IMPLEMENTATION OF SOLAR PV-BATTERY AND DIESEL GENERATOR BASED ELECTRIC VEHICLE CHARGING STATION

Abstract:

This project focuses on the implementation of a hybrid Solar PV-Battery and Diesel Generator-based Electric Vehicle (EV) Charging Station. The aim is to develop a sustainable and reliable charging solution that harnesses solar energy as the primary source, stores surplus generation in batteries, and incorporates a diesel generator as a backup to ensure continuous operation. This configuration is particularly suited for remote or off-grid areas, where grid power is unreliable or unavailable. The hybrid system not only minimizes operational costs and reduces greenhouse gas emissions compared to conventional diesel-only setups but also supports the growth of clean mobility infrastructure, aligning with global trends toward e-mobility and renewable integration.

Project Scope:

- Provide 24/7 EV charging by integrating solar PV, battery storage, and diesel backup.
- Prioritize renewable (solar) contribution to the charging load, with fossil generation used sparingly.
- Offer a scalable solution for standalone or supplemental EV charging in both rural and semi-urban environments.

Key Components:

- **Solar PV Array:** Captures solar energy to generate DC power for immediate EV charging and battery storage.
- **Battery Bank:** Stores excess solar energy, providing charging power during non-sunny periods and peak demand.
- **Diesel Generator:** Serves as an emergency power backup, activating only when solar generation and battery reserves are insufficient.

- **EV Charging Units:** Fast or standard charging points delivering AC or DC power to electric vehicles.
- **Inverter:** Converts DC from the PV array and batteries into AC for compatibility with most EV chargers.
- **Charge Controller:** Maintains optimal battery health by regulating charge and discharge cycles.
- **Intelligent Control System:** Supervises power flow, prioritizing solar usage, automating source switching, and logging usage data.
- **Grid Interface :** Integrated for additional reliability or net metering where available.

System Working Principle:

- **Sunny Conditions:** Solar PV supplies the EV chargers directly and charges the battery bank. Surplus power is stored for later use.
- **Low Sunlight/Night:** Battery bank powers the chargers, enabling nighttime or cloudy-day EV charging without interruption.
- **High Demand/Emergency:** If both solar and battery are insufficient, the diesel generator starts automatically to power the charging units and recharge the batteries if needed.
- The control system always prioritizes solar energy, automates transitions between sources, and ensures seamless and efficient operations.

Advantages:

- Significant reduction in diesel consumption and operational costs compared to standalone diesel charging stations.
- Continuous, reliable EV charging independent of grid limitations, supporting rural mobility and resilience.
- Lower greenhouse gas emissions, facilitating the shift to clean transportation.
- Scalable for different application sizes—public charging hubs, fleet depots, or commercial premises.

Typical Applications:

- Highway charging stations at grid-scarce locations.
- Rural community charging points.
- EV charging backbone for remote mining, agricultural, or industrial operations.
- Sustainable infrastructure in eco-friendly tourism sites.