Fire Protection Association	In-person
Byczek	Rich	Intertek Testing Services Inc	In-person
Cairns	Julie	CSA America, Inc.	In-person
Campbell	David	Representative of German Industry & Trade	In-person
Carroll	Stephanie	American National Standards Institute	In-person
Casey	Colin	Navistar	In-person
Christie	Blake	Noblis	In-person
Clute	Jeanette	Ford Motor Company	In-person
Collins	Watson	Northeast Utilities	In-person
Coop	Mike	ThinkSmartGrid	In-person
Cooper	Scott	American National Standards Institute	In-person
Davis	Patrick	U.S. Department of Energy	In-person
DiBernardo	Mary Jo	NIST – U.S. Department of Commerce	In-person
Djimenou	Manassé	PSA PEUGEOT-CITROEN	In-person
Dubay	Christian	National Fire Protection Association	In-person
Earley	Mark	National Fire Protection Association	In-person
Ebron	Al	West Virginia University	In-person
Fehr	Walt	U.S. Department of Transportation	In-person
Fietzek	Cliff	BMW NA	In-person
Frakes	Larry	Keystone Charge	In-person
Francfort	James	Idaho National Laboratory	In-person
Gonzalez	Paul	Noblis, Inc.	In-person
Grant	Casey	National Fire Protection Association	In-person
Guan	Adrian	Intelligent Transportation Society of America	In-person
Guth	Matt	Eaton	In-person
Hallenbeck	Lane	American National Standards Institute	In-person
Halliwell	John	Electric Power Research Institute	In-person

Last Name	First Name	Organization	Participation
Hansen	Frederick	Energetics Incorporated	In-person
Hardy	Keith	Argonne National Laboratory	In-person
Hauser	Kathryn	TransAtlantic Business Dialogue	In-person
Hearty	Paul	Sony Electronics Inc.	In-person
Hoyler	Susan	QUALCOMM Incorporated	In-person
Huss	John	Phoenix Contact	In-person
Ivanic	Ziga	Energetics Incorporated	In-person
Jameel	Akhtar	Better Place	In-person
Jeffries	Timothy	ATIS	In-person
Johnson	Bruce	International Code Council	In-person
Johnson	Terry	Electric Drive Transportation Association	In-person
Johnston	Michael	National Electrical Contractors Association	In-person
Kardos	Dale	Dale Kardos & Associates, Inc.	In-person
Ketchell	John	CEN CENELEC Management Centre	In-person
Kitzantides	Frank	National Electrical Manufacturers Association	In-person
Klein	Stanley	Open Secure Energy Control Systems, LLC	In-person
Kriegman	Andrew	Leviton Manufacturing Co Inc	In-person
Krumholz	Rena	American National Standards Institute	In-person
Kushnier	Gary	American National Standards Institute	In-person
Lanctot	Roger	Strategy Analytics	In-person
Lariviere	Stephane	CSA America, Inc.	In-person
Luckett	Scott	Automotive Aftermarket Industry Association	In-person
Manche	Alan	Schneider Electric	In-person
Mansfield	Curt	PacifiCorp	In-person
Maytrott	Craig		In-person
McCabe	James	American National Standards Institute	In-person
McDowell	Kelliston	New Energy and Industrial Technology Development Org	In-person
Meincke	Brian	American National Standards Institute	In-person
Mellon	Tim	SAE International	In-person
Miller	Susan	Alliance for Telecommunications Industry Solutions	In-person
Murray	Bill	Energy Intelligence Group	In-person
Nager	Michael	Phoenix Contact	In-person
Narayanan	Vivek	PG&E	In-person
Neelakantan	Radha	Intelligent Transportation Society of America	In-person
Neiman	Elizabeth	American National Standards Institute	In-person
Nieminski	Gregory		In-person
Oddsden	Dennis	Hubbell Incorporated	In-person
Owens	Edwin	U.S. Department of Energy	In-person
Parris	Andy	NIST – U.S. Department of Commerce	In-person
Patwardhan	Satyajit	Green Dot (Transportation) Inc.	In-person
Pauly	Chris	Underwriters Laboratories Inc.	In-person
Payne	Thomas	ATIS	In-person
Peng	Pei-Yuan	LG Electronics China R&D	In-person
Piqueira	Philip	GE Industrial Solutions	In-person
Plautz	Jason	Environment & Energy Publishing, LLC	In-person

