IVE | Engineering 工程

NENG

Rideable Solar Car Workshop 3
Electric Drive Technology

IVE | Engineering 工程

SOPHIE

SGOC

SMART CITY INNOVATION CENTRE

2026工作坊內容

01 1)初談高效節能設計
1月31日

02 車輛動力ABC
2月28日

03 電力驅動技術 I
3月14日

Shell Nxplorers Programme - 5月尾

04 車身設計大不同
5月23日

05 太陽能車攻略
7月4日

06 技術支援 網上直播
7月25日

IVE | Engineering 工程

HKFYG 青協

2026 SHELL NXPOLRERS PROGRAMME

ALERT!

Shell NXplorers

TO RIDERABLE SOLAR CAR TEAM

CLASS A:

◯ 23/5/2026 (10:00AM - 5:00PM)
◯ 24/5/2026 (10:00AM - 1:00PM)

CLASS B:

◯ 30/5/2026 (10:00AM - 5:00PM)
◯ 31/5/2026 (10:00AM - 1:00PM)

IVE Engineering 工程

	學校名稱	
1	新界鄉議局大埔區中學	A
2	嗇色園主辦可譽中學暨可譽小學	
3	靈糧堂劉梅軒中學	
4	獅子會蔣翠瑔中學	
5	元朗公立中學	
6	樂善堂顧超文中學	
7	香海正覺蓮社佛教正覺中學	
8	東華三院邱金元中學	
9	裘錦秋中學(元朗)	
10	香港四邑商工總會陳南昌紀念中學	
11	聖公會聖西門呂明才中學	
12	聖若瑟書院	
13	嶺南鍾榮光博士紀念中學	
14	東華三院馮黃鳳亭中學	B
15	嗇色園主辦可藝中學	
16	地利亞修女紀念學校（吉利徑）	
17	保良局馬錦明夫人章馥仙中學	
18	馬鞍山崇真中學	
19	香港布廠商會朱石麟中學	
20	林大輝中學	
21	天主教郭得勝中學一隊	
22	天主教郭得勝中學二隊	
23	鳳溪第一中學	
24	瑪利諾中學	
25	樂善堂梁植偉紀念中學	

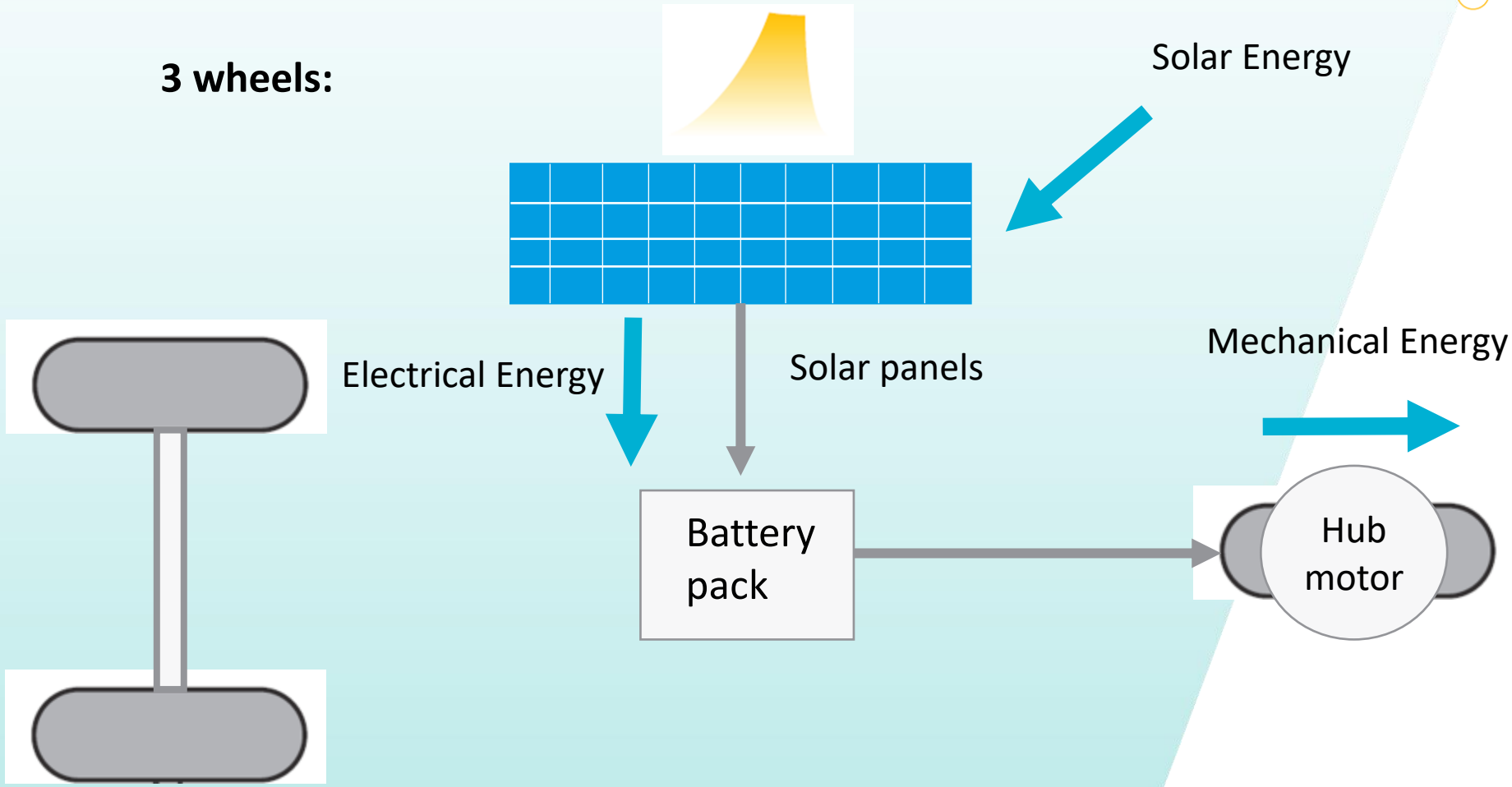
Topics

Electric Drive Technology

1) Power training
2) Energy storage and motor system
3) E-mobility
4) Typical questions

