

Project title:

“Machine Learning-Based Energy Management System for Optimization of Power in Hybrid Electric Vehicles.”

Goal :

Build a **Machine Learning model** that learns to **optimize power distribution** between the **engine and battery** while maximizing **efficiency** and minimizing **fuel consumption**

Data source :

Descriptions:

Column Name	Description	Data Type / Unit	Use in ML
Time (s)	Time elapsed since the start of the driving cycle. Used to analyze trends over time.	Numeric (seconds)	Optional (for time-series models like LSTM)
Speed (km/h)	Vehicle speed at each time instant. Directly affects power demand and fuel consumption.	Numeric	Important feature
Acceleration (m/s <sup>2</sup> )	Rate of change of speed — indicates driving behavior (e.g., sudden acceleration or braking).	Numeric	Important feature
Power Demand (kW)	Total power required by the vehicle at that moment (sum of engine + battery power).	Numeric	Can be used for validation (not usually a target)
Engine Power (kW)	Power contributed by the internal combustion engine.	Numeric	Possible <b>target variable</b> (if goal = predict optimal engine power)
Battery Power (kW)	Power supplied (+) or absorbed (–) by the battery.	Numeric	Possible <b>target variable</b> (if goal = predict battery power usage)
Fuel Consumption (L/100km)	Fuel consumed per 100 km. Indicates overall energy efficiency.	Numeric	Possible <b>target variable</b> (if goal = minimize fuel usage)

Column Name	Description	Data Type / Unit	Use in ML
SOC (%)	State of Charge of the battery — represents battery energy level.	Numeric	Key input feature
Battery Degradation (%)	Battery wear level or health percentage.	Numeric	Optional (for long-term optimization)
Regenerative Braking Power (kW)	Power recovered during braking (negative or positive depending on system).	Numeric	Feature affecting efficiency
Total Energy Used (kWh)	Total cumulative energy consumed (engine + battery).	Numeric	Optional output for energy balance
Driving Cycle Type	Category representing the type of driving (e.g., city, highway, mixed).	Categorical	Important contextual feature
Target Efficiency	Efficiency goal (%) under the given conditions.	Numeric	Possible <b>target variable</b> (if goal = predict or optimize efficiency)

### Choosing the Target Variable

Since your project's goal is:

*"Optimization of Power in Hybrid Electric Vehicles using Machine Learning"*

You have **two main directions** you can choose:

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#### Option 1 — Predict Engine Power (Power Optimization)

**Use Case:** Learn how to optimally split total power between engine and battery.

- **Target Variable:** Engine Power (kW)

#### Option 2 — Predict Target Efficiency (Efficiency Optimization)

**Use Case:** Learn driving and energy management patterns that maximize efficiency.

- **Target Variable:** Target Efficiency