



PROTON Green Technology – The Past, the Present & the Future

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Zero Emission

Today
2023



8 Billion
World Population



33 Megacities
4.4 Billion (55%)
Urban Population



1.1 Billion Cars (14%)

CO₂ emission ↑
(global warming)



Air pollution ↑
(health problems)

Stress on oil reserve ↑
(fossil fuel depleting)



Future
2050



9.8 Billion
World Population



47 Megacities
6.7 Billion (68%)
Urban Population



2.4 Billion Cars (24%)

Zero Accident

Traffic accidents ↑

100% Personalisation



The Big Picture: Driving Factors of the CASE Mobility Trends

The automotive industry is experiencing significant changes in response to government policies and regulations and evolving consumer demands.



Paris Climate Agreement 2016:
Reduce GHG emissions to limit global temperature rise to <2°C
Carbon Neutrality 2050:
Net zero GHG emissions



Global Agreement 2016-2050

National Automotive Policy 2020-2030

Low Carbon Mobility Blueprint 2021-2030

Automotive Regulations & Consumer Expectations

New elements in NAP 2020:
Mobility-as-a-Service (MaaS)
Next Generation Vehicle (NxGV)
Industrial Revolution 4.0 (IR4.0)



Smart Geely 2025 Strategy



New regulations:

- Driven by global issues – climate change, increase in traffic accidents
- Driven by new technologies – connected, autonomous, electric, OTA software and firmware updates

Consumer expectations:

- Change in driving needs – owning to using, performance to experiences, connected lifestyle (home, car, human)

Future core competitiveness in smart vehicles – Smart Geely 2025 Strategy:

- Smart cockpit (FOTA)
- Smart drive (L4|L5)
- Smart energy (“Leishen Power” brand)
- Smart manufacturing (Geely Industrial Internet Platform)
- Smart service

BEV Passenger Car:
9% TIV by 2027
15% TIV by 2030
100% government fleet by 2030
Public charger by 2025:
9000 AC chargers
1000 DC chargers



PROTON CASE Strategy 2030



Future of mobility, CASE:

- Connected (4G|5G)
- Autonomous (L2|L3)
- Shared (B2B|B2C|P2P|Non-profit)
- Electric (BEV|PHEV)

Legend: BEV – Battery Electric Vehicle; PHEV – Plug-in Hybrid Electric Vehicle; B2B – Business-to-Business, B2C – Business-to-Consumer, P2P – Peer-to-Peer, FOTA – Firmware Over-the-Air updates, GHG – Greenhouse Gases, L2/L3/L4/L5 – Refers to autonomous vehicle levels; TIV – Total Industry Volume

ASEAN EV Targets Towards Zero Emission Mobility by 2050

Thailand, Singapore and Indonesia aim to have 100% electric vehicles by 2050.



ASEAN BEV YTD Apr 2023:
24,151 units
Rank 1: BYD Atto 3
Rank 2: Neta V
Rank 3: Tesla Model Y

Malaysia
9% by 2027
15% by 2030



Σ 2658u
Rank 1:
BYD Atto 3

Indonesia
20% by 2025
100% by 2050



Σ 3094u
Rank 1:
Hyundai Ioniq 5

Thailand
30% by 2030
100% by 2035



Σ 18,399u
Rank 1:
BYD Atto 3

Philippines
21% by 2030

Brunei
60% by 2035

Singapore
100% by 2040

Powertrain efficiency

General overview



ICE

Hybrid [ICE + e-Motor]

BEV



Powertrain efficiency

20% ~ 30%

> 30%

>90%

Energy source

100% Petrol

[mix] Petrol & Electric

100% Electric

Increase overall % efficiency

ICE - Internal Combustion Engine

**Hybrid:
MHEV, PHEV, HEV, REEV**

BEV – Battery Electric Vehicle

Legend: BEV – Battery Electric Vehicle; ICE – Internal Combustion Engine; MHEV – Mild Hybrid Electric Vehicle; PHEV – Plug-in Hybrid Electric Vehicle; REEV – Range Extended Electric Vehicle; HEV – Hybrid Electric Vehicle

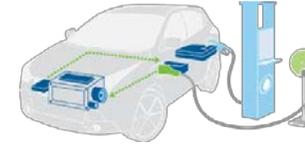
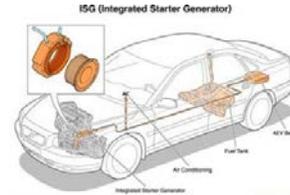


Vehicle Electrification

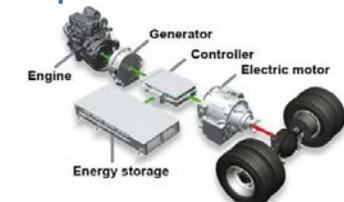
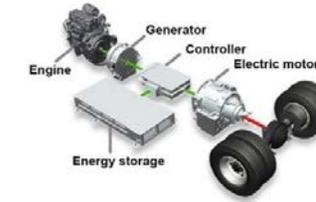
The concept



