AUSTRALIAN COMPETITION & CONSUMER COMMISSION

Lithium-ion batteries and consumer product safety

Report

October 2023

Acknowledgment of country

The ACCC acknowledges the traditional owners and custodians of Country throughout Australia and recognises their continuing connection to the land, sea and community. We pay our respects to them and their cultures; and to their Elders past, present and future.

Australian Competition and Consumer Commission
Ngunnawal
23 Marcus Clarke Street, Canberra, Australian Capital Territory, 2601

ACCC 08/23_23-56

www.accc.gov.au

Contents

Glossary

Term	Definition
ACCC	Australian Competition and Consumer Commission
Australian Consumer Law	The Australian Consumer Law, Schedule 2 of the *Competition and Consumer Act 2010* (Cth) is a national law to protect consumers.
Battery management system	A battery management system is dedicated to regulating and/or controlling a battery's cells, including preventing the battery from charging/overcharging.
Competition and Consumer Act 2010 (Cth)	The *Competition and Consumer Act 2010* (Cth) is a national law enacted to enhance the welfare of Australians by promoting fair trading and competition, and through the provision of consumer protections.
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia's National Science Agency
Electrical Equipment Safety System	A regulatory framework aimed at increasing consumer safety in household electrical equipment throughout participating jurisdictions in Australia and New Zealand.
Extra-low voltage	Extra-low voltage refers to electrical equipment that operates at a voltage below 50 Volt alternating current AC RMS or 120 Volt (ripple-free direct current).
e-scooters	A device with 2 or 3 wheels, handlebars and a floorboard that can be stood upon while riding, which is powered by an electric motor and/or human power.
e-vehicles	Includes electric and hybrid cars, motorcycles and Vespa-style motor scooters.
Household appliances and power tools	Includes cordless vacuums, drills, mowers, leaf blowers and other appliances and tools, including tools used by tradespeople.
Issues Paper	In 2022, the ACCC released an Issues Paper to seek information on Li-ion battery safety, and options to address the hazards.
Li-ion	Lithium-ion, a particular type of battery chemistry that stores (charges) and releases (discharges) energy by a reduction/oxidation reaction that causes electrons to flow from the cathode (positive electrode – metal oxide) to the anode (negative electrode – carbon graphite) through an external wire circuit which powers devices connected to that circuit.
Li-ion batteries	Rechargeable batteries that use Li-ion to store energy. These are used in consumer products such as personal devices, personal transportation devices, renewable energy storage systems and e-vehicles.
Personal devices	Includes consumer products such as mobile phones, tablets, laptops, wireless headphones, e-cigarettes, digital cameras, smart wearables and other personal devices
Personal transportation devices	Includes consumer products such as e-bikes and e-scooters hoverboards and other rechargeable personal transportation devices but does not include e-vehicles.
Residential renewable energy storage systems	Batteries for home renewable energy systems (not large energy grid scale batteries).

State and territory consumer protection agencies	Australian Capital Territory Commissioner for Fair Trading Attorney General's Department, Consumer and Business Services South Australia Consumer Affairs Victoria Consumer, Building and Occupational Services, Tasmania Department of Mines, Industry Regulation and Safety Western Australia (Consumer Protection) New South Wales Fair Trading Northern Territory Consumer Affairs Office of Fair Trading Queensland
State and territory electrical safety regulators	ACT Chief Minister, Treasury and Economic Development Directorate Department of Energy and Mining, Office of the Technical Regulator, South Australia Department of Mines, Industry Regulation and Safety Western Australia (Building and Energy) Energy Safe Victoria Electrical Safety Office, Office of Industrial Relations, Queensland Electricity Standards and Safety, Department of Justice, Tasmania New South Wales Fair Trading Northern Territory WorkSafe
Thermal runaway	Thermal runaway is a reaction that occurs when heat in a battery increases faster than it can be dispersed, causing the cell materials to decompose in a reaction that creates more heat. Thermal runaway can result in ejection of gas, extremely high temperatures, smoke and fire.

1. Executive summary

1.1 Overview

Li-ion batteries are ubiquitous. Many consumers currently use products powered by Li-ion batteries, benefiting from the ease and environmental benefits of rechargeable technology. In this Report the ACCC is seeking to demonstrate the importance of safe battery supply and design to support consumer confidence in the safety of Li-ion products.

Rechargeable lithium-ion (Li-ion) batteries are the most widespread portable energy storage solution globally.[1] They are used in a wide range of consumer products including:

- personal devices such as mobile phones, tablets, laptops
- household appliances and tools
- personal transportation devices such as e-bikes and e-scooters
- renewable energy storage systems
- e-vehicles.

The use of Li-ion batteries in consumer products is attractive as they are small with high energy density, and have better power efficiency than other battery types. The manufacturing and supply of Li-ion batteries in consumer products has grown significantly since the 1990s, both domestically and internationally. The global Li-ion battery market is expected to reach US$307.8 billion by 2032, compared to a market size of US$59.8 billion in 2022.[2] A key factor contributing to this growth is the increasing demand for consumer electronics.[3]

The Australian Competition and Consumer Commission (ACCC) developed this report as part of its 2022–23 product safety priority on scoping product safety issues and identifying potential hazard prevention strategies relating to Li-ion batteries. In 2023–24, Li-ion batteries remain a focus for the ACCC under the 2023–24 sustainability and maintaining product safety priority, to support Australia's transition to a sustainable economy including through education and awareness raising.

This report examines the risks and hazards associated with Li-ion batteries, the available incident data, the current Li-ion battery market and regulatory landscape governing Li-ion batteries in Australia. The ACCC makes a series of recommendations aimed at improving Li-ion battery safety outcomes for consumers informed by research, stakeholder engagement, and a report commissioned from the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The recommendations address both immediate actions for safe use and disposal, and longer-term strategies for regulation and improvements to disposal infrastructure.

1 Non-rechargeable batteries containing lithium in their chemistry are not considered in this report.

2 GlobeNewswire, *Lithium-Ion Battery Market is Slated to be Worth USD 307.8 Billion by 2032*, GlobeNewswire, 28 February 2023, accessed 5 May 2023

3 GlobeNewswire, *Lithium-Ion Battery Market is Slated to be Worth USD 307.8 Billion by 2032*.

1.1.1 What is the problem?

The ACCC is concerned by the limited but increasing number of incidents involving Li-ion batteries, which can have catastrophic consequences. Some Li-ion incidents have caused house fires resulting in serious injuries and property damage. Other incidents arising from Li-ion battery failure include burns, chemical exposure and smoke inhalation.

There has been one Australian fatality attributed to a Li-ion battery fire[4] and numerous reports of injuries in Australia and overseas associated with Li-ion batteries.[5] Obtaining national data relating to Li-ion incidents is challenging due to limitations in national data collection and analysis. Between 1 April 2017 and 31 March 2023, the ACCC received 231 product safety reports relating to Li-ion batteries.

The ACCC has also identified a sixfold increase in media reports relating to Li-ion battery incidents between February 2021 and February 2023. Further, there have been 23 recalls between 1 January 2017 and 31 December 2022 involving Li-ion batteries and products containing them. These recalls affect an estimated 89,000 products on the market.

Incident data is limited

While Li-ion battery incidents are limited in comparison to the number of Li-ion battery products, they are increasing, both in Australia and globally. However, there are significant gaps in the data available to verify incident rates. The number of incidents involving Li-ion batteries is likely underreported and there are differences in how the data is collected between jurisdictions and organisations, which makes data analysis challenging. Given the destructive nature of Li-ion battery fires it can be difficult to identify with certainty when a fire has been caused by Li-ion battery failure. It is important that relevant data is collected and reported consistently and appropriately shared between industry, emergency services and regulatory stakeholders, to support targeted and proportionate responses to risks.

