

Speaker for today



Davin Keon, an engineer at Asahi Kasei Plastics Singapore. With a focus on E-Mobility in India, he led successful marketing campaigns and technical advancements. Advocating co-development, Davin emphasizes creating value for consumers.

With 9 years of R&D experience at companies like The Polyolefin Company and REC Solar, he brings expertise in next-gen product development.



Enhancing EV Battery Safety with Asahi Kasei **XYRON™**

20th March 2024

Mr. Davin Keon

Engineer, Technical Support Department

Asahi Kasei Plastics Singapore

Who are we?

Asahi Kasei At a Glance

Asahi Kasei at a glance



1922
Founding



Global bases
>20
Countries and regions



Employee
48,897
More than 40% overseas



Net Sales
¥ 2,726.5
USD 20.5
billion



Operating Income
¥ 128.4
USD 0.96
billion



10,271
Patents filling

Material
Health Care
Homes
Group Business category



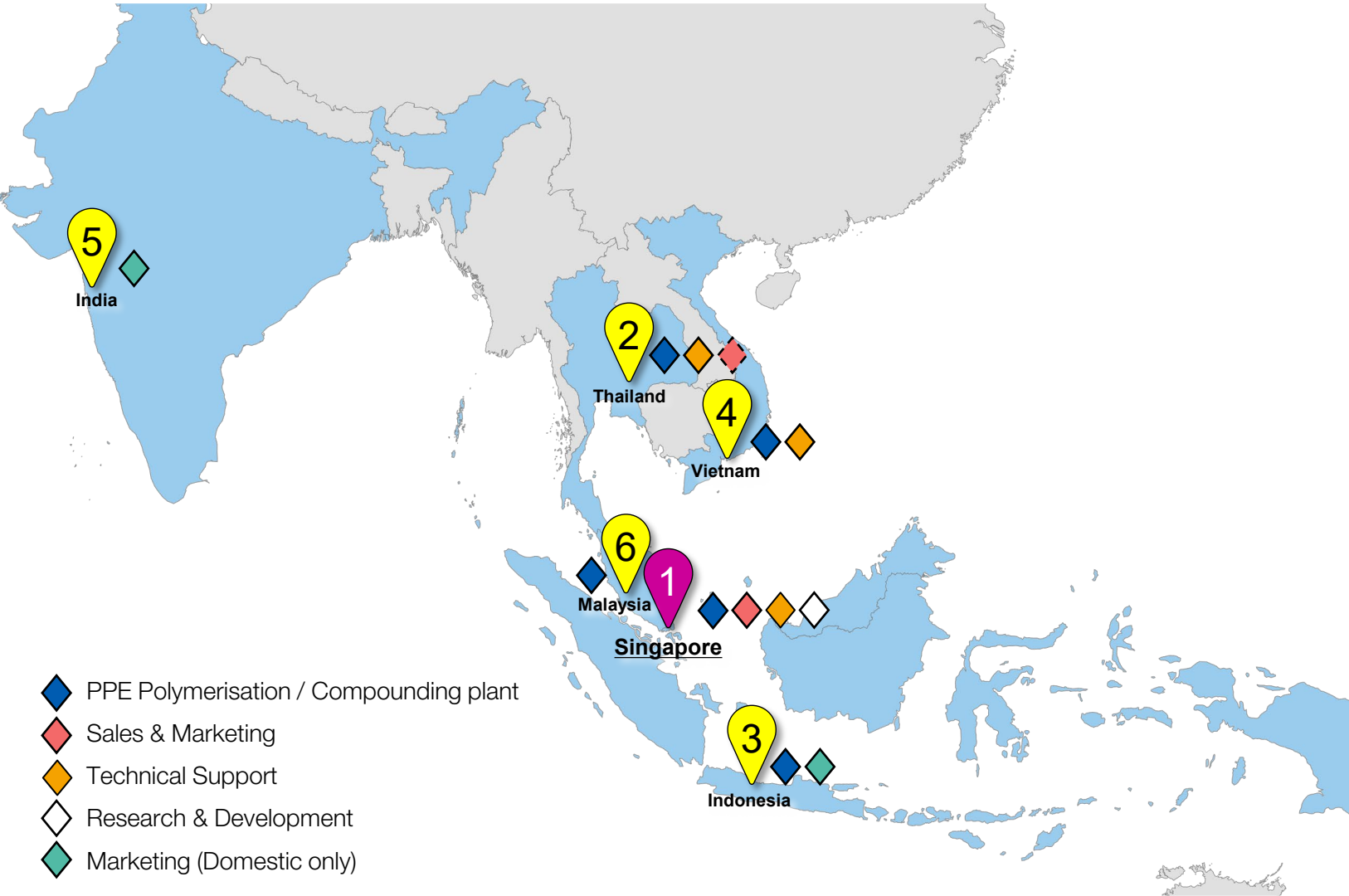
Engineering plastics



Engineering Plastics in ASEAN + India

- 1 Singapore**
 - ◆ Production (PPE raw material)
 - ◆ Technical Support
 - ◆ Sales & Marketing
 - ◇ Research & Development
- 2 Thailand**
 - ◆ Production (Compound)
 - ◆ Technical Support
 - ◆ Sales & Marketing (Domestic only)
- 3 Indonesia**
 - ◆ Production (Compound)
 - ◆ Marketing (Domestic only)
- 4 Vietnam**
 - ◆ Production (Compound)
 - ◆ Technical Support (CAE)
- 5 India**
 - ◆ Marketing (Domestic only)
- 6 Malaysia**
 - ◆ Production (Compound)

- ◆ PPE Polymerisation / Compounding plant
- ◆ Sales & Marketing
- ◆ Technical Support
- ◇ Research & Development
- ◆ Marketing (Domestic only)

