

# Testing and certification services for smart and bidirectional electric vehicle (EV) charging technologies



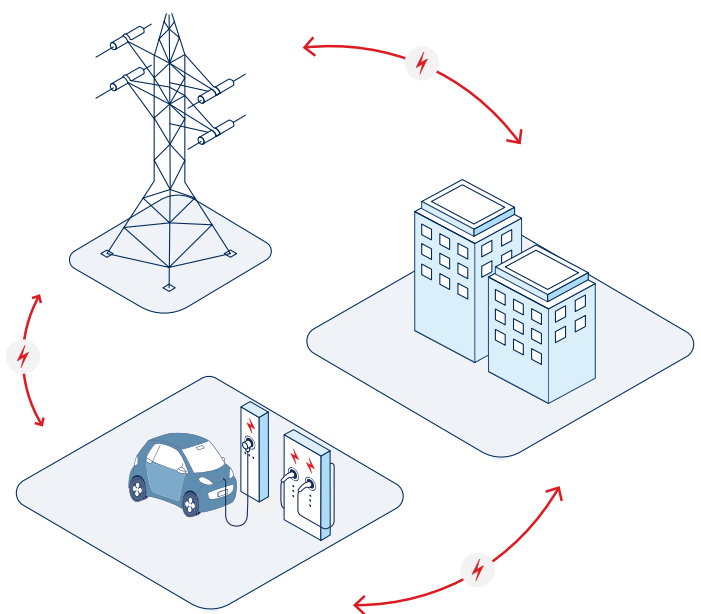
Unidirectional smart charging, also known as unidirectional vehicle-to-grid (V1G) and bidirectional vehicle-to-everything (V2X) technologies are changing electric vehicle (EV) charging systems with profitable new use cases beyond traditional charging. These technological changes require adapting regulatory frameworks and can vary by region. The European market is implementing new grid codes for V1G and V2G applications, while in North America, UL Standards are evolving for bidirectional charging systems.

UL Solutions has extensive expertise, accreditations and facilities to support smart and bidirectional charging technologies with testing and certification services.

## Understanding V1G and V2X charging technologies

**V1G**, is an intelligent EV charging system. This system manages and optimizes the charging process - time speed and power flow — based on various factors such as grid demand, electricity prices and the user's needs. As the name "unidirectional" implies, V1G only allows power to flow from the grid to the vehicle.

**V2X (vehicle-to-everything)** refers to an interaction model where the EV interacts with any entity that may affect or be affected by the vehicle's charging process.



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V2X technology for EV charging involves a combination of hardware and software that enables secure and efficient communication between the vehicle and various entities. It is an important part of the smart grid and smart city initiatives, aiming to improve energy efficiency, reduce costs, and enhance the overall sustainability of transportation and energy systems.

In the context of EV charging, V2X encompasses several specific interaction scenarios:

- V2G (vehicle-to-grid) – EVs interact with the power grid to sell excess energy back to the grid or to manage charging times based on grid load. This interaction helps stabilize the grid, especially during peak demand times.
- V2H (vehicle-to-home) or V2B (vehicle-to-building) – EVs can supply energy to a home or building. This capability allows EVs to act as a backup power source during outages or peak energy periods when electricity from the grid is more expensive (energy arbitrage).
- V2L (vehicle-to-load) – EVs provide power to external devices such as appliances in case of a power outage or in applications without access to the power grid.
- V2V (vehicle-to-vehicle) – In some cases, EVs could share power between vehicles. V2V is rarely used due to losses during power transfer.

## Why choose UL Solutions for bidirectional EV charging testing and certification services?

### Comprehensive expertise

UL Solutions draws on decades of experience in testing and certification services for EV onboard chargers, EV supply equipment (EVSE) and charging facilities.

### Global compliance support

We provide extensive testing and certification services that comply with global V1G and V2X standards, simplifying access for original equipment manufacturers (OEMs) to international markets.

### Safety and performance testing

Our services include unit safety and performance testing based on UL and IEC standards, helping you meet essential safety and operational benchmarks.

### Interoperability evaluation

We conduct interoperability evaluations in accordance with ISO and local property standards, which enhances device compatibility across different systems.

### Expert grid code compliance services

Engage with us for system modeling and grid studies to help ensure compliance with local grid code standards, assisting OEMs in fulfilling specific regulatory requirements.

### Comprehensive service provider

As a provider of testing, inspection and certification, we streamline the compliance process, helping to reduce the time and effort needed from OEMs.

### Convenient testing locations

We can test your bidirectional charging systems up to 500 kW at our facilities — including our laboratory in Madrid — or on site at your location.

### Wide accreditation network

Our certification schemes are recognized by [DAkKS](#), [ENAC No. 1](#) [No. 2](#), [A2LA](#), and [OSHA](#), providing credibility for compliance with over 60 grid codes worldwide.