Vehicle-Grid Integration

Programmatic Direction, Issues and Enabling Technologies

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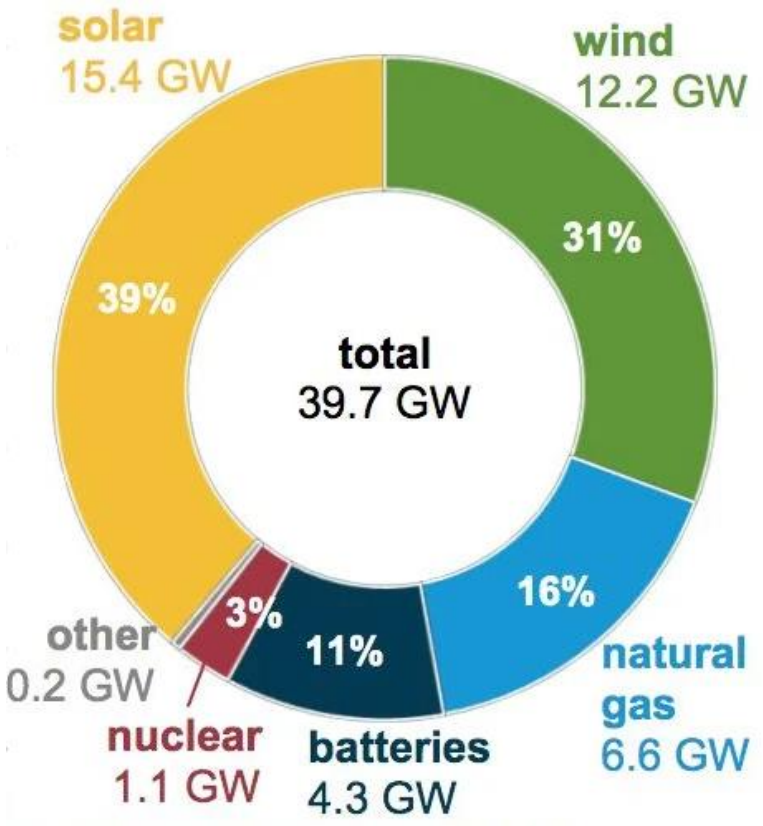
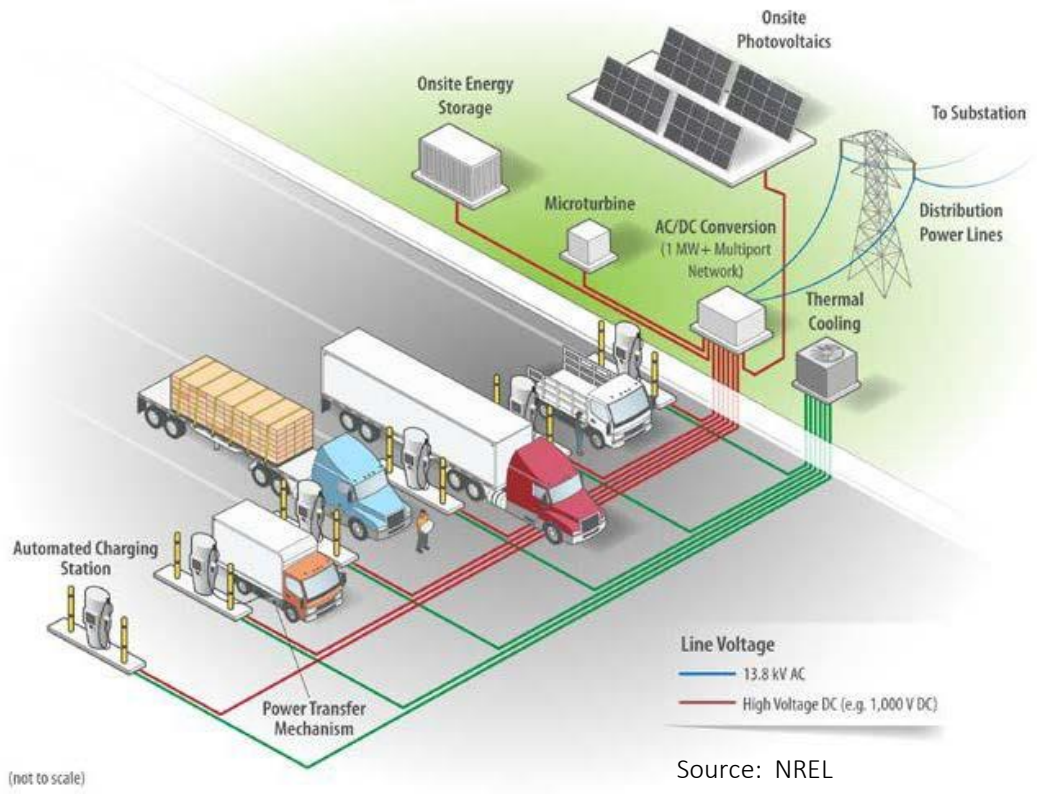


