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Hitachi Energy Grid Edge Solutions Vehicle to Grid (V2G) Technology

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- **What is V2G?**

- V2G stands for “Vehicle to Grid” and is a technology that enables energy to be supplied to the power grid from the battery of an Electric Vehicle (EV). With V2G technology, a car battery can be charged and discharged while plugged into a bidirectional inverter (EV charging station). As an example, Electric Vehicles (EV’s) can source power to the grid from their batteries (discharge) during peak power needs and later recharge their batteries by consuming power during non-peak power demands.

- **What is needed to implement V2G?**

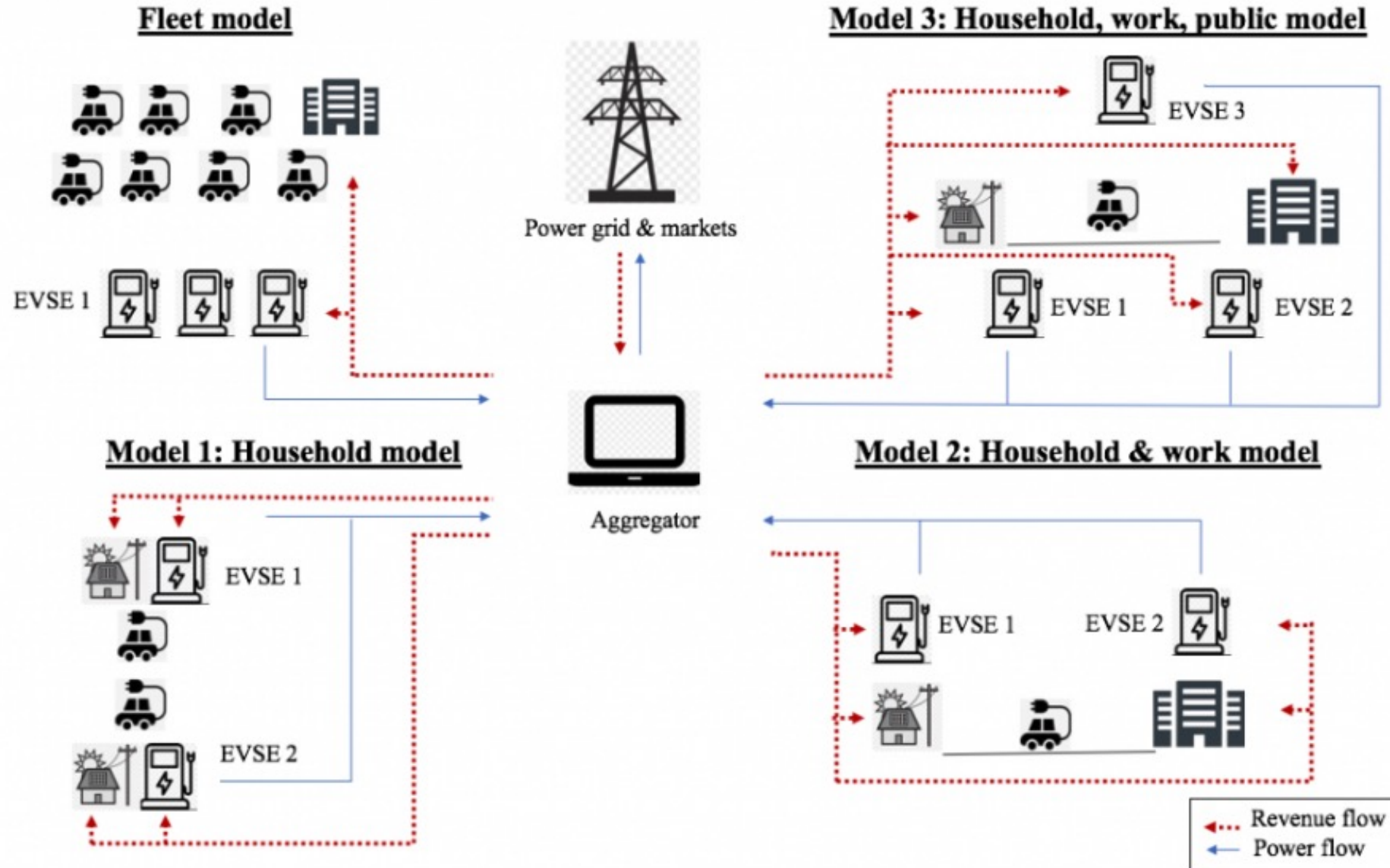
- An Electric Vehicle (EV) that allows its batteries to be safely and automatically charged and discharged.
- A bidirectional inverter (EV Charging Station) that automatically controls the flow of electricity in both directions. From grid to EV (AC to DC, charging battery) and from EV to grid (DC to AC, discharging battery).
- A way to control the process of safely charging and discharging the battery as well as metering the amount of electricity (billing/revenue) being consumed or provided by the EV.
- The integration of V2G into the existing infrastructure of the area wishing to adopt the technology.