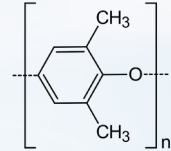


Asahi Kasei Plastics Singapore



2002

Founded



PPE polymer

Manufacture



Jurong Island

Plant & Technical Center
ISO 17K Accredited laboratory



Sales & Technical Support

3 Engineering Plastics



Harbour Front

Sale office

3 Engineering Plastics

LEONA™
Polyamide

TENAC™
Poly Acetal

XYRON™
Modified Polyphethylene Ether
m-PPE



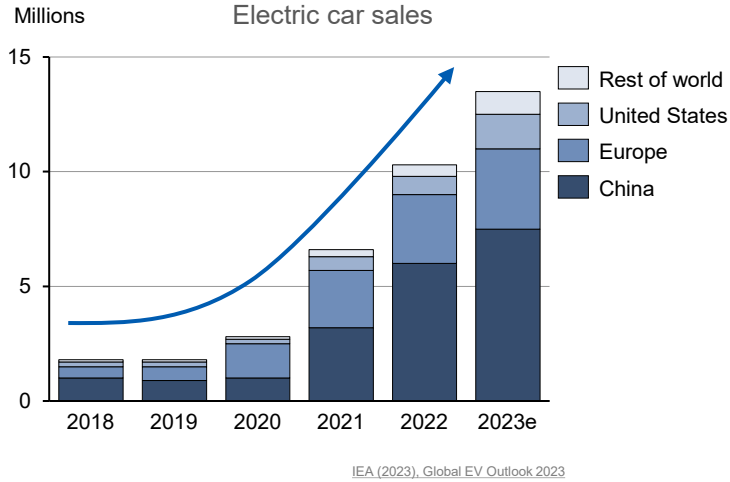
**Enhancing EV
Battery Safety**

Growing market – Electrification

Addressing E-Mobility growing trends

Electrification on rapid growth

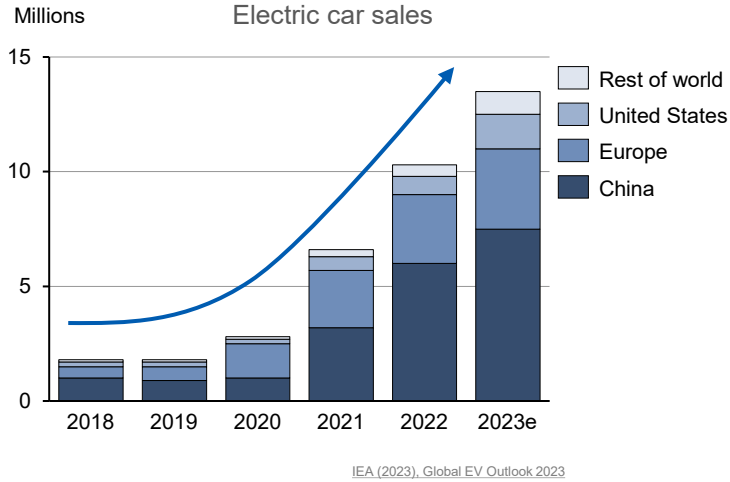
Electric car sales exceeded 10 million in 2022



Global sales of electric cars were increasing at a rapid rate. 2023 is set to be another record year.

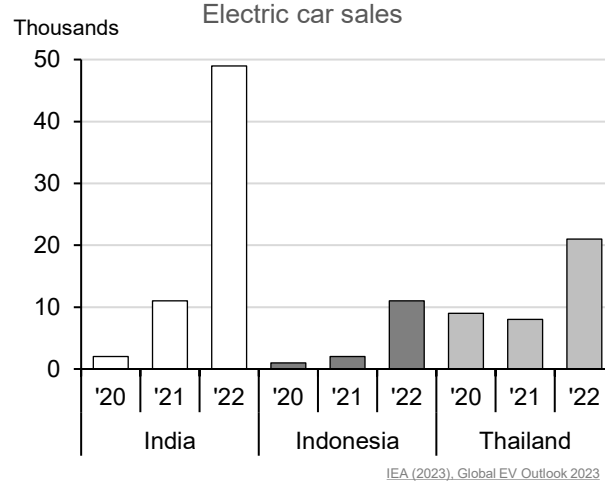
Electrification on rapid growth

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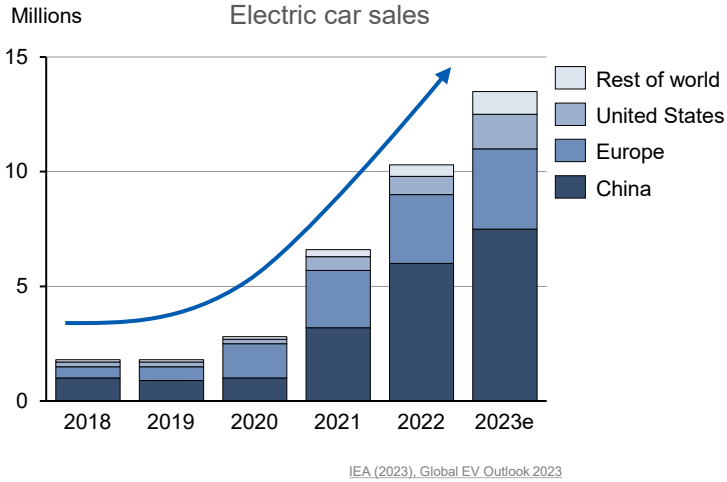
Electric car started to sell in emerging economies



Although motorcycles are generally much more prevalent in Asia, electric car sales jumped in [India](#), [Indonesia](#) and [Thailand](#) in particular.

