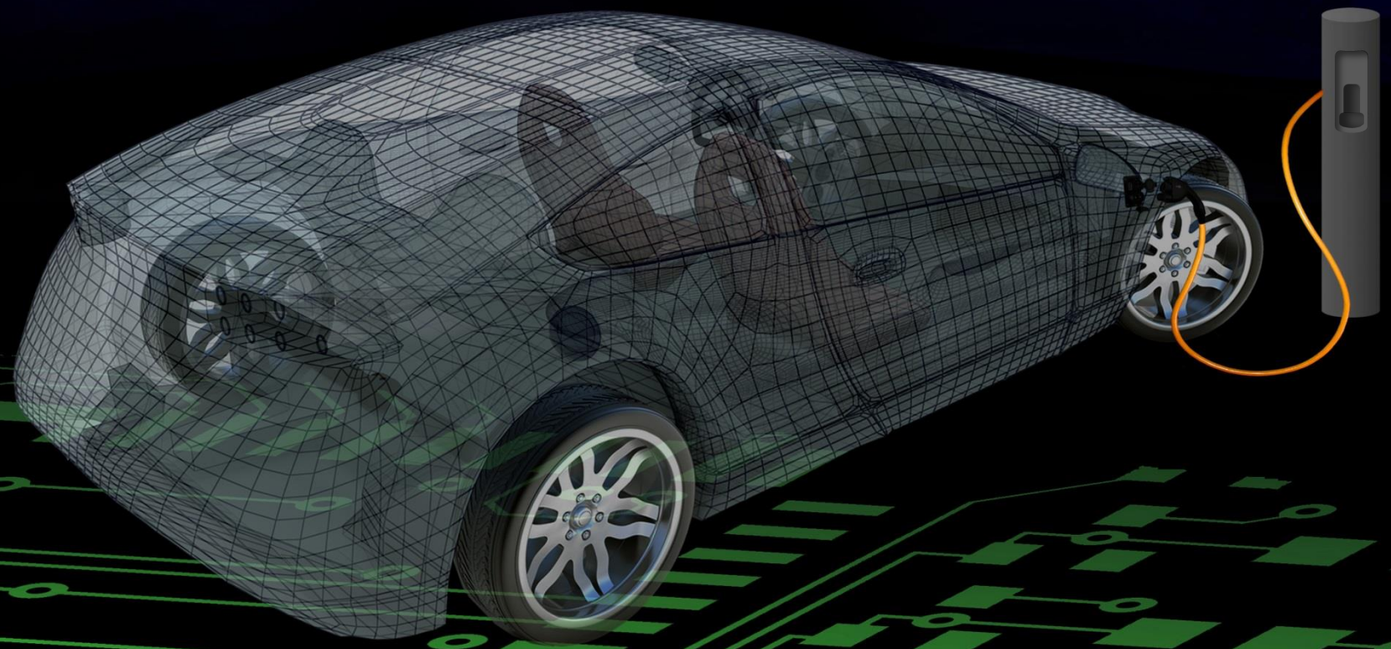
EV-Smart Grid Interoperability Centers

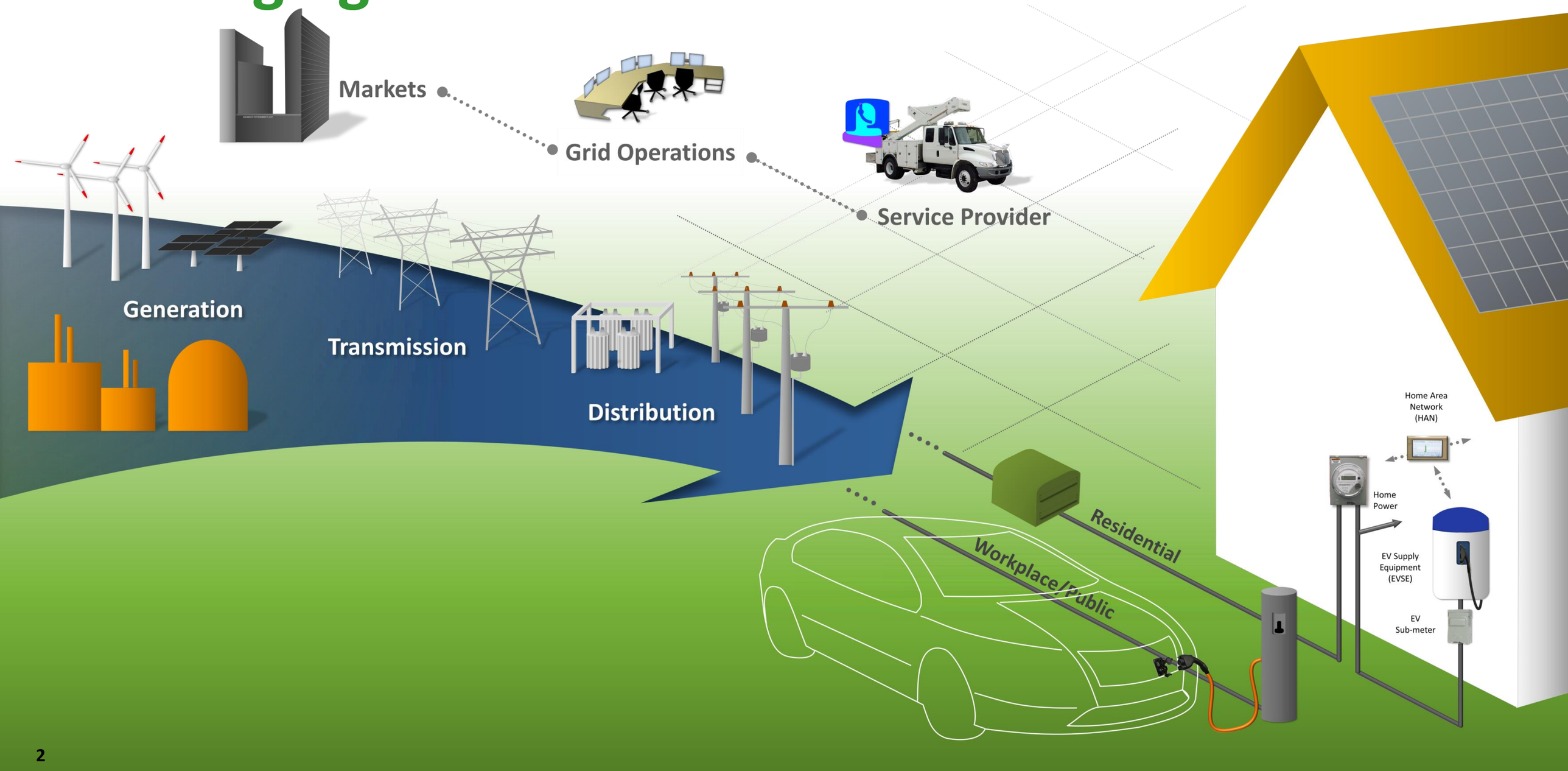
… to facilitate harmonization of standards, technology and test procedures



U.S. DEPARTMENT OF ENERGY

European Commission

EV Charging infrastructure



Transatlantic Agreement supports harmonization

- **E-mobility is recognized as a common growth area;** beneficial to job creation and transportation energy reduction objectives
- Automotive and electric utility industries **share manufacturers and suppliers**
- Harmonized standards and technology **minimize trade barriers** and facilitate adoption of new products

Interoperability Centers provide venues for collaborative development to facilitate universal connectivity between EVs and the charging infrastructure

- 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

Interoperability

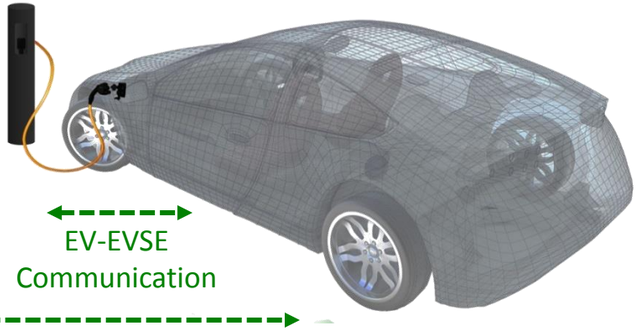
Capability of devices that conform to standards to function as intended with each other without special effort by the user