Li-ion battery hazards are complex

Li-ion batteries can present a range of hazards to consumers which can lead to severe injury or death. Hazards can arise from low-quality Li-ion batteries, unsafe charging practices, environmental or external factors, such as when Li-ion batteries are exposed to heat or moisture, or when products containing Li-ion batteries are repurposed or modified. This can result in incidents such as fire and explosions. As new consumer products are developed in an evolving technological landscape, new risks will emerge.

Fires arising from Li-ion batteries are difficult to extinguish and may spontaneously reignite. Fire emergency services are required to dedicate significant resources to protect consumers from fires caused by Li-ion batteries.

4 Allanah Sciberras, 'Woman whose partner was killed by e-scooter battery fire warns of danger of lithium-ion batteries', *Channel 9 News*, 14 February 2023, accessed 21 March 2023.

5 Rhiannon Shine, '*Concerns over growing number of fires linked to lithium-ion batteries in e-scooters and e-bikes*', ABC News, 18 January 2023, accessed 5 September 2023. Further information and data about injuries arising from Li-ion batteries is at Section 5.

Consumer guidance is needed

There are practical steps consumers can take to help mitigate safety risks associated with Li-ion batteries. To support consumers to take these steps, there is an immediate need for consumer guidance to address safety risks.

Chargers can play a significant role in the performance and reliability of Li-ion batteries. There may be risks associated with the charging of Li-ion products, such as when Li-ion battery products are overcharged. The ACCC considers greater consumer education about best practice for charging Li-ion products will assist with risk mitigation. However, more information is needed to consider targeted steps for specific product categories.

Steps consumers can take to reduce the likelihood of charging related incidents include:

- monitor charging times of Li-ion products and disconnect products from chargers once they are fully charged (consider setting timers as a reminder to unplug devices)
- do not use batteries or devices if products are overheating or showing signs of failure such as swelling, leaking or venting gas. In these cases, place leaking or damaged batteries in a clear plastic bag (after they have cooled down) and contact your local council for disposal options
- ensure the charger is suitable for the battery in the product being charged
- charge batteries and devices away from combustible materials (such as beds, sofas or carpet)
- store batteries and Li-ion products such as e-scooters in cool, dry places and out of direct sunlight, including while charging
- allow time for batteries to cool down after use and before recharging.

The ACCC recognises there are a wide range of products containing Li-ion batteries used by consumers in a variety of circumstances and the ease with which this guidance can be followed by consumers will depend on several factors, including financial and practical considerations. For example, generic chargers are often cheaper than branded products and manufacturers may make representations about their compatibility with branded products. From a practical perspective, this may also require a change in the way Australian consumers currently use Li-ion battery products.

Li-ion batteries should be disposed of correctly

Li-ion batteries are significantly more hazardous than standard batteries if they are disposed of incorrectly. Their chemical makeup means they may ignite when exposed to conditions that are common during household waste disposal, such as compaction or exposure to heat or moisture. They can create intense and persistent fires that are difficult and dangerous to extinguish. The number of Li-ion batteries being disposed of is expected to increase in coming years as product availability increases, presenting an increasingly significant safety hazard and a need for adequate safe disposal infrastructure.

It is important that consumers are aware of how and where to correctly dispose of Li-ion batteries. To be effective, disposal options need to be accessible and easy to use. Improvements in the infrastructure of disposal locations for Li-ion batteries and products containing Li-ion batteries, and associated consumer awareness of these, are needed to prevent their disposal into household bins.

The regulatory framework is fragmented

Under the existing regulatory framework, Australian states and territories are equipped with different tools and powers to deal with electrical safety issues. This inconsistent approach to electrical safety regulation creates regulatory gaps and leads to confusion and duplication of responsibilities across jurisdictions and inconsistent treatment of electrical hazards that cross state borders. The ACCC considers the most significant challenges arising from the current regulatory framework are the lack of uniform state and territory compulsory recall powers and lack of regulatory coverage for extra-low voltage products (which includes a significant proportion of Li-ion battery products). This creates a reliance on the ACCC to intervene in a specialist product safety regime, in circumstances where a nationally consistent response is required.

Consistent state and territory legislation regulating products containing Li-ion batteries is needed. State and territory electrical safety regulators have the established infrastructure and expertise to regulate electrical consumer products containing Li-ion batteries. Leveraging this existing expertise will more effectively ensure all products containing Li-ion batteries are regulated, whereas establishment of a national regulator would require significant time and investment to establish the required expertise and experience. State and territory regulators are already equipped with the expertise and infrastructure to administer pre-market approval, registration and certification requirements for electrical products. While the ACCC can and does provide strategic interventions in important matters, it is not a substitute for the role of a specialist electrical regulator. The absence of nationally consistent requirements for testing, certification or labelling for Li-ion battery products also makes it difficult for consumers to have confidence about the quality or safety of products they purchase. The ACCC considers it is important to identify and regulate products that may pose a safety risk for consumers.

The Li-ion battery standards environment is complex

There is currently no single mandatory safety standard for Li-ion batteries or products containing Li-ion batteries.[6] There are a number of voluntary standards which apply to Li-ion batteries. These may be incorporated by electrical safety regulators in the creation of any nationally consistent regulatory framework.

Testing, certification and labelling are important

There are currently no nationally consistent requirements for testing, certification or labelling for Li-ion battery products. The labelling of Li-ion battery products is important to assist consumers in identifying quality products which have been tested to applicable standards as low-quality imported products present greater safety risks to consumers. Labelling will also assist in alerting consumers to key safety warnings. Testing Li-ion battery products is challenging given the significant expenses and lack of domestic testing facilities.

6 The ACCC administers a range of mandatory safety standards, which set out the requirements for specific products. Mandatory standards are generally based on certain parts of a relevant voluntary standard. Voluntary industry standards are published documents that establish technical specifications and procedures designed to ensure products, services and systems are safe. This may be through requirements for the design, construction, performance, and information and testing of products. Voluntary standards are typically developed by technical committees, made up of technical business, academic, government and community experts.

A multifaceted approach is needed to manage the risks

The management of Li-ion battery safety is a complex and challenging issue. The ACCC considers a multifaceted approach, with action by government, industry and consumers, is needed to address the risks and hazards associated with Li-ion batteries. The recommendations set out below include actions that will be undertaken by the ACCC, as well as recommendations that may be taken up by others:

- **Recommendation 1 (Incident data)**: Commonwealth, state, and territory governments should improve, expand and standardise data collection practices around the hazards posed by consumer electrical products, including Li-ion batteries. Wherever practicable and to the extent permitted by law, Li-ion incident data should be regularly shared among stakeholders to facilitate a better understanding of emerging risks and hazards.
- **Recommendation 2 (Consumer safety)**: Consumers should have clear and accessible educational resources on Li-ion battery safety.
- **Recommendation 3 (Disposal and end-of-life)**: The Australian Government and industry should continue to develop infrastructure, regulation and supporting policies to enable the safe and efficient collection and recycling of Li-ion batteries.
- **Recommendation 4 (Regulatory landscape)**: State and territory governments should build a fit-for-purpose, nationally consistent regulatory framework for electrical consumer products, supported by the Australian Government.
- **Recommendation 5 (Regulations)**: State and territory electrical safety regulators should introduce, administer and enforce clear requirements for the testing, labelling transportation and storage of Li-ion batteries and products containing Li-ion batteries. These requirements should be consistent across all jurisdictions.
- **Recommendation 6 (Online platforms)**: Regulators including the ACCC and state and territory Australian Consumer Law and electrical safety regulators, continue to work with online platforms regarding risks and hazards arising from products containing Li-ion batteries being sold online.