PROTON



Plug-in & full EV driving possible

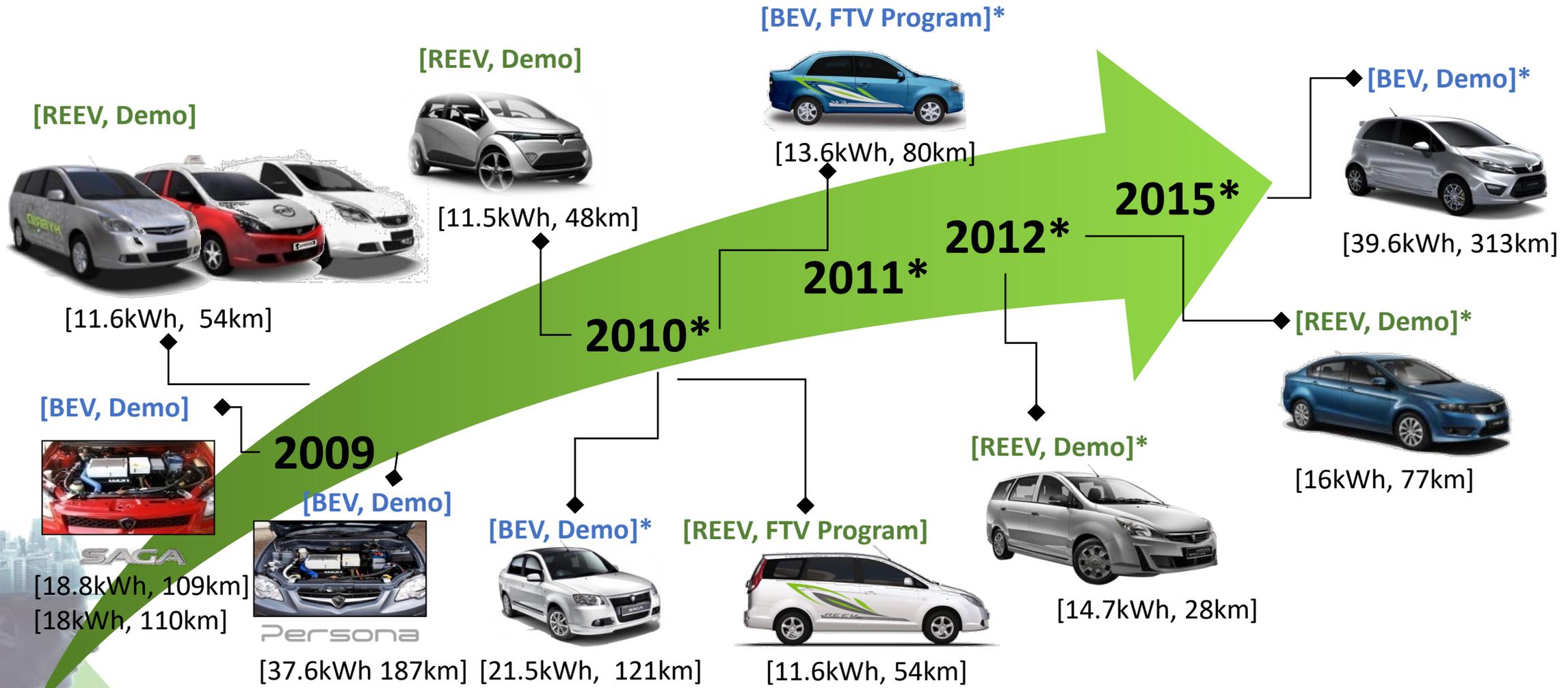


Hybrid Type	Non-Hybrid	Parallel Hybrid			Series Hybrid	Full Electric	
Motor Power	Not available	<5kW	5 – 15kW	20 – 40kW	60 – 120kW	60 – 150kW	
CO2 reduction	0%	1 – 2%	10 – 15%	~ 30%	> 50%	> 50%	
Electrification Class	Full ICE	Micro Hybrid	Mild hybrid Electric Vehicle (MHEV)	Hybrid Electric Vehicle (HEV)	Plug-in HEV (PHEV)	Range Extended EV (REEV)	Battery Electric Vehicle (BEV)
Technology	<ul style="list-style-type: none"> Normal ICE Work base on pedal demand 	<ul style="list-style-type: none"> Motor <5kW Battery ~ <1kWh Enhanced starter Direct starter 	<ul style="list-style-type: none"> Motor ~5 – 15kW Battery ~ <1kWh BSG Integrated starter gen. 	<ul style="list-style-type: none"> Motor ~20 – 40kW Battery ~ 1 – 2Wh ISG & Electric axle Power split hybrid 	<ul style="list-style-type: none"> Motor ~60 – 120kW Battery > 10kWh HEV + Plug-in charging 	<ul style="list-style-type: none"> Motor ~60 – 150kW Battery 1.5 – 40kWh EV + Range extender 	<ul style="list-style-type: none"> Motor ~60 – 150kW Battery ~> 30kWh Full electric drive Fuel cell EV (FCEV)
Motor as traction	• No	• No	• Torque assist to traction at short time	• Limited distance only as small HV battery	• 100% traction if HV battery SOC enough	• 100% as traction	• 100% as traction
Advantage	• Conventional engine	• 1 – 2% FC reduction (No engine idling FC)	• 10 – 15% FC improve • μ Hybrid + torque assist + regen braking	• ~30% FC improvement • MHEV + EV assist	• >50% FC improvement • HEV + EV Range (>30km)	• >50% FC improvement • HEV + EV Range (>30km)	• Zero CO ₂ tailpipe emission
Mass Pro model	<ul style="list-style-type: none"> Saga Iriz 	<ul style="list-style-type: none"> Myvi Bezza Mazda 6 	<ul style="list-style-type: none"> X90 Nissan Serena 	<ul style="list-style-type: none"> Toyota PRIUS Honda City RS 	<ul style="list-style-type: none"> Binyue PHEV (EV Range NEDC 62km) XC40 PHEV (EV range WLTP = 46km) 	<ul style="list-style-type: none"> Nissan Note E power Daihatsu Rocky Mazda MX-30 e-Sky BMW i3 REX Fisker Karma 	<ul style="list-style-type: none"> smart #1 Otto 3 Tesla model 3 Toyota bz4x