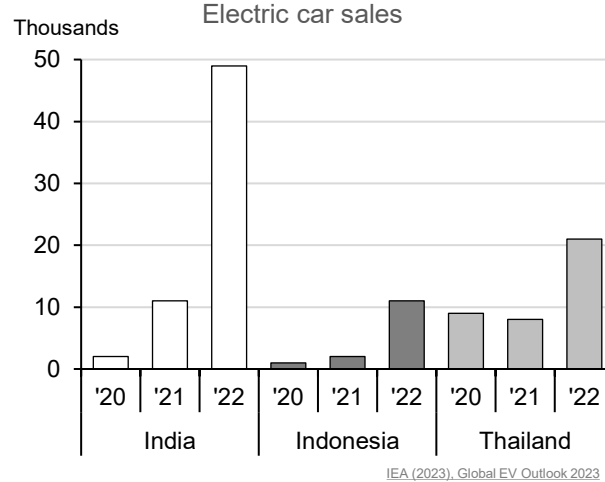
Electrification on rapid growth

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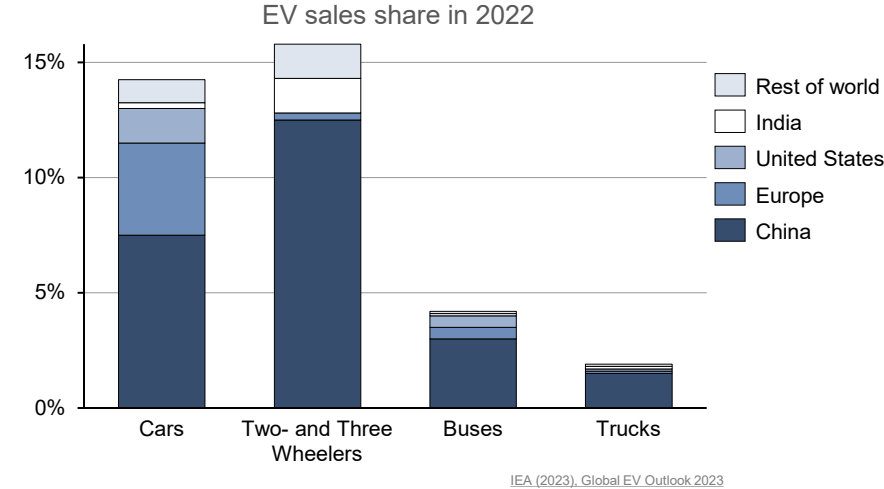
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Electrification is not only about cars



Electrification is already widespread among **Two and Three wheelers**. Sales of **electric buses** are picking up; **Trucks** are the next frontier for electrification.

- Not only **Electric Cars**, Electrification of **2 & 3 Wheelers**, **Bus** and **Truck** will also be rapidly increasing.
- How about **safety** of **Electric Vehicles**? **Is it safe?**

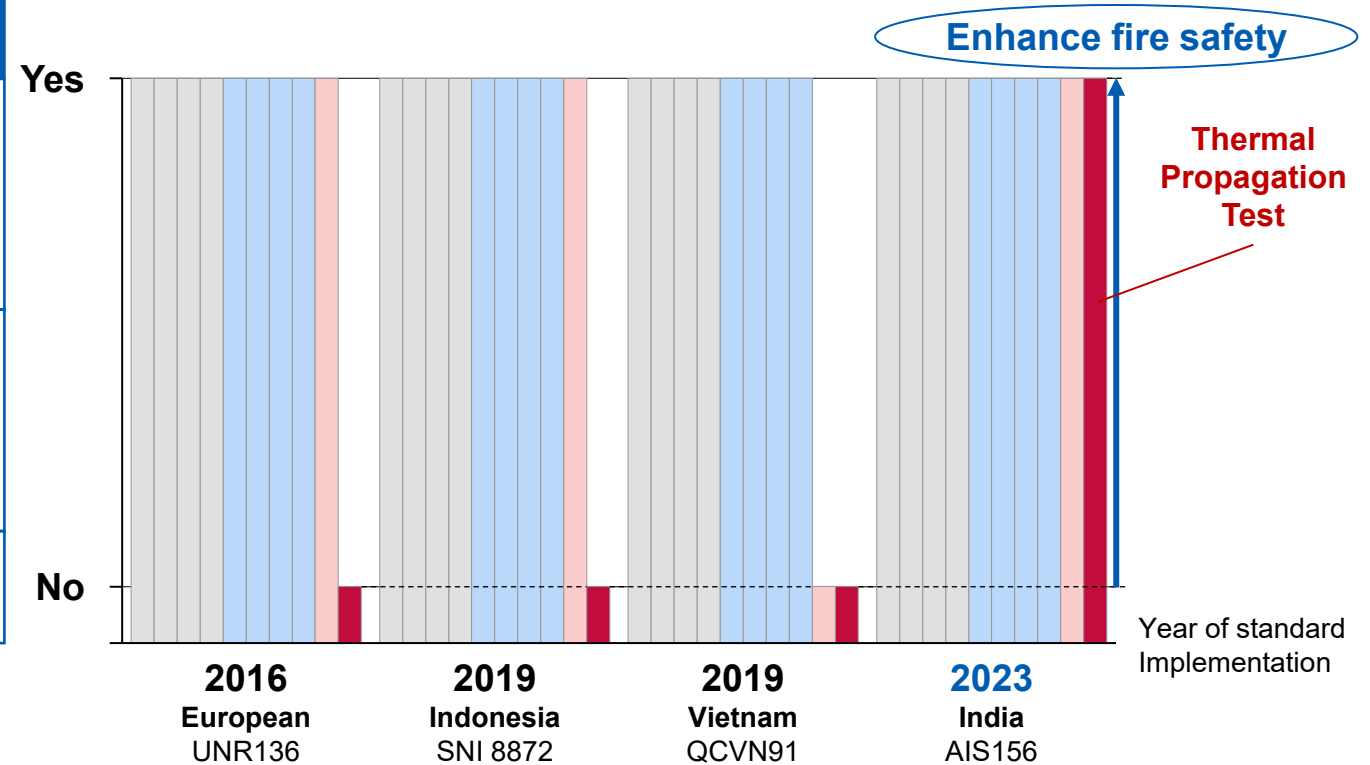
Lithium-ion battery accidents

Transportation	Personal Mobility Device (PMD)	E-bike	E-Scooter	E-Bus	E-Car
					
Country	Singapore	USA	India	China	USA
Root Causes	<u>Lithium-Ion battery malfunctioned</u>	<u>Lithium-Ion battery malfunctioned</u>	Likely due to <u>Lithium-ion battery</u>	Likely due to <u>Lithium-ion battery</u>	Likely due to <u>Lithium-ion battery</u>
Consequences	1 Fatality	4 Fatality	8 Fatality	5 E-Bus destroyed	1 E-Car destroyed
Sources	Channel News Asia	Associated Press	Reuters	South China Morning Post	WFAA

- **Lithium-Ion batteries** pose a **fire hazard** if not manage properly.
- With **enhanced safety regulatory**, **fire accident** can be **prevented**.

