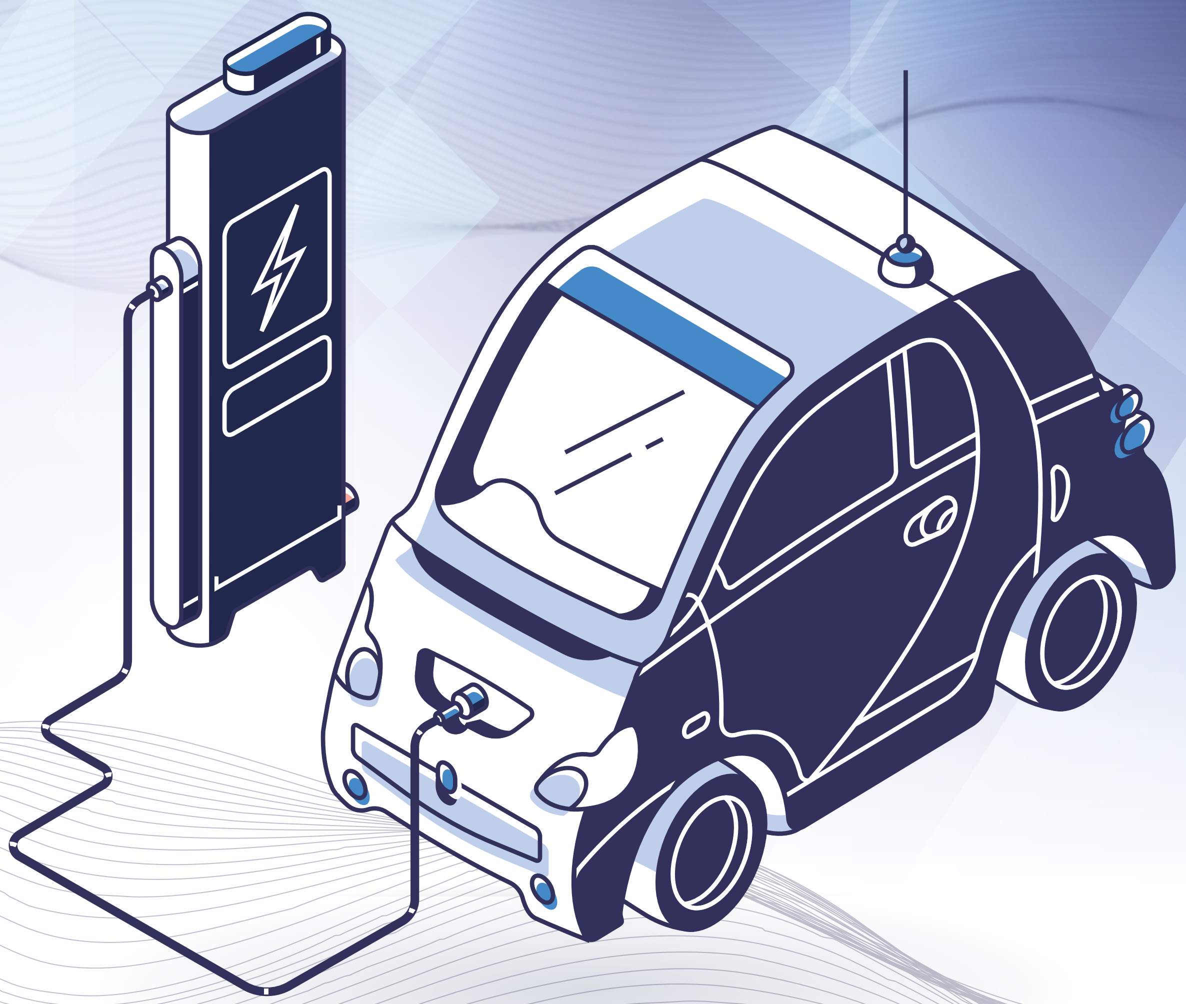
SUMMARY FACTSHEET



ELECTRIC-VEHICLE SMART CHARGING

EMERGING TECHNOLOGIES FOR THE RENEWABLE ENERGY SECTOR

UNITED NATIONS
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Shared Prosperity **Dignified Life**

CONTENT

SUMMERY

1. What is Smart Charging?

Smart charging refers to the process of tailoring the charging cycle of electric vehicles to both the conditions of the power system and the needs of car users. This simplifies the integration of EVs while addressing mobility requirements. (IRENA,2019).

Smart charging gives a certain control over the charging process. It offers many pricing and technical charging alternatives. The most basic type of incentive is time-of-use pricing which encourages users to shift their charging from peak to off-peak hours.

