

E- mobility and lithium-ion battery safety in the home



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Introduction

Who are we ?

EV-EXBOX was formed out of a concern that there was absolutely **NO** risk assessment process as part of the design and operation of EV charging infrastructure in the UK.

- EV hubs
- Petrol filling stations
- Bus stations & repair depots
- Distribution depots
- Airports
- Local authority infrastructure
- Carparks
- **Residential basement parking**
- LiBess storage systems
- Battery handling & disposal sites

In almost every EV charging location we assess we come across **e-mobility devices** and lithium-ion battery equipment



Today's webinar

1. The challenge and the goal
2. Growth of e-mobility
3. Fire statistics e-mobility
4. Why Lithium-ion batteries fail
5. Damaged battery packs
6. Illegal e-bikes
7. Thermal runaway
8. Vapour cloud and rapid-fire spread
9. How do we make e-mobility safer
10. Risk awareness – inform
11. Risk awareness - engage
12. Aggregating the risk through purpose-built facilities
13. Proximity to walls
14. Summary
15. Q&A

The challenge and goal

The Challenge

E-mobility and lithium-ion batteries become an unacceptable risk when the combination of device condition, behaviour, and location creates a foreseeable, high-consequence event.

Today's Landlord environment :

Required to make defensible and proportionate decisions
Need to cut through confusion, fear, and misinformation
Are under pressure to “do something”
Bound by a fear of both over-reacting and under-reacting

The Goal

The path to safer charging will involve both **behavioural** and **physical** changes to how lithium-ion battery fire risk is managed through:

Raising awareness - informing

Offering support – engaging

Creating safer charging locations – in homes

Creating controlled charging environments – in buildings

The growth of e-mobility & lithium-ion battery devices

Growth of E-Mobility in the UK

In 2024 The British Cycling Association estimated almost 150,000 e-bikes were purchased, mostly online.

UK has approximately 1.2 m mobility scooters + powered wheelchairs.

The UK does not publish official e-scooter unit sales because privately owned e-scooters remain illegal for road use.

Most e-bikes, e-scooters and powered wheelchairs are charged in the home.

Litium ion batteries in the home

Items (2 adults + 2 teenagers)	My Neighbour	My Family
E-bikes	4	0
E- scooter	2	0
Mobility scooter	0	0
Laptop and Tablets (currently used)	6	6
Phones (currently used)	4	4
Other accessories - toothbrush, razor, speaker, etc..	8	8
Vapes	3	0
Toys	6	0
Old laptops, tablets and phones	12	10
Total	45	28

Where do you charge ?

E-bikes – easy in easy out often left by front door.

E-scooters – children and teenager owned often charged in bedrooms.

Mobility scooter – space may drive charging location but often its in bedrooms.

Phones – often by beds at night

Laptops – as they are used and sometimes never unplugged

Fire statistics (last 5 years)

London Fire Statistics e-mobility devices

Year	Recorded Fires - London
2017	7
2018	5
2019	12
2020	31
2021	78
2022	116
2023	179
2024	171
2025	206

5 fire-related deaths since 2023 (LFB)

Hundreds of injuries annually

Many incidents linked to indoor charging

Safety & Fire Statistics

QBE (insurer) used FOI data for the UK regarding lithium-ion battery fires:

2022 = 690

2023 = 1038

2024 = 1330

2024 e-bikes accounted for 362 fire (27%) of all lithium-ion battery fires.

In Europe there is a clear pattern of multiple fatalities per year from 2022 – onwards - **typically concentrated in dense urban housing environments.**

Why lithium-ion batteries fail ?

Why Lithium-Ion Batteries Fail

When the device battery pack fails it enters “thermal runaway” due to any one or combination of the following:

Overcharging

Use of incompatible chargers

Physical damage

Poor quality manufacture and design

Inexperienced DIY conversion



What does a damaged battery pack look like ?



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Know what damaged looks like



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Know what damaged looks like





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Know what damaged looks like



What does an illegal e-bike look like ?

Know what modified looks like



Look for additional battery packs.

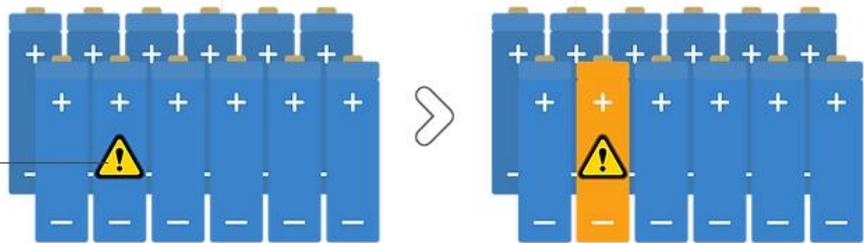
Be aware of e-bikes that move without being peddled.