[The past] Vehicle electrification

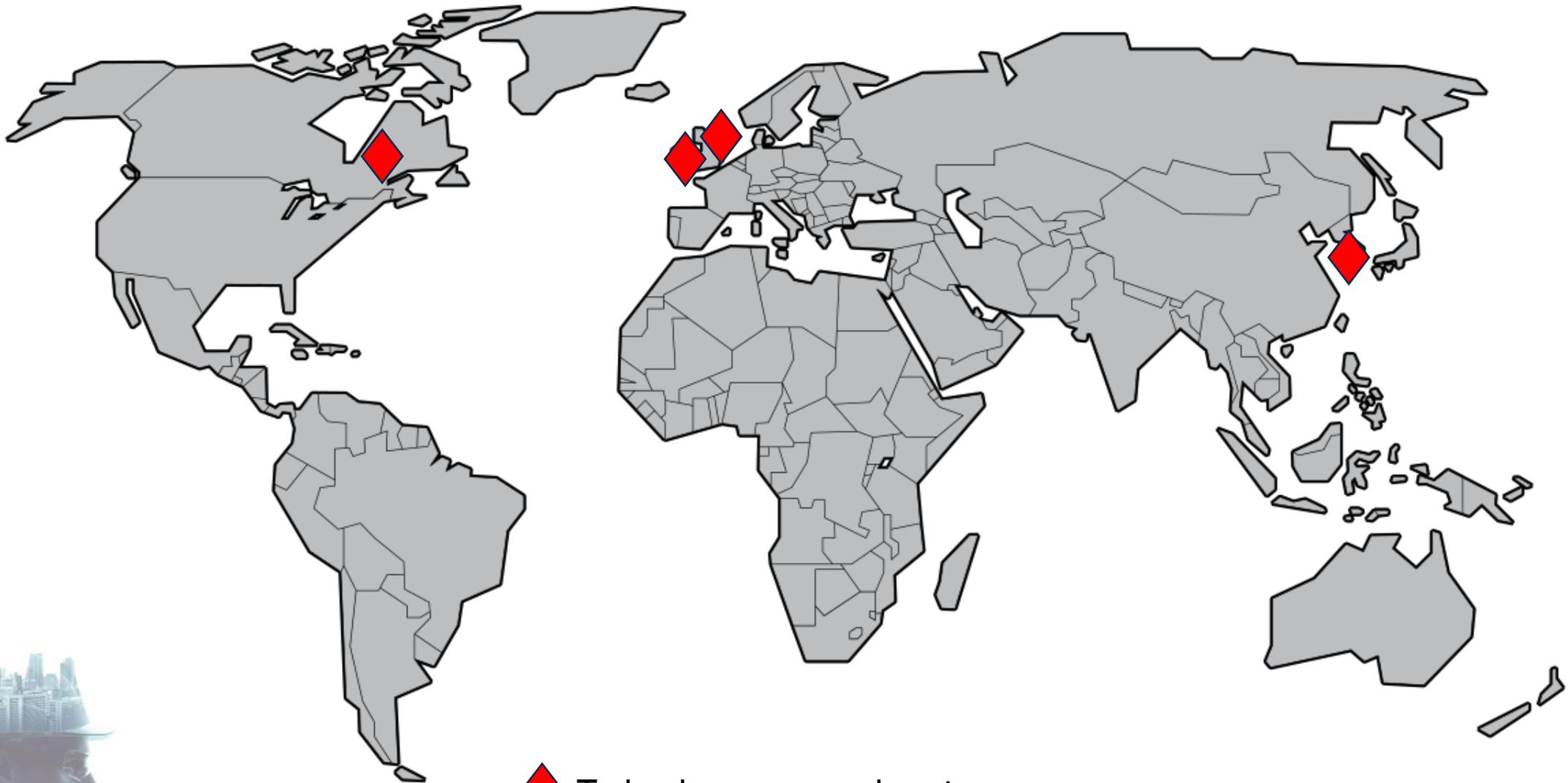


[2010-2015] Achievement: Completed four projects on BEV* and two project on REEV* with key technology partners;



Legend: FTV – Fleet Test Vehicle

[The past] Our technology partners