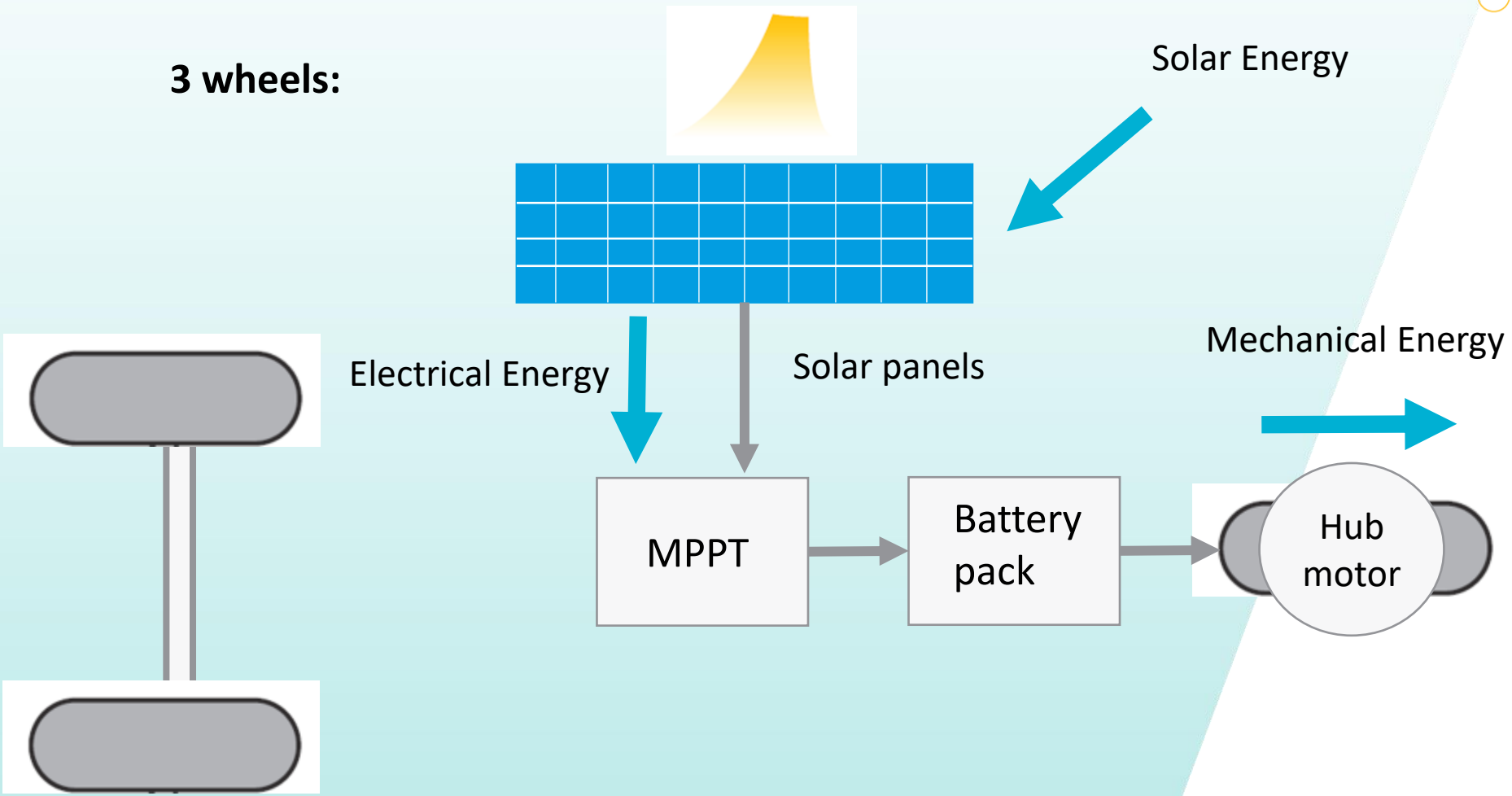
Power Train exploration

3 wheels:



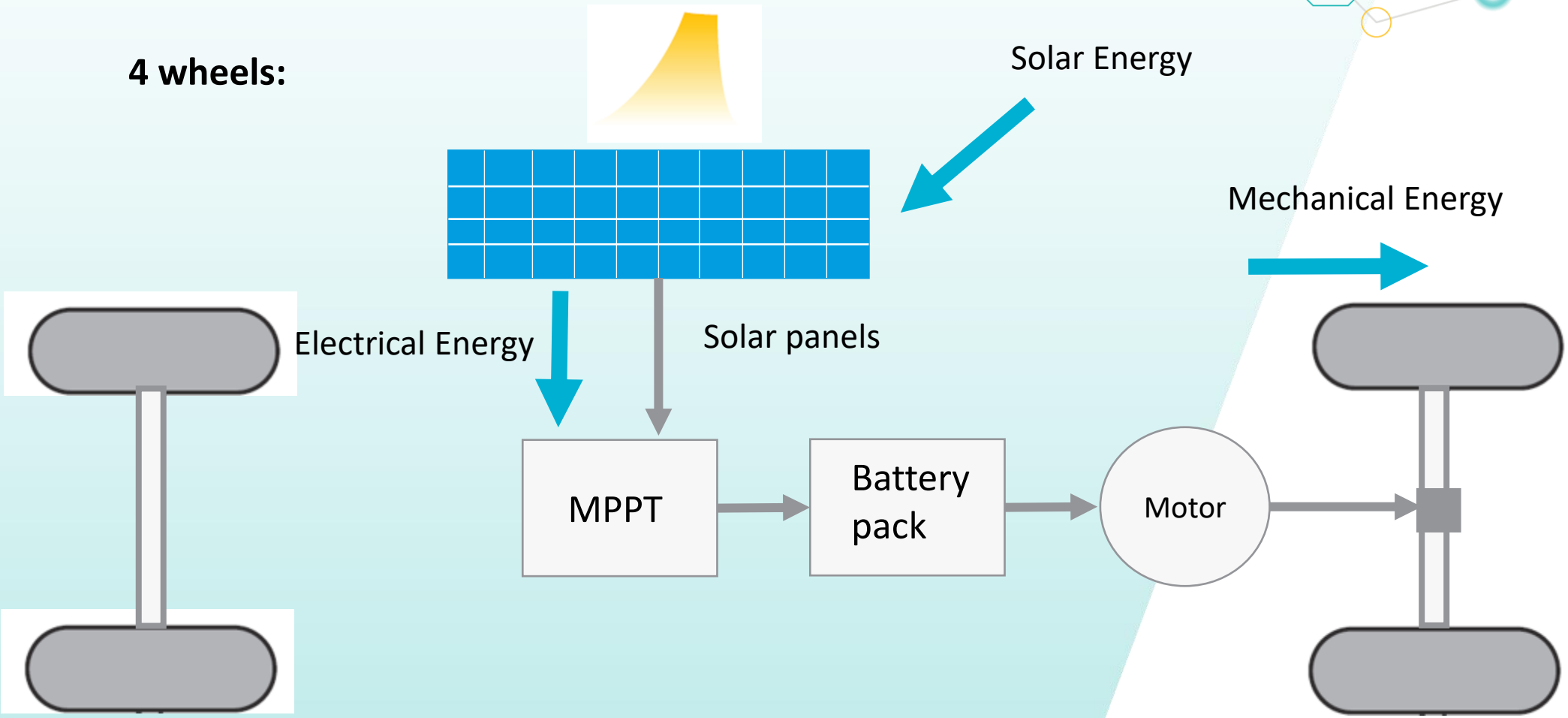
Power Train exploration

3 wheels:



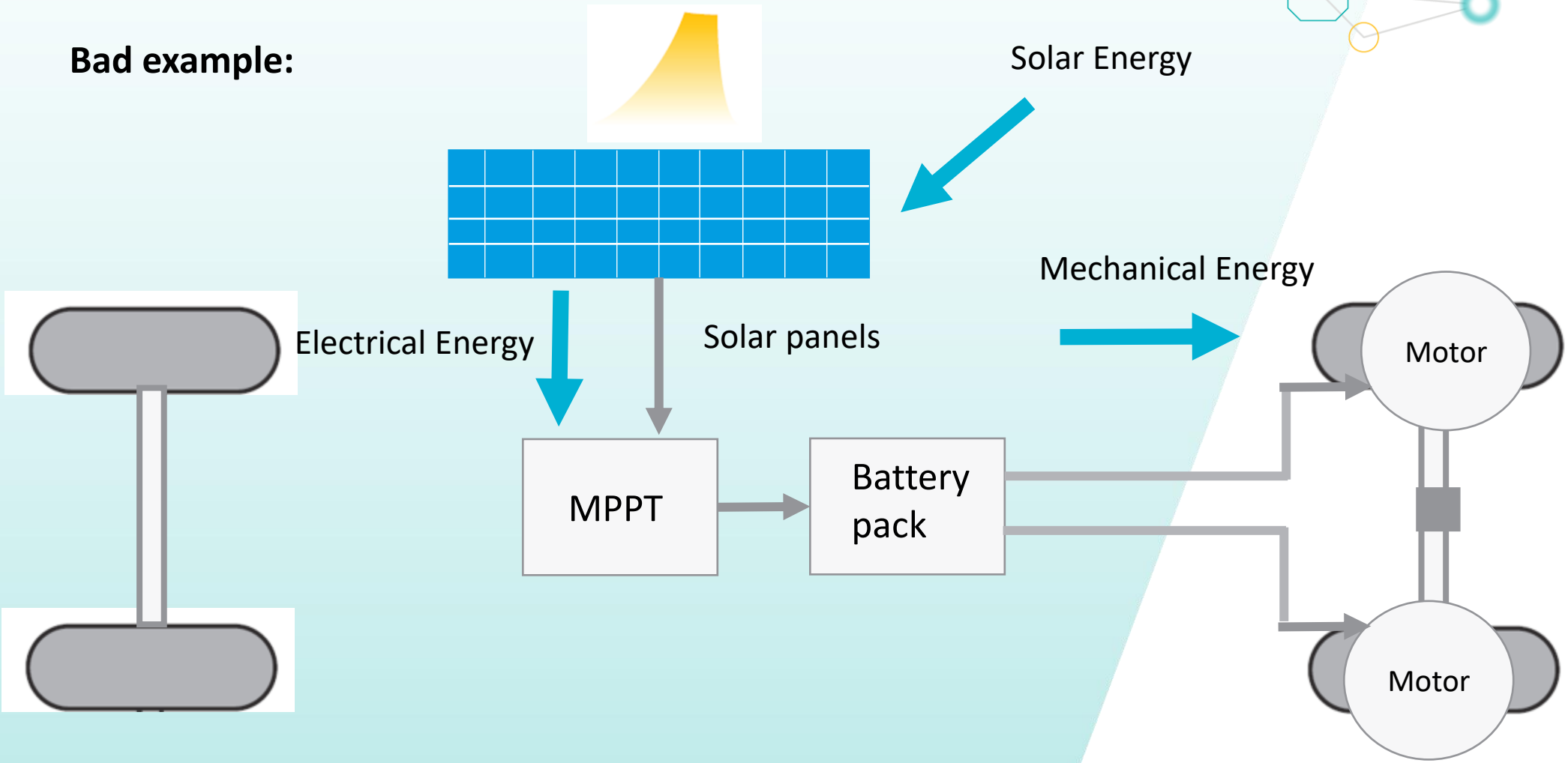
Power Train exploration

4 wheels:



Power Train exploration

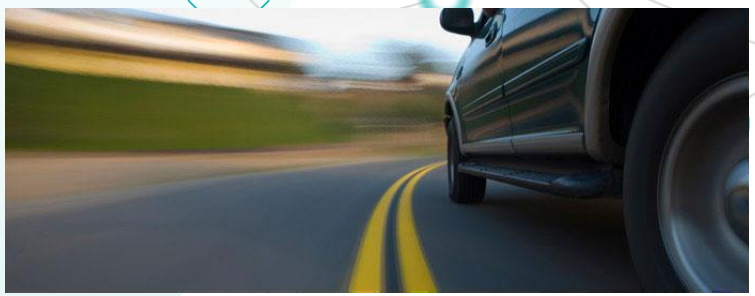
Bad example:

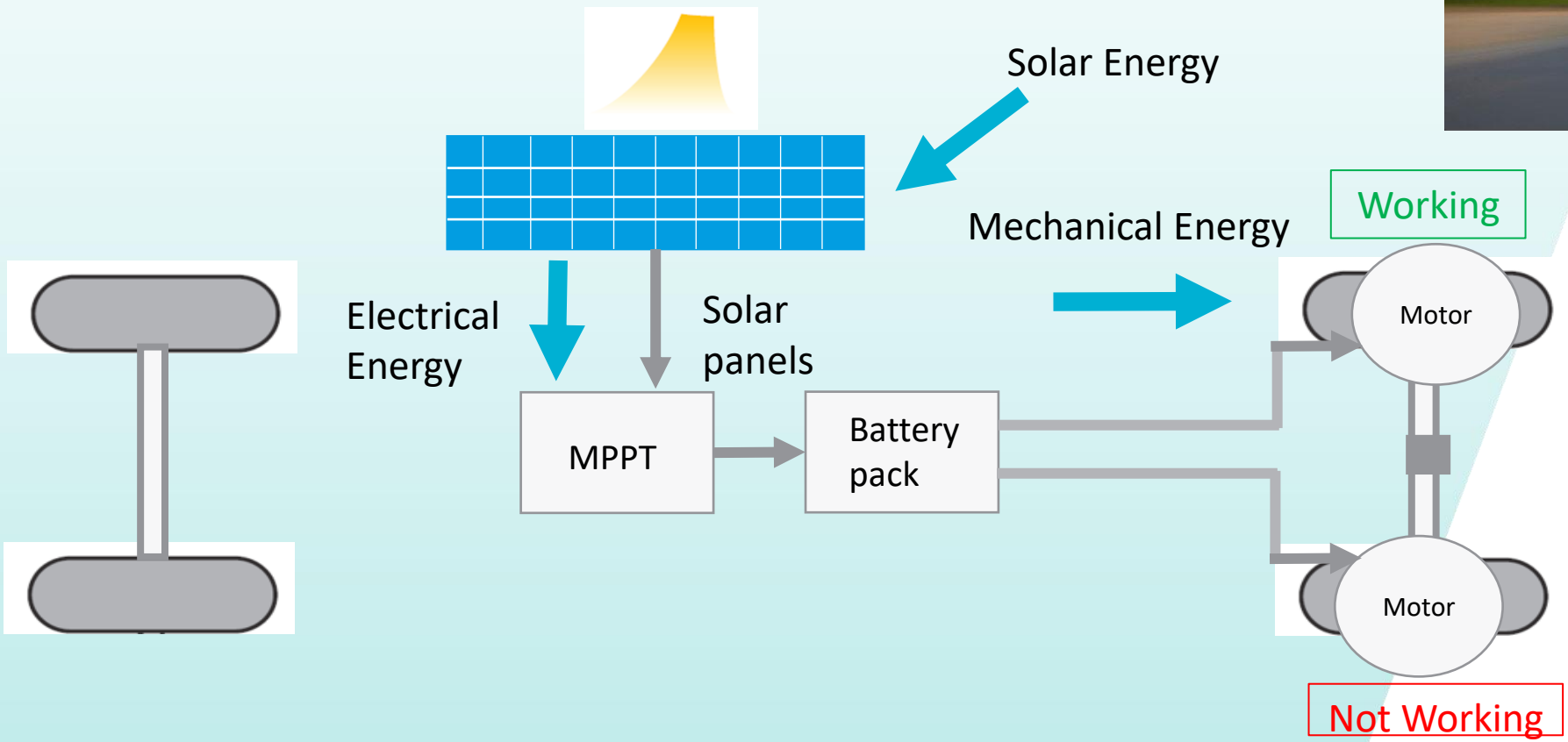


Power Train exploration

If one motor is not working:

Car crash accidents



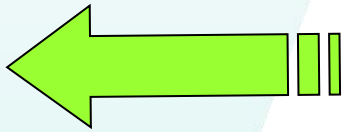


Energy storage and motor system

輸入功率

Input Power

Solar panels →Battery pack →Motor



輸出功率

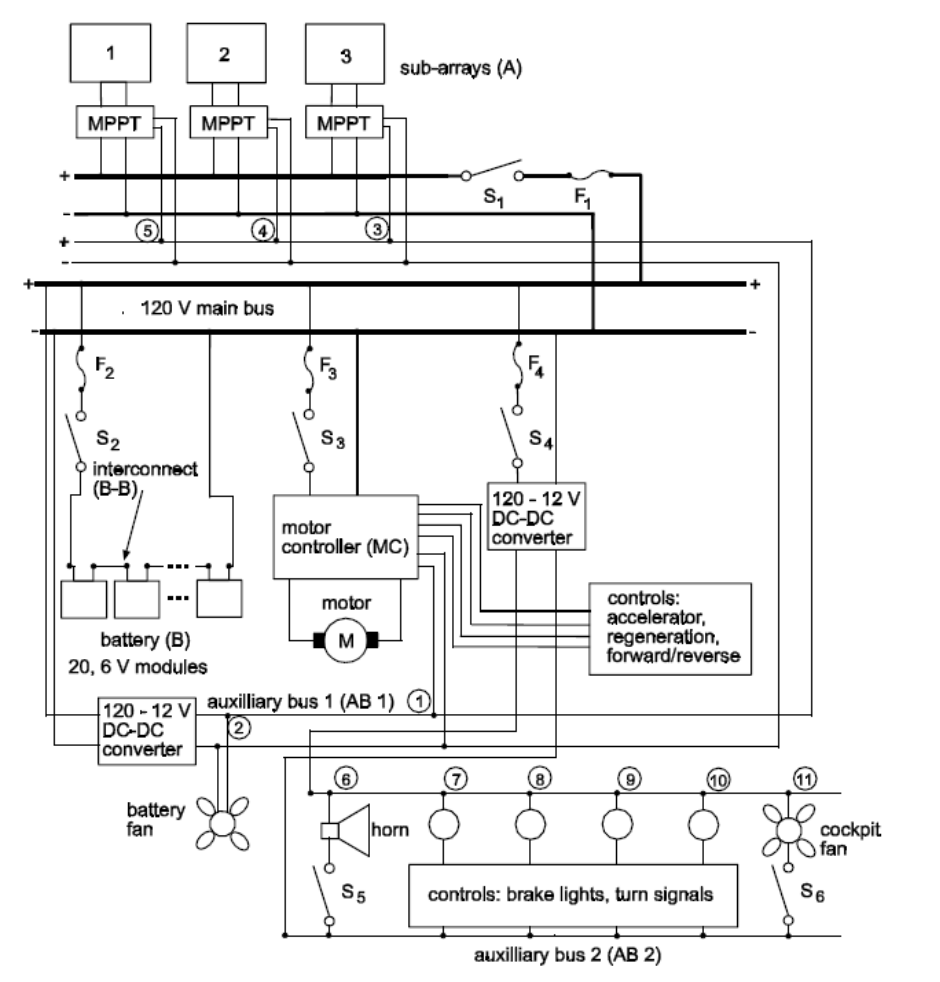
Output Power

Rolling Resistance

Air Resistance

Acceleration

Energy storage and motor system



Power System Schematic

Power Sources:

1. Solar cell array giving 9 A, 120 V, (standard conditions);
2. 20, series-connected, 6-V, Ag-Zn batteries.

Energy storage and motor system

Major Batteries developed for EVs

	Specific energy (Wh/kg)	Specific power (W/kg)	Cycle life (cycles)	Cost (USD/kWh)
VRLA	30–45	200–300	400–600	150
Ni-Cd	40–60	150–350	600–1200	300
Ni-MH	60–120	150–400	600–1200	200–350
Zn/air	230	105	NA	90–120
Na/S	100	200	800	250–450
Li-ion	90–160	250–450	1200–2000	600–1000

Energy storage and motor system

Storing Electric Energy (1):

Storage Methods. All autonomous cars must use propulsive energy stored in the car. Vehicles using *chemical* storage run on the energy stored in gasoline or other hydrocarbon fuels.