Global Interoperability requires …

Harmonized Standards & Test Procedures

Energy Service Providers

EVSE-Grid Communication



EV-EVSE Communication

Key Standards

- **AC L1&L2 charge communication**
- **DC communication**
- **Interoperability**
- **Wireless charging**

Interoperability

Compatible Enabling Technologies

Metrology/sub-metering

Communication controllers & messaging protocols

Charge couplers

Interoperability Center Capabilities
Argonne National Laboratory

Argonne has developed extensive expertise and state-of-the-art facilities to support analysis, development, and testing of EV and smart grid technologies.

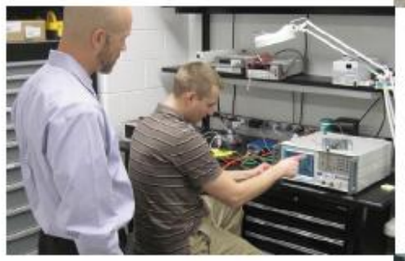
Charging Systems: Studying and validating EVSE technologies (AC, DC, and wireless) to allow any EV to plug into any EVSE safely and reliably.

Communications Technologies: Developing and verifying software, embedded systems, and messaging protocols that connect EVs and EVSEs with the utility/grid operator to provide information to support billing and load management.

Networks: Examining infrastructure-related systems to help develop a robust and reliable vehicle-to-grid network – from emerging smart grid technologies to micro-grids.

Advanced Powertrain Research Facility (APRF): 2-wheel and 4-wheel drive vehicle dynamometer test lab with thermal and multi-fuel capability; EV and HEV test procedure development; component hardware-in-the-loop testing.

Vehicle Systems Lab Space ▶
Vehicle-sized RF chamber, 200 kW/480 VAC power



◀ Embedded Controls Lab
Bench-level interoperability and communications technologies

Charging Systems Lab ▶
AV ABC-170 battery cycler, Magnacharge power supply, and thermal chambers

◀ EV Charging Pilot Project
Campus-wide deployment of EVSE and communications technologies for workplace charging studies

Joint Research Center
Institute for Energy & Transport

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

Components ▶
X-ray CT of battery

Smart Grids ▼
Pre-normative research

As the 'research arm' of the European Commission, the JRC supports electro-mobility through pre-normative R&D of harmonized testing methodologies and global standards. The JRC's work on hybrids, EVs, their components, and on smart grids gives special emphasis to:

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

EV component and battery testing: Performance and safety validation of EV energy storage devices under typical and abusive operating conditions.

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 Emissions Laboratories (VELA): 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.

Activities/Accomplishments
supporting grid interoperability

Codes & Standards: Helping 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. Prototype is a fraction of the size and cost of existing systems.

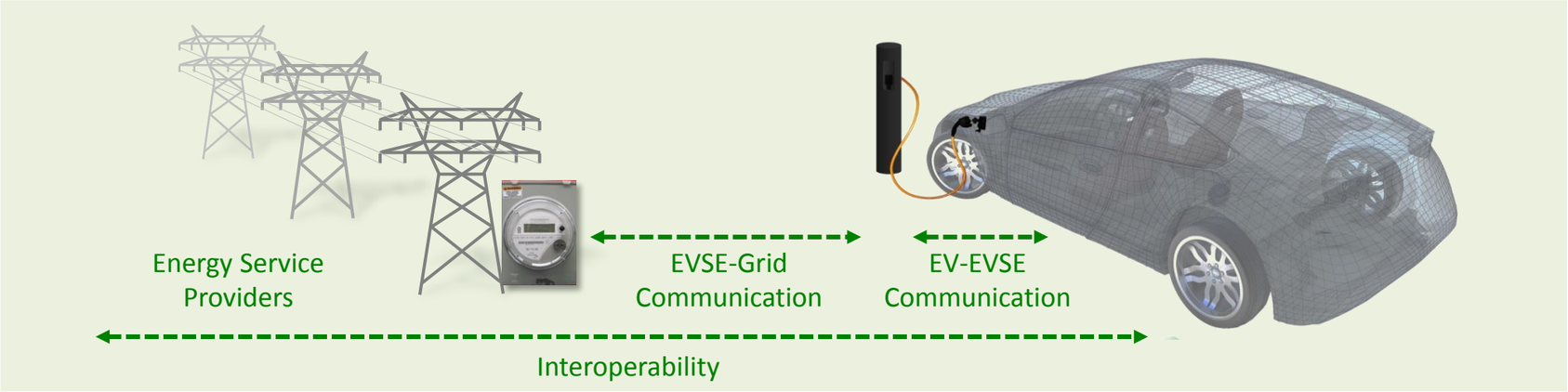
Smart Energy Profile: Developing a gateway to bridge the existing messaging infrastructure used by utilities (SEP 1.1) to SEP 2.0. This includes adapting off-the-shelf hardware for use in field trials to encourage commercial development.

