Electrical Vehicle

E-V typically contain several main components that work together to enable their operation. These components include:

- Chassis

- Electric Motor

- Battery

- Controller

-Power transmit

- Throttle

- Braking System

- Suspension System

- Wheels and Tires

- Body and Cabin

- Lights and Signals

- Electrical Wiring and Connectors

Chassis

- **Materials :** Maximum Alloy materials are used

titanium The strongest **titanium** alloys are comparable to the strongest steels. Stiff **titanium** frames need larger-diameter tubes than comparable steel frames

carbon fiber - material is lightweight and has a high stiffness ratio and higher fatigue resistance

Aluminium.- The most common bike frame material, **aluminium** is known for being corrosion resistant, fairly light (though typically not as light as carbon Fiber)

Steel is inexpensive, exceptionally durable, highly resistant to fatigue, easily repaired and easy to work with. Unlike carbon Fiber and aluminium

https://www.bicycling.com/bikes-gear/a21784287/bike-frame-materials-explained/

- **Frame Design**
- **Fabrication**

Electric Motor

(https://intellipaat.com/blog/types-of-motors-in-electric-vehicle/)

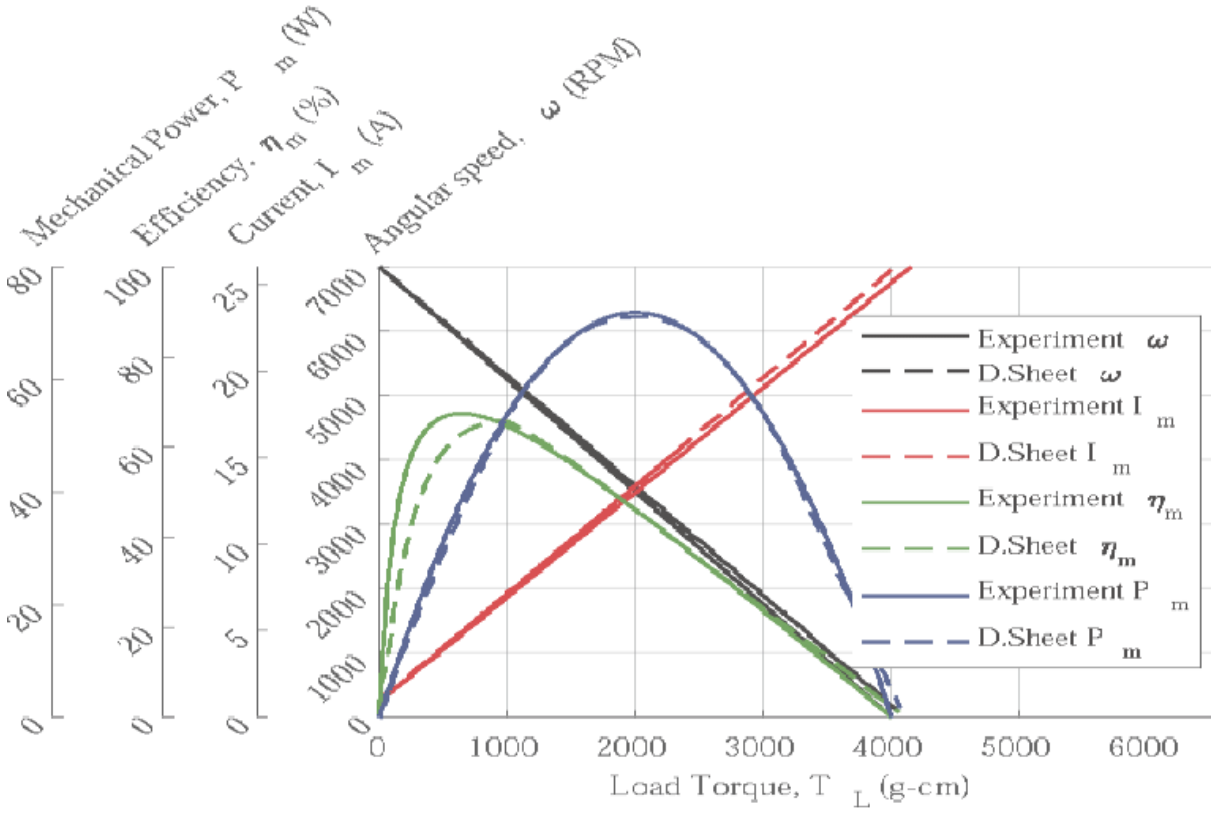
1. **Permanent magnet DC motor(PMDC)**
2. **Brushless DC motor (BLDC (Ac motor))**
3. **Permanent Magnet Synchronous motor (PMSM)**