2. Recommendations

The ACCC considers a multifaceted approach, with action by government, industry and consumers, is needed to address the risks and hazards associated with rechargeable Li-ion batteries. Recommendations set out below include actions that will be undertaken by the ACCC, as well as recommendations that may be taken up by others.

Recommendation 1 (Incident data): Commonwealth, state, and territory governments should improve, expand and standardise data collection practices around the hazards posed by consumer electrical products, including Li-ion batteries.

Wherever practicable and to the extent permitted by law, Li-ion battery incident data should be regularly shared among stakeholders to facilitate a better understanding of emerging risks and hazards.

The ACCC recognises the valuable work underway to capture data reflecting injuries and incidents arising from Li-ion batteries. More consistent and comprehensive datasets will have significant benefits in identifying trends and emerging risks, responding to those areas that present the greatest risks, and informing policy and regulatory reform.

Data collection could be improved in the following ways:

- **A national product safety incident database** – there is currently no national product safety incident database to capture data and support national identification and analysis of consumer product safety hazards. Instead, product safety incident data is fragmented across a range of government and non-government organisations. With appropriate funding, the ACCC considers it is best placed to administer a national product safety incident database and recommends the ACCC is funded to develop and administer this.

  The ACCC supports the Department of Health's focus on developing a National Injury Prevention Strategy and considers that improved data such as through a national product safety incidents database would improve safety and help prevent injuries.

  A central repository for incident and injury data collection and analytics related to consumer electrical products (see Recommendation 4) could provide an effective model on which to leverage a broader national product safety incidents database, noting such a database would be costly and time consuming to establish. Centralised data collection supports the identification and analysis of consumer hazards more generally.
- **National injury surveillance** – in the absence of a national product safety database, the ACCC recommends continued efforts by state and territory governments to support consistent and comprehensive state injury surveillance, including the standardised collection of product specific injury data. Dedicated injury surveillance units currently operate in some states including Victoria, Queensland and South Australia and the remaining states monitor data – collected in various ways – within state government health departments. Standardisation of injury surveillance data collection should continue to be developed and improved.

- **National fire incident database** – the ACCC recommends the Australasian Fire and Emergency Service Authorities Council (AFAC) continues to support its members in implementing relevant reporting codes to capture Li-ion battery related fires, and develop a national fire incident database – or expand existing systems – to allow state and territory fire authorities to collect and share comprehensive data on Li-ion battery related fires, among other incidents. The ACCC recognises that development and maintenance of such a database requires appropriate resourcing; this recommendation is predicated on funding being made available for this purpose.

  For each of these methods to be most effect in addressing risks, sharing incident data will be important.
- **Sharing Li-ion incident data** – the ACCC recommends data collected by emergency services, hospitals, coroners and regulators should be shared to support a holistic understanding of current Li-ion battery hazards by all relevant stakeholders, having regard to privacy obligations and as permitted by law.

Recommendation 2 (Consumer safety): Consumers should have clear and accessible educational resources on Li-ion battery safety.

It is vital that consumers have clear and accessible guidance on the practical steps they can take to help mitigate safety risks associated with Li-ion batteries.

The ACCC and stakeholders will enhance consumer awareness through a targeted safety and education campaign on Li-ion battery safety. This will be led by the ACCC with assistance from government, fire agency and industry stakeholders to amplify consumer messaging, having regard to the common interest these groups have in promoting Li-ion battery safety. The education campaign will focus on increasing consumer awareness about:

- how to select, use, store and dispose of Li-ion batteries safely
- how to identify when batteries are at risk of being unsafe
- practical steps and risk mitigation strategies consumers can take to help stay safe.

Following the consumer safety and education campaign above, the ACCC will assess whether there is a need for further educational activities, including activities focused on specific product categories. Such activities may be led by stakeholders other than the ACCC.

This recommendation is linked to other recommendations:

- Recommendation 1 (Incident data) and the sharing of this data among stakeholders which will inform the need for further educational activities.
- Recommendation 4 (Regulatory landscape) which includes a single point of contact for consumers and businesses to report electrical safety issues and seek safety information about electrical products.

Recommendation 3 (Disposal and end-of-life): The Australian Government and industry should continue to develop infrastructure, regulation and supporting policies to enable the safe and efficient collection and recycling of Li-ion batteries.

The development of infrastructure, policies and regulations related to disposal of Li-ion batteries should be led by the Department of Climate Change, Energy, the Environment and Water, recognising its current work to develop options for e-waste product stewardship.

Industry should engage with government to seek opportunities to engage in product stewardship initiatives. All stages of the life cycle of a Li-ion battery and products containing Li-ion batteries should be considered by industry from design for recyclability through to end-of-life management, including for damaged Li-ion batteries.

With sufficient infrastructure, safe disposal and recycling becomes more sustainable and scalable.

Recommendation 4 (Regulatory landscape): State and territory governments should build a fit-for-purpose, nationally consistent regulatory framework for electrical consumer products, supported by the Australian Government.

A national framework for electrical safety regulation that provides a consistent approach across states and territories is integral to addressing safety risks associated with electrical consumer products including those containing Li-ion batteries.

A nationally consistent regulatory framework should include:

- national adoption of the Electrical Equipment Safety System into law to provide consistent pre-market controls
- uniform compulsory recall powers for all states and territories
- comprehensive regulatory coverage for extra-low voltage products, including those containing Li-ion batteries
- consistent post-market controls for electrical products that enable effective surveillance and enforcement
- a single point of contact for consumers and businesses to report electrical safety issues and seek safety information about electrical products
- a central repository for incident and injury data collection and capability related to consumer electrical products to support broader work in this area for consumer product safety
- National Ministerial oversight and decision making involving all jurisdictions and spanning the entire regulatory framework (including but not limited to the Electrical Equipment Safety System)
- clearly defined roles for jurisdictions and the Commonwealth to prevent regulatory duplication.

Recommendation 5 (Regulations): State and territory electrical safety regulators should introduce, administer and enforce clear requirements for the testing, labelling, transportation and storage of Li-ion batteries and products containing Li-ion batteries. These requirements should be consistent across all jurisdictions.

Addressing product safety risks associated with Li-ion batteries requires mitigating risks at various stages of the supply chain including importation; transportation and storage; and testing, certification and labelling. State and territory electrical safety regulatory possess the required technical expertise and industry connections to mitigate these risks.

State and territory electrical safety regulators should introduce, administer and enforce clear and consistent requirements for the testing, labelling, transportation and storage of Li-ion batteries and products containing Li-ion batteries. Effective enforcement of these regulations will serve to deter the supply of low-quality Li-ion products in Australia, which pose particular risks to the safety of Australian consumers.

The requirements should incorporate:

- safety standards and practices relating to transport and storage of Li-ion batteries, including a requirement to comply with UN38.3 (the prevailing United Nations standard that lithium batteries must meet to receive certification for safe transport globally)
- requirements that products be labelled as containing Li-ion batteries including marking the products with a recognised hazard and danger symbol
- introduction of a new compliance mark or expansion of the Regulatory Compliance Mark in-scope equipment list (AS/NZS 4417.2, which provides general requirements for the use of the Regulatory Compliance Mark) to include products containing Li-ion batteries to alert consumers to the risks posed by Li-ion batteries and to help inform consumers as to products that meet certain requirements.