Bikes that are propelled by the battery pack and motor via a throttle without peddling are illegal.

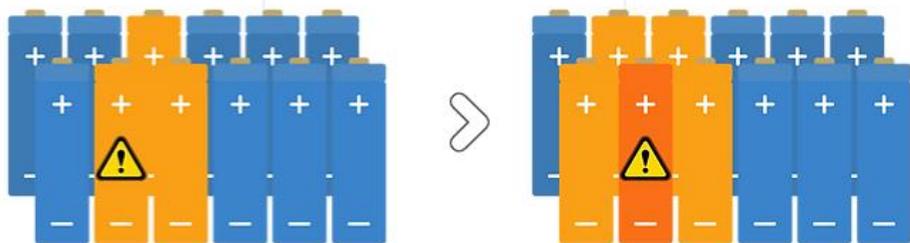
Thermal runaway – when the battery critically fails

1

Cell affected by short circuit



2



3

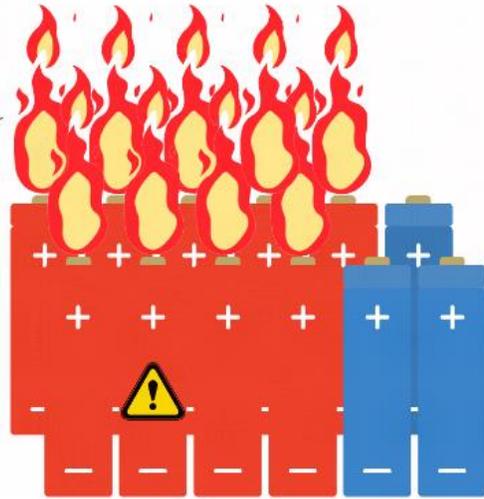
Heavy metal particles present as a dark cloud, followed by a white vapour cloud of toxic flammable gases



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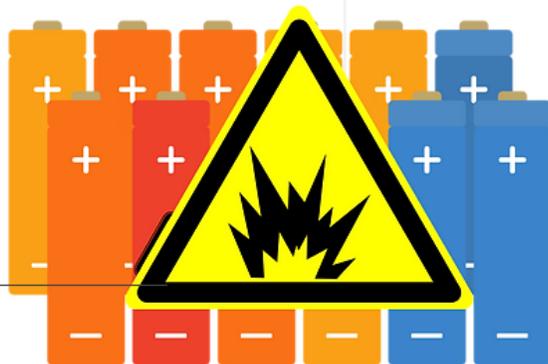
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Ignition will occur anywhere between seconds & minutes of the white vapour cloud showing