Thermal Propagation test

BMS, Material or Design	Standard Tests
BMS – Battery Management System	<ul style="list-style-type: none"> External Short Circuit Protection Overcharge Protection Over Discharge Protection Over-Temperature Protection
Material + Design	<ul style="list-style-type: none"> Vibration Thermal shock & Cycling Drop Test Mechanical Shock
Material	<ul style="list-style-type: none"> Fire Resistance Thermal Propagation Test



- **Thermal Propagation test** is likely to be introduced in future standard revision to enhance fire safety.
- **XYRON™** can increase fire safety of batteries pack by protecting passenger from Thermal Runaway situation.

Modified Polyphenylene Ether (m-PPE)

XYRON™ – Features & Benefits

Well balance XYRON™ meeting battery requirements

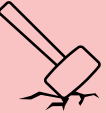
 End user concern




 Key requirements

 Battery fire


Flame Retardancy (FR)

 Cracks after dropping swappable batteries


High Impact resistance

 Heavy batteries pack (Low Mileage)

Low Specific Gravity

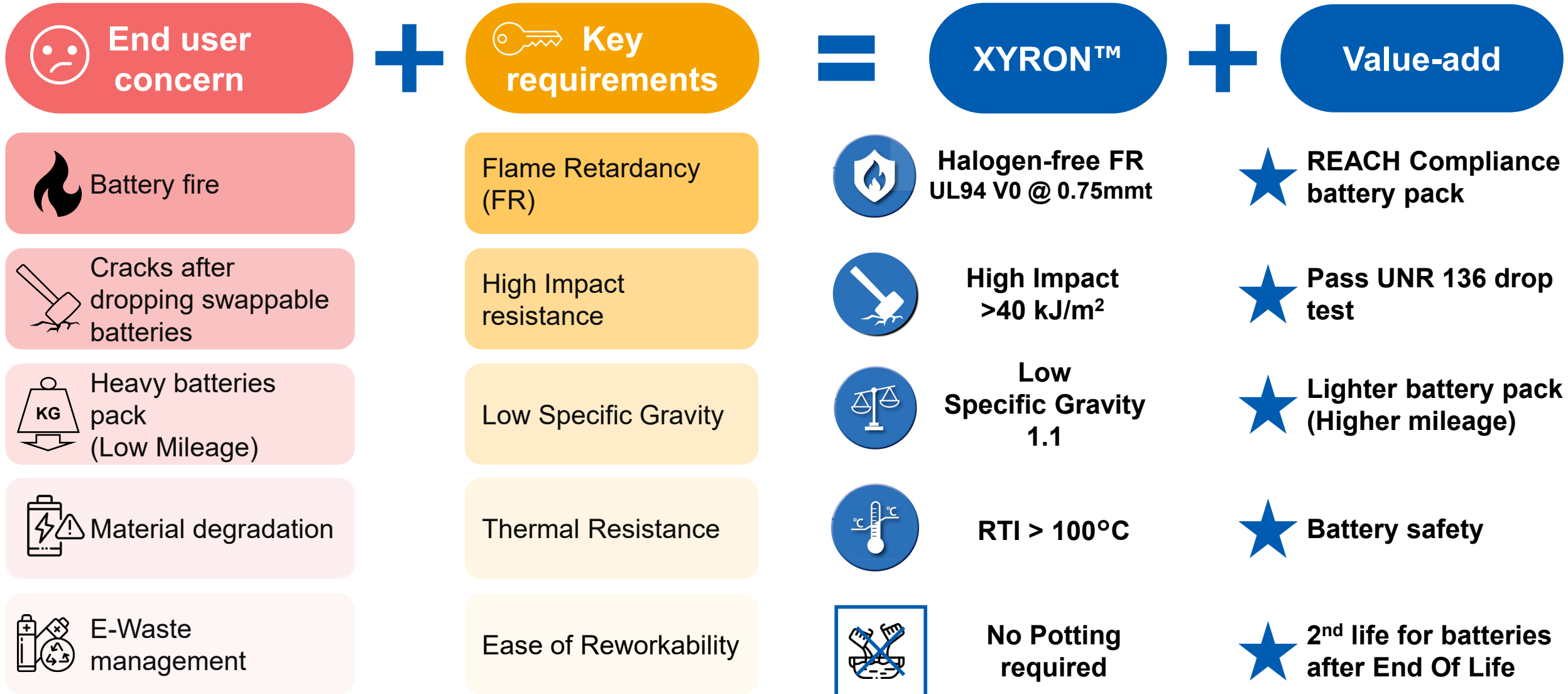
 Material degradation

Thermal Resistance

 E-Waste management

Ease of Reworkability

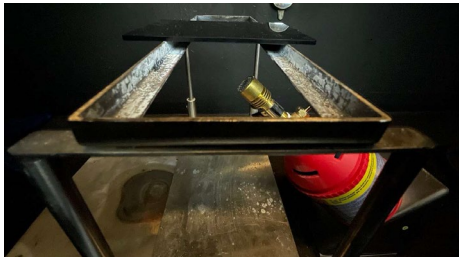
Well balance XYRON™ meeting battery requirements



Superior Fire Resistance of XYRON™

Testing Condition

3 mmt plates



~4 cm at 45° from the sample's contact surface.

Maximum temperature is around **850°C**.

The fire and timer is stopped once a pin hole is observed on the plate.