Recommendation 6 (Online platforms): Regulators including the ACCC and state and territory consumer protection agencies and electrical safety regulators should work with online platforms regarding risks and hazards arising from products containing Li-ion batteries sold online.

The Australian Product Safety Pledge was introduced by the ACCC to help protect Australian consumers from safety risks when shopping online by strengthening product safety measures across online businesses through voluntary good practice commitments. Where Li-ion products are identified as posing significant risks and hazards, such as where there is an increasing trend in reports to the ACCC about safety issues with products containing Li-ion batteries, the ACCC will use its established channels with online platforms to address consumer product safety concerns.

State and territory consumer protection agencies and electrical safety regulators should also continue to work with online platforms to address risks and hazards arising from products containing Li-ion batteries. Electrical safety regulators should act where they identify Li-ion products available for supply on online platforms that may pose a risk to consumers.

3. Introduction

Li-ion batteries are ubiquitous. Many consumers currently use products powered by Li-ion batteries, benefiting from the ease and environmental benefits of rechargeable technology. In this Report the ACCC is seeking to demonstrate the importance of safe battery supply and design to support consumer confidence in the safety of Li-ion products.

The use of Li-ion batteries is likely to increase in coming years as we move toward net zero emissions and a circular economy, and the challenges and opportunities of this exponential growth are currently being considered by governments globally. At the time of this report, concurrent initiatives and studies are being progressed across government. Notably, the Department of Industry, Science and Resources is developing the National Battery Strategy, to grow a sustainable and thriving battery industry in Australia.[7] Similarly, the Department of Climate Change, Energy, the Environment and Water is working to develop a regulatory product stewardship scheme for small electrical and electronic equipment and solar photovoltaic systems.[8]

3.1 The ACCC's role, the regulatory framework and scope of this report

3.1.1 ACCC's role

The ACCC is an independent Commonwealth statutory agency that promotes competition, fair trading and product safety for the benefit of consumers, businesses and the Australian community. The primary responsibilities of the ACCC are to enforce compliance with the competition, consumer protection, fair trading and product safety provisions of the *Competition and Consumer Act 2010* (CCA), regulate national infrastructure and undertake market studies.

The Australian Consumer Law, set out in Schedule 2 to the *Competition and Consumer Act 2010*, governs consumer protection and fair trading, including the safety of consumer goods. Regulation and administration of the Australian Consumer Law is a shared responsibility between the ACCC and state and territory consumer protection agencies. The ACCC and state and territory consumer protection agencies are responsible for regulating the safety of general consumer products.

There is no law that generally prohibits unsafe goods from being sold in Australia. The ACCC's product safety role involves identifying, prioritising and addressing risks to persons arising from unsafe consumer goods and product-related services. The ACCC does this by administering the consumer product safety provisions of the Australian Consumer Law. The Australian Consumer Law provides for the relevant Minister responsible for product safety to issue compulsory recalls, product bans, safety warning notices, and mandatory safety and information standards.

Scoping product safety issues and identifying potential hazard prevention strategies relating to Li-ion batteries was an ACCC 2022–23 product safety priority.[9] In 2023–24, Li-ion batteries remain a focus for the ACCC with a focus on sustainability and maintaining product safety, to support Australia's

7 Department of Industry, Science and Resources, *National Battery Strategy Issues Paper*, Department of Industry, Science and Resources website, 3 February 2023, accessed 20 June 2023.

8 DCCEEW, *Wired for change: Regulation for small electrical products and solar photovoltaic systems*, DCCEEW website, published 20 June 2023

9 ACCC, *Product safety priorities 2022–23*, ACCC website, June 2022, accessed 14 November 2022. The ACCC Product Safety Priorities policy sets out the principles adopted by the ACCC for prioritising and addressing product safety risks.

transition to a sustainable economy including through education and awareness raising.[10] A key focus is supporting consumer confidence in the safety of products needed to underpin Australia's transition to a net zero and the circular economy. Li-ion batteries can play a role in this transition, given their long-term use, high energy density and ability to store energy from renewable sources.

3.1.2 Regulatory framework

The current regulatory framework does not squarely address the safety risks of Li-ion batteries in Australia. The product safety provisions in the Australian Consumer Law do not contain the full suite of tools needed to effectively regulate specialist products, such as electrical products. Instead, electrical products are regulated by state and territory electrical safety regulators using a range of state and territory based legislation. The Australian Consumer Law is at times relied on to address gaps in state and territory electrical safety regulation as part of a patchwork of regulations. The framework relies, in part, on ex-post action by consumers or regulators sometimes, after a safety incident has occurred.

Under the Australian Consumer Law consumers have the right to expect certain things when they buy a product or service. These basic rights are called consumer guarantees, and among other things, require that products must be of acceptable quality. If the consumer guarantees are not met, consumers may be entitled to a remedy, such as a repair, replacement or a refund depending on the circumstances. The ACCC cannot resolve individual disputes about whether the consumer guarantees have been met and cannot take enforcement action in relation to consumer guarantees alone. The ACCC's enforcement actions seek to maximise impact and leverage any outcomes across an industry sector and direct resources to matters that provide the greatest overall benefit.

The current regulatory framework in Australia does not comprehensively address the hazards associated with Li-ion batteries. Regulations vary significantly between states and territories in their coverage of consumer goods containing Li-ion batteries. This results in regulatory gaps for many Li-ion battery products. The absence of comprehensive regulation and the increasing prevalence of Li-ion battery products poses a significant risk to the safety of Australian consumers.

3.1.3 Report scope

This report addresses consumer products containing Li-ion batteries including:

- personal devices, household appliances and power tools, personal transportation devices, e-vehicles and residential renewable energy storage systems
- products like power tools used by tradespeople, e-bikes used by delivery riders and rental e-bikes and e-scooters, as these types of products are frequently also used by consumers and/or stored in homes.

This report addresses rechargeable Li-ion batteries and does not cover non-rechargeable batteries.

This report addresses products containing Li-ion batteries generally, rather than examining the nuances in risks and hazards associated with particular product categories. The ACCC has taken this approach given the vast range of products containing Li-ion batteries, and because the available data does not provide a basis to focus on particular product categories. An improved understanding of the risk profile of products containing Li-ion batteries would enable greater focus on high risk products and more targeted consumer education, however at this stage a lack of comprehensive data prevents such an assessment.

10 ACCC, *Product safety priorities 2023–24*, ACCC website, June 2023, accessed 17 July 2023.

3.1.4 CSIRO Report

The ACCC commissioned a report from the Commonwealth Scientific and Industrial Research Organisation, Australia's National Science Agency (CSIRO) to seek expert scientific views on product safety risks and mitigation measures for Li-ion batteries. The CSIRO report is published in full on the Product Safety Australia website, and select content is incorporated in this report. The CSIRO report considers:

- the role of different Li-ion chemistries in the severity of battery failure
- the role of the battery management system in electronically managing the cells within the battery
- charging and charger issues
- the hazards posed to users and the public when a Li-ion battery fails
- end-of-life considerations, including second life, disposal, and recycling
- the standards and regulatory framework in Australia.

Many of the CSIRO recommendations align with the recommendations made by the ACCC in this report. Other recommendations are outside the ACCC's role and are more appropriate for consideration by other regulators and industry. The CSIRO's recommendations are in Appendix 1.

