

HARMONIZATION OF STANDARDS, TECHNOLOGY AND TESTING

# EV-Smart Grid Interoperability Centers

in Europe and the U.S.



# Electromobility holds great promise for economic growth

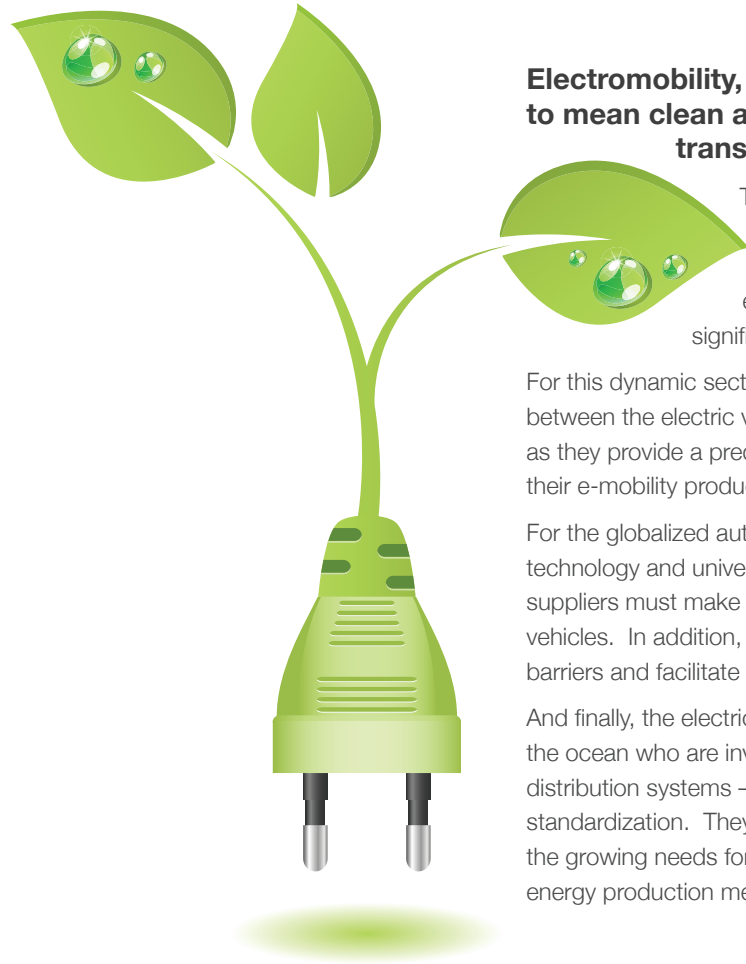
**Electromobility, or e-mobility, is a word that has been coined to mean clean and environmentally friendly electric vehicle transportation.**

The European Union and the United States recognize that e-mobility has the potential for enormous economic growth. E-mobility will not only help reduce the amount of energy used by the transportation sector, but will also create significant employment opportunities.

For this dynamic sector, harmonized technology standards and interoperability between the electric vehicle (EV) and the grid are becoming increasingly important as they provide a predictable framework that gives innovators confidence to bring their e-mobility products to market.

For the globalized automotive industry, the development of standardized e-mobility technology and universal interoperability is particularly urgent; the industry and its suppliers must make investment decisions to support production of the electric vehicles. In addition, globalized standards and technology will minimize trade barriers and facilitate adoption of new technology.

And finally, the electric utility industry and network operators on both sides of the ocean who are investing heavily in the development of intelligent electricity distribution systems – known as smart grids – are also pushing for e-mobility standardization. They must “future-proof” their infrastructure investments to meet the growing needs for electric vehicles, as well as those for differing renewable energy production methods.



# Transatlantic agreement facilitates e-mobility harmonization



David Sandalow (left), DOE Assistant Secretary for Energy Efficiency & Renewable Energy, and Dominique Ristori, Director General, European Commission Joint Research Centre, sign the agreement to establish EV-Smart Grid Interoperability Centers at Argonne National Laboratory and the JRC – the Commission’s in-house science service. In the background (left to right), Günther Oettinger, European Commissioner for Energy, Karel deGucht, European Commissioner for Trade, and Michael Froman, Assistant to the President and Deputy National Security Advisor for International Affairs, witness the signing at the annual Transatlantic Economic Council meeting in Washington, D.C.