U.S. electricity generating capacity is moving in the right direction

Consistent with the administration's decarbonization strategy and supports the transition to zero emission vehicles

Planned utility-scale electricity generating capacity additions (2021)
Source: U.S. Energy Information Administration, October 2020



Source: NREL

Current administration supports development and deployment programs for EV technologies and charging infrastructure

Responsibility of the Departments of Energy and Transportation

- Cabinet-level Electric Vehicle Working Group
- Clean Electricity Performance Program
- Electric Vehicle Charging Infrastructure
- Clean Energy Innovation and Communities
- Clean Heavy-Duty Vehicles
- Etc.

Source: INL

Source: NREL

DOE Vehicle Technologies Office will launch EVs @ Scale lab consortium

R&D to support standards and technology development

- Vehicle Grid Integration/Smart Charge Management
- High-Power Chargers and Charging Facilities
- Dynamic Wireless Power Transfer
- Cybersecurity
- Codes & Standards

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Vehicle Grid Integration/ Smart Charge Management

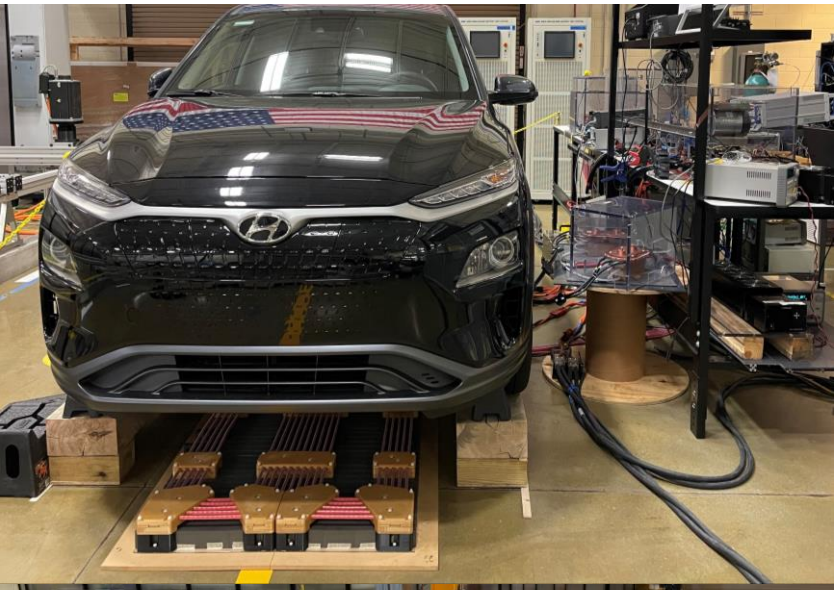
Meet the needs of millions of EV drivers while minimizing negative impacts on the grid

- Integrate with DERs and other grid-connected devices
- Implement smart charge management strategies
- Support development of enabling technologies for smart charging ecosystems

