SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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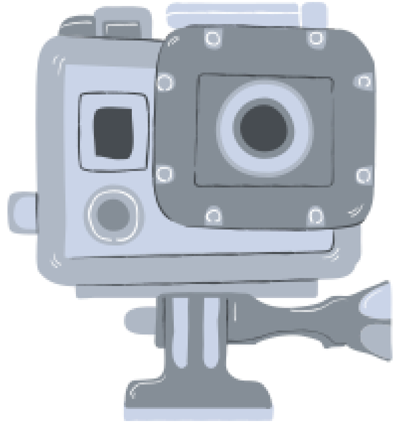
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

UNIT 2

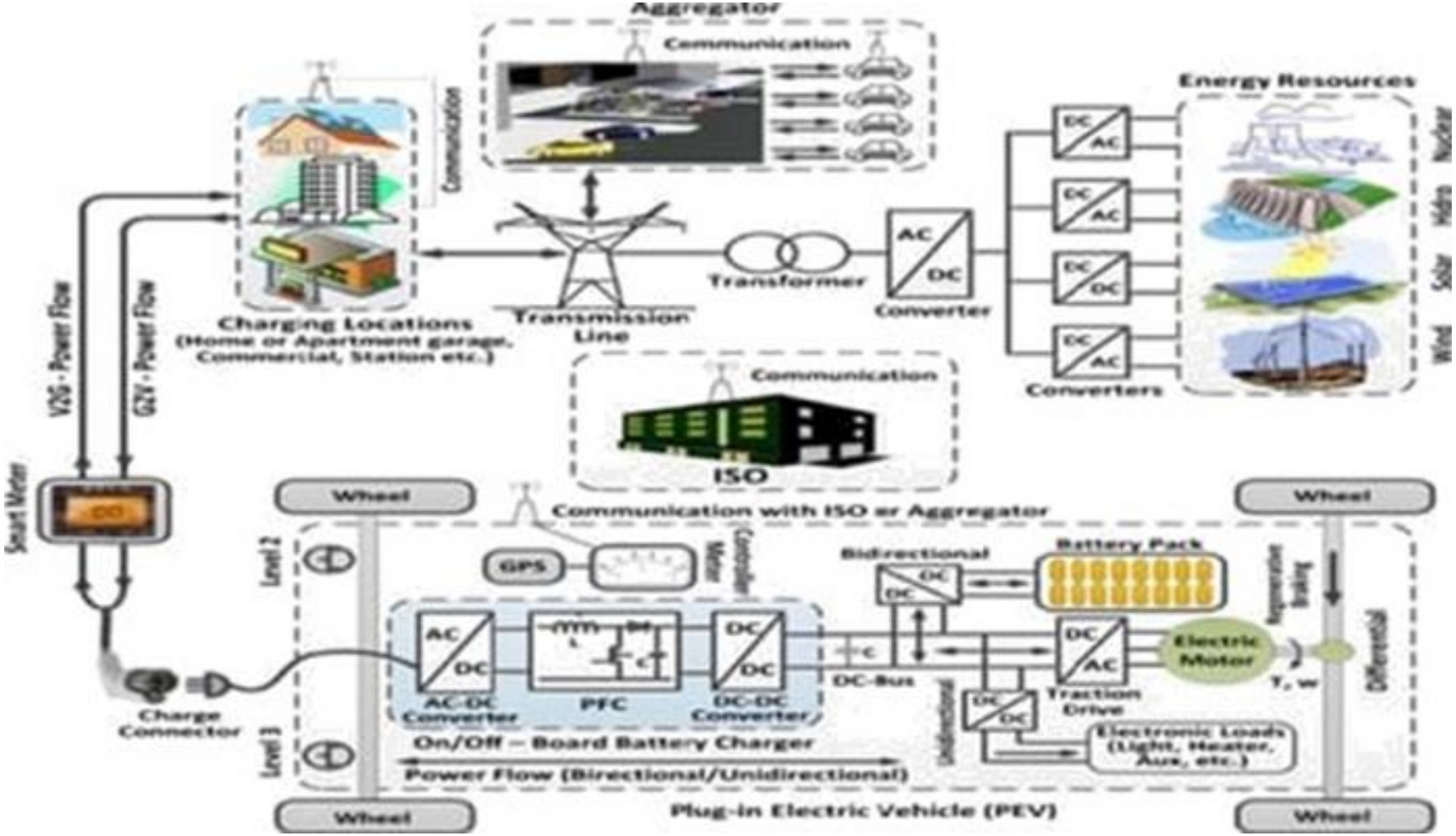
SMART GRID TECHNOLOGIES – V2G Technology