Solar energy can be stored in several ways: by *sensible* storage (heating a mass), by *phase change* storage (melting a substance) by *electrochemical* storage or *capacitive* storage (conversion to electric energy and storage in a battery or capacitor, respectively), or by *flywheel inertial* storage (converting electric energy to rotational kinetic energy and storing it in a spinning flywheel).

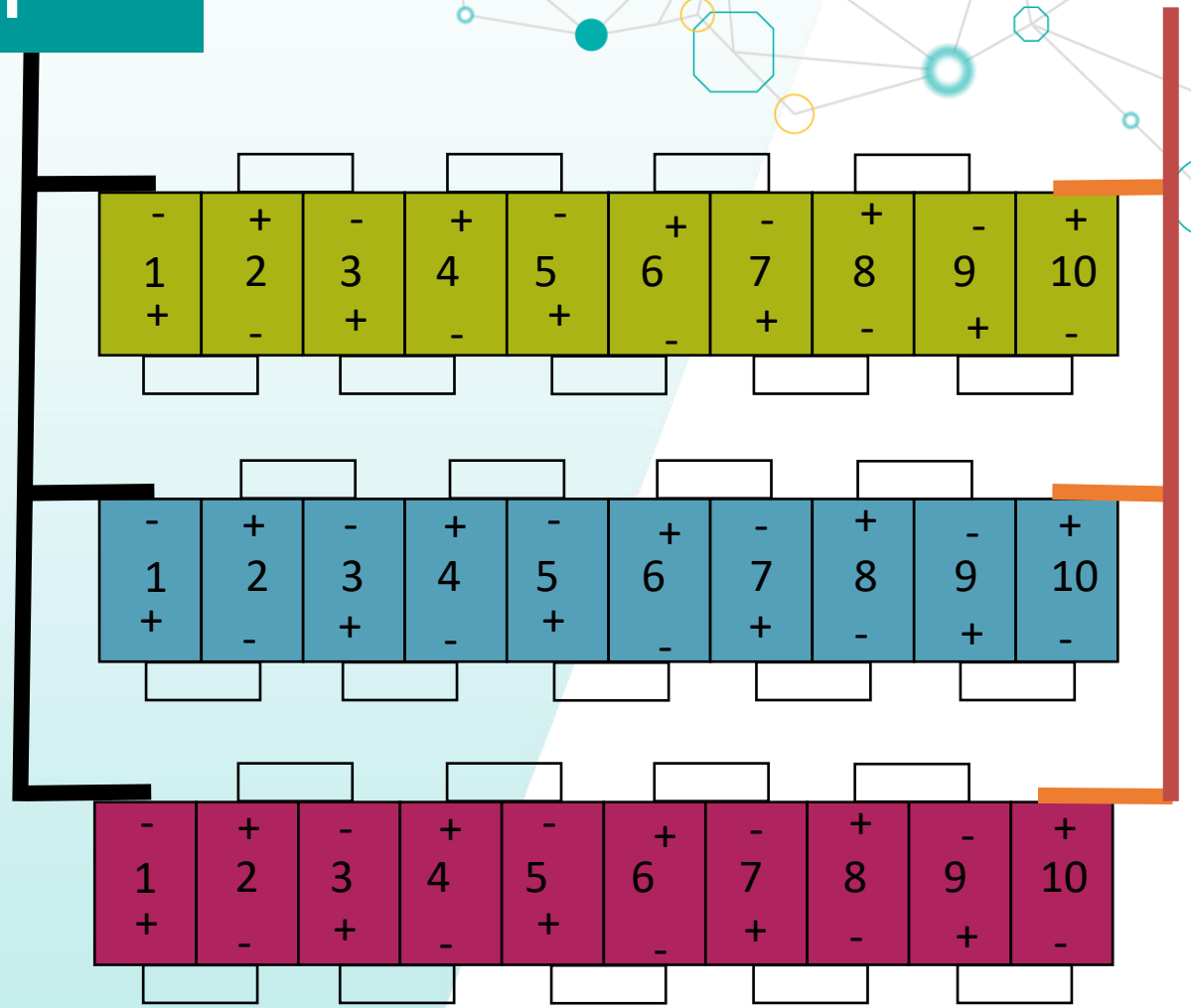
Note that inertial storage is intrinsic to all vehicles because each stores kinetic energy in its own mass and the rotating masses of its wheels and drive.

Energy storage and motor system

Battery connection:

Example:

3.7 Volts x 10 in serial = 37 V
Battery is 2600 mAh
For 3 sets in parallel = 2600mAh x 3 = 7.8Ah
Battery pack capacity(Wh) = 37 x 7.8 = 288.6 Wh



Energy storage and motor system

Energy Source / storage

-Any energy storage device**, must not exceed a nominal voltage of 48 VDC.**

-The energy storage device, must be **installed outside** of the driver's compartment.

- Nominal voltage of battery will be referred to battery specification.

- According to 5.Technical Documents c), The circuit drawing must contain batteries, fuses, circuit breakers, power switchers, solar generator, power trackers, capacitors, motor-controller or chopper, motor(s) and junction cables.
  All components in the circuit drawing must be labelled with their detailed electrical specifications.

Energy storage and motor system

Only one propulsion battery and one accessory battery per vehicle are allowed.

Propulsion battery

provide power to the power train

Li-ion battery pack need a Battery Management System (BMS)

Accessory battery

provide power to all safety devices such as, E-stop relay, lighting

cannot be used for cooling systems, electric motors

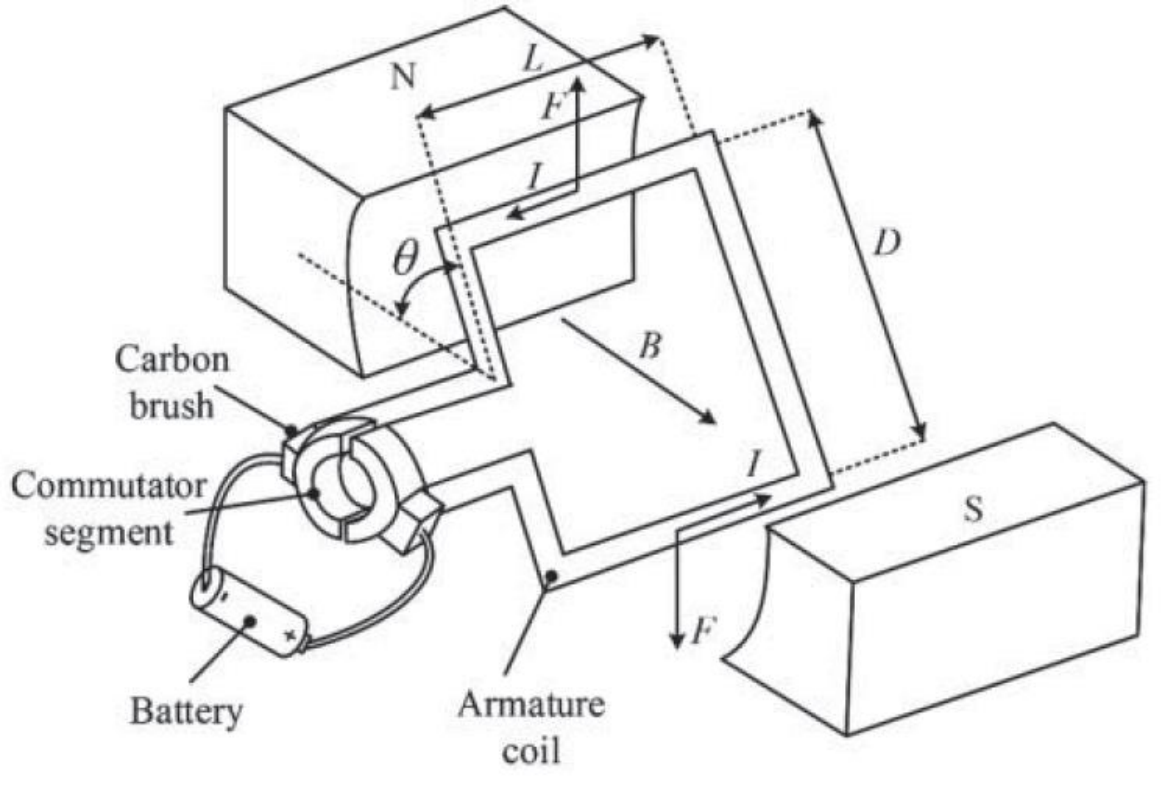
only one unit

Energy storage and motor system

The energy storage device, including fuel cell, must be equipped with protective measures to **automatically isolate** the said device in the event of overvoltage, overcurrent, short-circuit, thermal overload and other abnormal operation of the said device without the need for power other than from the said device.