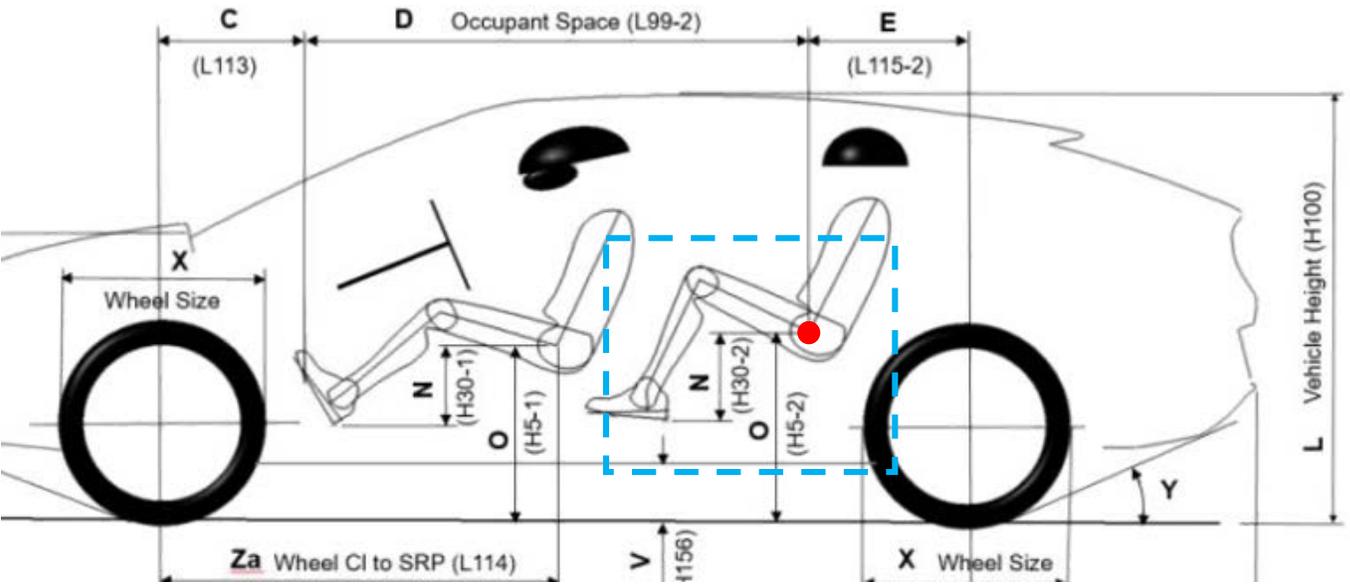
◆ Technology partners location



[The past] Lesson learnt

Sharing

1. [BEV] Challenge: High Voltage Battery packaging – modified existing underfloor: cause rear seat hip-point to raise up.

