Integration of electric vehicles in smart grids: A review of the advantages and challenges of vehicle-to-grid technology

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ABSTRACT

The term 'vehicle-to-grid (V2G)' refers to the ability of electric vehicles to supply or consume power from the grid. V2G implementation may provide reactive power support, load balancing, harmonic filtering, and even power grid breakdown recovery. In certain situations, these technologies may provide auxiliary functions, such as voltage and frequency control and transient stability. Aside from the grid services, EV owners may reap major financial advantages from employing V2G services. These include lower operating costs, no congestion charges, free parking, and higher resale value. However, it has implications for both grid operators and EV owners. Increased EV adoption may have a negative impact on power distribution network operations due to transformer, cable, and feeder overloading. To compensate for the overload, an extra generator will be needed, which will increase voltage deviations and current distortions. From the EV owners' standpoint, the cost of battery degradation and wear caused by frequent charging and discharging is the biggest concern. While V2G operation may reduce the lifespan of EVs, it is expected to be more cost-effective for EV owners and grid operators in the long term. Therefore, the purpose of this article is to examine and analyze the benefits, challenges, and technology of EVs in a V2G system.

KEYWORDS

Distribution system; Electric vehicles; Smart grid; V2G benefits; V2G challenges

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