FR PC/ABS
V0: 1.5 mm



Burn time: **0 min 58 sec**
Burn through: Yes

FR PC
V0: 1.0 mm



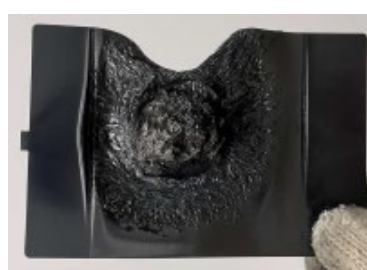
Burn time: **1 min 51 sec**
Burn through: Yes

XYRON™ 340Z
V0: 0.75 mm



Burn time: **1 min 24 sec**
Burn through: Yes

XYRON™ 540Z
V0: 0.75 mm



Burn time: **2 min 19 sec**
Burn through: Yes

XYRON™ 443Z
V0: 0.75 mm



Burn time: **2 min 58 sec**
Burn through: Yes

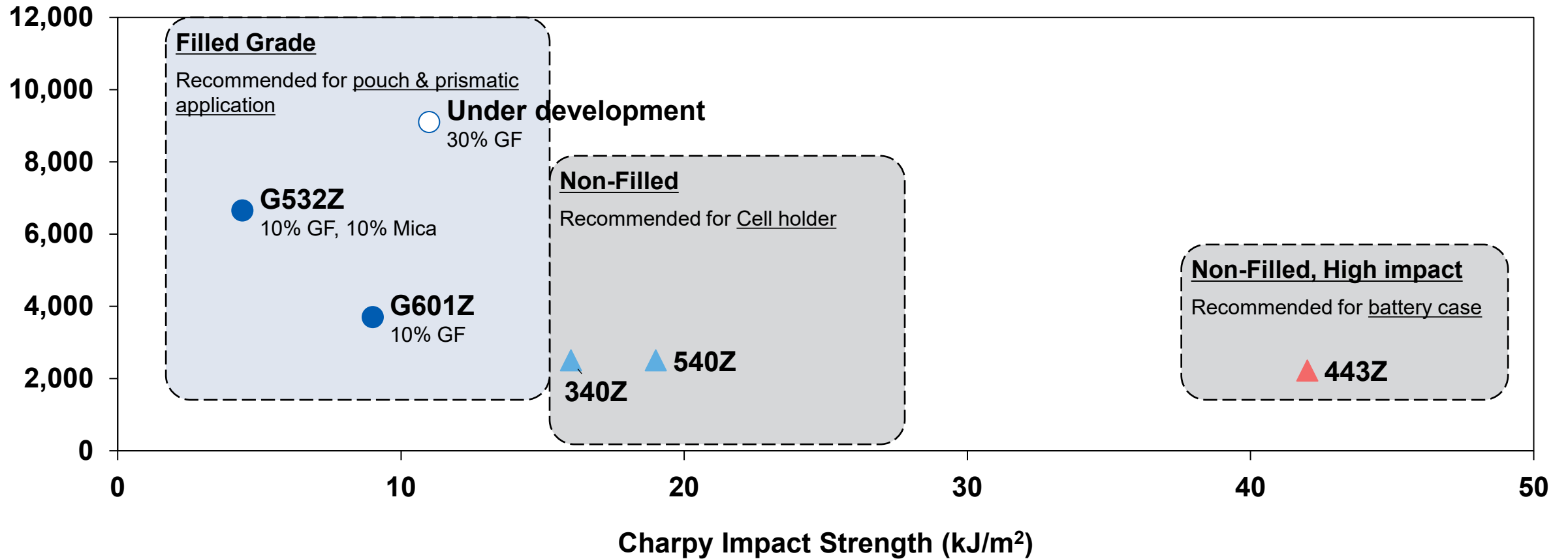
XYRON™ G532Z
V0: 0.75mm



Burn time: **>5 min 23 sec**
Burn through: **No**

XYRON™ Grade proposal

Flexural Modulus (MPa)



Above XYRON™ grades are Halogen-Free Flame Retardant → **V0 @ 0.75 mmt, 5VA @ 2.5 to 3 mmt.**

XYRON™ Benchmarking

Value proposition		Property	XYRON™	PC PC/ABS	PBT
Energy efficiency due to low weight		Low Specific Gravity	●	●	●
Structural integrity for large and complex designs		Dimension Stable	●	●	●
Battery Safety UN R 136, AIS 156	Fire Resistance Test	Non-Halogen FR	●	●	●
	1m Drop Test, Direct Indirect contact of water	Impact Strength (After aging) ¹	●	●	●
	Thermal Shock Test	Impact Strength (After aging) ²	●	●	●
IEC 60068-2-38 Environmental testing	Composite temperature/ humidity cyclic test	Impact Strength (After aging) ³	●	●	●