3.2 Stakeholder consultation and engagement

In October 2022, the ACCC released a short survey, promoting it through the ACCC's social media channels and distributing to stakeholders, to seek information about consumer experiences with Li-ion batteries. The survey sought views on how consumers perceived the risks related to Li-ion batteries, to help inform the ACCC's assessment of consumer awareness about the risks associated with Li-ion batteries. There were more than 4,000 responses to this survey. The findings of the survey are identified throughout this report.

On 6 December 2022, the ACCC released the Li-ion Batteries Issues Paper for public consultation.[11] The Issues Paper invited responses from stakeholders on how the safety hazards posed by Li-ion batteries should be addressed, safety risks, consumer information and the Li-ion battery market in Australia.

The ACCC received 74 submissions in response to the Issues Paper from stakeholders including manufacturers, consumer advocates, individual consumers, testing and certification agencies, and government agencies. Where consent has been given to publish, these submissions are discussed in relevant sections of the report and are available on the ACCC Consultation Hub.[12] The stakeholders that provided submissions are listed at Appendix 5.

11 ACCC, *'Lithium-ion Batteries - Issues Paper'*, ACCC website, 6 December 2022, accessed 1 September 2023.

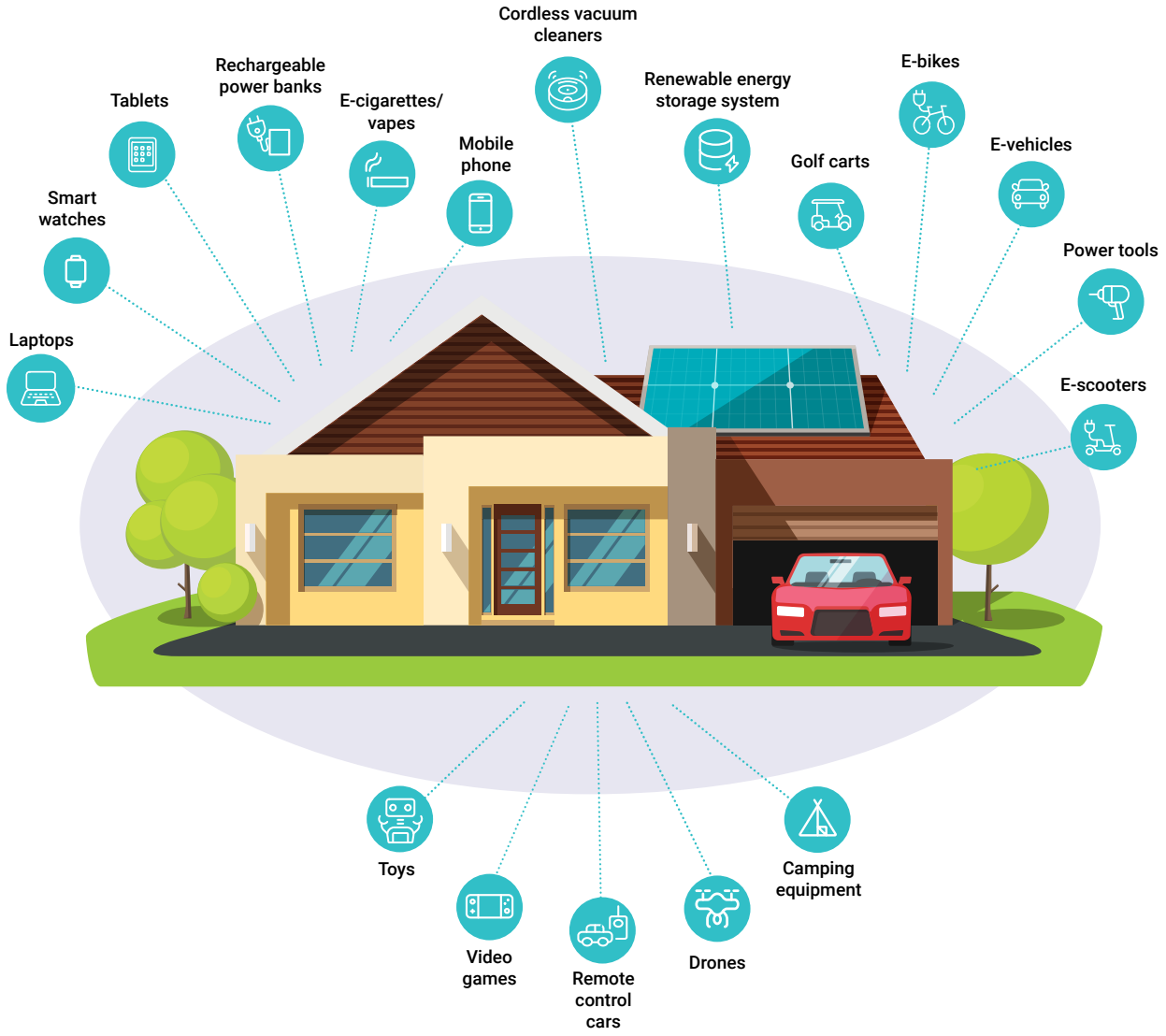
12 Submissions to the Issues Paper are available at the ACCC Website, https://consultation.accc.gov.au/accc/lithium-ion-batteries-issues-paper/.

4. Li-ion batteries: What is the problem?

4.1 What is a Li-ion Battery?

Li-ion batteries are now common in products in Australian homes, powering portable consumer electronics, transportation solutions (e-scooters, e-bikes and e-vehicles) and energy storage systems. Figure 1 below indicates some of the household products that commonly use Li-ion Batteries.

Figure 1: Common household products containing Li-ion batteries



Li-ion batteries contain cells that store (charge) and release (discharge) energy.

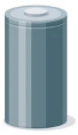
A Li-ion battery is comprised of several components including:

- cell(s)
- wiring
- external connection
- depending on the size of the device, potentially an active or passive cooling system.[13]

A key feature of a Li-ion battery pack is the battery management system.[14] The battery management system plays an important role in managing the performance, efficiency, and safety of the battery system, especially for high energy density and long lifespan products.[15]

Li-ion batteries are available in different cell formats depending on the type of product requiring a Li-ion battery. Table 1 summarises the common cell formats.[16] While button batteries are a type of Li-ion battery, the ACCC's previous work on button batteries is separate to the scope of this report. Button batteries have a particular risk profile and are covered by 4 mandatory standards, which the ACCC is responsible for enforcing.[17] This is separate to the work completed to produce this report.

Table 1: Common Li-ion battery cell formats

Format	Cell image	Dimensions	Typical capacity/ AMP hour (AH)	Example application
Coin or button cell		Variable	Less than 1	Consumer
Cylindrical		18 mm (diameter) x 65 mm (height)	3–5	Consumer, Automotive
Cylindrical		26 mm (diameter) x 65 mm (height)	4–8	Consumer, Automotive, Energy Storage System
Cylindrical		46 mm (diameter)x 80 mm (height)	10–12	Automotive
Pouch		Variable	Up to 100	Automotive, Aerospace, Consumer,
Prismatic		Variable	Up to 300	Energy Storage Systems

13 More detail about the technical aspects of batteries and chemical composition is considered in the CSIRO Report. See for example, p 21.

14 Best et al., *Lithium-ion battery safety,* p 11.

15 Best et al., *Lithium-ion battery safety*, p 11.

16 Best et al., *Lithium-ion battery safety*, p 9.

17 ACCC, *Button and coin batteries*, https://www.productsafety.gov.au/product-safety-laws/safety-standards-bans/mandatory-standards/button-and-coin-batteries, accessed 6 September 2023.