Last Name	First Name	Organization	Participation
Pokrzywa	Jack	SAE International	In-person
Roman	Matt	Electro-Static Technology	In-person
Rondeau	Clifton	CSA America, Inc.	In-person
Schrotter	Frances	American National Standards Institute	In-person
Scolnik	Alvin	National Electrical Manufacturers Association	In-person
Seaman	Tammy	Intertek Commercial & Electrical	In-person
Shah	Vishant	EnerNex	In-person
Shimura	Yuichiro	Mitsubishi Research Institute	In-person
Slezak	Lee	US Department of Energy	In-person
Smart	John	Idaho National Laboratory	In-person
Smidt	Jeff	Underwriters Laboratories Inc.	In-person
Sommers	Beth	Magna ECar USA	In-person
Spek	Erik	TUV SUD Canada	In-person
Stuebing	Gary	Duke Energy	In-person
Swift	Roy	American National Standards Institute	In-person
Tamborra	Nicholas	Volkswagen Group of America	In-person
Telleen	Paul	U.S. Department of Energy	In-person
Teninty	Daniel	Fulton Innovation	In-person
Thompson	Joseph	Nissan Research & Development Inc.	In-person
Tomobe	Osamu	Hitachi Ltd.	In-person
Tyehimba	Nkosi	Siemens Energy, Inc.	In-person
VanLuven	Tom	Intertek Testing Services Inc	In-person
Vondrasek	Robert	National Fire Protection Association	In-person
Wagner	Fred	Energetics Incorporated	In-person
Wells	Jack	Pass & Seymour/Legrand	In-person
Wolfel	Lee	ITT Interconnect Solutions-VEAM	In-person
Yates	Lane	EV Broker	In-person
Yeider	Ted	Paceco Corp.	In-person
Young	John	Siemens Industry, Inc.	In-person
Zabinski	Jana	American National Standards Institute	In-person
Zegers	Charles	American National Standards Institute	In-person
Zertuche	Tony	American National Standards Institute	In-person
Bales	Fred	ISO	Webinar
Boroughs	Ralph	Tennessee Valley Authority	Webinar
Doggett	Scott	edmunds.com	Webinar
Erickson	Kellie	NEC Laboratories Europe	Webinar
Geiger	Marie	U.S. Department of Commerce - ITA	Webinar
Hijikata	Heidi	U.S. Department of Commerce - ITA	Webinar
Hodson	Richard	Southern California Edison	Webinar
Jongkind	James	American Honda Motor Co., Inc.	Webinar
Kingston	Nancy	ABI Research	Webinar
Kissane	Daniel	Pass & Seymour/Legrand	Webinar
Kissel	Gery	General Motors Corporation	Webinar
Adey	John	American Boat & Yacht Council	Webinar
Lamey	Andrew	Pleasant Limousines	Webinar

Last Name	First Name	Organization	Participation
Levitt	Marc	Georgetown Climate Center	Webinar
Lobnig	Sabine	Cars21.com	Webinar
MacIntyre	Ian	Natural Resources Canada	Webinar
McDonald	Joshua	Southern California Edison	Webinar
Molitor	Stephen	National Electrical Manufacturers Association	Webinar
Nelson	Carla	NES	Webinar
Picariello	Pat	ASTM International	Webinar
Poole	Jeffrey	I-CAR	Webinar
Press	Barry	Washington CORE	Webinar
Rivaldo	Alan	Public Utility Commission of Texas	Webinar
Rivkin	Carl	National Renewable Energy Laboratory	Webinar
Rowland	Kate	Energy Central	Webinar
Rupp	John	Textron Inc.	Webinar
Russotti	Bob	American National Standards Institute	Webinar
Salazar	Jose	Southern California Edison	Webinar
Scholer	Rich	Ford Motor Company	Webinar
Shang	Danny	Shang Consulting	Webinar
Sill	Steve	U.S. Department of Transportation / RITA ITT-JPO	Webinar
Smith	Jordan	Southern California Edison	Webinar