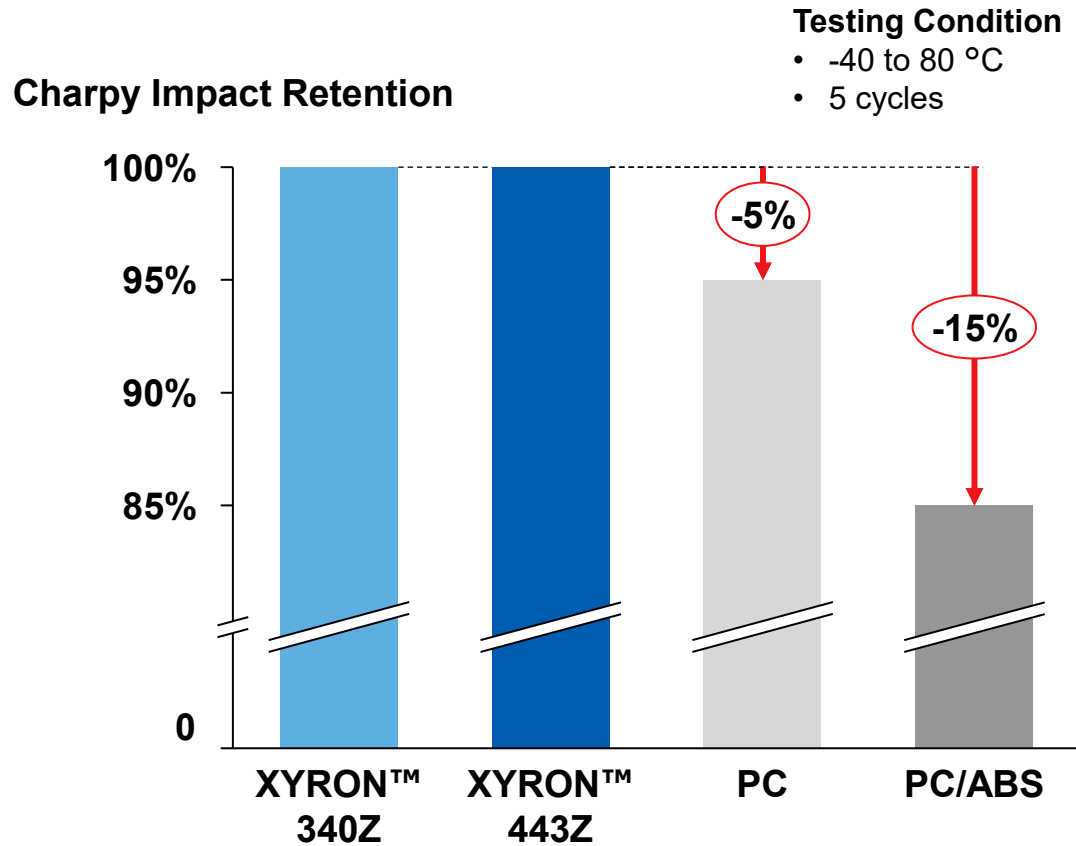


Testing conditions:

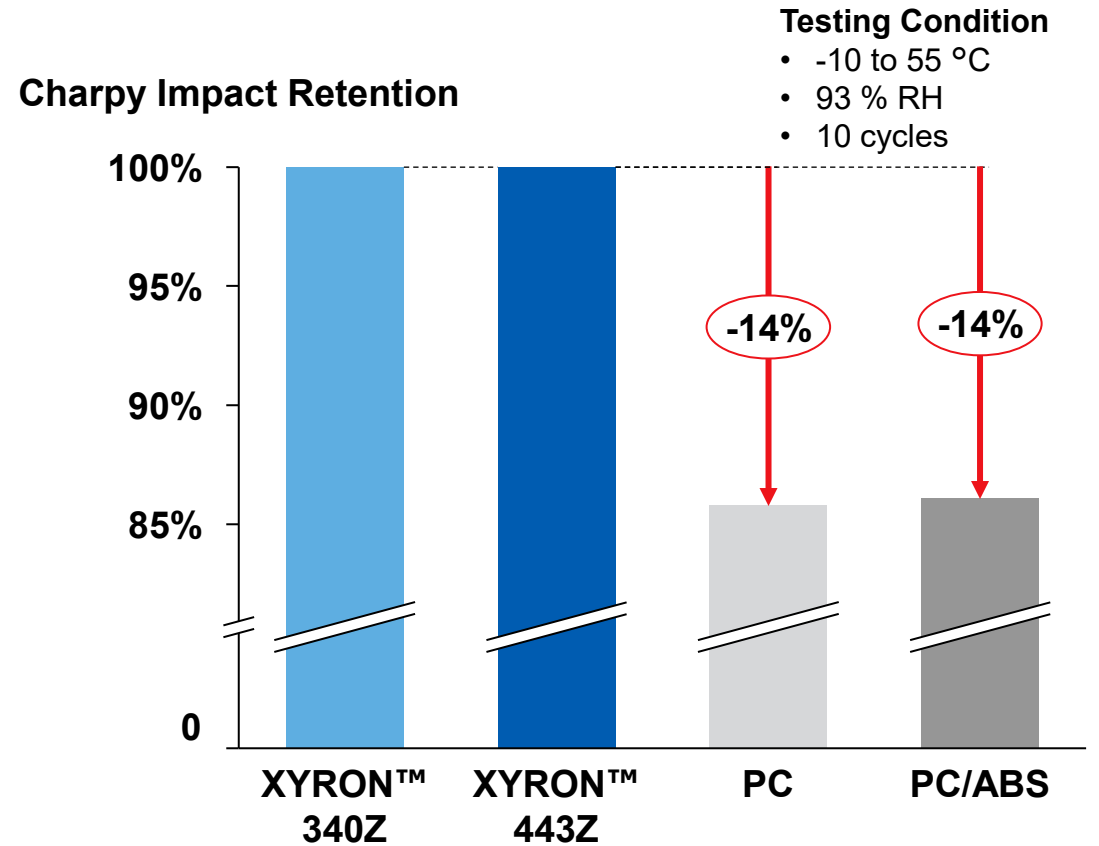
- 1 – Internal Method: -20 °C to 85 °C/85 %RH for 10 cycles.
- 2 – UN R 136/AIS 156: -40 °C to 80 °C for 10 cycles.
- 3 – IEC 60068-2-38: -10 °C to 55 °C/93 % RH for 10 cycles.