Source: Daimler

High Power Chargers and Charging Facilities

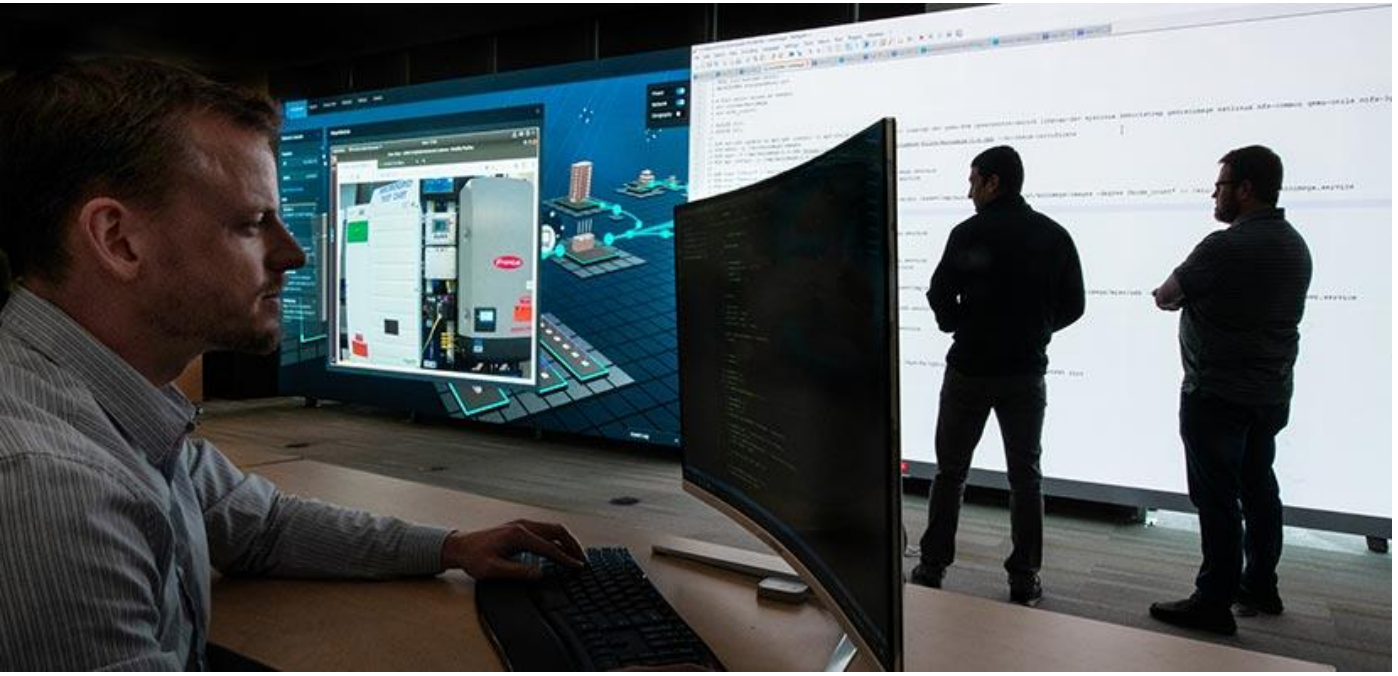
- 1+ Megawatt charging connectors, chargers, and site equipment
- Validation of megawatt-scale charging facilities with medium voltage interconnection
- Interoperable hardware, communication, and control architectures



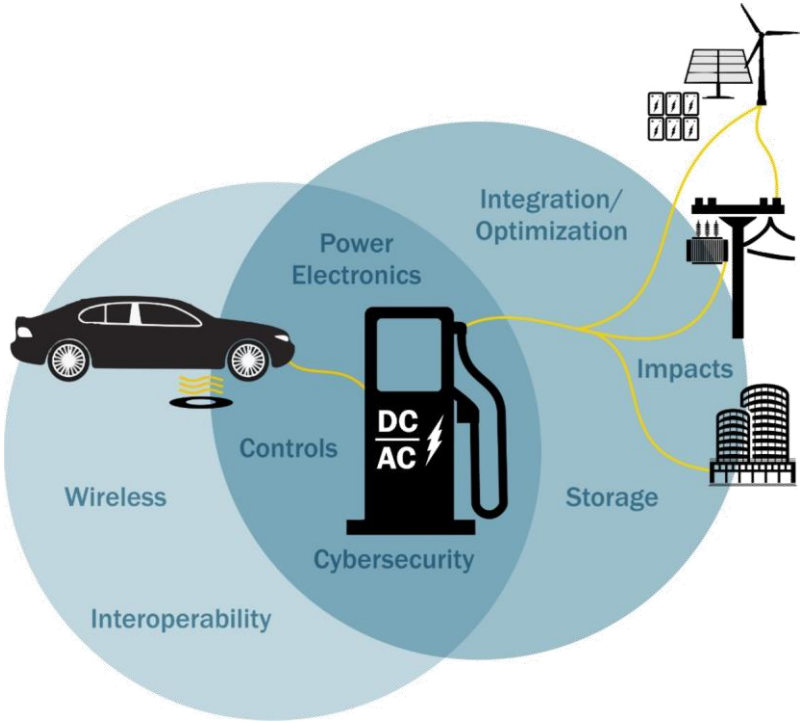
Dynamic Wireless Power Transfer

- Demonstrated 92% efficient bi-directional 20 kW stationary power transfer with 28 cm air gap (UPS vehicle); 97% efficient 120 kW system with 15 cm air gap
- 200 kW stationary system to be demonstrated this year
- Dynamic WPT development up to 300 kW