Energy storage and motor system

Principle of DC machine rotation

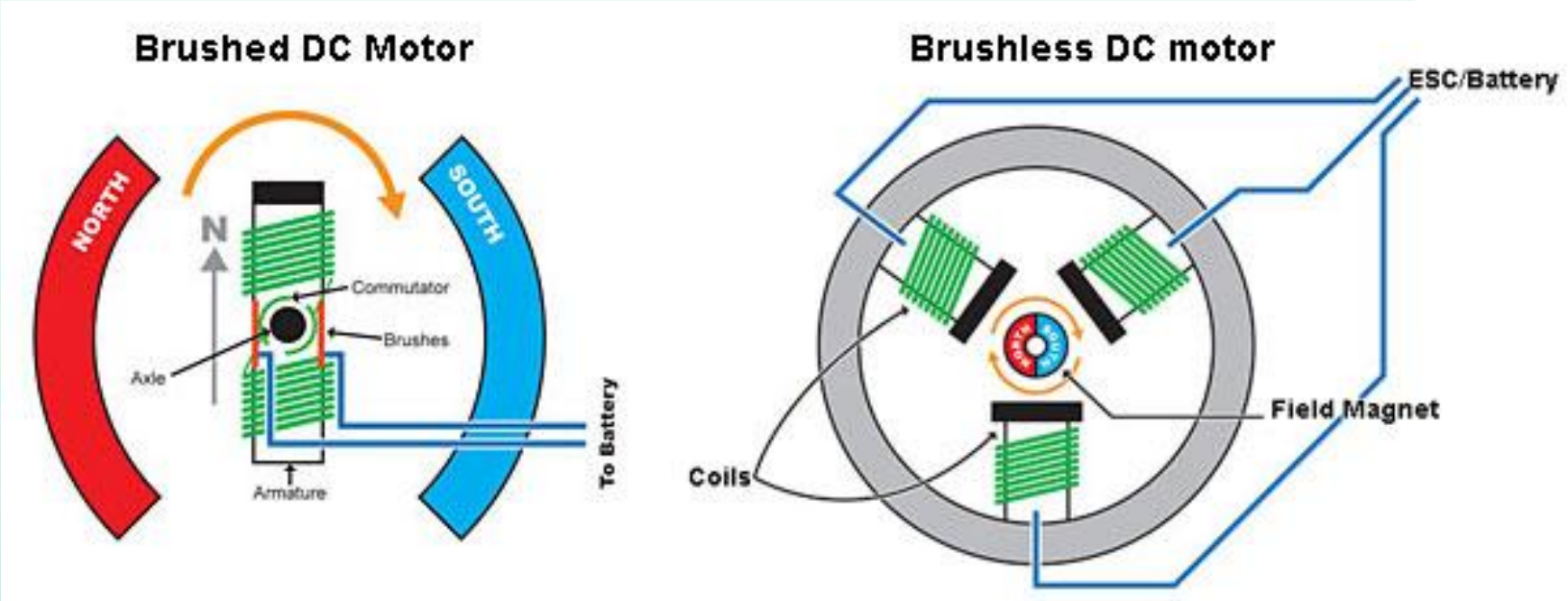


- Electric Current
- Magnetic Field

- Force (Rotation)

Energy storage and motor system

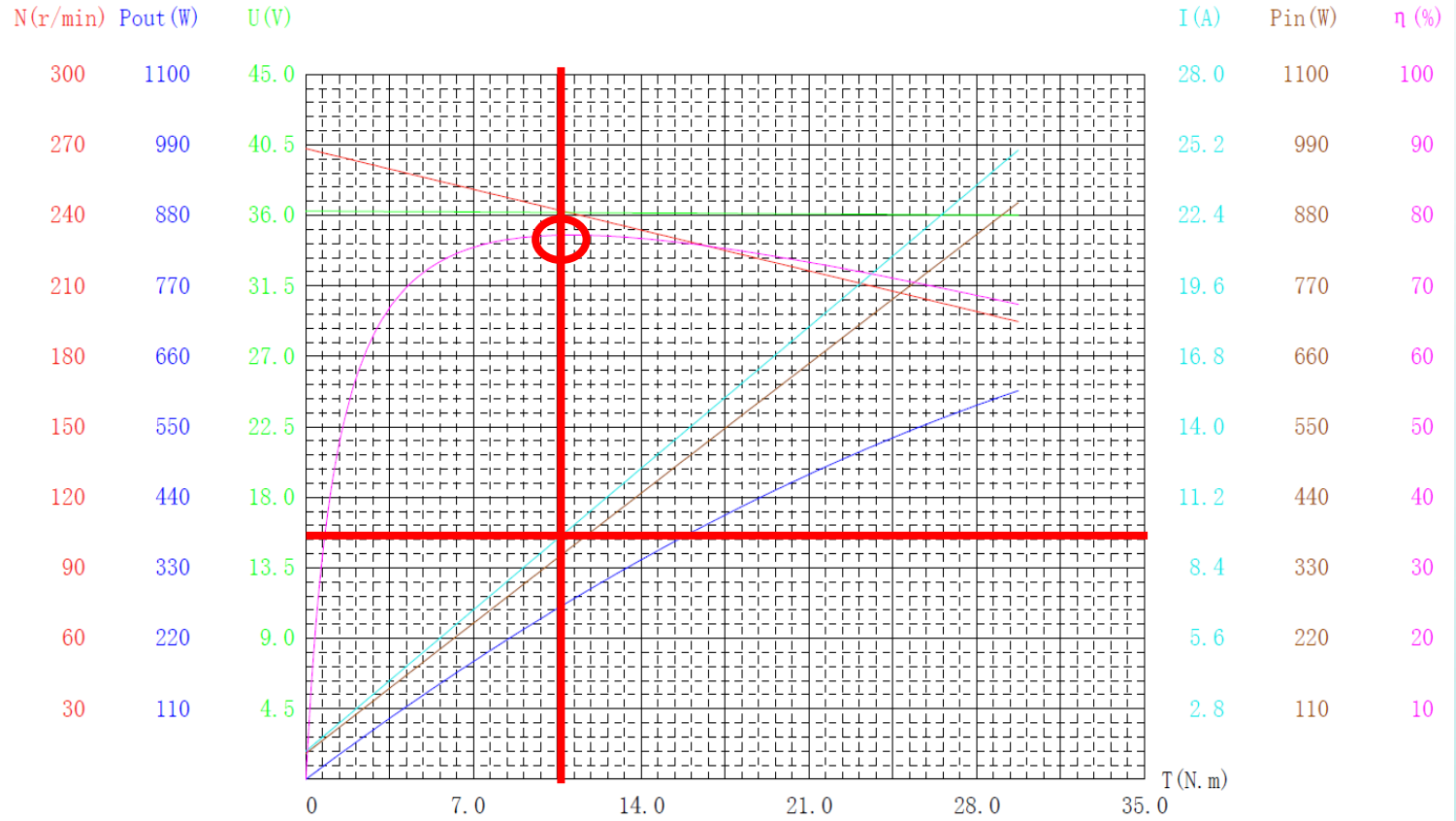
- Electric controller(ESC) is required to keep the motor running which is sometimes more expensive than the motor.