19EEE308 – SMART GRIDS
III year / VI Semester



- **Vehicle to grid (V2G) technology can be defined as a system in which there is a capability to control, bi-directional flow' of electric energy between a vehicle and the electrical grid. The integration of electric vehicles info the power grid is called the vehicle-to-grid system.**

Components and Power Flow in V2G

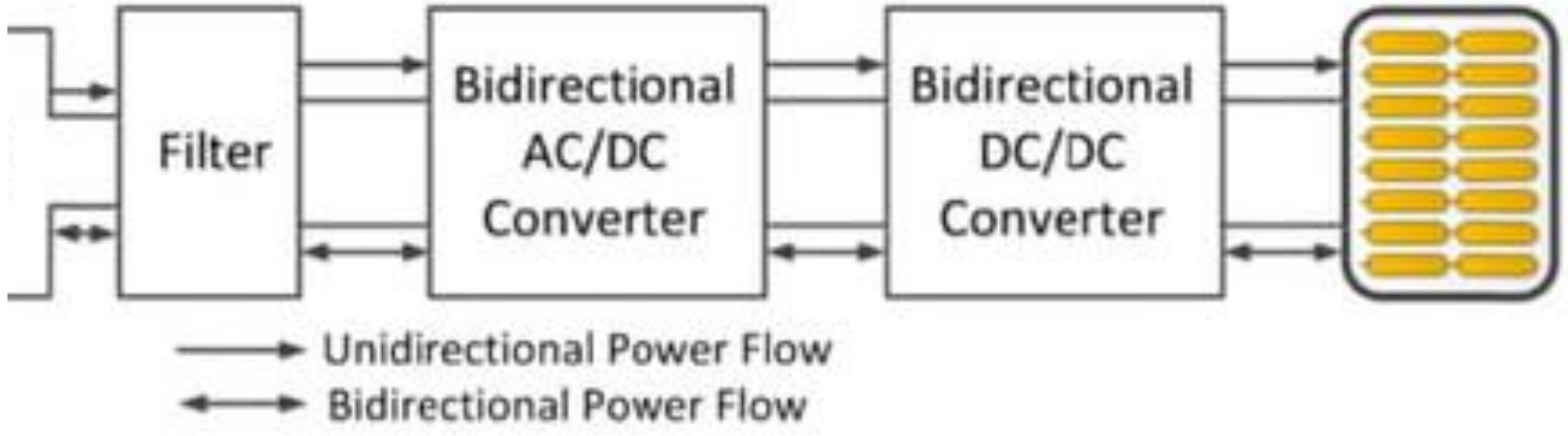


Motivation Towards V2G

The concept of Vehicle to grid integration (V2G) was first introduced by Willet Compton of the Delaware University. The initial goal of The V2G was to provide peak power that is the electric vehicle owners charging their cars in low load with low electric price and discharging the vehicles in peak load with higher prices so that the vehicle owners can make significant amount of profit from the V2G project.

Average personal vehicles in the US travel on the road only 4–5% of the time, sitting in home garages or parking lots the rest of the day. Statistics show that the passenger vehicles are parked idle for about 20 to 22 hours in a day. The normal driving time of a passenger vehicle is about 2 to 4 hours per day. During this time the battery in the passenger vehicles can acts a distributed mobile storage unit of power system and the battery power can be fed back into the grid when there is a deficit of power in the grid. The concept requires a power connection to the grid, a communication connection with the grid operator, and suitable metering. An efficient power transaction requires substantial information exchange . While the power flow can be either unidirectional or bidirectional, unidirectional V2G is a logical first step because it limits hardware requirements, simplifies interconnection issues, and tends to reduce battery degradation.