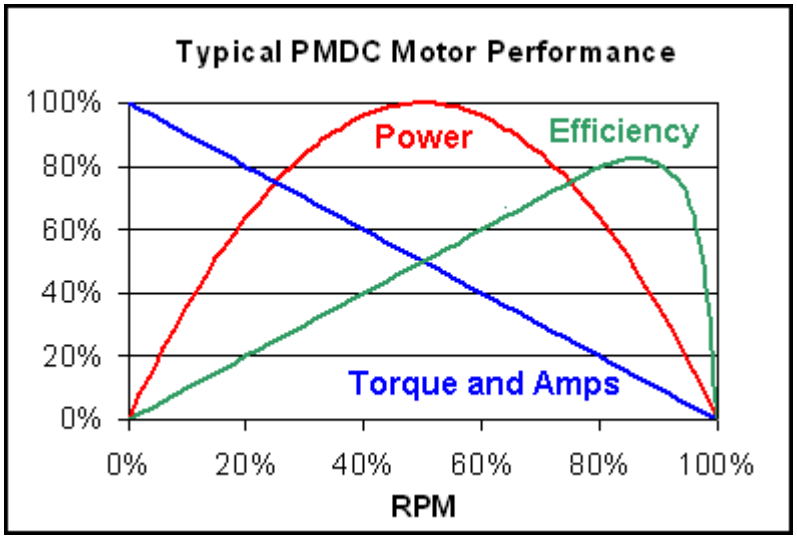
Motor selection done based on

- **Power and Torque**
- **Efficiency**
- **Space**
- **Availability**
- **Cost**
- **Speed**
- **Voltage and current rating**
- **Cooling method**

PMDC

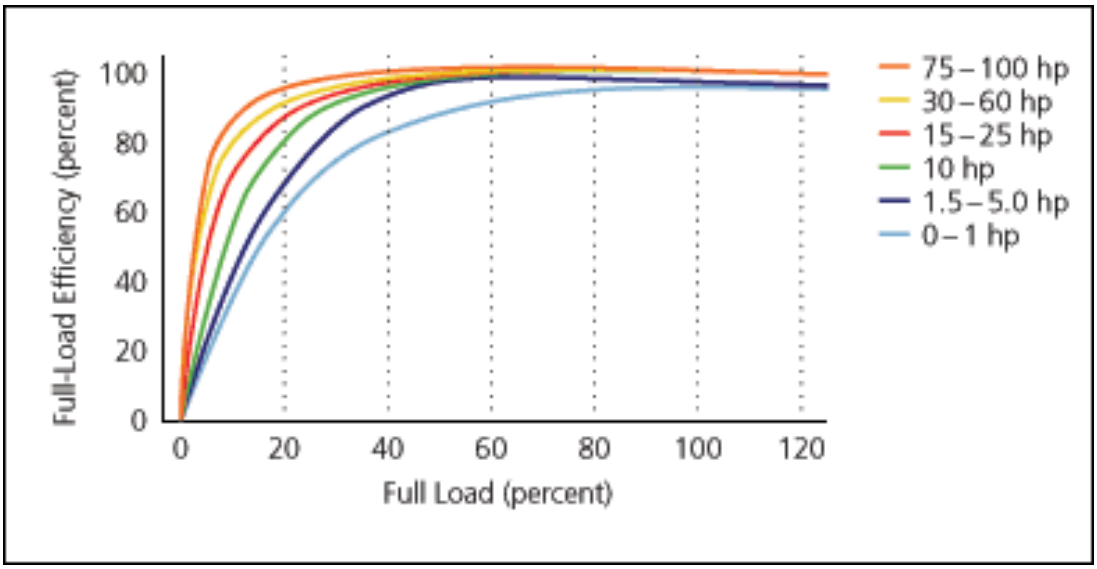
PMDC motors typically have efficiency levels ranging from 70% to 90% or even higher, depending on the specific motor and its operating conditions. It's important to note that the efficiency of a PMDC motor can vary at different load levels