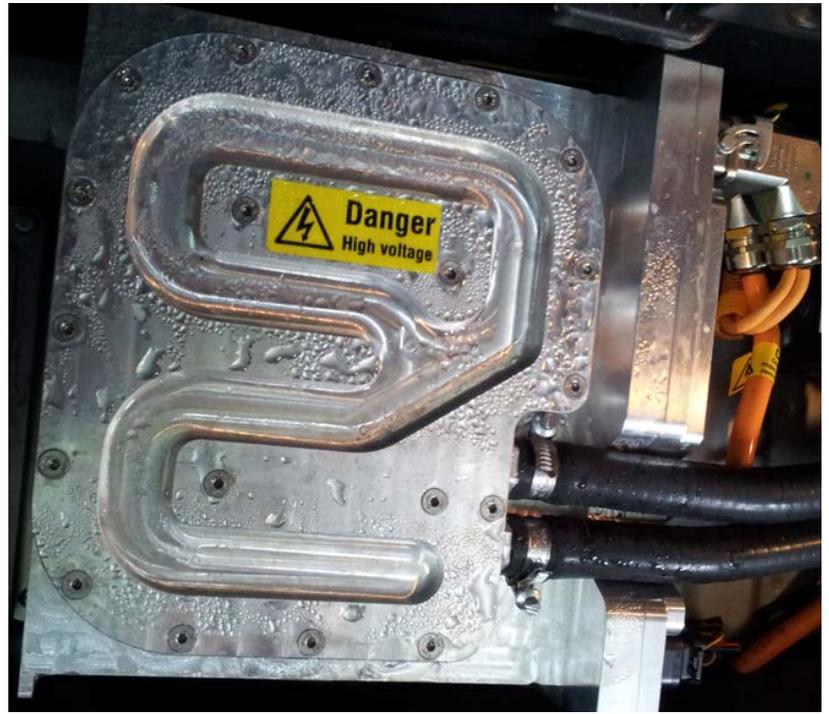


Hip-point for rear passenger

3. [REEV] Charge sustaining speed: unable to drive > 110km/h to keep on battery charging.



2. [REEV] Condensation outside the on-board charger: liquid cool with chiller system



Condensation at outer surface of on-board charger





[The present] New Energy Vehicle (NEV) On-Job Training at Geely Research Institute

To learn in multiple disciplines: development, integration, manufacturing and sales & service.

Dr Li Chunrong, CEO of PROTON

“When PROTON and Geely started collaborating in 2017, one of the pillars of the partnership was for PROTON to accelerate its model development timetable by incorporating technologies readily available from Geely. That has been successfully done, and now, we are **leveraging the group's global experience in NEVs to boost our model development timeline.**

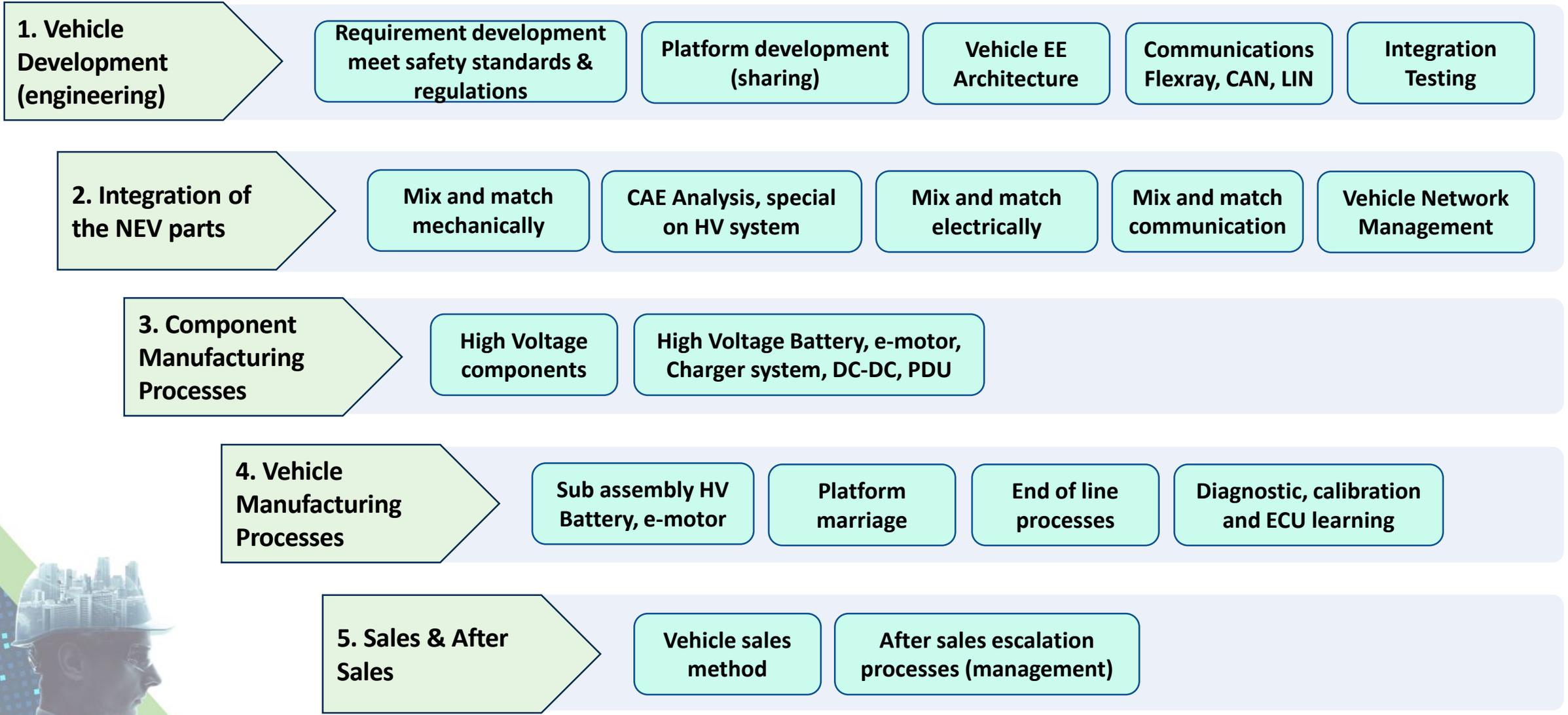
PROTON invests in knowledge acquisition for our staff as we believe it is the best way for the company to move forward. The experience and training they gain will not only benefit the company but indirectly, it will also help **raise the skill level of Malaysia’s automotive industry** as more staff members are sent for training. This is one of the reasons PROTON was established, and the company is proud to fulfil that aim,” added Li Chunrong.