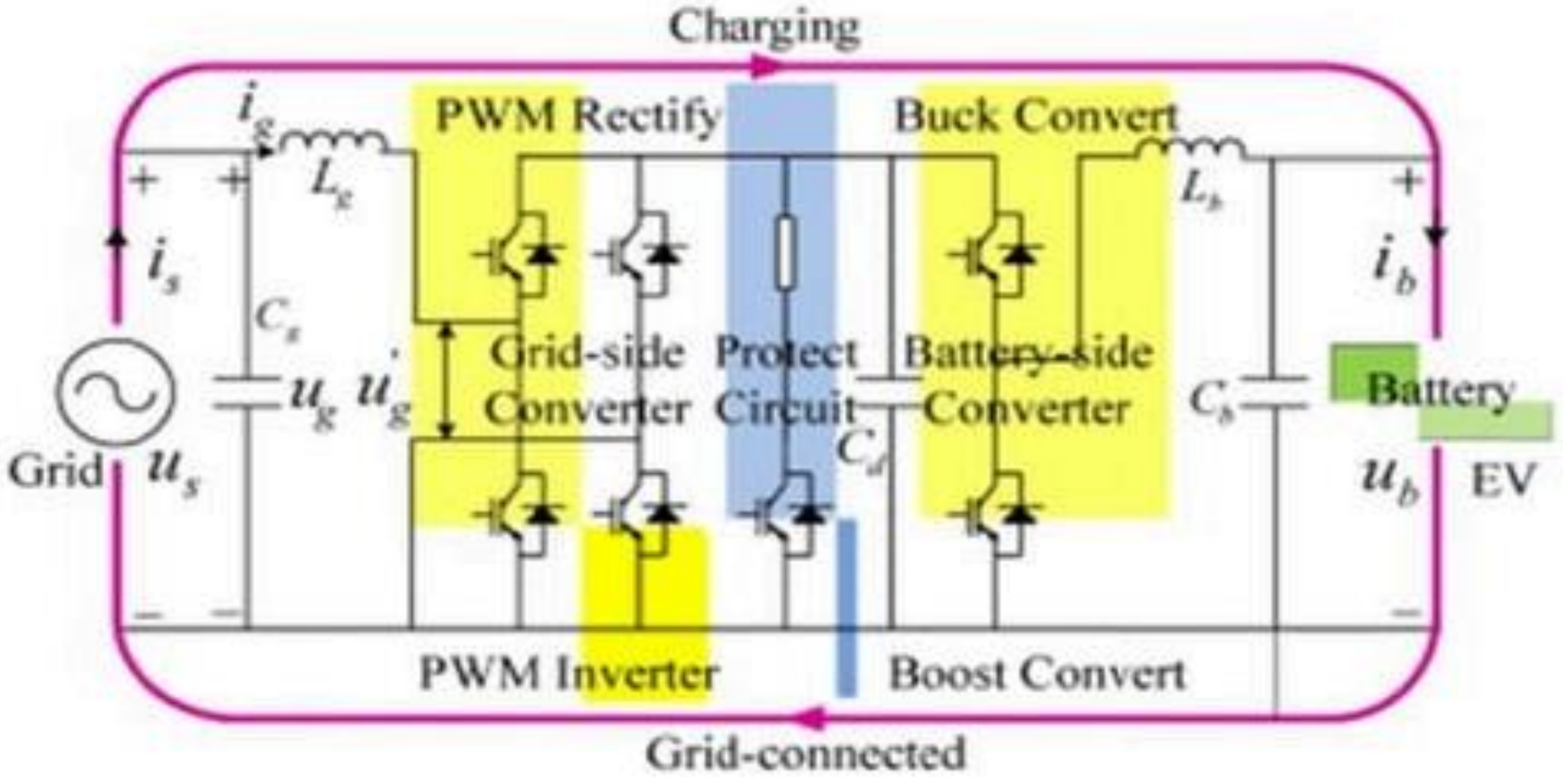
One properly designed electric-drive vehicle can produce about 10 kW which is equivalent to the average electricity consumption of 10households. The key to realizing economic value from V2G are grid-integrated vehicle controls to dispatch according to the power system needs.