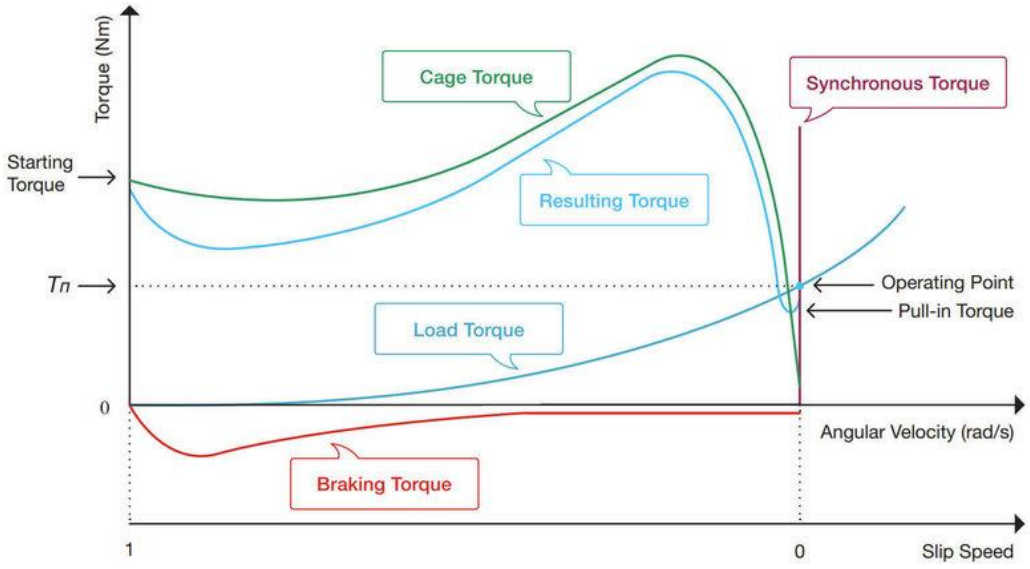
BLDC

Brushless motors have higher efficiency rates of up to 85 to 90. This means that the mechanical power of a BLDC motor can be up to 90% of the total electrical power input. This efficiency rate is much better than those of brushed DC motors



PMSM

PMSM motors have higher efficiency than BLDC motors because the PMSM motors do not produce torque ripples during the commutation process. In some cases, PMSM motors have an efficiency of more than 92% while BLDC motors have an efficiency between 85% to 90%



Power transmit

1. **Direct drive**- like Hub Motor
2. **Indirect Drive**

	Mechanical Adv	**Efficiency in %**
○ **Belt drive** ○ **Chain drive**	Long range power transmit	95-98
○ **Gear drive**		
▪ **Spur gear**	Easy to manufacture	94-98
▪ **Helical gear**	Less noise ,shock absorb more	94-98
▪ **Bevel gear**		
▪ **Worm gear**	90deg power transmit	97-99.5
▪ **Cycloidal gear**	High reduction ratio & Back movement lock	50-92
▪ **Hypoid gear**	Backlash is less and High reduction ratio	88-98
	High reduction ratio	92-95

Controllers

- PMDC motor controllers utilize a technique called pulse-width modulation (PWM)
- BLDC AND PMSM (AC)motor controllers employ a more complicated technique called vector control or field-oriented control (FOC)

Battery

Batteries are rated in milliampere-hours (mAh). A battery with a rating of 2000 mAh can deliver a consistent current of 2000 mA for one hour

Battery C Rating : is the measurement of current in which a battery is charged and discharged at