*Photo courtesy of the U.S. Department of State, November 2011*

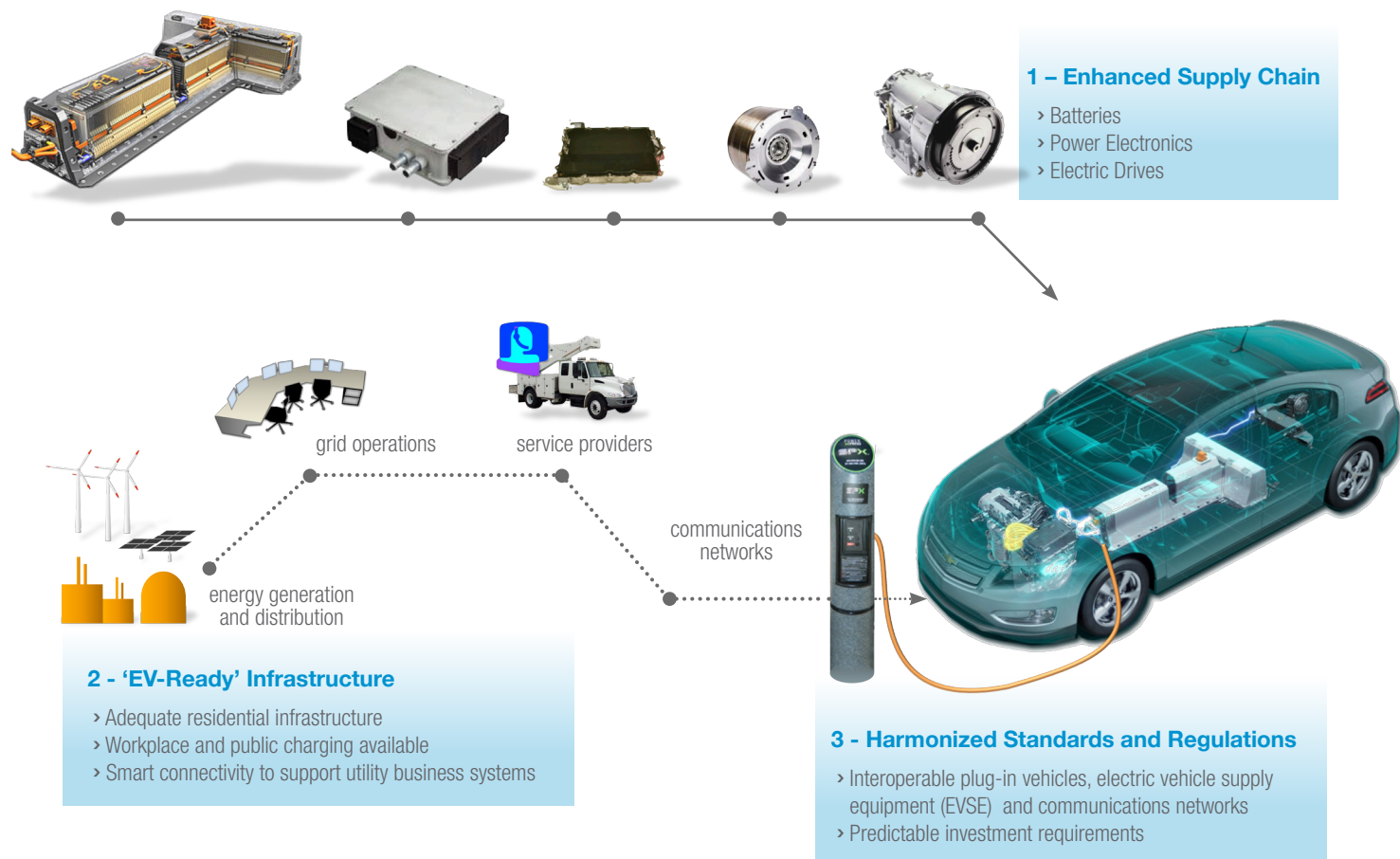
The **EV-Smart Grid Interoperability Centers** at the U.S. Department of Energy’s Argonne National Laboratory and the European Commission’s Joint Research Centre (JRC) are providing a venue for global industry-government cooperation that is focused on the joint development of EV standards and test procedures.