*“The programme will see them based at the renowned Geely Research Institute in Ningbo. They will be trained in multiple disciplines involved in the **development, integration, manufacturing, and sales and service** of a new generation of vehicles that the national automotive brand will gradually introduce.”*

[The present] What have we learnt?

Multi disciplines: development, integration, manufacturing and sales & service.



[The present] EV – Typical components

General overview



e-compressor

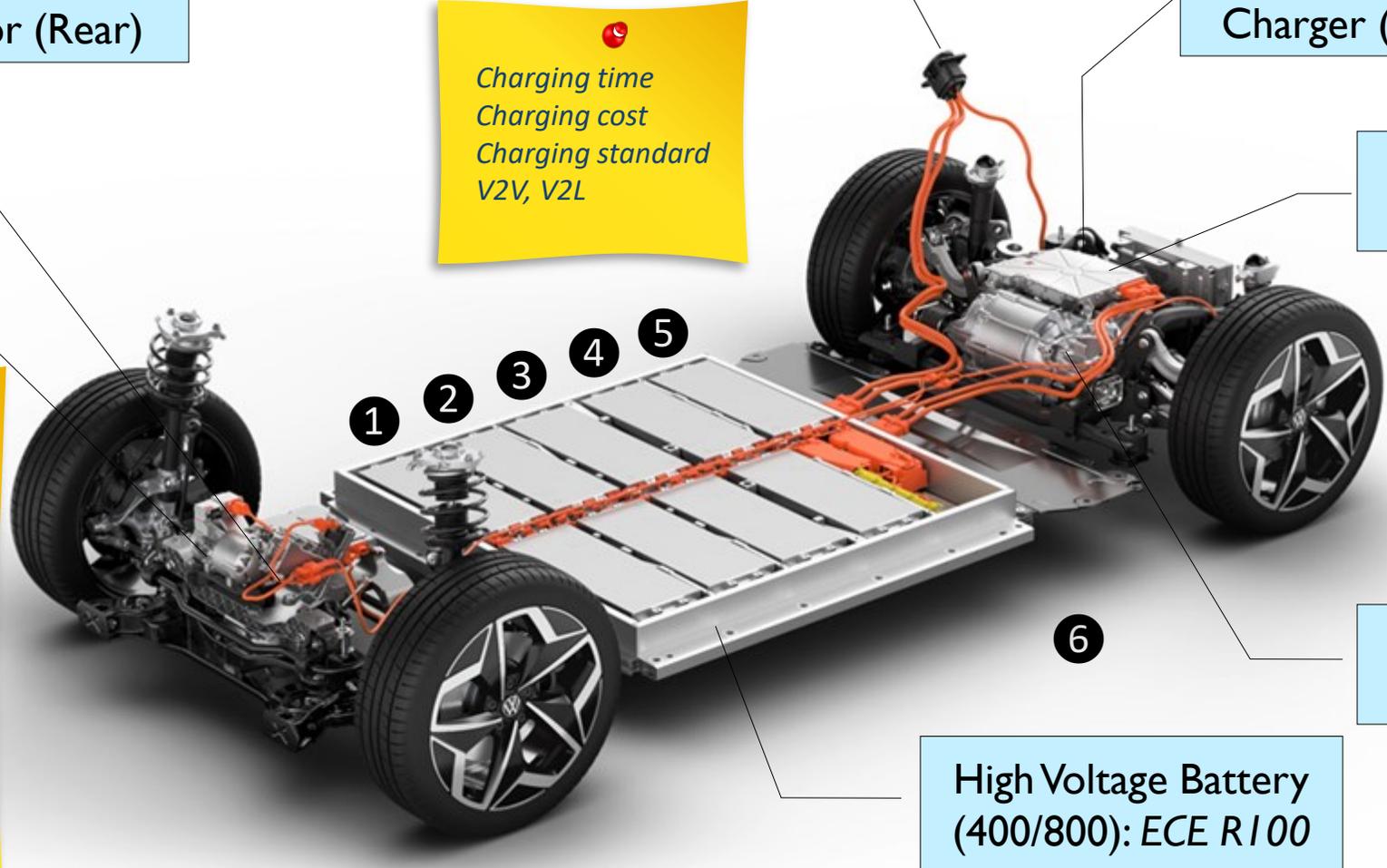
Power train – motor (Rear)