Power Flow in V2G System

UNIDIRECTIONAL AND BIDIRECTIONAL POWER FLOW COMPARISONS

	Situation	Power Flow and Switches	Power Level	Control	Cost	Battery Effect	Distribution system	Requirements and Challenges	Benefits
Unidirectional Power Flow	Available	One-way electrical energy flow, basic battery charge (G2V) Diode Bridge + Unidirectional converter	Levels 1, 2 and 3	Simple. Active control of charging current. Basic control can be managed with time-sensitive energy-pricing.	Low price, no additional cost	No discharging degradation	No update or investment. With high penetration of PEVs: meets most utility objectives	Power connection to the grid	-Simplifies interconnection issues -Simple control and easy management - Provides services based on reactive power and dynamic adjustment of charge rates, even without reversal -Supplies or absorbs reactive power, without having to discharge a battery, by means of current phase-angle control -Voltage and frequency control
Bidirectional Power Flow	Not available	Two-way electrical energy flow and communication, charge/discharge (V2G) MOSFET (low power) IGBT (Medium power) GTO (High power level)	Expected only for Level 2	Complex. Extra drive control circuits. Extensive measures.	High price	Extra degradation due to frequent cycling	Necessary updates and investment costs	-Two-way power connection and communication -Suitable smart metering/sensors -Substantial information exchange -Extra investment and cost -Energy losses -Device stress	-Ancillary services -Active power regulation and stabilization Voltage regulation Frequency regulation (down-up) -Spinning reserves -Reactive power support -Peak shaving -Valley filling -Load following -Energy balance -Current harmonic filtering -Tracking the output of renewable energy sources



Types and Requirement

Three versions:

V2G is a version of battery-to-grid power applied to vehicles. There are three main different versions of the vehicle-to-grid concept, all of which involve an onboard battery:

- A hybrid or Fuel cell vehicle, which generates power from storable fuel, uses its generator to produce power for a utility at peak electricity usage times. Here the vehicles serve as a distributed generation system, producing power from conventional fossil fuels, biofuels or hydrogen
- A battery-powered or plug-in hybrid vehicle which uses its excess rechargeable battery capacity to provide power to the electric grid in response to peak load demands. These vehicles can then be recharged during off-peak hours at cheaper rates while helping to absorb excess night time generation. Here the vehicles serve as a distributed battery storage system to buffer power
- A solar vehicle which uses its excess charging capacity to provide power to the electric grid when the battery is fully charged.

V2G SYSTEM REQUIREMENTS AND POWER FLOW:

The components and power flow of a V2G system. The system consists of six major subsystems:

1) Energy resources and an electric utility

2) An independent system operator and aggregator

3) Charging infrastructure and locations

4) Two-way electrical energy flow and communication between each PEV and ISO or aggregator

5) On-board and off-board intelligent metering and control

6) The PEV itself with its battery charger and management.

Challenges

CHALLENGES TO VEHICLE-TO-GRID CONCEPT:

Although V2G systems have many benefits, increasing the number of PEVs may impact power distribution system dynamics and performance through overloading of transformers, cables, and feeders. This reduces efficiency, may require additional generator starts, and produces voltage deviations and harmonics. The greatest challenges to a V2G transition are battery technology and the high initial costs compared to ICE vehicles.

1. Massive Introduction of electric vehicles can significantly reduce the CO2 emissions. On the other side the integration of Renewable Energy Sources in the existing conventional grid causes some technical constraints in the grid, especially issues Concerning Power Quality. At present there is no such system for Integrating EV in the conventional electric grids

2. The most important barrier to the spread of electric propulsion from the point of view of electric variables are voltage and current, frequency and connections to the vehicle

3. Two-way communication (" Smart charging") system between utility and PEV's are needed to be implemented to shift the charging of PEV's completely to off - peak periods .

Summary

Activity

KEEP LEARNING..

Thank u

SEE YOU IN NEXT CLASS