The two organizations are leveraging their expertise in EVs and smart grid technologies with their state-of-the-art facilities and testing equipment to enable universal connectivity and interoperability between EVs and the electric charging infrastructure. The centers are collaborating to:

- ▶ Develop and verify standards, technologies and communication protocols
- ▶ Harmonize test procedures for vehicles, batteries and interoperability – to facilitate EV compatibility with products from global suppliers
- ▶ Identify gaps in standards or technology; recommend solutions through the creation of proof-of-concept systems and validation of proposed approaches

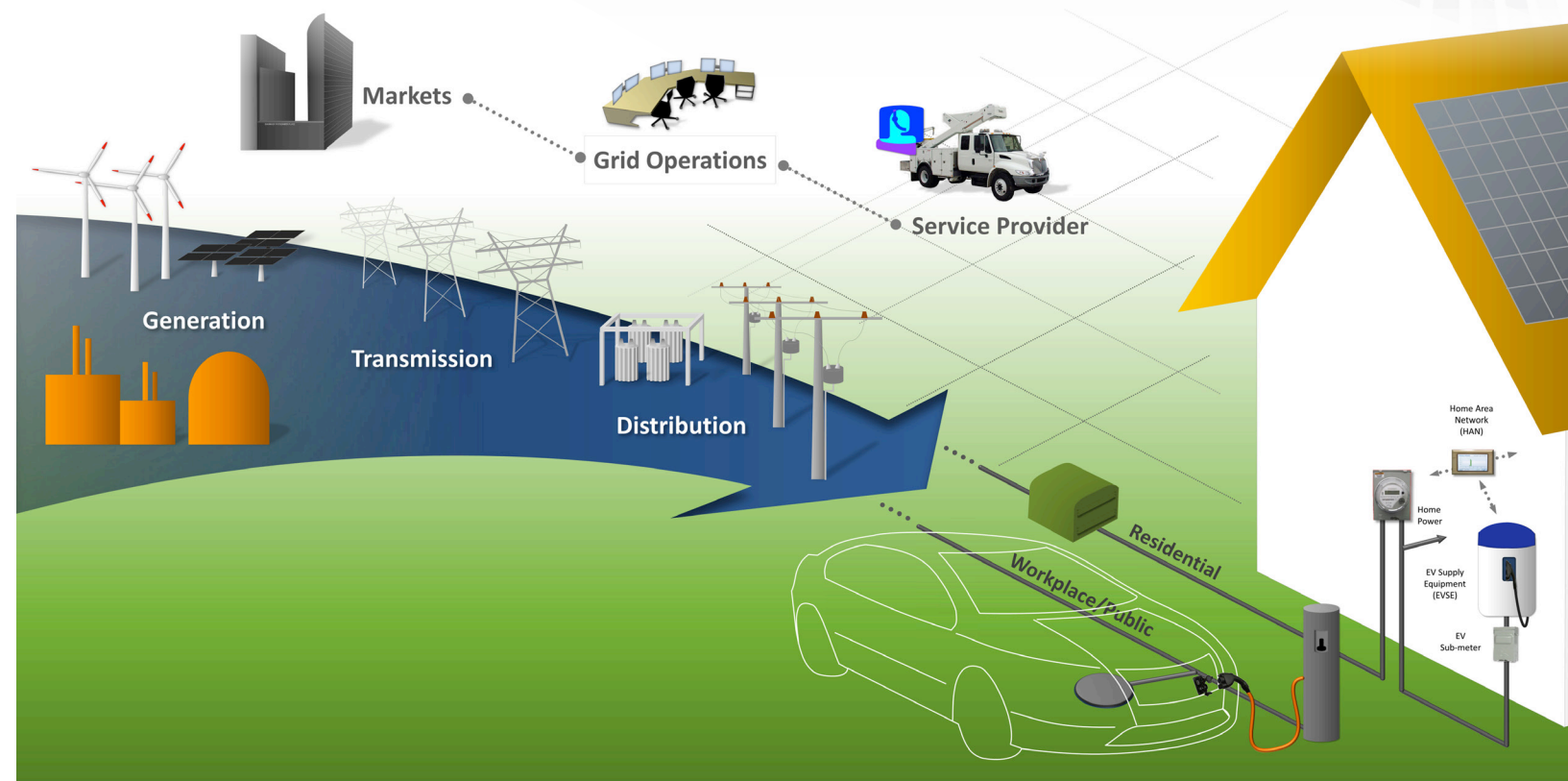


## Aggressive goals for EVs in the U.S. and Europe require investment and multinational cooperation



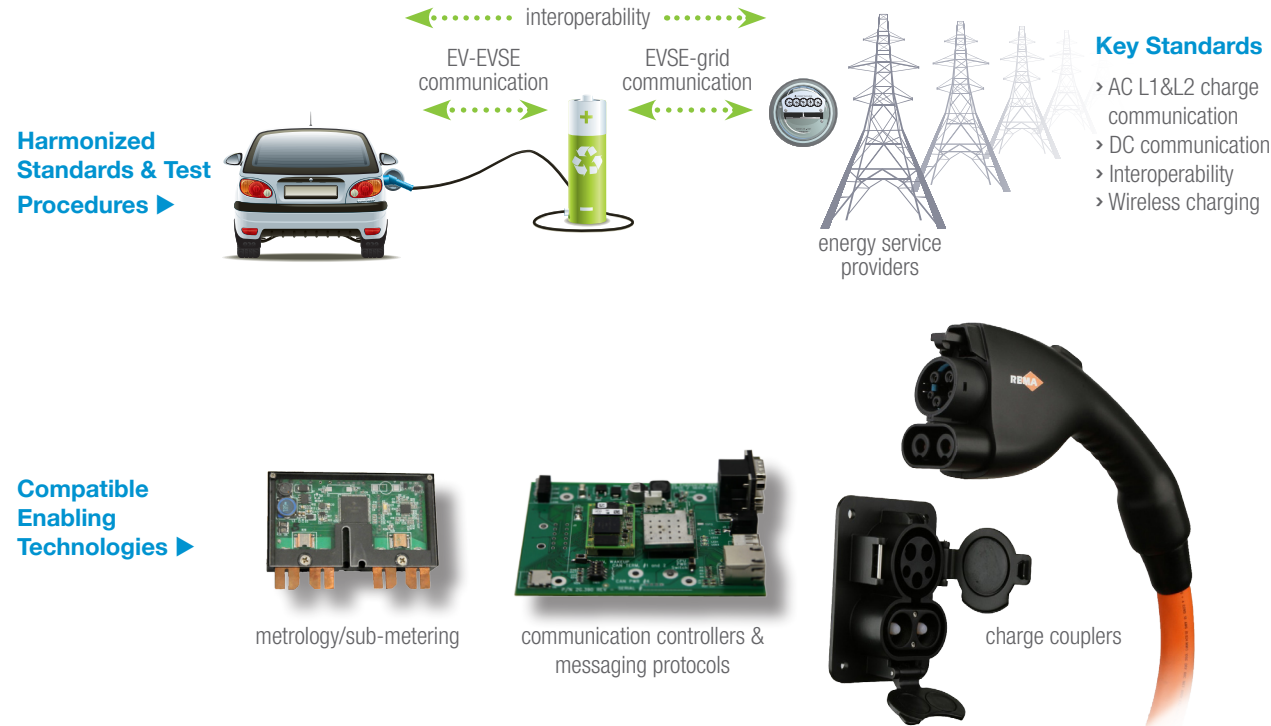
## EV charging infrastructure

Interoperability supports the ideal of universal charging...any plug-in electric vehicle... any electric vehicle supply equipment...anywhere...anytime.



# Global interoperability requires ...

Interoperability will provide standardized devices that are capable of functioning as intended with each other — without special effort by the user.



# Joint Research Centre – the European Commission’s in-house science service



**Vehicles**  
EV test at -7 °C in the VELA labs

**Components**  
X-ray CT of battery

**Smart Grids**  
Pre-normative research



**The JRC’s Institute for Energy and Transport (IET)** provides scientific and technical support to policymakers of the European Union on energy and transport issues. Special emphasis is given to the security of the energy supply; to sustainable, safe and clean energy production; and to Electromobility.