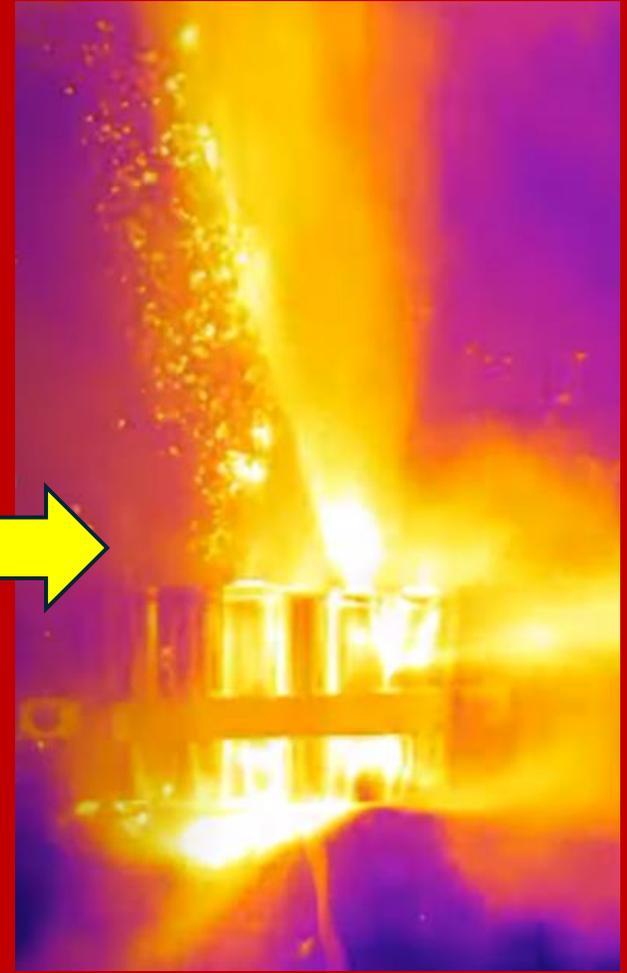
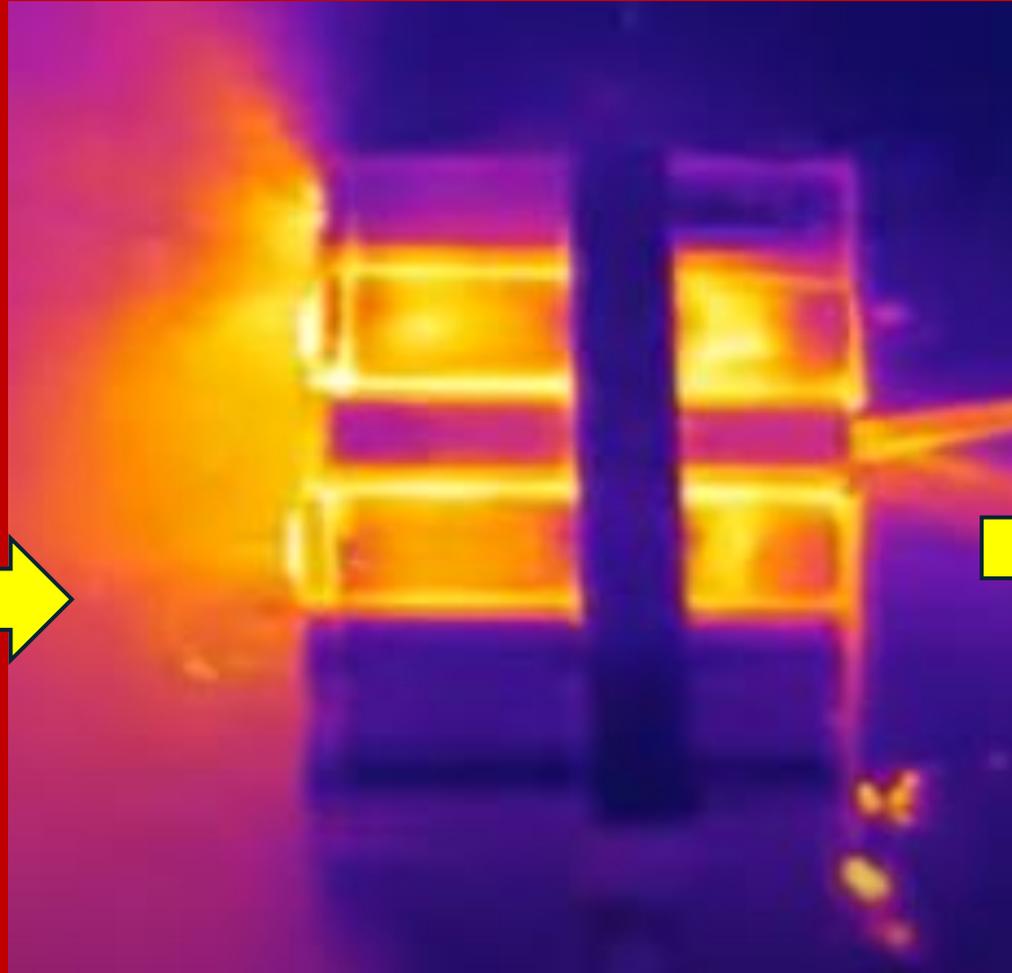
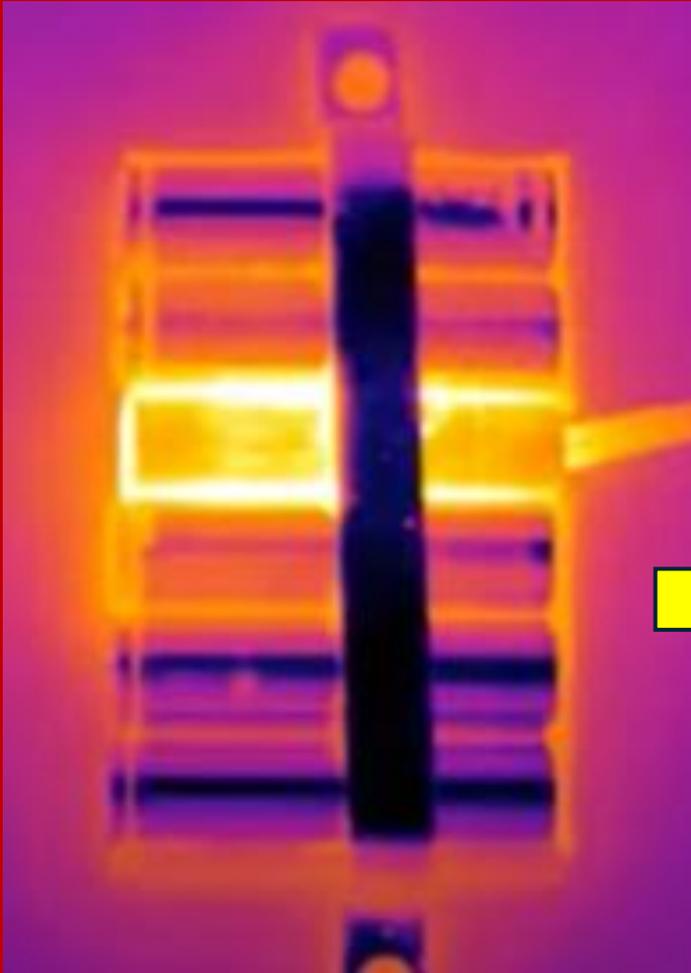