Charging Port: DC/AC

On-Board Charger (AC)

DC-DC Converter

Charging time
 Charging cost
 Charging standard
 V2V, V2L



High Voltage Battery (400/800): ECE R100

Power train – motor (Front)

- ECE R100;**
- *Vibration (6.2)*
 - *Thermal shock and cycling (6.3)*
 - *Mechanical Shock (6.4.1)*
 - *Mechanical Integrity (6.4.2)*
 - *Fire Resistance (6.5)*
 - *External short circuit protection (6.6)*
 - *Overcharge protection (6.7)*
 - *Over-discharge protection (6.8)*
 - *Over-temperature protection (6.9)*
 - *Overcurrent protection (6.10)*
 - *Low-temperature protection (6.11)*
 - *Management of gases emitted from REESS*
 - *Warning in the event of operational failure of vehicle controls that manage REESS safe operation*
 - *Warning in the case of a thermal event within the REESS Thermal propagation (6.15)*

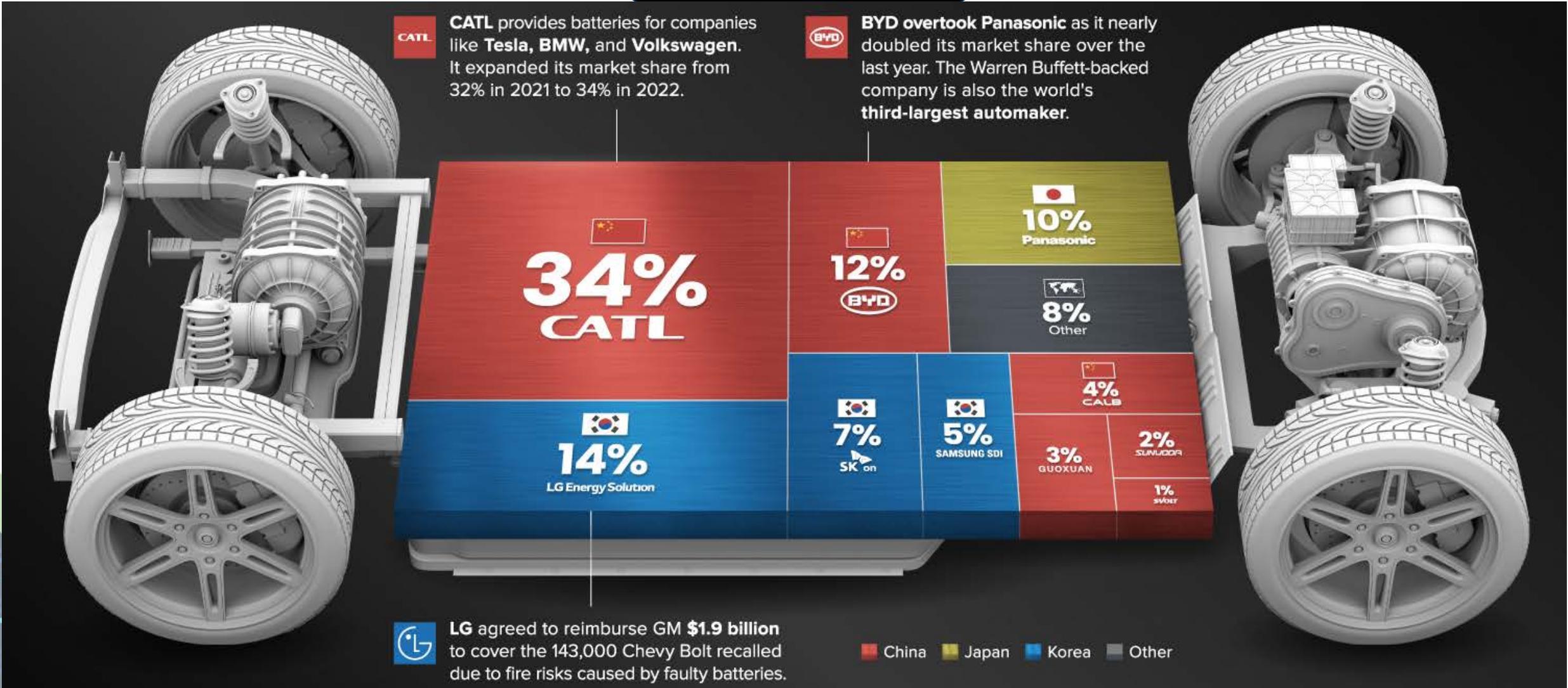
[The future] Battery manufacturers

The top 10 EV battery Manufacturers in 2022



The EV battery market is expected to grow from \$17 billion in 2019 to \$95 billion by 2028