$$Max.\ Amps = C.\ rating \times Amp.\ hours$$

$$Run.\ Hours = \frac{1}{discharge.\ C.\ value}$$

$$discharge.\ C.\ value = \frac{Discharge.\ Current}{Amp.\ hours}$$

Primary Batteries **cannot be recharged**

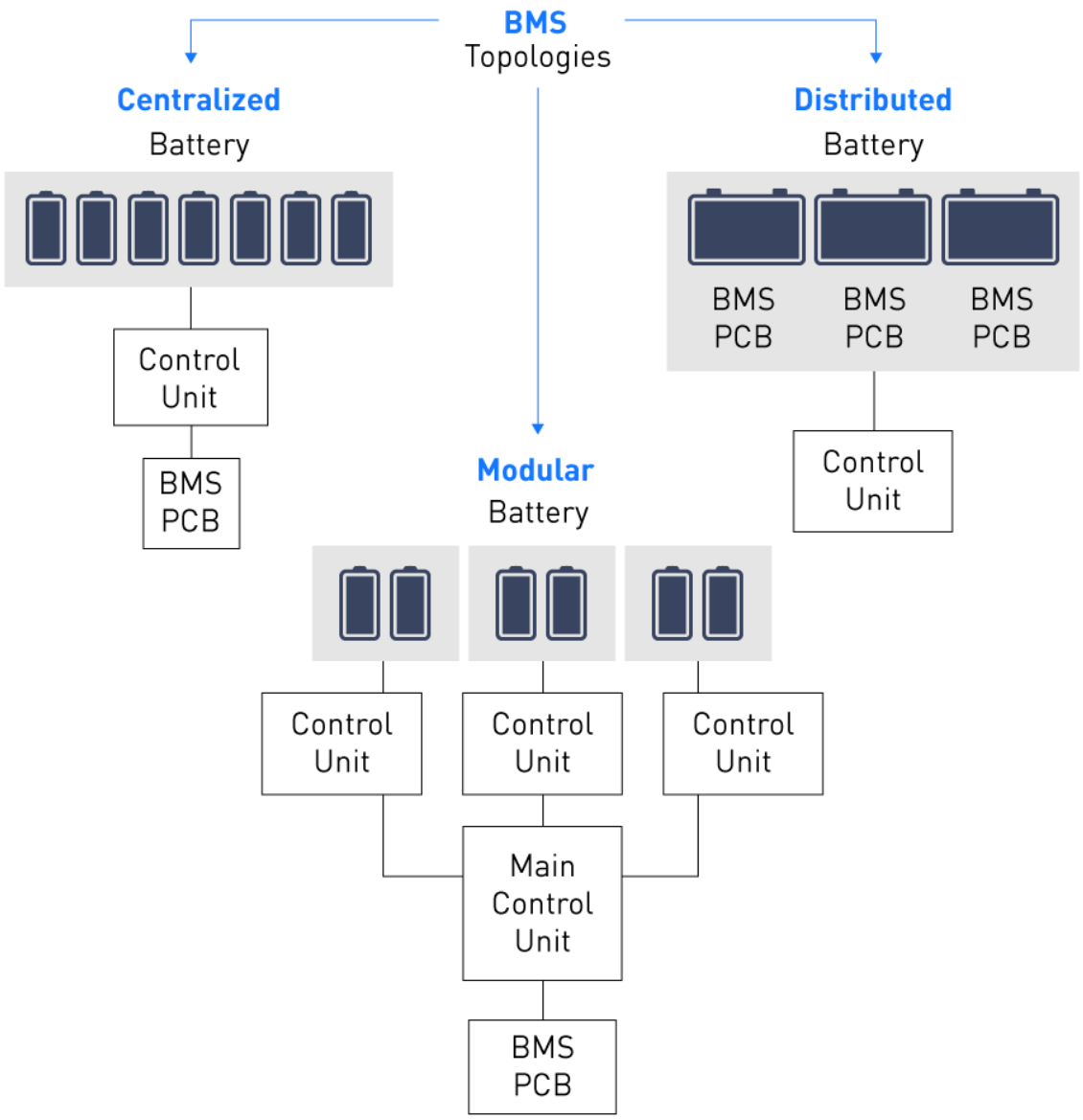
Zinc-Carbon batteries, Lithium batteries, mercury batteries, Silver-Oxide batteries, Zinc-air batteries, and Zinc-Chloride batteries

Secondary Batteries **rechargeable batteries**

1. Nickel Cadmium (Ni-Cd)
2. Nickel-Metal Hydride (Ni-MH)
3. Lead-Acid
4. Lithium-ion (Li-ion)
    1. Lithium iron phosphate (LiFePO4)
    2. Lithium Nickel Manganese Cobalt Oxide (NMC)
    3. Lithium Nickel Cobalt Aluminium Oxide (NCA)
    4. Lithium Cobalt Oxide (LCO)
    5. Lithium Manganese Oxide (LMO)
    6. Lithium Titanate (LTO)

https://circuitdigest.com/article/different-types-of-batteries

Battery management System



Vehicle Range/ mileage affecting points

Engine Condition	- Maintenance
Battery Quality	- Traffic Conditions
Riding Habits	- Environmental Factors
Tire Pressure	- Fuel System Efficiency
Vehicle Weight	- Route Selection
Aerodynamics	- Vehicle Design

Problem Statement :

1000 kg load required to carry

10kw motor (assuming with efficiency 100%)

Calculate required battery for 150km range of speed 20km/h and 40km/h

Ans.