**EV-EVSE Compatibility:** Evaluating connectivity and functionality of vehicles and charging equipment to ensure safety and code compliance.

**Smart Grid Simulation:** Offline power system simulation; real-time simulation and component testing; interoperability and communications; mobile lab and field testing; visualization and interaction.

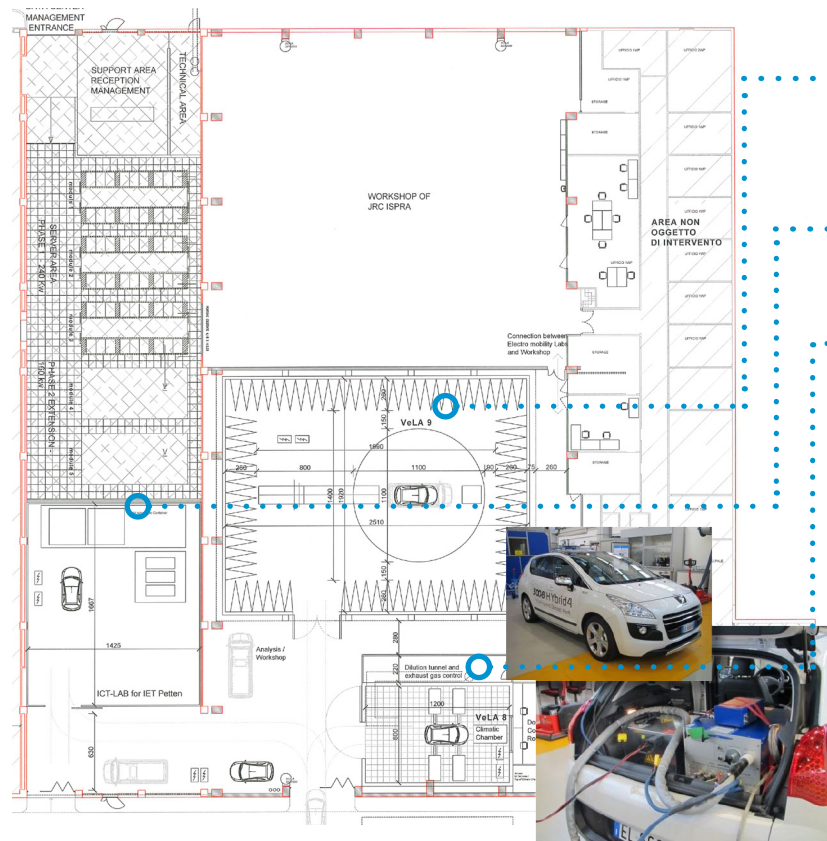
**Vehicle and Engine Emission Laboratories:** Testing all types of vehicles and engines under legislative as well as realistic operating conditions, including on-the-road, low-temperature, and in the near future, EMC tests.

**EV Component and Battery Testing:** Performance and safety validation of EV energy storage devices under typical and abusive operating conditions.

**The JRC facilities are based in Ispra, Italy and Petten, Netherlands.**



# JRC-IET activities and accomplishments supporting grid interoperability



**Build-Up of New EV/HEV Laboratories:**

- ▶ **Anechoic Chamber (VeLA-9)** – Emission/immunity tests in lieu of non-metallic car bodies, new frequency bands to manage, and high-power and inverter frequencies in EV drivetrains.
- ▶ **Smart Grid Simulation** – Laboratory with space for mounting information and communication technology in cars; full-fledged smart grid simulator container.
- ▶ **Cold/Warm Cell (VeLA-8)** – Full exhaust gas analysis for energy efficiency and HVAC issues in EVs.

**Joint Publications in Process**

Interoperability centre development and hybrid vehicle testing at the Advanced Powertrain Research Facility.

**Technical Staff Exchange:** EV-EVSE-grid communication; AC and DC charge communication implementation at Argonne.

**Industry Outreach:** Meetings with Transatlantic Business Council and automotive, supply, electric utility and battery industries.

# Interoperability Center capabilities at Argonne National Laboratory

The **U.S. Department of Energy's EV-Smart Grid Interoperability Center** leverages established vehicle, battery and powertrain component test facilities and the embedded controls lab at Argonne National Laboratory.