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If it occurs, vapour cloud explosion is a high risk to emergency responders



What Thermal Runaway Looks Like



What Thermal Runaway Looks Like

Toxic vapour - that looks like smoke

Jet-like flames

Potential for explosion

Exceptionally rapid-fire spread

Risk of reignition



What Thermal Runaway Looks Like



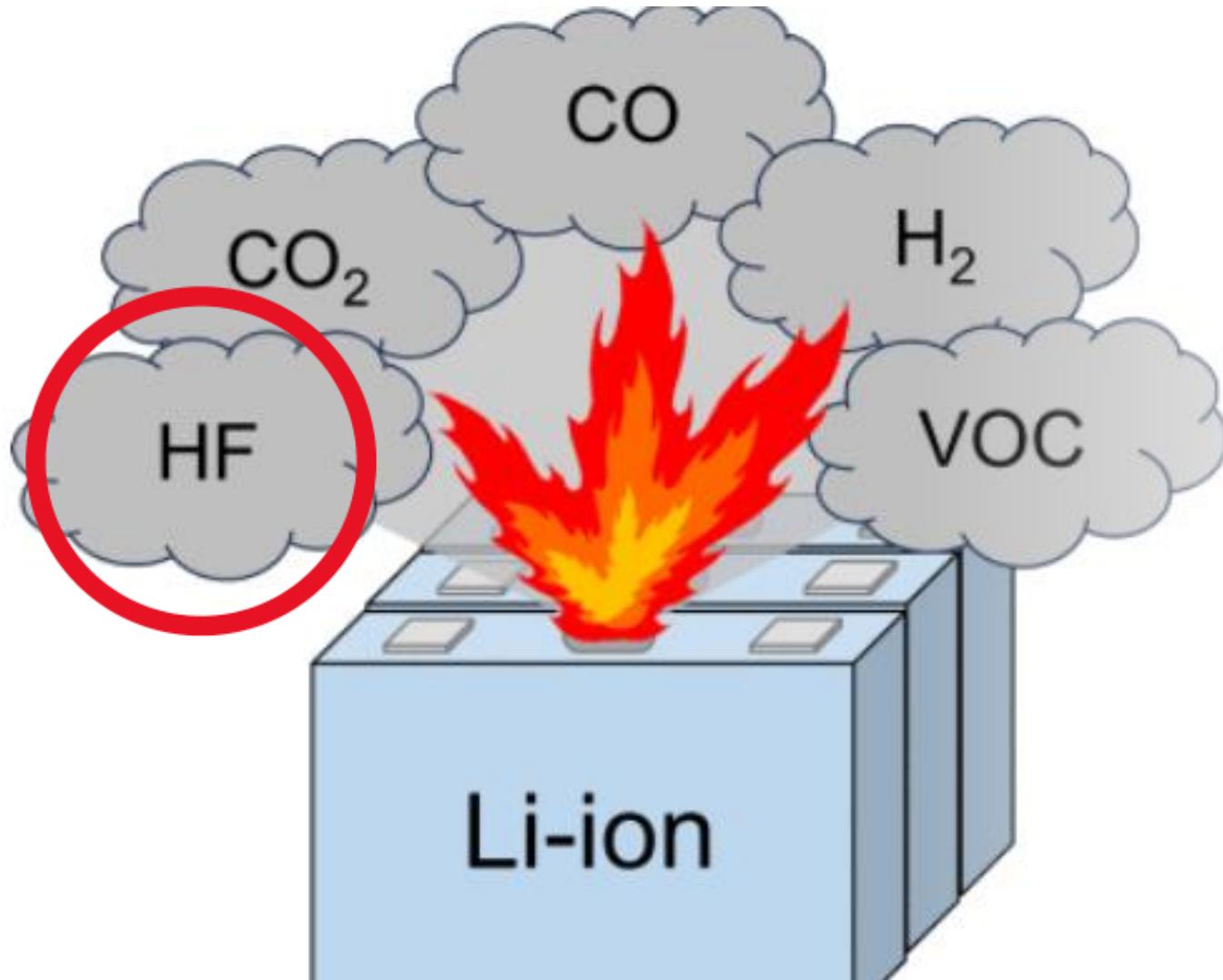
Off gassing
to explosion
or fire can be
hours,
minutes or
seconds.