Energy storage and motor system

Energy storage and motor system

Motor characteristic curve:



Parameter:

1. N (r/min): Revolution(s) Per Minute
2. Pout(W): Power output
3. U(V): Motor voltage
4. I(A): Motor current
5. Pin(W): Power input
6. η (%): Motor power efficiency

Energy storage and motor system

Recall Lesson 1:

$$P = V\ x\ I = T\ x\ rpm$$

Pin= V x I = 358.2 W

Pout= Pin x η

= 358.2 x 0.772

=276.5 W

I = 9.95 A, V= 36V, and η = 77.2 %

Parameter:

1. N (r/min): Revolution(s) Per Minute
2. Pout(W): Power output
3. U(V): Motor voltage
4. I(A): Motor current
5. Pin(W): Power input
6. η (%): Motor power efficiency
7. T(N.m.) Torque

Energy storage and motor system

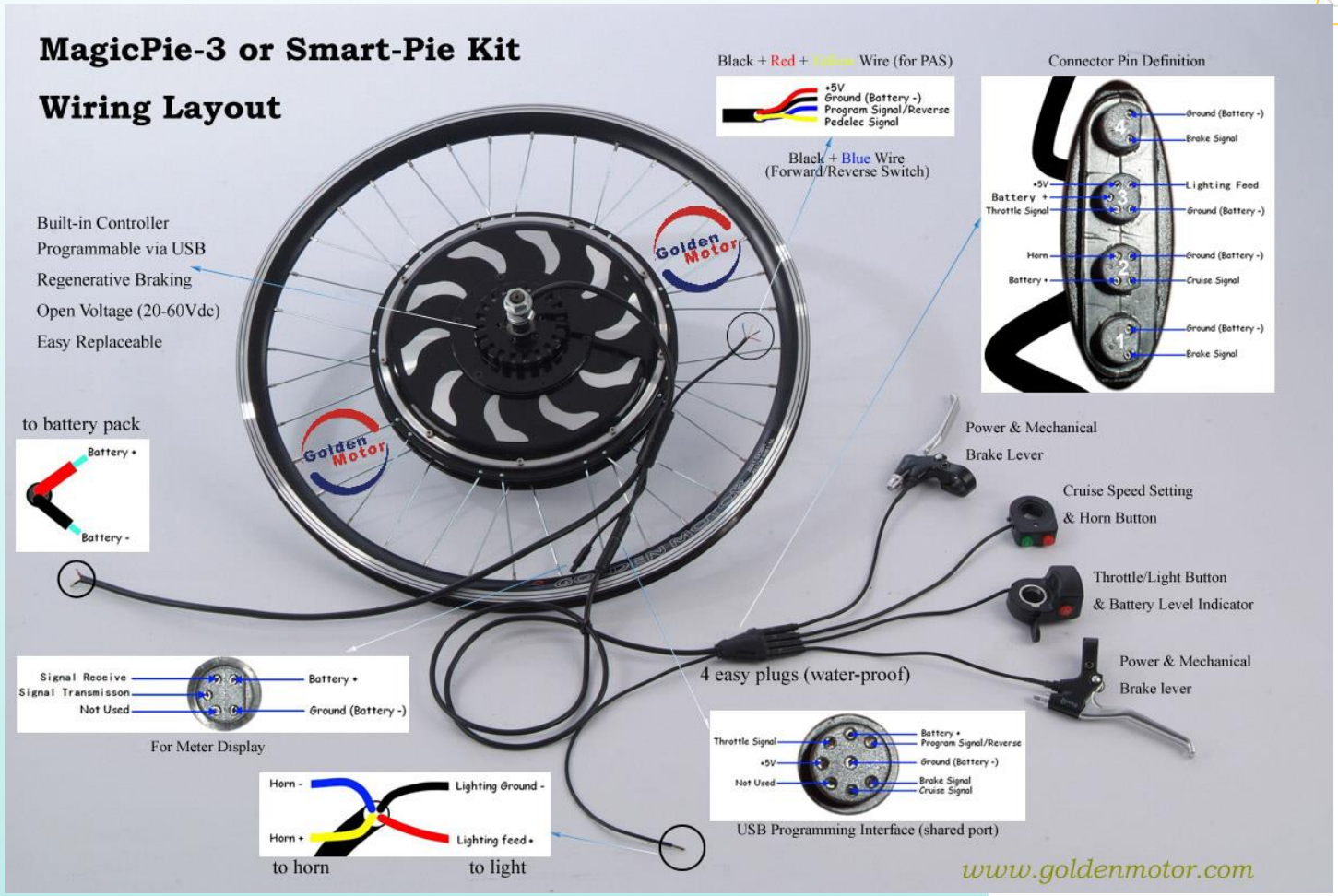
Why in-wheel motor?

- high torque
- fast response
- gearless operation
- zero transmission loss

Energy storage and motor system

Motor control example:

- On/Off
- Forward/ Reverse
- Speed control
- Stop
- Light & horn
- Meter display



IVE | Engineering 工程

SOPHIE SGOC SMART CITY INNOVATION CENTRE

小休

IVE | Engineering 工程

SOPHIE

SGOC

SMART CITY INNOVATION CENTRE

E-Mobility

How about your project progress?

- What is your designed external dimension?
- Which type of chassis do you choose?
  - Monocoque
  - Space frame/ I beam
- Hand-made or purchase
- Delivery date of the key component?

E-Mobility

Flat Surface

Sheet metal?
Thin Balsa wood?

IVE | Engineering 工程

SOPHIE

SGOC

SMART CITY INNOVATION CENTRE

E-Mobility

E-Mobility

E-Mobility

IVE | Engineering 工程

SOPHIE

SGDC

SMART CITY INNOVATION CENTRE

E-Mobility

IVE | Engineering 工程

SOPHIE

SGOC

SMART CITY INNOVATION CENTRE

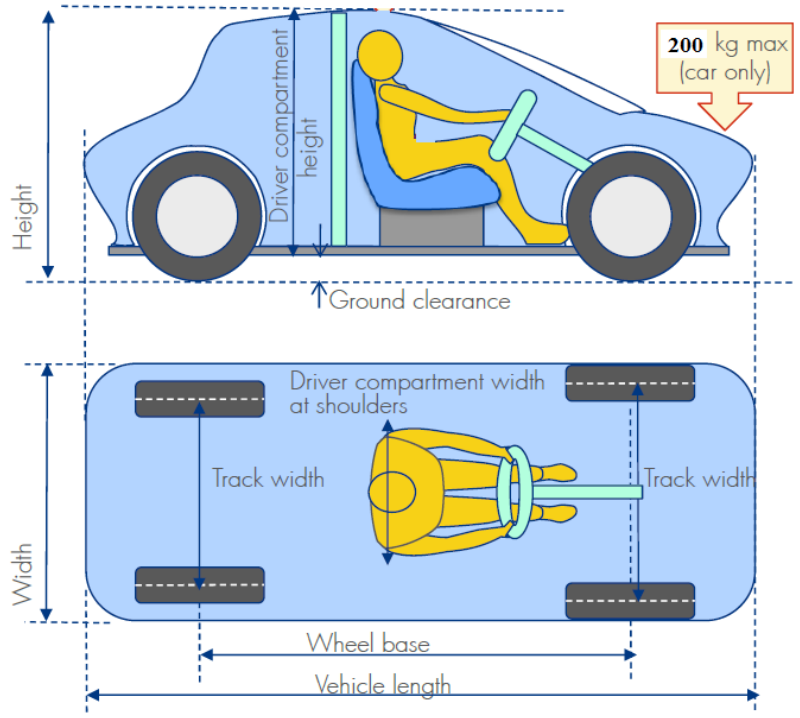
E-Mobility

Typical questions

1. Any allowance for the limit of external dimension?

(Regulation 3. Car design 3.1 Dimensions)

Dimension	Limits
Max. Height	1300mm
Max. Width	1300mm
Max. Length	3500mm
Track width	50% of width
Wheelbase	>1200mm
Ground clearance	>100mm
Max. vehicle weight (without driver)	225 kg