Source: ORNL

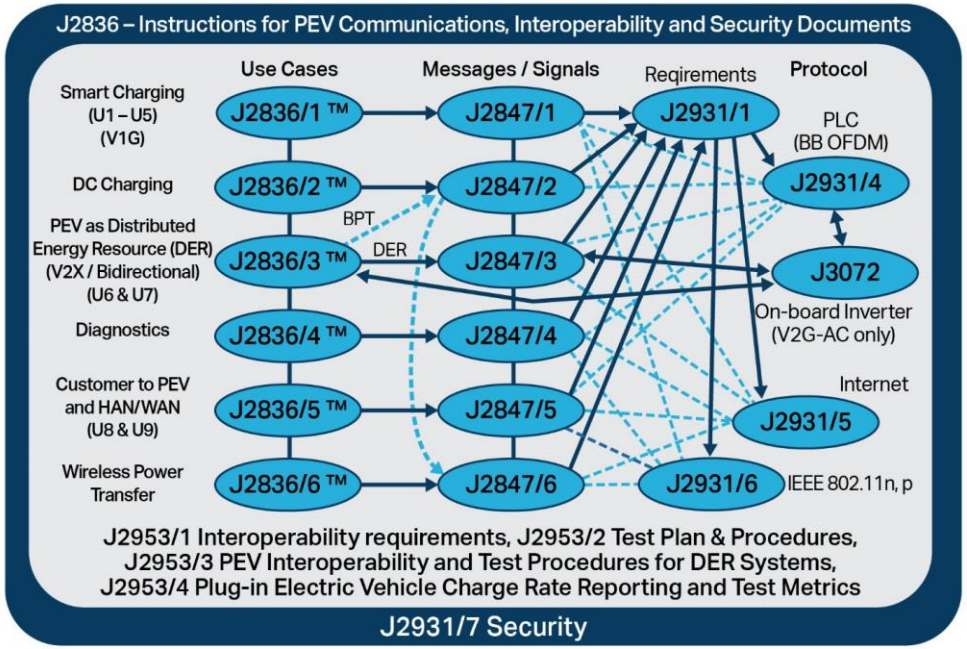


Source: NREL

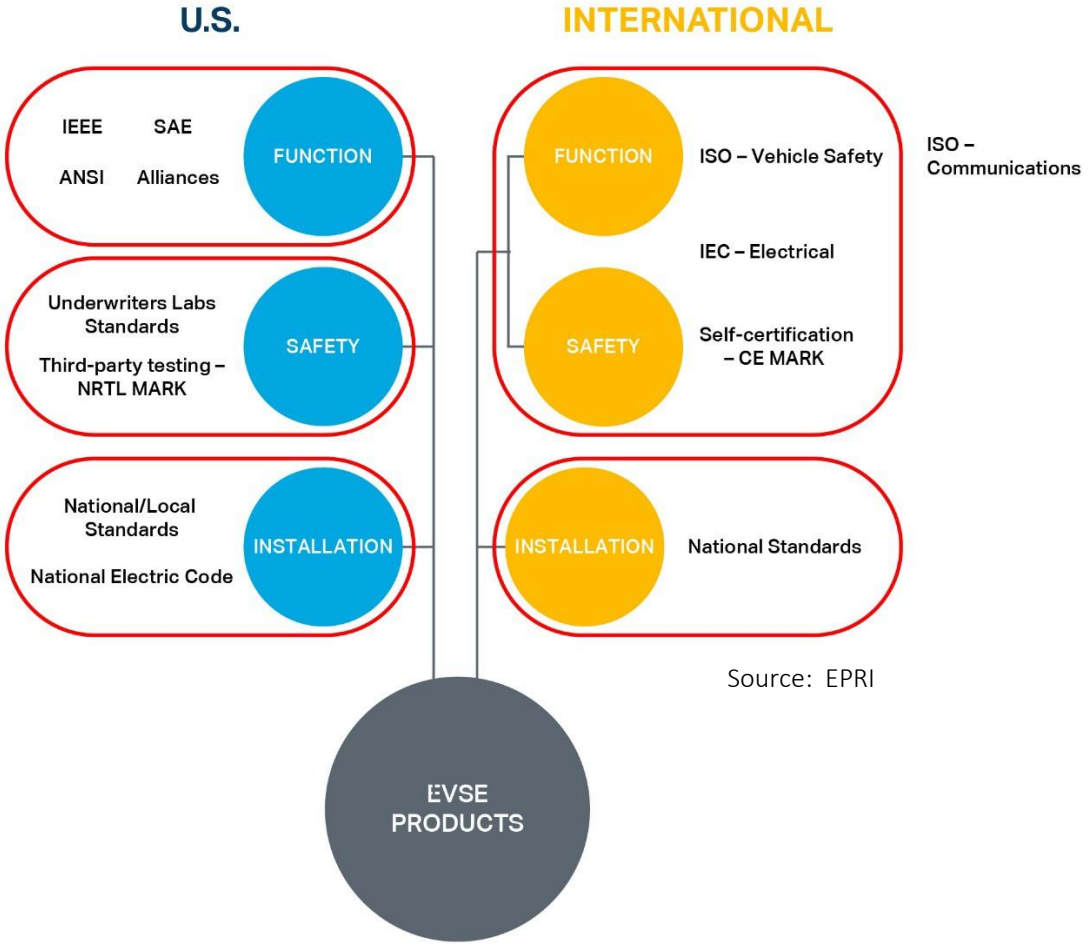


Cybersecurity

- R&D to support cyber-physical security at the grid edge
- Vulnerability and risk assessments of charging equipment and charging network communications