Thermal runaway is an exothermic chemical reaction that is extremely difficult to stop once it has started.

Vapour cloud & rapid-fire spread

Vapour Cloud & hydrogen fluoride (HF)



Will pass through clothing / PPE

Readily absorbed through skin & mucus membranes

Causes blindness & fluid accumulation in the lungs

Children & infants are more susceptible

HF requires an antidote

Vapour Cloud - Hydrogen Fluoride



Rapid fire spread

Domestic homes & offices filled with combustible materials

Lack of space creates a close proximity between heat source and fuel

Burning debris projected over 20 metres

Unsupervised charging and lack of smoke detection allows rapid fire growth before action is taken.



How do we make e-mobility safer ?

What can we influence ?

Household items	Behavioural awareness	Physical Infrastructure
E-bikes	YES	YES
E- scooter	YES	YES
Mobility scooter	YES	YES
Laptop and Tablets (currently used)	YES	UNLIKELY
Phones (currently used)	YES	UNLIKELY
Chargeable accessories - toothbrush, razor, speaker..	YES	UNLIKELY
Vapes	YES	POSSIBLY
Toys	YES	UNLIKELY
Old laptops, tablets and phones	YES	UNLIKELY

So how do we make e-mobility safer ?

Increase risk Awareness

Promote good charging habits

Identify and quantify high risk locations

Minor home adaptation / improvements

Aggregating risk through purpose-built charging facilities



Risk awareness – inform

Risk Awareness – inform

There is lots of great safety information out there - no one is going to read an entire manual.

Keep the message simple.

Where possible use visual guides and supply a consistent message.

This may also help to drive **engagement** if the offer of further support and advice is available.

Electric Vehicle

safety at charging sites

It's good to know EV incidents & fires at charging sites are rare, but it's important to be aware of the hazards & know what to do.

Do not charge your EV if it:

-  Has been involved in a road traffic collision where emergency help was required, submerged in flood water, exposed to fire or has been recalled by the manufacturer

> Get EV checked by dealer or service centre

Before & after charging:

-  Check for fault or warning lights on dashboard or app
Check the charging unit, plug & cable for wear & tear
Do not use damaged charging equipment

> Review user manual or notify charging site owner

-  Ensure cables are not at risk of causing a trip or snip hazard
Where possible, minimise use of extension cords & power boards
After charging, place cables in a safe place to reduce risk of damage, wear & tear

Know the signs of EV battery fire

-  EV battery fires are very rare, but be alert to the signs of:
Loud popping, hissing or whistling noises
Large clouds of dark & light gases (looks like smoke)

> Evacuate & call for emergency help

Location:

Site contact:

Emergency:

 This poster is designed for general guidance only & should not be considered regulatory in any way. EV FireSafe & EV FireSafe for Business accepts no liability for losses caused to any entity from any EV incident. EV FireSafe is an Australian company funded by the Department of Defence to research electric vehicle battery fires & emergency response. See our research at evfiresafe.com & learn with us at evfiresafe.training





Fire action

If you discover an electric vehicle (EV) fire

EVACUATION

In the event of an EV fire, evacuate the immediate vicinity and move to a point of safety.

CONTACT AUTHORITIES

Alert emergency services immediately and provide accurate information about the situation, including the vehicle model, location, and any potential hazards.

AVOID WATER USAGE

Fire services typically avoid putting an EV fire out, and rather allow it to burn out in a controlled manner. However, in confined spaces like covered car parks, firefighting might be necessary, demanding more than double the water required for extinguishing traditional internal combustion engine vehicle fires.