4.2 Demand for Li-ion batteries is growing

As noted above, global market demand for Li-ion batteries is projected to be worth USD $133–151 billion in 2030.[18] The electrification of transport, both passenger and commercial presents the highest growth areas with EVs capturing 62% of battery pack sales in 2030.[19] The number of batteries and available brands is expanding rapidly as more companies enter the battery market to meet growing customer demand.[20]

The volume of Li-ion batteries placed on the global market has increased significantly over recent years and this trend is expected to continue.[21] This is driven in large part by the increased usage of related consumer products, as well as an increase in the uptake of e-vehicles – with the number of e-vehicles sold globally each week in 2021 being comparable to the number sold annually in 2012.[22]

4.2.1 Manufacturers

In 2022, Chinese company Contemporary Amperex Technology Co. Limited (CATL) was the world's leading manufacturer of Li-ion batteries by market share (35% of sales globally).[23] Other major global manufacturers by market share include:

- LG Energy Solution Ltd (15.9%)
- Panasonic Holdings Corporation (Japan) (9.9%)
- SK On Co., Ltd (6.6%)
- China Aviation Lithium Battery Co., Ltd (4.4%)
- Samsung SDI Co., Ltd (3.8%).[24]

These manufacturers produce Li-ion batteries which feature in products including electronic devices, e-vehicles and residential energy storage systems.

In Australia, there are a small number of Li-ion battery manufacturers. Energy Renaissance, for example, manufactures energy storage and transport related Li-ion batteries.[25] Lithium Batteries Australia manufactures and supplies batteries for a range of applications including marine electronics.[26]

18 Future Battery Industries CRC, 'Future Charge, Building Australia's Battery Industries', *Future Battery Industries CRC*, June 2021, accessed 30 August 2023, p 11.

19 Future Battery Industries CRC, 'Future Charge, Building Australia's Battery Industries', *Future Battery Industries CRC*, June 2021, accessed 30 August 2023, p 11.

20 Australian Battery Industry Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 1.

21 Eric Melin, *The lithium-ion battery end-of-life market – A baseline study*, World Economic Forum, 21 December 2021, accessed 19 July 2023.

22 Department of Climate Change, Energy, Environment and Water (DCCEEW), *National Electric Vehicle Strategy*, DCCEEW, Australian Government, 2023, p 7.

23 Statista, *Global market share of lithium ion battery makers in 2022*, Statista website, 2022, accessed 1 September 2023.

24 Statista, *Global market share of lithium ion battery makers in 2022*.

25 Energy Renaissance, *Applications*, Energy Renaissance website, n.d., accessed 4 May 2023.

26 Lithium Batteries Australia, *About Us*, Lithium Batteries Australia website, n.d., accessed 4 May 2023.

4.2.2 Retailers

Retailers sell a wide range of consumer products containing Li-ion batteries, such as mobile phones, laptops, tablets, household appliances, power tools and e-vehicles.

According to IBIS World, the 2 largest retailers of domestic appliances in Australia as of February 2023 are JB Hi-Fi Limited and Harvey Norman Holdings Limited.[27] Both retailers sell a range of consumer electronics including mobile phones, computers and tablets, TVs and digital cameras.

According to the Electric Vehicle Council, there are 45 electric vehicle models available in Australia including 95 variants. In 2022, the major retailers based on the number of e-vehicles sold include Tesla, MG Motor, Hyundai and Polestar.[28]

4.2.3 Australian consumers

The use of Li-ion batteries in consumer products is attractive as they can be portable, have a high energy density and have better power efficiency than other battery types.[29] In the 10 years to 2017, Li-ion battery energy consumption in Australia more than tripled, with increasing demand for consumer products a major contributor.[30] The proportion of Australians who own at least one Li-ion battery product is also high and increasing, with more than 9 out of every 10 Australians owning a smartphone with a Li-ion battery.[31] [32]

Consumers are quickly adopting a range of Li-ion battery technologies. In Australia, there has also been a significant rise in the uptake of e-vehicles, with the Department of Climate Change, Energy, the Environment and Water reporting that the number of e-vehicles purchased increased by 86% in 2022.[33] Similar trends have also been seen for e-bikes, with national e-bike sales increasing from around 9,000 in 2017 to around 75,000 in 2021.[34] With a shift towards developing a more sustainable economy, the ACCC expects the use of Li-ion battery products will continue to increase.

4.3 Consumer safety risks

Many Li-ion battery products have been and will continue to be used by consumers without incident. While the rate of Li-ion battery incidents is limited in comparison to the number of Li-ion battery products available, as the prevalence of Li-ion batteries in Australian homes increases, we can expect an increase in Li-ion battery related incidents. Li-ion battery incidents can present a range of hazards to consumers, with risks at various stages of the battery's lifecycle. There are some practical steps consumers can take to be aware of and help mitigate these safety risks and minimise the rate of incidents occurring.

---

27 IBISWorld, *ANZSIC Report G4221A Domestic Appliance Retailing in Australia*, IBISWorld website, n.d., accessed 4 May 2023.

28 Electric Vehicle Council, *State of Electric Vehicles October 2022*, *Electric Vehicle Council website*, n.d., accessed 9 May 2023.

29 Clean Energy Institute, University of Washington, *What is a lithium-ion battery and how does it work?*, Clean Energy Institute website, n.d., accessed 5 May 2023.

30 Austrade, *The lithium-ion battery value chain – New economy opportunities for Australia*, Austrade website, December 2018, p 7.

31 Deloitte, *Mobile Nation 2022*, Deloitte website, n.d., accessed 20 July 2023.

32 The report was amended on 28 May 2024 to remove the estimate of how many devices powered by lithium-ion batteries on average, would be in a household by 2026. The source for this estimate was in relation to internet connected devices which includes both lithium-ion and non-lithium-ion battery devices.

33 Department of Climate Change, Energy, Environment and Water (DCCEEW), *National Electric Vehicle Strategy*, DCCEEW, Australian Government, 2023.

34 Bicycle Network, *Australia's EV strategy misses the turnoff for faster climate action*, Bicycle Network website, 27 April 2023, accessed 5 May 2023.

All types of batteries present risks, however Li-ion battery failure can be particularly catastrophic, due to the flammable and volatile liquid electrolyte solution within a Li-ion battery.[35] Combustible system components, battery chemistry and format, electrical capacity, and energy density all contribute to the potential fire hazard.[36]

Heat is a by-product of the normal function of a Li-ion battery.[37] However, in an uncontrolled failure, the combination of heat and the volatile liquid electrolyte solution can cause a serious and self-sustaining fire.[38] These fires can be difficult to extinguish and may spontaneously reignite.[39] Further, as multiple cells are often linked within a battery pack, this may create a chain reaction causing a larger fire event.[40]

Other hazards such as vapour clouds, venting (which can be identified when a battery makes a 'hissing' sound[41]), and toxic chemicals may also be hazardous to consumers throughout the battery lifecycle. Thermal runaway (illustrated in Figure 2) is an internal battery overheating reaction which occurs when heat in the Li-ion battery increases faster than it can be dispersed to its surroundings.[42] The high temperature causes the cell materials to decompose in a reaction that creates more heat, causing the materials to decompose at a faster rate. Thermal runaway can result in ejection of gas, extremely high temperatures, smoke and fire.[43]

Figure 2: Thermal runaway[44]