Source: SAE

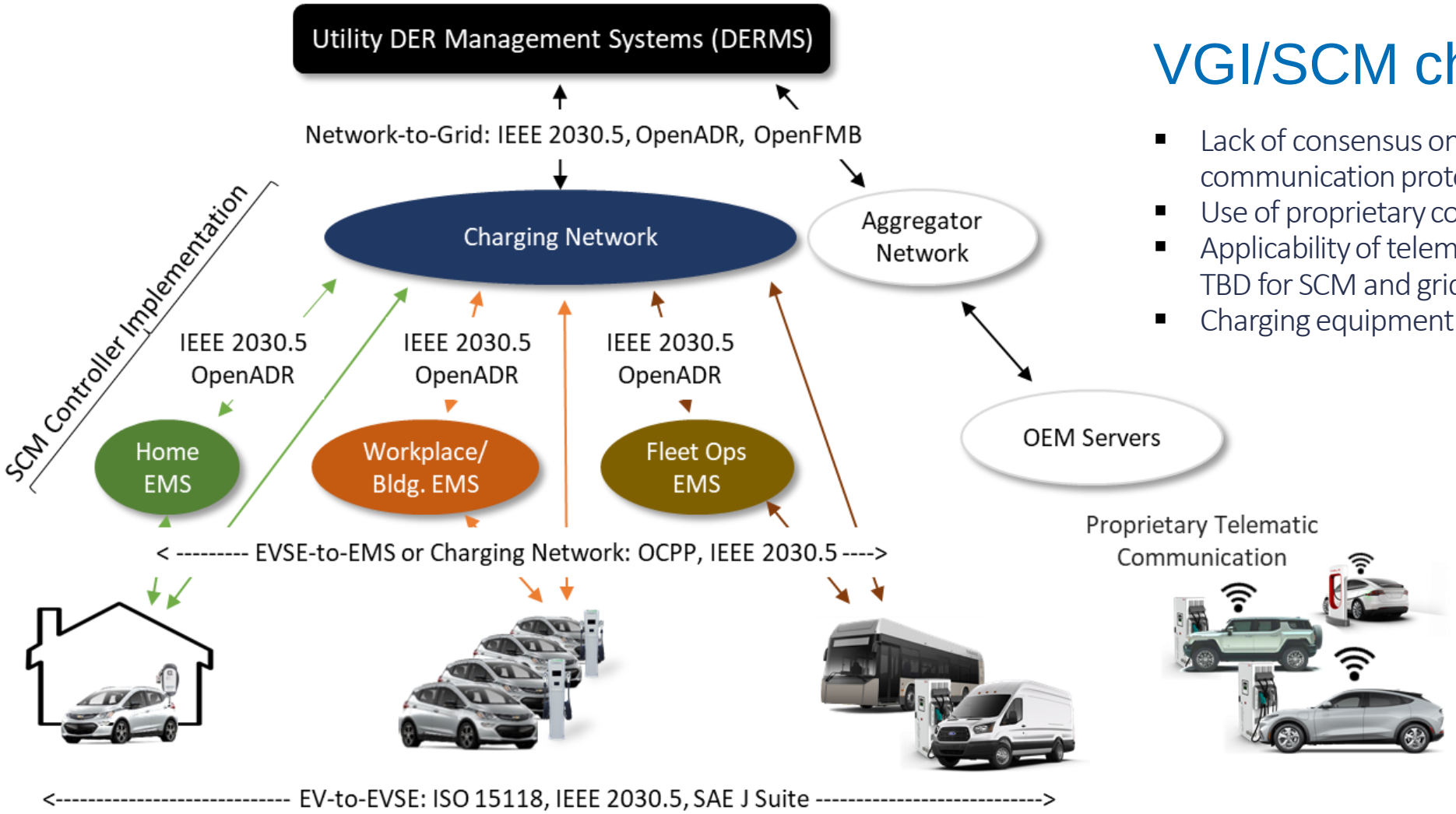


Source: EPRI

Codes & Standards

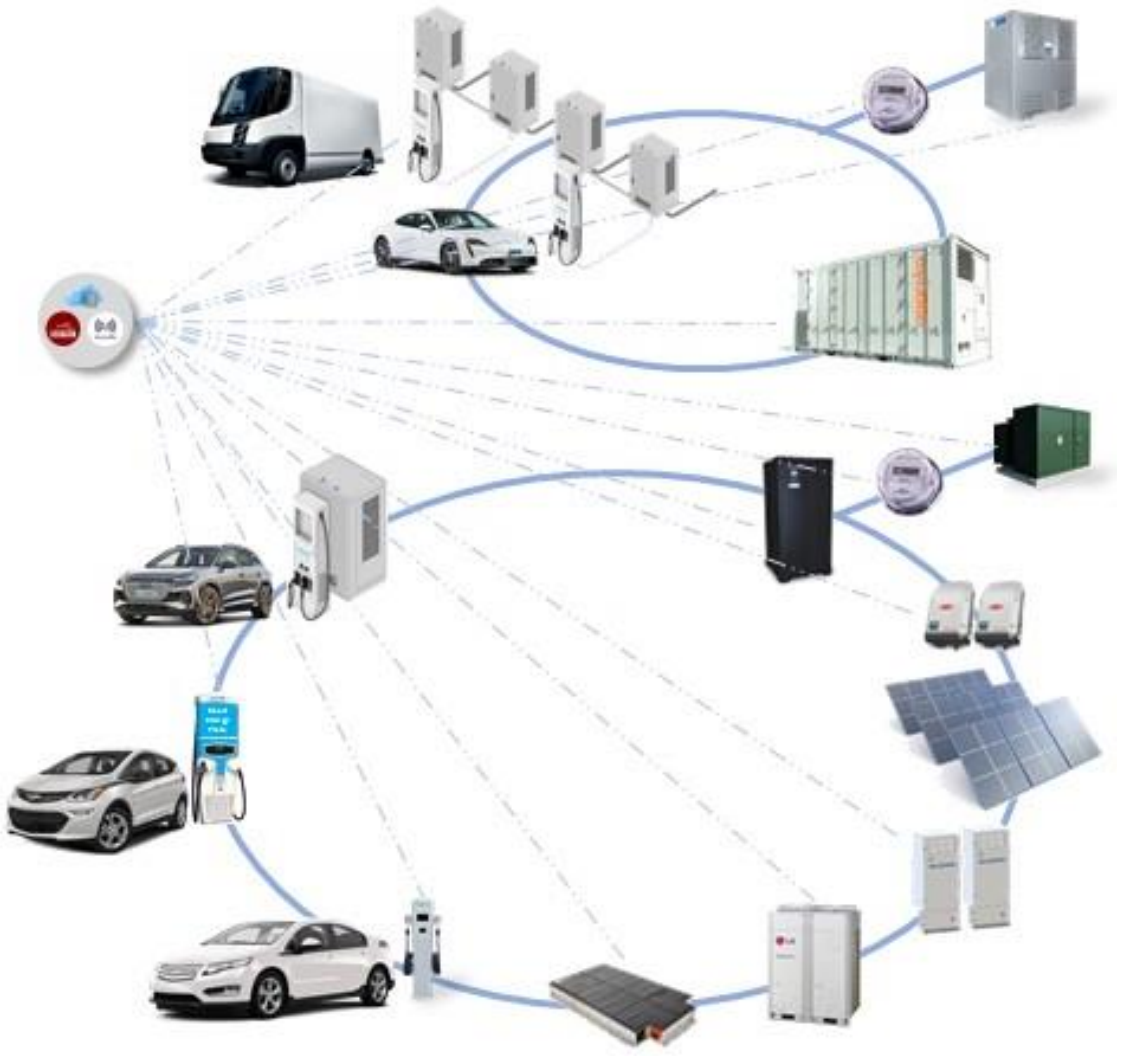
Priorities …

- High-power DC charging
- DC charging with integrated storage
- Vehicle-grid integration
- High-power scalable/interoperable wireless charging
- Vehicle-oriented system standards (including non-road, electric aircraft)