XYRON™ shows no deterioration after thermal cycle test

UNR 136 Thermal Shock Test



IEC 60068-2 Composite temperature/ humidity cyclic test



Total application development using CAE analysis

Planning

Planning → Receive part design from customer

Total application development using CAE analysis

Planning

Conceptual

Planning → Receive part design from customer

Conceptual → Topology and parametric design optimisation

Total application development using CAE analysis

Planning

Conceptual

Design
Modification

Planning → Receive part design from customer

Conceptual → Topology and parametric design optimisation

Design modification → Structural analysis

- Nonlinear Static with multiple contacts
- Thermal expansion
- Creep & Stress relaxation
- Predict of failure load
- **Dynamic: crash/impact analysis → Drop Impact test**
- Anisotropic analysis
- Fatigue analysis
- **Modal & Frequency response analysis → Vibration test & Mechanical Shock**
- Acoustic analysis
- Multibody dynamics analysis

Total application development using CAE analysis

Planning

Conceptual

Design
Modification

Prototyping
Verification

Planning → Receive part design from customer

Conceptual → Topology and parametric design optimisation

Design modification → Structural analysis

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Prototyping Verification → Mold filling analysis

- **Thermoplastic injection molding**
 - Optimization of gate position
 - Prediction and improvement of warpage
 - Prediction of injection machine size
 - Residual stress
 - And more...
- Gas-assist
- Overmolding
- Injection compression
- Multiple-barrel thermoplastics injection molding

Total application development using CAE analysis



Planning → Receive part design from customer

Conceptual → Topology and parametric design optimisation

Design modification → Structural analysis

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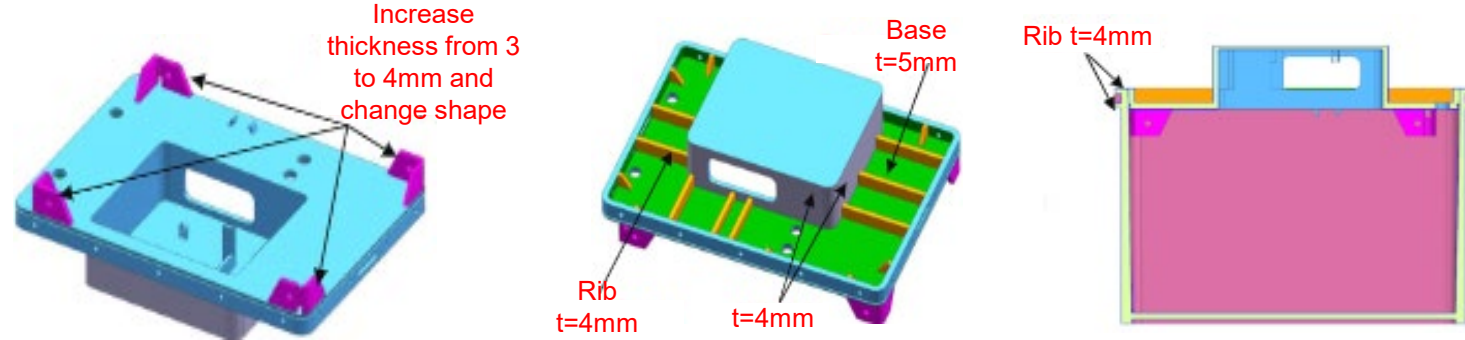
E-Mobility solutions



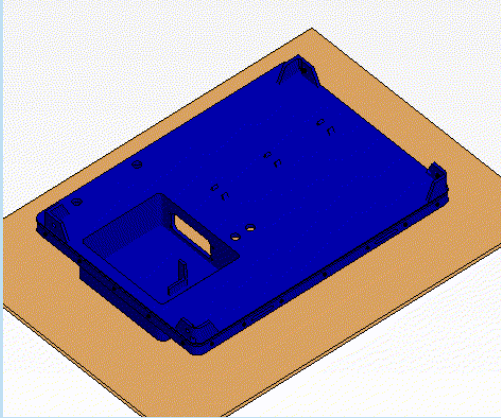
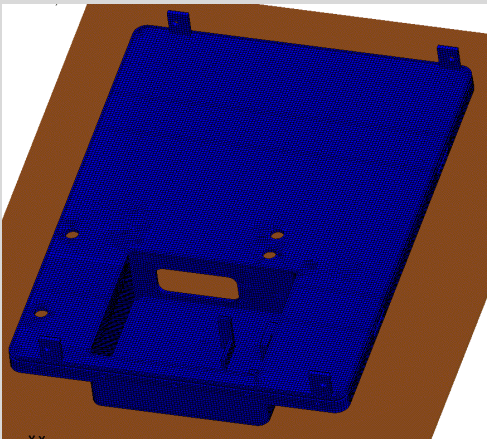
Case study – 1

XYRON™ + CAE support to customer

XYRON™ + CAE = Complete solution for E-mobility

Design Modifications



Requirement	Actual		Simulation			
	After Modification	Result	After Modification	Result	Before Modification	Result
Drop Test	  <p>No Crack after 6 axis drop test</p>	PASS		PASS		FAILED

XYRON™ + CAE + Customer = Project Success!

E-Mobility solutions

Case study – 2

Thermal Propagation test by Nail Penetration method



Thermal Propagation test by Nail Penetration method

Battery Pack Information

Battery Energy: 2 kwh
Cell dimension: 18650

Design

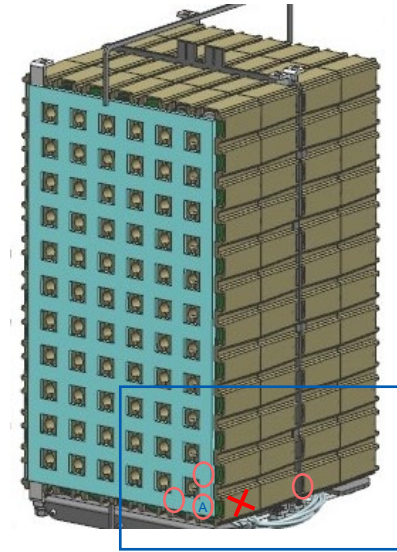
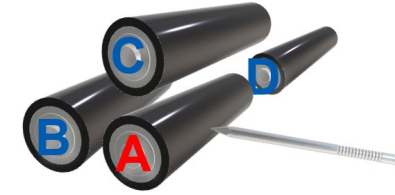
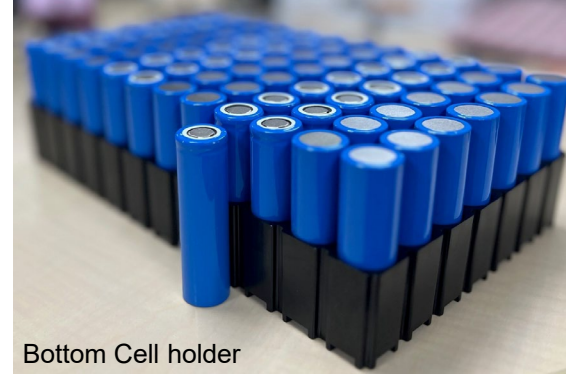
Cell wall: High Cell Wall, covering battery cell
Any Potting: No potting
Re-workability: Easy, Not bonded with battery cell