**Charging Systems:** Studying and validating AC, DC and wireless electric vehicle supply equipment (EVSE) to ensure any EV can plug into any EVSE safely and reliably.

**Communications Technology:** Developing and verifying software, embedded systems and messaging protocols to support standard connectivity and communication between the EV, EVSE and energy service (grid) interface.

**Networks:** Examining infrastructure-related systems to help develop a robust and reliable vehicle-to-grid network.

**Vehicle and Component Testing:** Two- and four-wheel drive dynamometers; thermal and multi-fuel capability; PEV and HEV test procedure development; and component hardware-in-the-loop testing at the Advanced Powertrain Research Facility.

**Advanced Powertrain ▶ Research Facility**

*EV, HV and PHEV testing, 4WD dynamometer, multi-fuel capability and thermal testing*



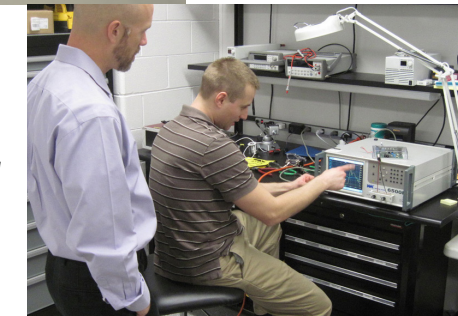
**◀ Vehicle Lab**

*200kW/480 VAC power and vehicle-sized Electromagnetic Isolation Chamber*



**Embedded Controls Lab ▶**

*Bench-level interoperability and communications technologies*



## Argonne activities and accomplishments supporting grid interoperability



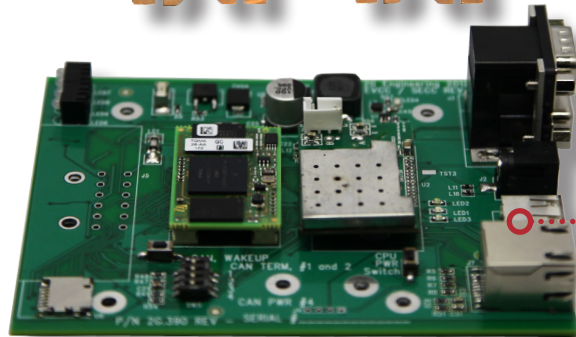
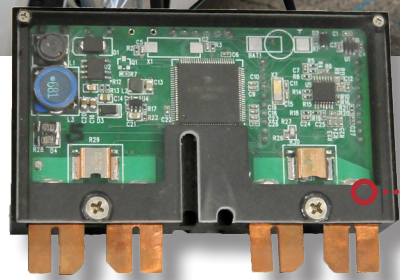
▶ **Codes and Standards:** Helping to develop and refine EV standards to enable smart, convenient and safe interaction with the electric grid; e.g., ISO/IEC 15118, SAE J1772 (conductive charge coupler), SAE J2954 (wireless charging) and SAE J2953 (interoperability).

▶ **Compact Metrology System:** Development of proof-of-concept device to measure and communicate charge energy.

▶ **Smart Energy Profile:** Developing a gateway to bridge the existing messaging infrastructure used by utilities (SEP 1.1) to SEP 2.0, including the adaption of off-the-shelf hardware for use in field trials to encourage commercial development.

▶ **Wireless Charging:** Developing the test requirements, protocols and a standard test fixture for wireless charging systems.

▶ **Electric Vehicle Communication Controller (EVCC) and Supply Equipment Communication Controller (SECC):** Creating test methods to evaluate power line communication (PLC) technologies that enable messaging between EVs and EVSE as well as EVSE to the grid.



## Future directions for EV-Smart Grid Interoperability Centers

### ▶ Collaborative EV-grid projects

Apply communication and metrology technology to evaluate proposed communication standards in the U.S. and Europe with production plug-in vehicles and electric vehicle supply equipment.

### ▶ Continue discussions on interoperability center in China

Assess feasibility of establishing a cooperative center in China as a means to promote harmonization of standards in the EU, US and China.

### ▶ Shift toward grid integration

Facilitate low-cost power/energy measurement and communication by harmonizing grid connectivity standards and technology







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