VGI/SCM challenges

- Lack of consensus on 'smart' standard communication protocols
- Use of proprietary communication protocols
- Applicability of telematic communication pathway TBD for SCM and grid services at a local level
- Charging equipment is not network agnostic



Direct XFC Project

- Integrated communication and control of high-power charging and energy storage to minimize grid impacts

Smart Vehicle-Grid Integration Project

- Integrated communication and control of EVSE, building systems, solar PV and energy storage using non-proprietary protocols and interfaces
- Use cases/ grid services with controlled and smart charging
- Dynamic response to external grid conditions
- Enabling technologies for VGI/SCM

Source: Freightliner

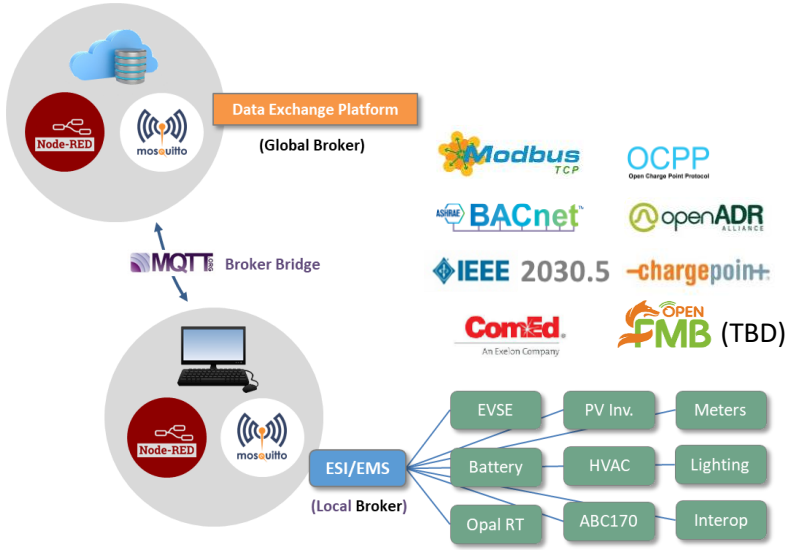
Next Gen Profiles Project

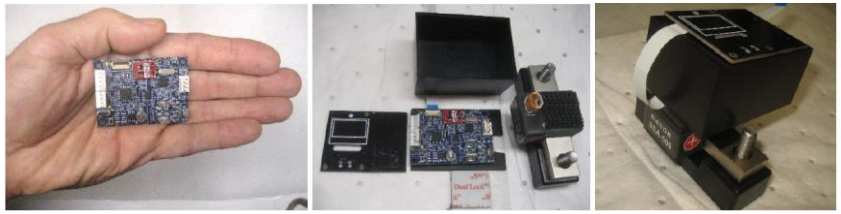
- Capture charging profiles for vehicles and charging equipment with > 200 kW to 1+ MW
- Characterize efficiency and power quality of EVSE
- Collaborate with JRC on test procedures