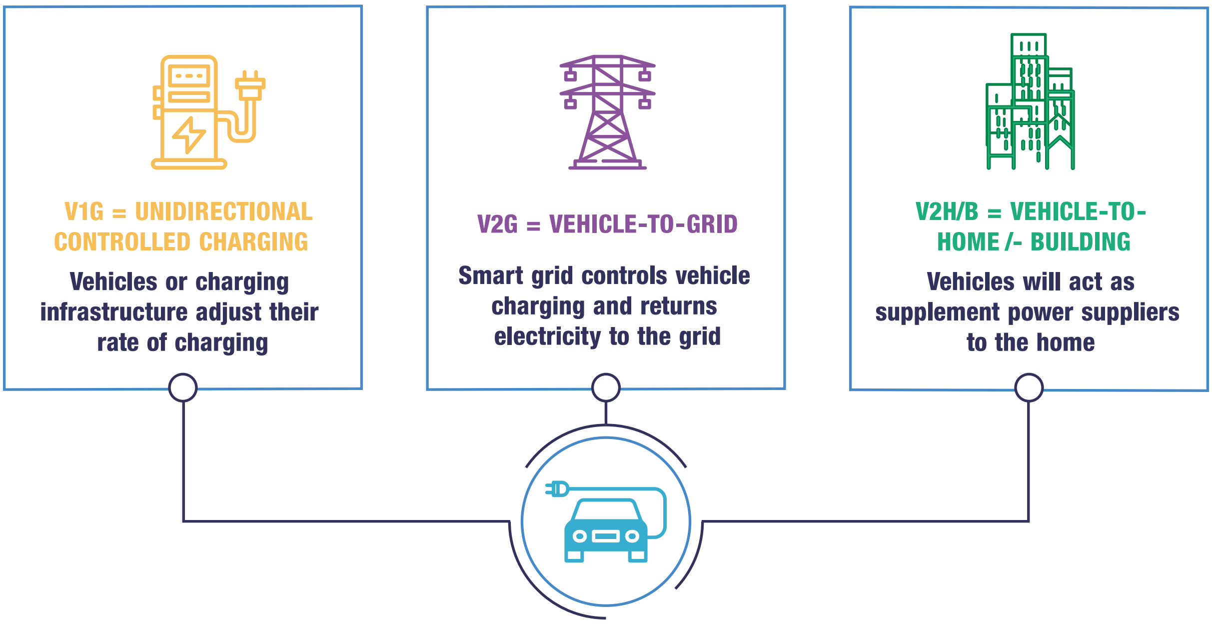

Figure 1:Advanced forms of smart charging

2. The Role of Smart Charging in The Power Sector

Electric vehicle fleets have the capacity to create electricity storage capacity. They can function as flexible loads as well as decentralized storage resources, offering additional flexibility to power system operations. EVs might change their charging patterns to flatten peak demand, fill load valleys, and enable real-time grid balancing by altering their charging levels.

Smart charging lowers the costs of strengthening local power systems. In contrast to unregulated charging, it reduces simultaneity and demand peaks.

3. Applications of Smart Charging in The Energy Sector

Smart charging could provide services and contribute to both system and local flexibility:

System flexibility

- **Peak shaving**

This entails flattening peak demand and filling the "valley" of demand by incentivizing late morning/afternoon charging in systems with high solar penetration and nighttime charging that could be adjusted based on nighttime wind production, as cars are parked for longer than they need to charge fully. Early evening charges, which would otherwise raise peak demand, would be postponed in this manner. As a result, investments in extra peak capacity would be postponed (Weiller and Sioshansi, 2016).

Local flexibility

- **Behind-the-meter optimisation and "back-up power**

This includes increasing self-consumption of locally produced renewable electricity, as well as decreasing reliance on the electricity grid and lowering energy bills by purchasing low-cost electricity from the grid during off-peak hours and using it to power homes when the electricity tariff is higher.

Both local and system flexibility

• **Ancillary services**

This entails assisting with real-time grid balancing by altering EV charging levels to maintain constant voltage and frequency. While transmission system operators have well-developed flexibility at the system level, most distribution system operators do not yet have flexibility from distributed energy resources to operate their grids.

4. Challenges and Enabling Factors

• **Charging infrastructure**

Developing charging infrastructure requires significant investments, and there are currently few commercial models for private investment. Governments can provide incentives for installing charging stations at either residential or public access places. Support for charging infrastructure development might be based on ambitious EV targets first and then on particular funding for implementation initiatives.

• **Stakeholders' roles and responsibilities**

Smart charging requires close coordination between the electricity market and the e-mobility market (EV drivers, charging point operators, mobile service providers)

• **Design regulation for vehicle-grid integration**

Smart charging will not "happen" until the proper incentives are provided in dynamic price signals. The potential revenue sources for EVs that must be enabled in order to incentivize smart charging A well-functioning electricity market, as well as competitive wholesale and retail markets, are required to give incentives for EV grid service valuation.

• **Aggregators**

When EVs are aggregated, they can complement one another, resulting in a virtual power plant with a quick response and the ability to supply services for the required time period. Aggregator business models make it possible to employ EVs as a source of flexibility. At least 1–2 MW of capacity must be sold to make EV power provision viable at the wholesale level. This necessitates the aggregation of approximately 500 automobiles and recharge stations.

• **Big data and artificial intelligence for smart charging**

Big data and artificial intelligence advancements may facilitate and optimize the services provided by smart charging solutions. ICT improvements such as data management and data analytics from drivers, charging patterns, and charging stations will improve smart charging features and reduce the cost of providing grid services. Furthermore, digital technology and data analytics will allow mobility demand and power supply patterns to be as compatible as feasible, as well as determine the best locations for charging outlets.

• **ICT control and communication protocols**

Communication protocols must be designed in order to optimize the system and promote information sharing across all actors. Smart charging is the charging of an electric vehicle (EV) controlled by bidirectional communication between two or more actors to optimize all customer requirements, grid management, and energy production, including renewables, in terms of system costs, limitations, reliability, security, and safety.

5. Projects and Services

Vehicle-grid integration project in San Diego (US)

San Diego Gas & Electric (SDG&E) has initiated a vehicle-grid integration pilot project that aims to improve grid stability by making fleets of EVs available as dispatchable distributed energy resources.

Vehicle-to-grid projects in Hamburg (Germany)

The City of Hamburg initiated the ELBE project, which aims to subsidize the construction of EV charging stations in buildings and commercial properties. The project incorporates the use of V2G technology and load-dependent tariffs, where EVs are considered controllable consumption.

References

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• Weiller, C. and R. Sioshansi (2016), "The role of plug-in electric vehicles with renewable resources in electricity systems," Revue déconomie industrielle, vol. 148: 291–316.