Using water to extinguish an EV fire might not be effective and could pose additional risks due to the high voltage system. Emergency responders should use specialised equipment designed for electrical fires, this may include the use of AVD (Aqueous Vermiculite Dispersant) extinguishers and/or fire blankets.

EV Vehicle Fire

**Do not attempt to
fight EV vehicle fires.
Clear area & call 999**

Risk awareness – 6 essential habits

1. Never charge while sleeping
2. Use original manufacturers chargers only
3. Check the battery before during and after charging
4. Do not store or charge near an only means of escape.
5. Keep away from flammable / highly combustible materials
6. Always charge in a room with a smoke alarm



Risk awareness - 6 early warning signs

1. Swelling of the battery pack / Cracked casings
2. Battery pack or charger becomes hot
3. Strange smells during use or charging
4. Damaged wiring
5. Slow charging or rapid discharge of power
6. Leaking fluids

E-Bike Battery **Warning** Signs You Shouldn't Ignore

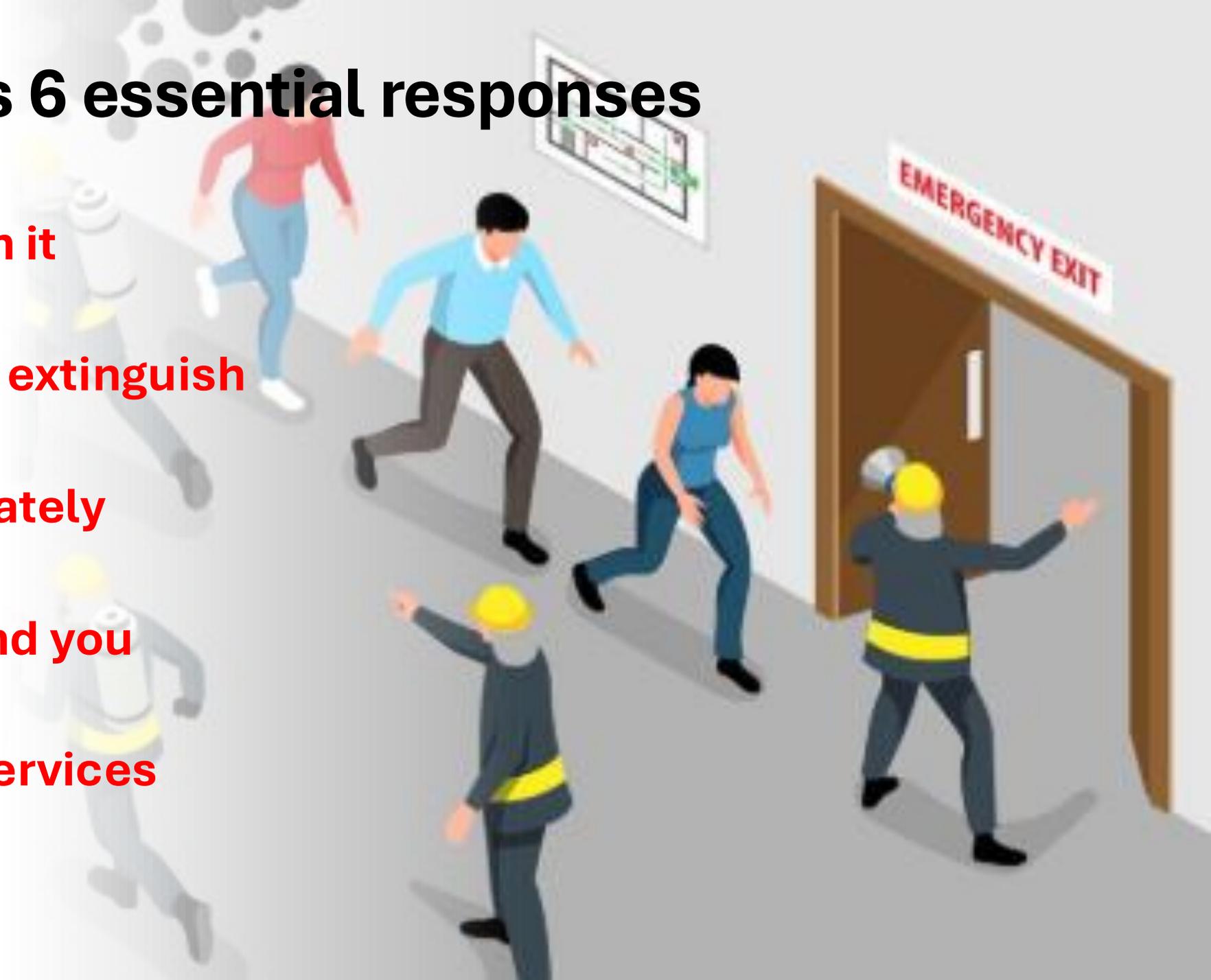


- Swollen battery case**
– cells are expanding.
- Hissing, cracking, or popping** – warning of possible failure or fire.
- Strong chemical smell**
– battery may be leaking.
- Too hot to touch**
– likely a short circuit or failing cells.
- Smoke or flames** – immediate danger.
- Leaking fluid** – highly flammable and corrosive.