Source: Proterra

Enabling technologies

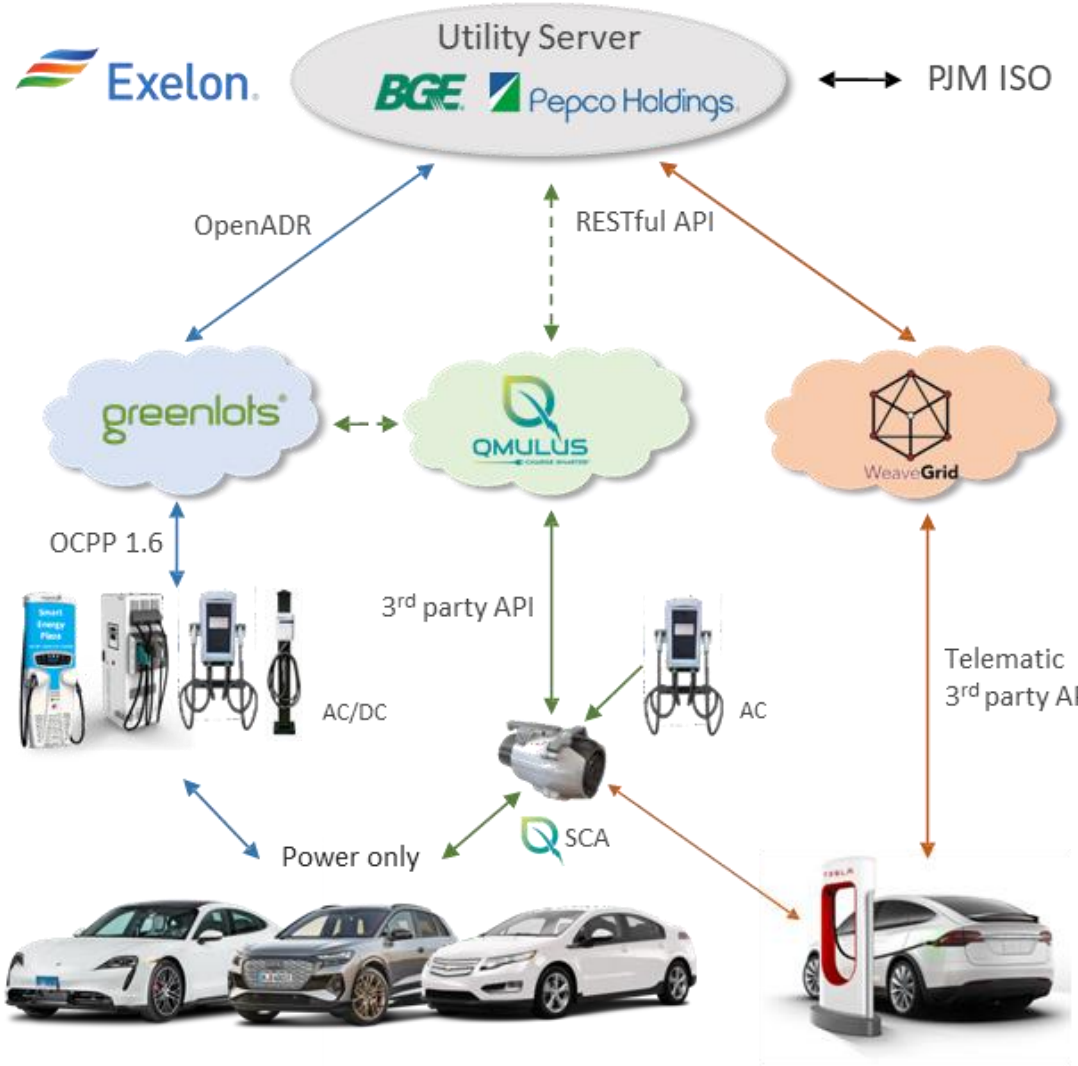
- Energy management systems
- Communication controllers for EV and EVSE
- Sub-metering

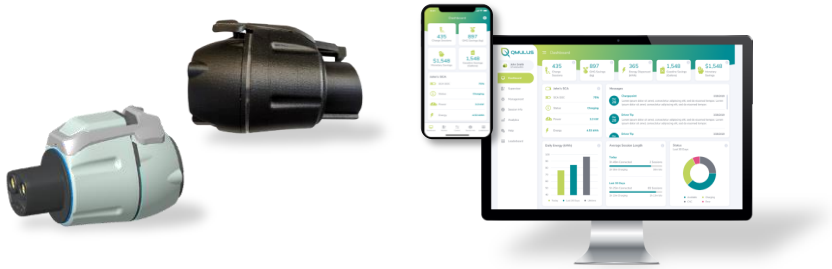




Enabling technologies

- Smart charge/diagnostic adaptor
- Smart charging ecosystem
  - ISO 15118/OCPP 2.0 EVSE
  - ISO 15118 EVSE dashboard
  - PEV charge scheduler algorithm
  - OCPP 2.0 PEV charge scheduler application and dashboard





Demonstration of Utility Managed Smart Charging

Identify managed charging techniques that can be shared industry-wide and reduce the impact of EV charging on grid assets

- Validate capability of charging equipment to support use cases and customer programs
- Identify cybersecurity risks and vulnerabilities of EVSE and vehicle telematics software
- Evaluate customer incentive programs and ability to provide grid services

International Collaboration

Science and Technology Agreement with EC-Joint Research Centre

USG cooperative initiatives with APEC and ASEAN

Visiting researchers


Roads to the Future 2021
Thank you!
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