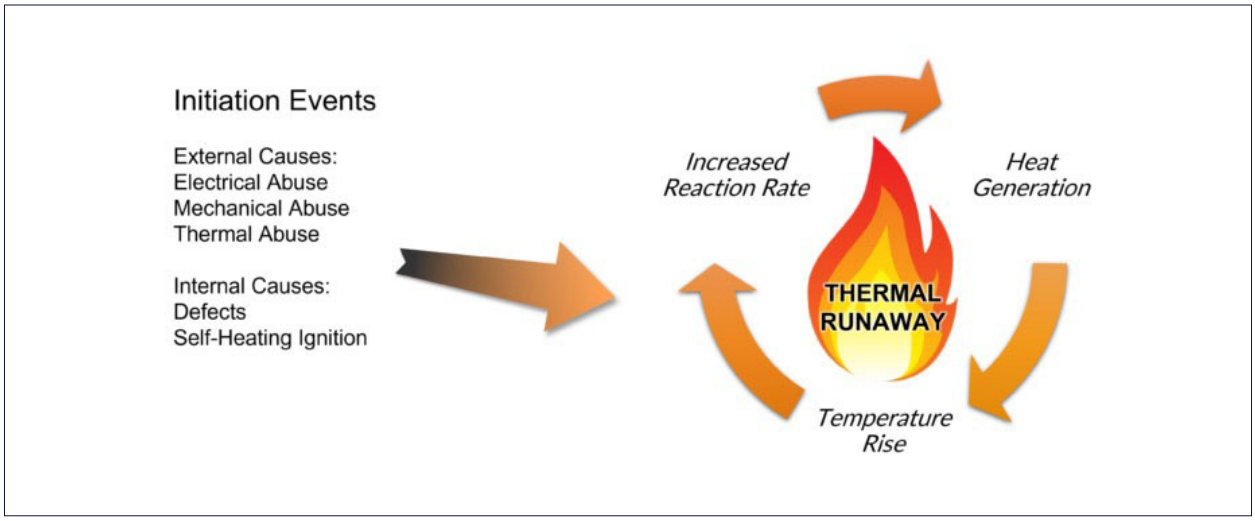


Table 2 outlines some of the key risk factors that may trigger a Li-ion battery incident or fire.

35 University of New South Wales, *Seven things you need to know about Lithium-ion battery safety*, University of New South Wales website, 20 March 2023, accessed 12 May 2023.

36 Best et al., *Lithium-ion battery safety*, p 30.

37 Y Chen, Y Kong, Y Zhao, L Wang, J Liu, Y Li, Z Liang, X He, X Li, N Tavajohi and B Li, 'A review of lithium-ion battery safety concerns: The issues, strategies, and testing standards', Journal of Energy Chemistry, August 2021 59:83-89, doi: 10.1016/j.jechem.2020.10.017.

38 University of New South Wales, *Seven things you need to know about Lithium-ion battery safety*, University of New South Wales website, 20 March 2023, accessed 12 May 2023.

39 Fire and Rescue NSW, *Battery and Charging Safety*, Fire and Rescue NSW website, 2023, accessed 12 May 2023.

40 C Lopez, J Jeevarajan and P Mukherjee, , 'Experimental Analysis of Thermal Runaway and Propagation in Lithium-Ion Battery Modules', Journal of The Electrochemical Society, 2015, 162(9): 1905-1915, doi:10.1149/2.0921509jes.

41 Best et al., *Lithium-ion battery safety*, p 23.

42 Best et al., *Lithium-ion battery safety*, p 4.

43 UL Research Institutes, *What is Thermal Runaway?*, UL Research Institutes Website, 24 August 2021, accessed 6 July 2023.

44 Movitherm, *Reducing the Risk of Battery Thermal Runaway*, Movitherm website, n.d., accessed 8 September 2023.

Table 2: Risk factors leading to Li-ion battery incidents

	**Unsafe charging practices** Use of incompatible chargers or overcharging batteries is a risk factor.[45] There may be charging risks where there is no battery management system to protect against overcharging, **or where incompatible charging equipment** is used **or** devices are overcharged
	**Environmental or external factors** Risks may occur when Li-ion batteries are exposed to heat, moisture or damage. Specifically: ▪ Li-ion batteries may overheat when subjected to high external temperatures, causing leakage of the flammable/corrosive electrolyte solution or thermal runaway and fire[46] ▪ when liquid or airborne moisture enters into Li-ion battery powered devices, it may cause electrical shorting, potentially leading to thermal runaway.[47] Li-ion batteries may also be hazardous where there is potential chemical exposure, as they contain toxic chemicals that may be emitted if they are not disposed of properly.[48] The risks relating to the disposal of Li-ion batteries are discussed further at Section 4.4 below.
	**Repurposed, modified or customised battery applications** Hazards may arise when products with Li-ion batteries are repurposed or modified. This includes DIY retrofitted and second-life battery applications.[49]
	**Manufacturing defects or low- quality batteries** The quality of a Li-ion battery is a key factor affecting its safety.[50] Accordingly, defective Li-ion batteries, or Li-ion batteries which have been poorly manufactured pose a significant risk to consumers. Submissions supported battery quality as a risk factor, with low-quality cells and battery management system components affecting a battery's overall safety.[51] The use of low quality batteries or battery chargers was noted as a particular risk for hand-held devices, electric scooters and other portable products.[52] Lower quality aftermarket batteries are also at a greater risk of overheating when they are being charged.[53] The impact of battery quality and associated manufacturing issues is illustrated in 2 case studies in this report: the LG home battery recall (discussed at Section 5.1.6) and hoverboards (discussed at Section 8.3.3).

45 Best et al., *Lithium-ion battery safety*, p 30.

46 ibid.

47 Best et al., *Lithium-ion battery safety*, p 27.

48 NSW Environmental Protection Authority, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 4.

49 Allianz Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

50 Australasian Fire and Emergency Service Authorities Council (AFAC), *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

51 UL Research Institutes, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

52 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

53 National Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

The following case study illustrates some of the risks posed by faulty Li-ion batteries.

Case Study 1 – Risks posed by Li-ion batteries: E-bike explosion

Fourteen fire trucks were call to an Eastgardens home to extinguish a fire in July 2023, when an e-bike with a faulty Li-ion battery caused a fire that tore through the ground floor of a home and destroyed a vehicle.

Fire and Rescue New South Wales reported that a faulty Li-ion battery on the e-bike exploded, causing the fire. Firefighters remained overnight to prevent the battery from reigniting and removed several other Li-ion batteries from the scene, concerned they may ignite or explode because of the fire.[54]

54 Fire and Rescue NSW, *E-bike explodes in flames, spreads to home – Video – Eastgardens*, Fire and Rescue NSW website, 20 March 2023, accessed 25 July 2023.

4.4 Risks in the disposal process

When Li-ion batteries are disposed of in household rubbish or recycling bins, they pose profound risks to people, the environment and property. There have been reports of serious fires resulting from incorrect disposal of Li-ion batteries in general rubbish or recycling bins, including fires in garbage trucks and at waste processing facilities.[55] The National Waste and Recycling Industry Council has indicated that an average of 3 fires per day in Australia are attributed to batteries being incorrectly disposed. In response to this issue, the Victorian Environmental Protection Agency for example, has banned Li-ion batteries (and electronic waste more broadly) from landfill.[56] Similarly the Victorian Government has implemented the Waste Fire Prevention Program, a partnership of state government departments with an aim to reduce the number and severity of fires at waste and recycling facilities.[57] Many stakeholders highlighted the risks associated with the incorrect disposal of Li-ion batteries, and the knowledge gaps that exacerbate this.

Li-ion batteries are more hazardous than standard batteries when incorrectly discarded into household rubbish and recycling bins. Their chemical makeup means they are likely to ignite when exposed to conditions common during household waste disposal, such as compaction or exposure to heat or moisture. Li-ion batteries create intense and persistent fires that are difficult and dangerous for firefighters to extinguish. The ACCC expects the number of waste Li-ion batteries will increase in coming years unless there are improvements in safe disposal and recycling of these products.