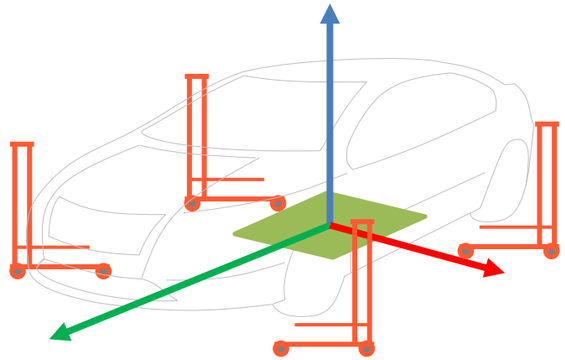
Wireless Charging: Developing the test requirements and protocols for the certification of wireless charging systems.

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.

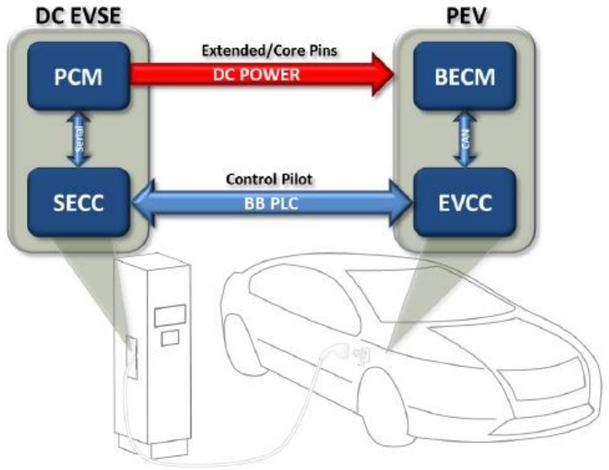
Current Projects

focus on connectivity & communication standards

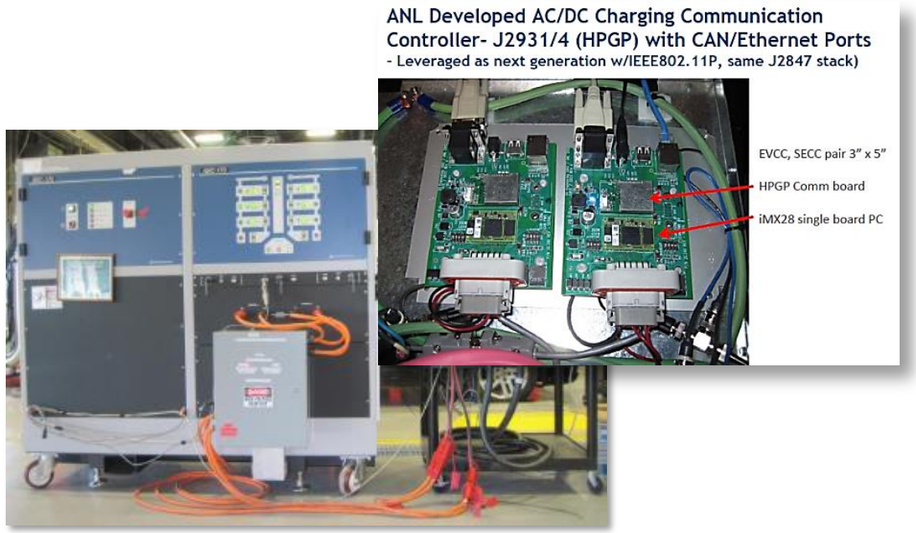