Testing Conditions

Pre-Test: Fully charged & Cell temperature 60°C before test.
Nail Penetration: Center of the cell

Requirement

No Thermal Propagation to other cells

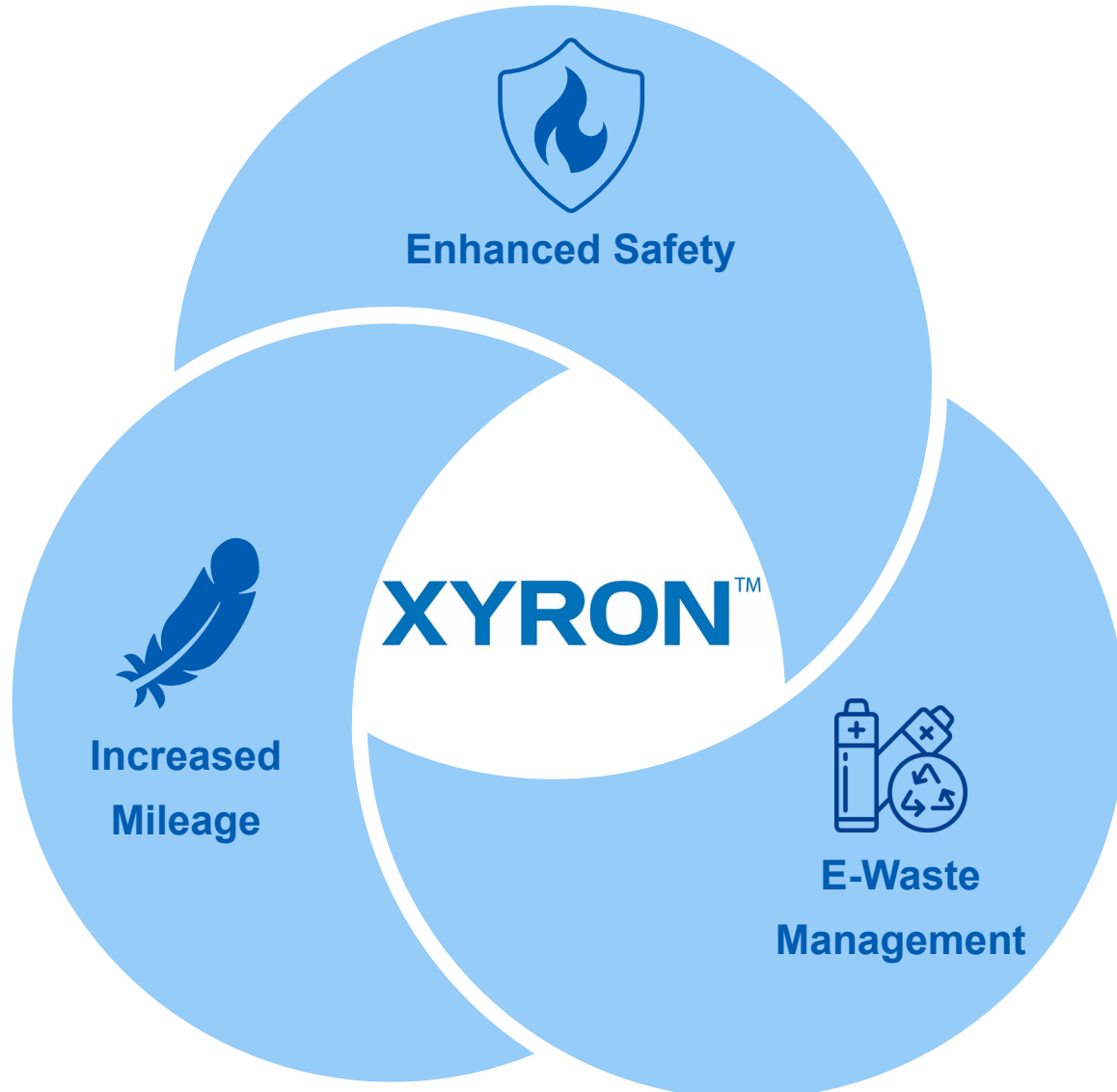


Before	During Test	After Test		Battery Cell	Cell Voltage detected?		Results
		Battery Case – XYRON™ 443Z	Cell Holder – XYRON™ 540Z		Before	After	
				A	Before	After	No Thermal Propagation
		XYRON™ contained the flames within the battery pack.	XYRON™ achieved protection of individual cells	B	✓	✗	
				C	✓	✓	
				D	✓	✓	

XYRON™ summary

Key Takeaways

Key benefits of XYRON™



- **Enhanced Safety:**
 - Isolating thermal runaway reactions
 - Compliance with safety standards i.e AIS156 Thermal Propagation test, UN R136 drop test, etc.
- **Increased Mileage:**
 - Low specific gravity
 - Non-potting solution
- **E-Waste Management:**
 - With design to increase in cell wall & elimination for the need of potting,
 - Allowing batteries to have potential second-life application, contributing to reduction in E-waste, aligning with sustainability goals.

Question & Answers

Contact information

Webinar content

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AsahiKASEI

Creating for Tomorrow

THE COMMITMENT OF THE ASAHI KASEI GROUP:

To do all that we can in every era to help the people of the world make the most of life and attain fulfillment in living.

Since our founding, we have always been deeply committed to contributing to the development of society, boldly anticipating the emergence of new needs.

This is what we mean by “Creating for Tomorrow.”