REALLY GOOD BIKES
reallygoodbikes.com

Risk awareness 6 essential responses

1. Do not stop to film it
2. Do not attempt to extinguish
3. Evacuate immediately
4. Close doors behind you
5. Call emergency services
6. Warn neighbours



Risk Awareness – engage

People are **creatures of habit** often driven by **convenience** – this typically drives their charging habits.

If you just tell people, they often **forget**.

If you offer something they are more likely to **engage**.

Could helping define a dedicated charging place or dedicated charging socket help make charging within homes safer ?

In home / communal area solutions - engage

In home solutions

Engagement can help identify a safer place to charge.

This is about reducing impact as opposed to removing risk.

The reality will often be the selection of the least bad location.

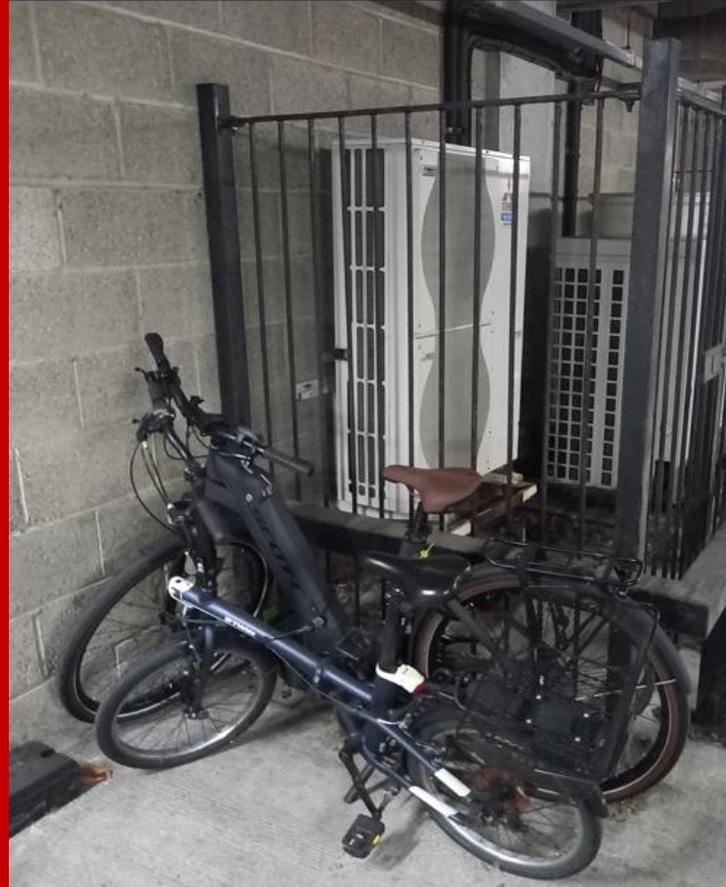


In home / communal area solutions



Aggregating the risk through purpose-built facilities

Aggregating the risk through purpose-built facilities



Do not allow storing or charging of e-bikes to be random.

Aggregating the risk through purpose-built facilities



“ We don’t allow e-mobility devices in our premises” - check how enforceable a no e-mobility clause really is.

Aggregating the risk through purpose-built facilities



Aggregating the risk through purpose-built facilities

Secure communal facilities allow for a more controlled charging and storage environment as opposed to spreading risk throughout a building.

Secure from theft (or no one will use them)

Passive ventilation

Power supply fitted with RCD

Time limited charging

Smoke detection

Visual / audible alarm

Clear means of escape

Clear instructions on what to do in the event of an alarm activation

Aggregating the risk through purpose-built facilities

Basements can provide good safe areas for charging.

Transient locations

60 minutes fire resistance

Can be modified at relatively low cost





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Outside may not always be best

An only means of escape can still be blocked by a fire that starts outside of a home.

Proximity to external walls



Generic advice is that e-bikes should be stored 6m from walls.

Not all walls are equal.

UVPC windows rapidly fail when exposed to fire allowing the glass to drop out .