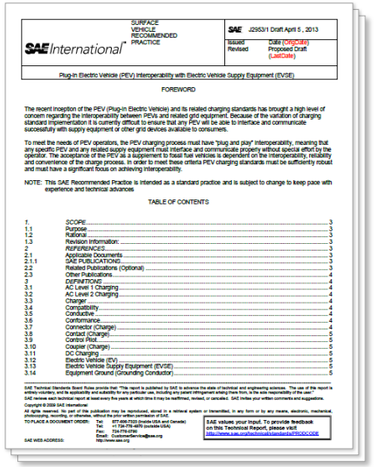


SAE J2954
Wireless charging test fixture



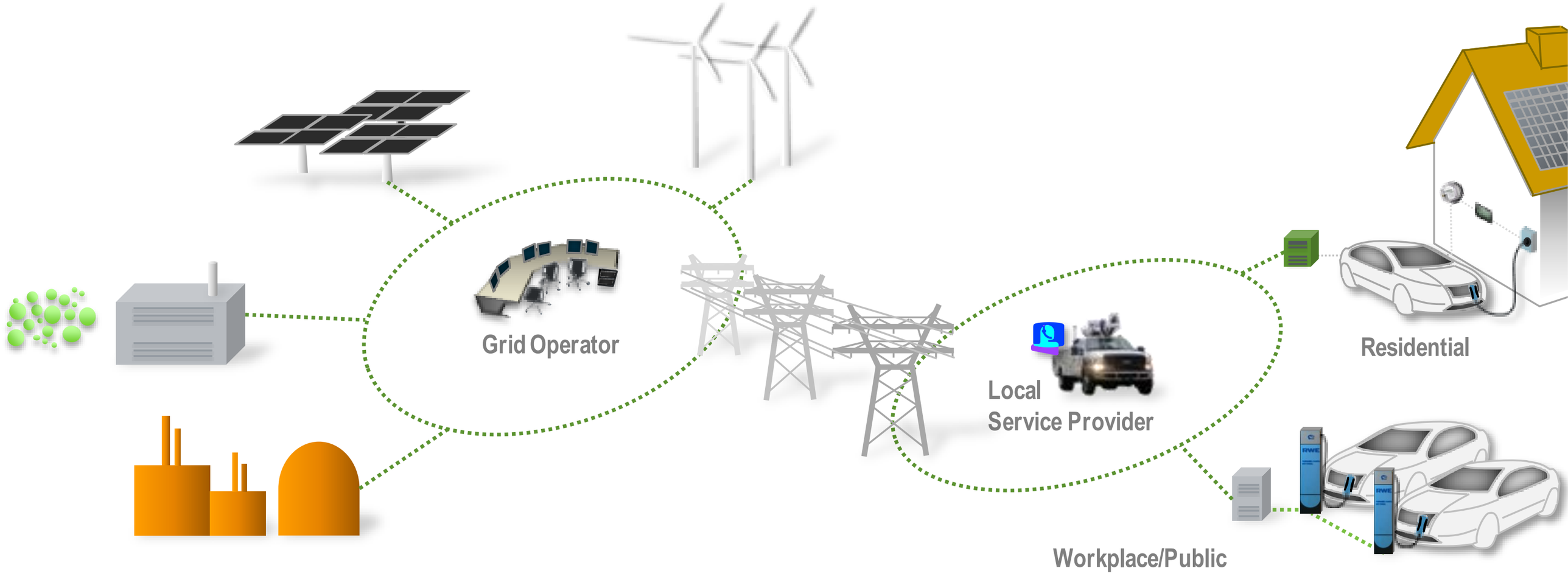
DC charging communication





Draft SAE J2953 Interoperability Standard & EV-EVSE Compatibility Test Equipment

Future Direction

…collaborative EV-grid projects (US and EU)

… shift toward grid integration