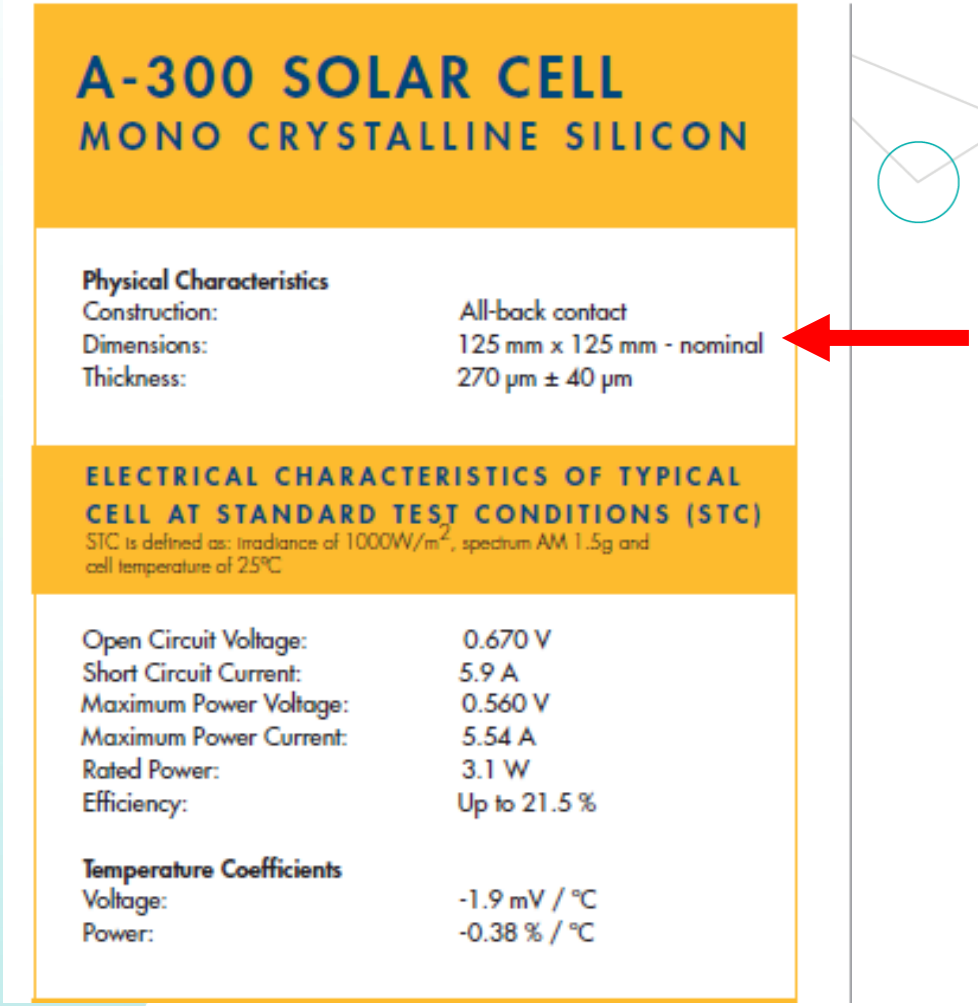
Typical questions

2. Solar Panel limitation:

(Regulation 4.2 Solar Panel)

Maximum allowable solar collector with **Silicon solar cells** is 1.0 $m2$.

GaAs solar cells, the maximum solar collector array will be reduced to 50 per cent of the maximum solar collector area specified for Silicon solar cells



A-300 SOLAR CELL
MONO CRYSTALLINE SILICON

Physical Characteristics

Construction:	All-back contact
Dimensions:	125 mm x 125 mm - nominal
Thickness:	270 µm ± 40 µm

ELECTRICAL CHARACTERISTICS OF TYPICAL CELL AT STANDARD TEST CONDITIONS (STC)

STC is defined as: Irradiance of 1000W/m^2, spectrum AM 1.5g and cell temperature of 25°C

Open Circuit Voltage:	0.670 V
Short Circuit Current:	5.9 A
Maximum Power Voltage:	0.560 V
Maximum Power Current:	5.54 A
Rated Power:	3.1 W
Efficiency:	Up to 21.5 %

Temperature Coefficients

Voltage:	-1.9 mV / °C
Power:	-0.38 % / °C

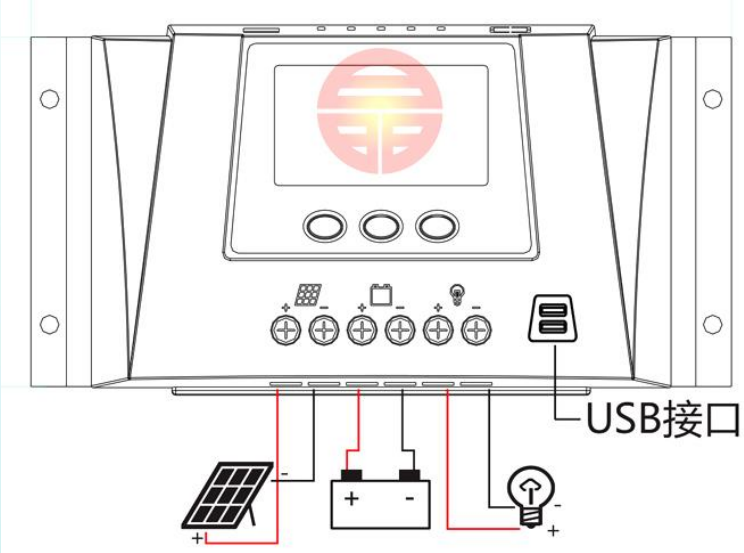
Typical questions

MPPT converter

Example:

We have 2 set of 50 W 18V,

2 set of 150W 24V.



At least 2 set of MPPT converter need.

The converter can only work under same voltage level.

Most efficient way is series the solar panels/ separate with converter.

Typical questions

3. Brake:

Two independently triggered braking systems commanded by one single command unit, e.g. a foot pedal or lever, must be installed onto the vehicle.

2 Independent Braking System

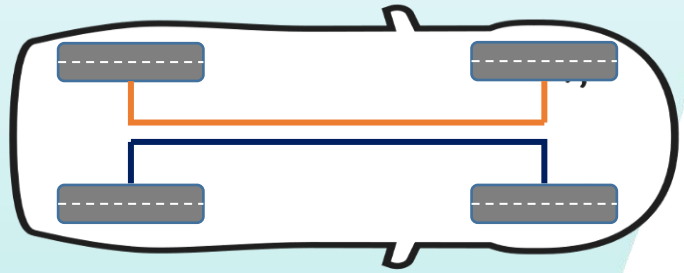
- Primary Braking
- Parking Braking

Ensure the car can STOP moving! Even one of them FAIL!

Typical questions

Each braking system must NOT act on only one side of wheels.