- **How Does V2G Work?**

- V2G directs the charging and discharging of EV batteries in accordance with the EV users' needs and the grid's supply of available electricity. For example, when electricity supply exceeds demand, EV charging occurs. During peak electricity demand, EV's supply electricity to the grid.
- Most vehicles remain stationary more than 95 percent of the time, so V2G leverages that inactivity, enabling a two-way energy exchange between vehicle and grid. The energy from the EV batteries is available to the electric grid to serve peak needs, with the vehicles recharging during non-peak hours.

- **Benefits of V2G?**

- V2G allows the grid to optimize the supply of local renewable energy and reduce infrastructure costs, while the EV owner can enjoy greener, more economical consumption of electricity and be financially rewarded for serving the electricity grid.
- V2G comes with the following benefits for the EV owner and the distribution network:
 - Supporting electrical grid, reducing concerns for grid overload
 - Maximize the business case opportunity of EV's and their owners
 - Cheap, fast and clean energy storage
 - Making the most use from existing resources
 - Reduction of environmental impact by leveraging and utilizing renewable energy



- **Applications for V2G**

- Revenue stream for EV owners
- EV's providing a renewable source of energy to the power grid (grid optimization)
- Voltage regulation
- Frequency regulation
- Optimal utilization of the energy resources (electric cars as battery reserves) will result in minimum cost of energy consumption for the end users as well as reduced impact on the electric power grid.

- **Challenges of V2G**

- Battery degradation due to the high number of charge/discharge cycles. Most EV manufacturers are not providing warranty for V2G operations except a few such as Nissan and Mitsubishi. This strategy is still in its early stages to be implemented on a large scale.
- Not available yet in most areas. Currently there are few bidirectional EV charging stations that support V2G.
- Motivation (financial incentive) and convenience for EV owner to participate.
- Adoption of V2G is still in its infancy due to various challenges: battery technology, lack of business models, grid management, infrastructure, commercial feasibility, lack of policies & global standards and regulatory issues.

Success Story: Arlington Microgrid Vehicle-to-Grid (V2G)

- 2 x Level 2 chargers (208-240V, 3kw – 19kw)
 - 6kW bi-directional charger
- 2 x Electric Vehicle
 - Nissan Leaf
 - 40kWh and 62kWh
- **This was one of the first V2G grid-connected systems in the country.**
- In 2018, there were fewer, less evolved standards and PUD only found two companies that could offer bi-directional charging infrastructure for this application.
- MELCO Mitsubishi Electric EV Bidirectional Chargers.
- 2 x Nissan Leaf EVs. 2019 model has 40 kWh and 2020 has 60 kWh. In 2018 the Nissan Leaf was the only vehicle in the US that is V2G capable, and it's been that way since 2013.
- Microgrid control by Hitachi Energy e-mesh.



Source: Snohomish County Public Utility District

- Standards and documentation are important
- Work with experienced partners and integrators
- EVs can charge and discharge in a microgrid
- The EV ecosystem is evolving rapidly
- EV warranty (Most don't warranty batteries for V2G)
- **Public power utilities, others pursue vehicle-to-grid opportunities (2/21)**
 - When Washington State's Snohomish County Public Utility District (SnoPUD) in late 2020 contracted with Mitsubishi Electric, Hitachi ABB and Doosan GridTech to install two electric vehicle-to-grid (V2G) chargers the PUD joined a growing number of utilities pursuing V2G. **The V2G chargers are being sited at Snohomish PUD's Arlington microgrid site and will be able to charge an electric vehicle and also send the stored energy back to the grid during a power outage. "We see this as an important step in our 'utility of the future' vision and for SnoPUD to be one of the premier utilities in the country,"** John Haarlow, the utility's CEO and general manager, said in a statement.



Source: Snohomish County Public Utility District

Source: American Public Power Association - "Public power utilities, others pursue vehicle-to-grid opportunities"

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Thank You