Summary

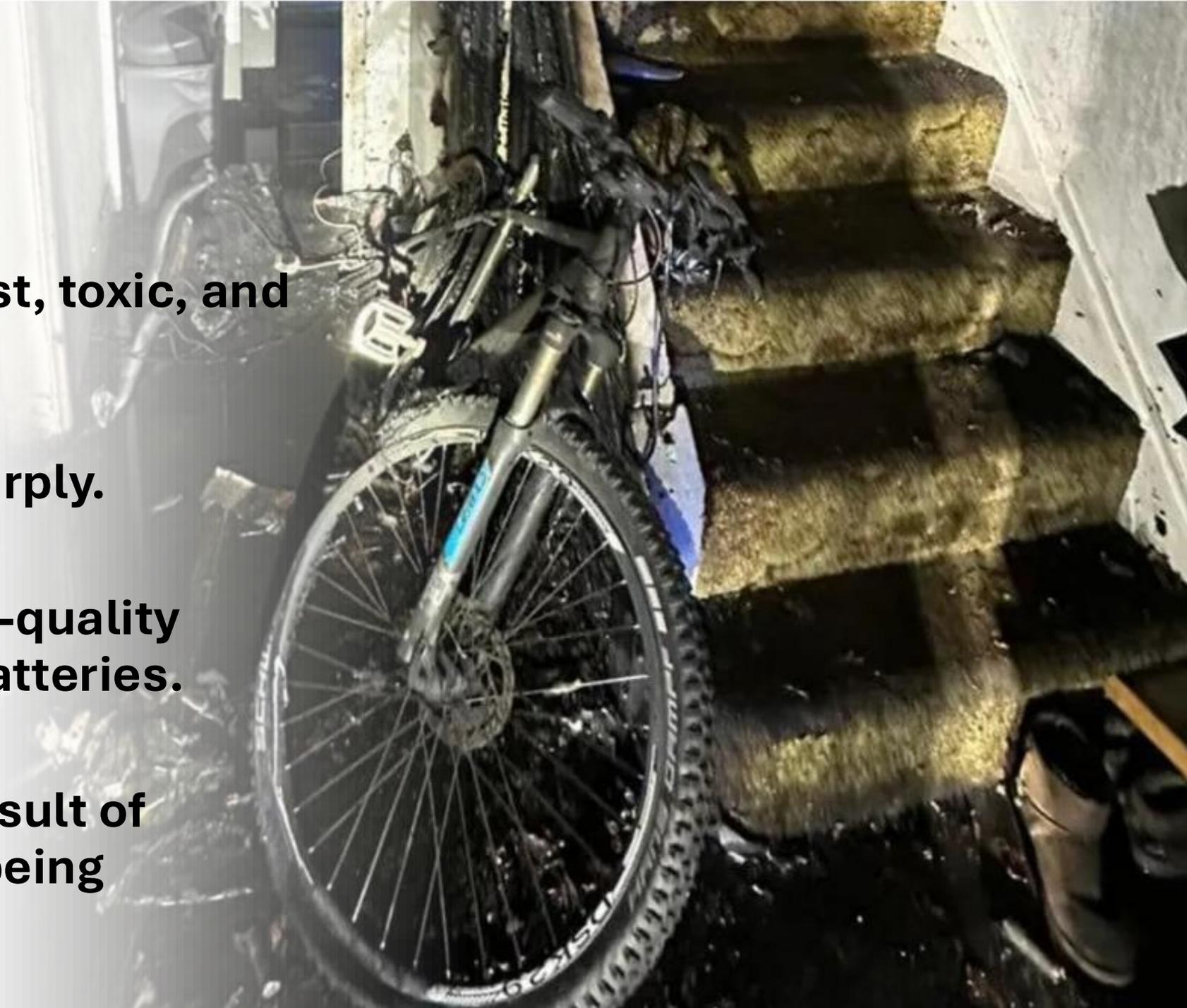
Summary

Lithium-ion fires are fast, toxic, and explosive

Incidents are rising sharply.

Many fires involve poor-quality chargers or modified batteries.

Fatalities are often a result of where the device was being charged or stored.



Summary

Awareness is key to prevention.

Safe charging practices reduce risk.

Aggregated e-mobility areas may reduce the spread of risk throughout a building.

Out of sight cannot mean out of mind.



Questions ?

Thank You - Stay safe. Protect your home.

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What Thermal Runaway Looks Like



<https://www.youtube.com/watch?v=Ka2hMktqoCY>

Risk Awareness

Electrical Fire Safety First has a great 4-minute video free to use*.



* <https://www.electricalsafetyfirst.org.uk/battery-breakdown/safer-use/>