Caution: Each system must NOT act only one side of wheels



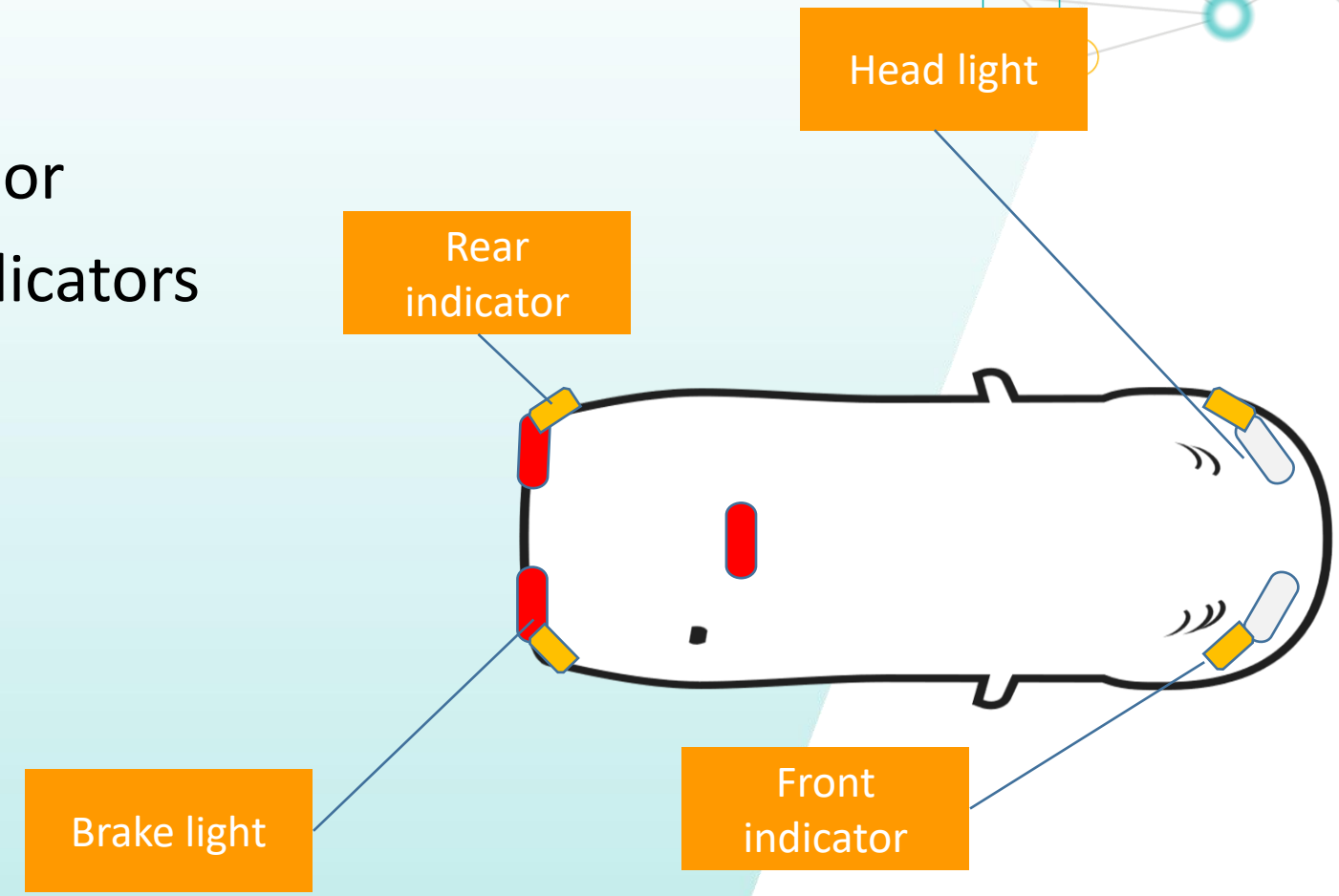
Typical questions

4. Light fitting

- Headlights in white color
- Front and rear turn indicators

In amber color

- Stoplights in red color



Typical questions

5. Seat belt installation (at least 5-points)

2.16 Safety Belts

a)	The Driver's seat must be fitted with an effective safety harness with at least five mounting points to maintain the Driver securely in his/her seat. The five independent belts must be firmly attached to the vehicle's main structure and be fitted into a single buckle, specifically designed for this purpose.

Typical questions

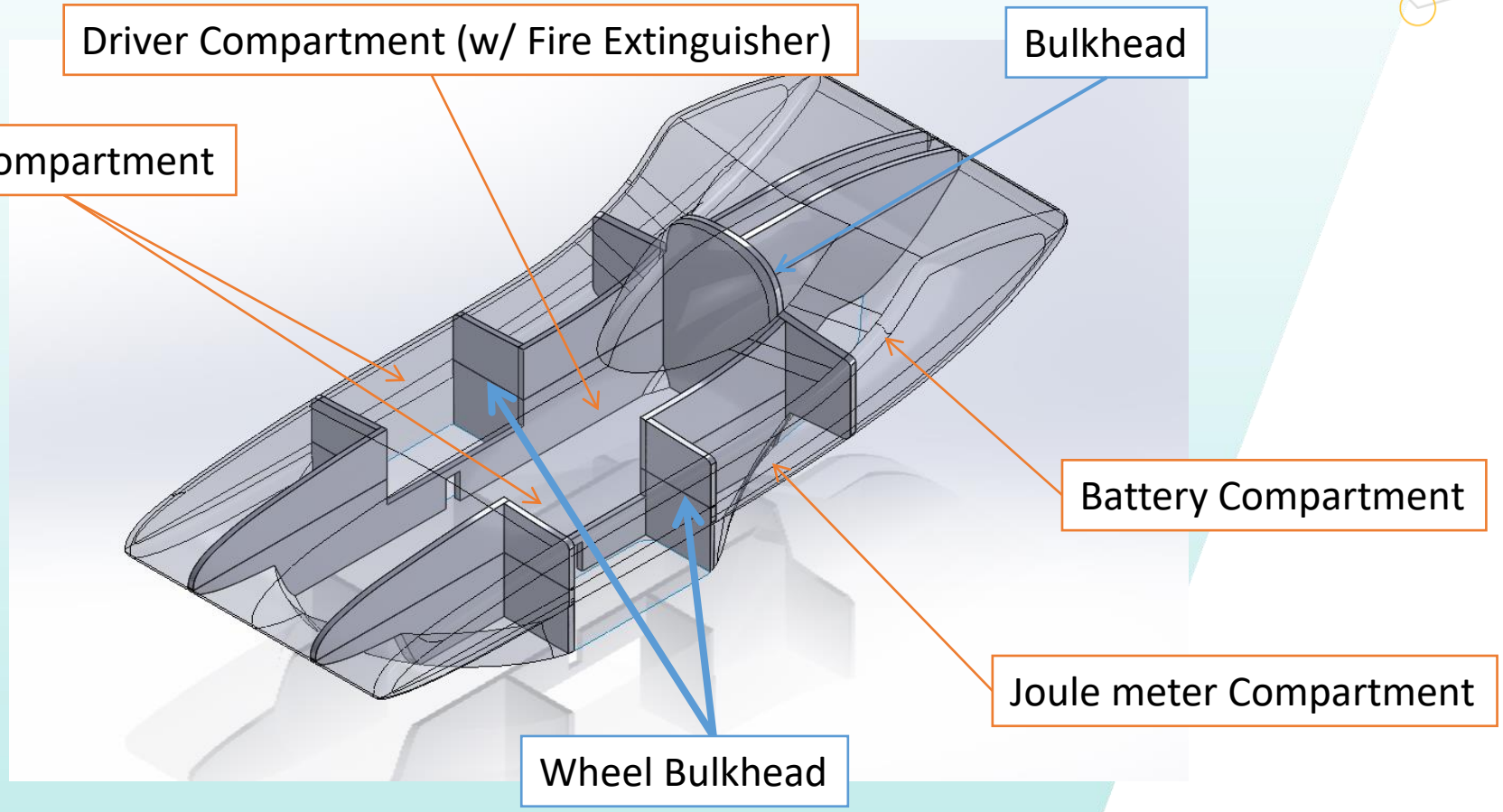
6. Steering rack

Typical questions

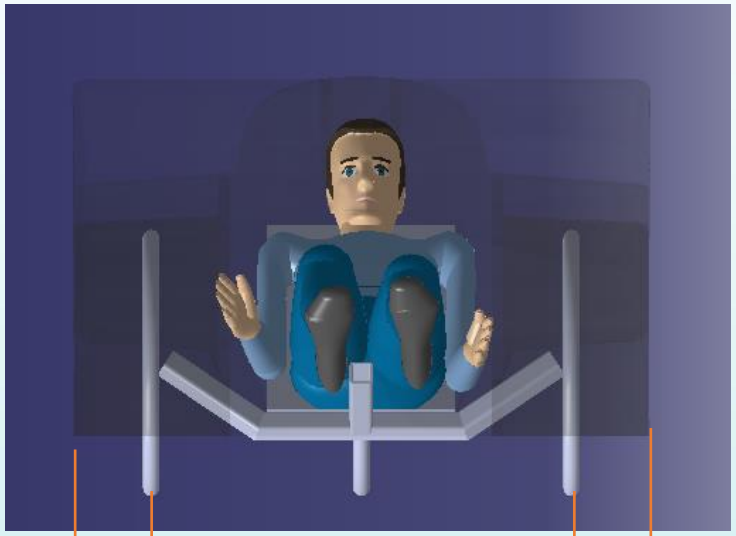
2.22 Fire Extinguisher

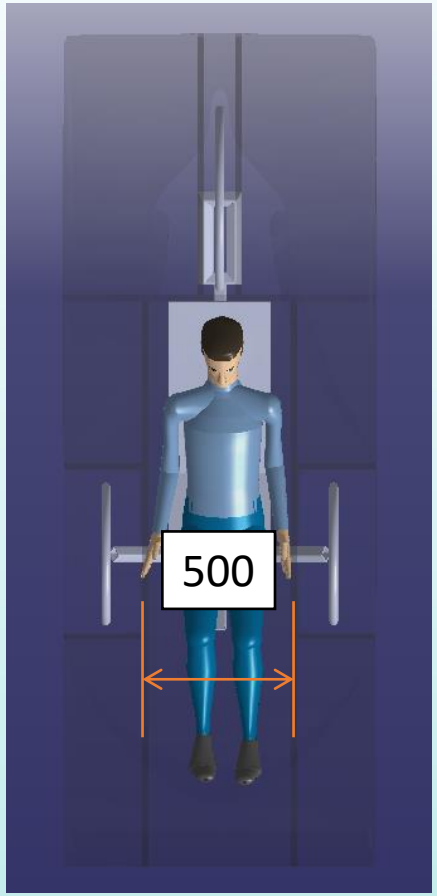
a)	Each vehicle must be fitted with a 1kg fire extinguisher within the cockpit and be accessible to the Driver. These should be securely mounted to prevent movement while driving / braking. All Drivers must be trained in the use of said fire extinguisher.
b)	The extinguisher must be pressurised to 8 bar minimum and 13.5 bar maximum. The following information must be visible on each extinguisher: capacity, type of fire extinguisher, weight or volume of the fire extinguisher and date the extinguisher must be checked, which must be no more than two years after either the date of filling or the date of the last check.
c)	The extinguishers must be easily accessible for the driver.

Typical questions



Typical questions





IVE | Engineering 工程

SOPHIE

SGDC

SMART CITY INNOVATION CENTRE

End