- considering power transmission losses , Aerodynamic losses, cable losses, tyre friction losses all r
- 10degree route inclination average Considering

we created Windows software for this Calculation please go true it

Ev Motor & Battery Calculator.rar

For 150 km range and 20km/h speed required Battery

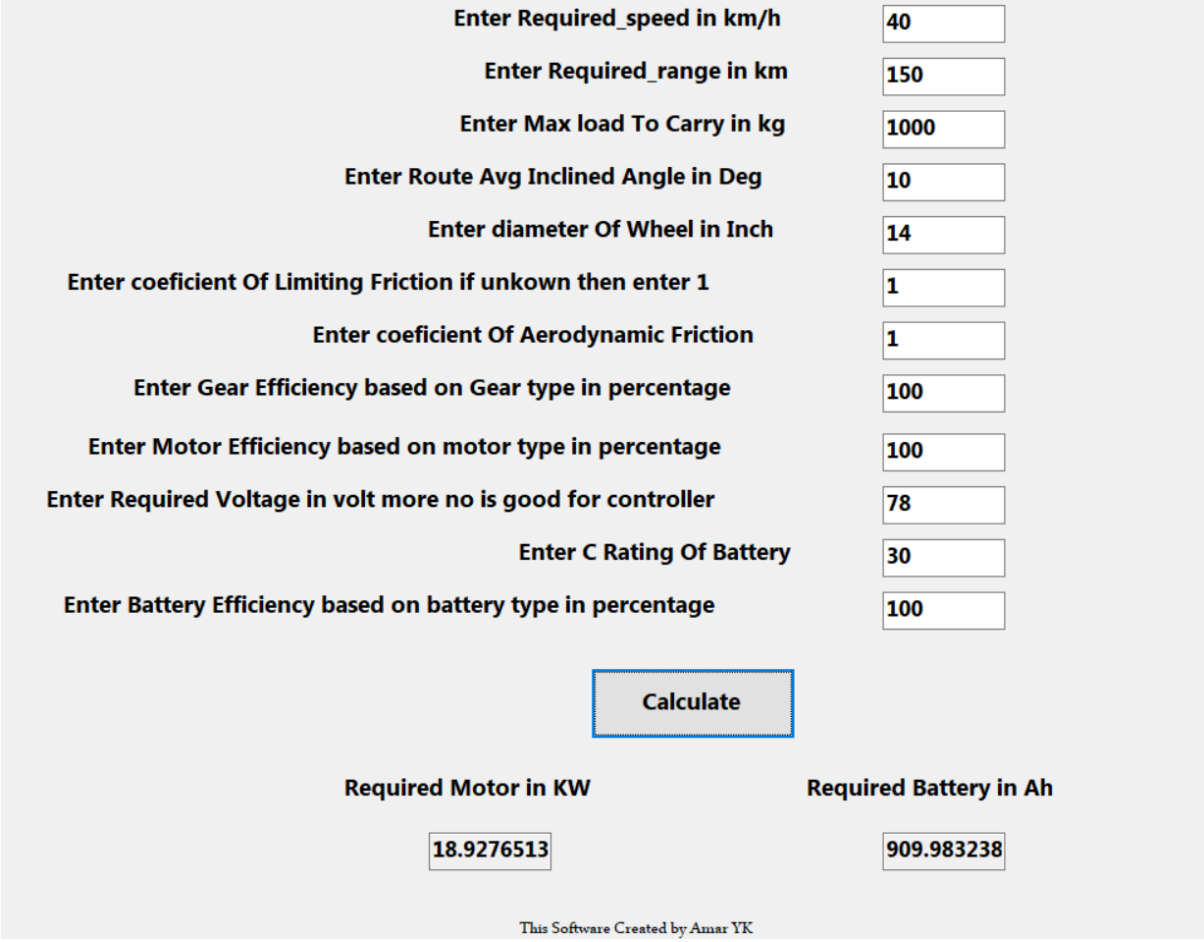
Enter Required_speed in km/h	20
Enter Required_range in km	150
Enter Max load To Carry in kg	1000
Enter Route Avg Inclined Angle in Deg	10
Enter diameter Of Wheel in Inch	14
Enter coeficient Of Limiting Friction if unkown then enter 1	1
Enter coeficient Of Aerodynamic Friction	1
Enter Gear Efficiency based on Gear type in percentage	100
Enter Motor Efficiency based on motor type in percentage	100
Enter Required Voltage in volt more no is good for controller	78
Enter C Rating Of Battery	30
Enter Battery Efficiency based on battery type in percentage	100

Calculate

Required Motor in KW	Required Battery in Ah
9.46382568	909.983238

This Software Created by Amar YK

For 150 km range and 40km/h speed required Battery



for this calculation reference r taken from this site

https://engineering.stackexchange.com/questions/28452/motor-torque-calculation-about-the-units