Here are the world's biggest battery manufacturers in 2022



CATL provides batteries for companies like **Tesla, BMW, and Volkswagen**. It expanded its market share from 32% in 2021 to 34% in 2022.

BYD overtook **Panasonic** as it nearly doubled its market share over the last year. The Warren Buffett-backed company is also the world's **third-largest automaker**.

LG agreed to reimburse GM **\$1.9 billion** to cover the 143,000 Chevy Bolt recalled due to fire risks caused by faulty batteries.

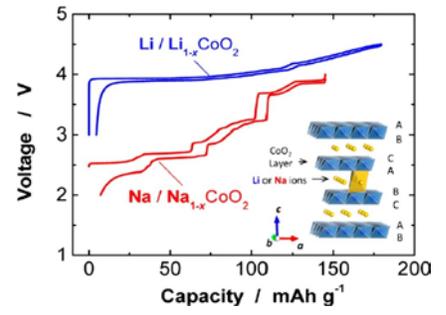
China Japan Korea Other

[The future] Battery technology

[1] Lithium-ion battery

Lithium-Ion	2010	...	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023 (Q1)
Battery Price (\$/kWh)	1200	...	606	393	303	226	186	160	140	132	135	110

[2] Sodium-ion battery



[3] Condensed battery (Semi solid state)

宁德时代凝聚态电池
CATL CONDENSED BATTERY

高比能 + 高安全
HIGH ENERGY DENSITY + HIGH LEVEL OF SAFETY

单体能量密度
ENERGY DENSITY OF A SINGLE CELL
最高 500 Wh/kg

SOURCE: CATL

[4] Solid state battery

EV manufacturers: who will win a race for an EV solid-state battery?

(Source: Solid-State Battery 2021, Yole Développement)

- 2022: NIO, WeLion New Energy Technology Co., LTD
- 2025: TOYOTA
- 2025: Volkswagen, Quantum Scope
- 2026+: BMW, Solid Power
- 2028: NISSAN
- 2030+?: Renault, KION, MITSUBISHI, Ionic Materials
- 2030+?: HYUNDAI, Ionic Materials

(Yole Développement, according to companies' announcements)
Non exhaustive list of companies

1. Faster charging 6x
2. Safer – eliminate flammable liquid electrolyte.
3. Reduce size and weight at same energy density
4. Charge cycle (10k)=15years
5. Higher energy density – 1000km EV range

The Future of Mobility: Connected, Autonomous, Shared and Electric (CASE)



The combination of each CASE offers a range of solutions that significantly improve users' mobility experience while ensuring environmental sustainability and safety.

Goals: Zero tailpipe Emission, Zero Accident, 100% Personalisation

Simplified Meaning of CASE	Industry Focus Area	Industry Mission	2020 Status	2030 Forecast
<p>Connected Vehicle Car connected to the internet through built-in embedded SIM</p>	C	Deliver new digital experiences to consumers and leverage data in new ways to streamline operations	48% of new vehicles shipped globally with built-in connectivity	96%
<p>Autonomous Vehicle Car that can take user from origin to destination without the need for human intervention</p>	A	Reduce accidents in the short-term, help improve productivity in the mid-term and fully manage traffic flow in the long-term	45% of new vehicles shipped globally with L2 autonomy or higher	79%
<p>Shared Vehicle One same car can be used throughout the day by more than one user</p>	S	Maximise utilisation of vehicles and deliver lower cost journeys to consumers in congested cities	1% of mobility profits derived from new sources	26%
<p>Electric Vehicle Car that runs fully or partially on electricity</p>	E	Reduce the reliance on fossil fuels and improve air quality by replacing internal combustion engines with electric vehicles	3% of new cars sold that are electric vehicles (including BEV / PHEV)	24%

- Salient points**
- » The automotive is undergoing massive digital transformation.
 - » By 2030, the vehicles will be more connected, autonomous, electric and being shared.
 - » User preference shifting from "RPM" to "EPM" (vehicle performance to experience).
 - » OEMs needs to expand into new areas (CASE) to stay competitive as vehicle sales decline in the 2030s.

Source: SPM 2030 Report



Q & A





THANK YOU



“Committed To Engineering Excellence”

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