55 Declan Bowring, '*Lithium-ion batteries to blame for garbage truck, waste facility fires*', ABC News, 29 May 2023, accessed 22 September 2023.

56 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

57 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 9.

5. Li-ion battery incident data

5.1 Available Data

Recognising the breadth of Li-ion products and purposes for which Li-ion battery incident data may be collected, there is no single source that captures data about Li-ion battery incidents in Australia. The ACCC has reviewed relevant data including ACCC internal data, fire and emergency department data and media reports to assess incidents, injuries and fires.

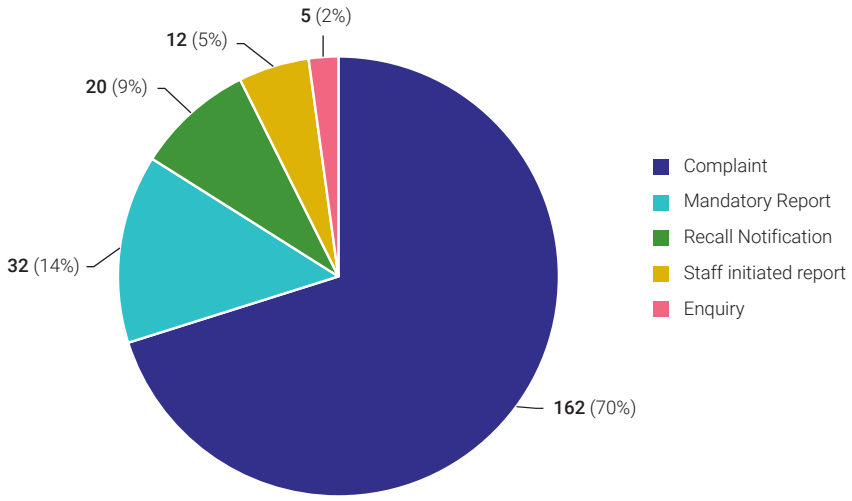
The ACCC reviewed data available from a range of sources and while incidents of Li-ion battery incidents are on the rise, both in Australia and globally, there are gaps in the available data to verify incident rates. There are various factors contributing to this situation, including likely underreporting of incidents and differences in collection practices between different jurisdictions and organisations such as the ACCC, state and territory health departments, fire and emergency services, and state and territory electrical safety regulators and consumer protection agencies.

5.1.1 ACCC Data

The ACCC receives data from consumers and businesses on product safety incidents involving Li-ion batteries. This is comprised of consumer complaints as well as mandatory supplier reports of deaths and serious injury or illness and voluntary reports of incidents, such as near misses, which do not meet the mandatory reporting threshold.

Between 1 April 2017 and 31 March 2023, the ACCC received 231 product safety reports relating to Li-ion batteries. Figure 3 shows the breakdown of reports made to the ACCC during the period. Complaints from consumers comprised the largest proportion of results with 162 reports (70%). Significant underreporting is suspected for reasons discussed below.

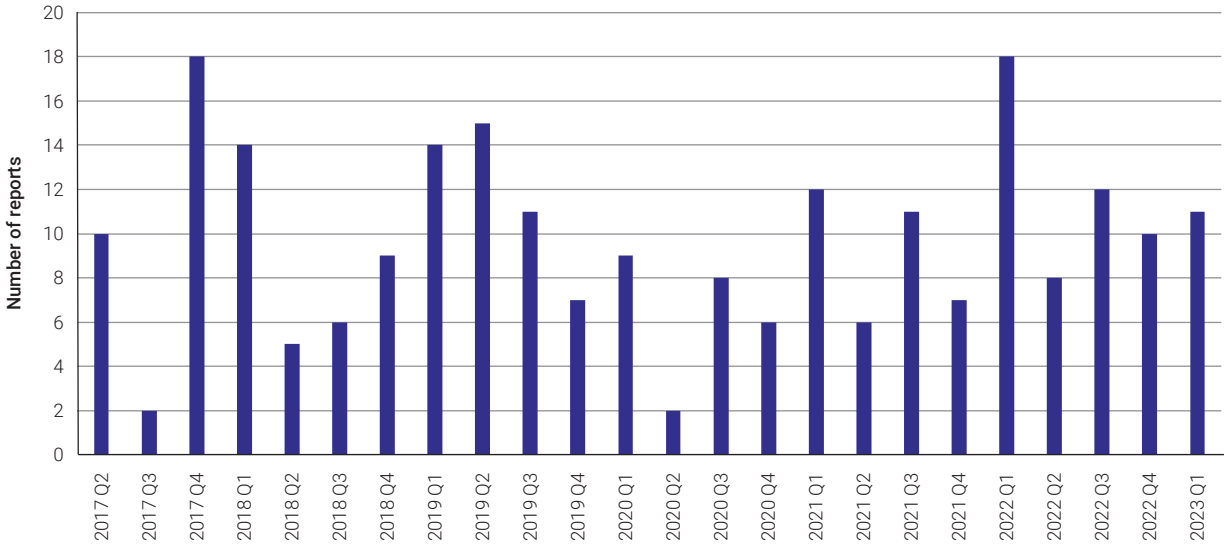
Figure 3: Product Safety Reports to the ACCC



When any participant in the supply chain becomes aware that a consumer product they supplied caused or may have caused serious injury, serious illness or death they are required to notify the ACCC of these incidents.[58] Mandatory reports from suppliers relating to Li-ion batteries comprised 32 of the 231 product safety reports (14% of product safety incident reports to the ACCC involving Li-ion batteries). The remaining 16% of reports consist of recall notifications, consumer enquiries and staff initiated reports (reports from staff arising from monitoring of incidents reported in the media).

Figure 4 shows the number of reports made to the ACCC over time. There has been an upward trend since late 2020. This is due in part to an increase in reports captured through the ACCC's monitoring of media articles identifying product safety incidents (which was established in late 2021), and increases in reporting rates by consumers. The ACCC considers there is significant underreporting of products safety related injuries, through a combination of underreporting of mandatory incidents, and the absence of mandatory requirements to report near misses. The ACCC estimates each year there are around 780 deaths and 52,000 injuries in Australia from unsafe consumer products. It follows that the number of Li-ion related incidents may be much higher than is reflected in this data.

Figure 4: Li-ion Battery Safety Reports to ACCC over time



Approximately 25% of the Li-ion battery product safety reports involved injuries or illnesses that were alleged to have been caused by Li-ion battery incidents. The most common injuries being burns (63% of injuries). Mobile phones and wearables (including smart watches and fitness trackers) were the products most likely to cause burn injuries, and this may be due to their prevalence and proximity to the user's body.

Product categories

The most common product types involved in reports to the ACCC regarding Li-ion batteries were consumer items such as mobile phones, tablets and laptop computers. This may reflect the widespread supply of these goods and the increasing prevalence of Li-ion battery powered devices in Australian homes as discussed in Section 4.2.3.

58 Suppliers must submit a report to the ACCC to satisfy their obligation to notify the Commonwealth Minister within 2 days if they become aware that a consumer good or product related service they supply caused or may have caused a death, serious injury or serious illness. This applies even if the consumer good was not used in the intended way (misused), so long as the misuse was foreseeable. Serious injury or illness is acute (sudden, brief and severe) and requires medical treatment. Further information on this requirement can be found at https://www.productsafety.gov.au/product-safety-laws/legislation/mandatory-reporting.

Figure 5: Li-ion battery reports by product category

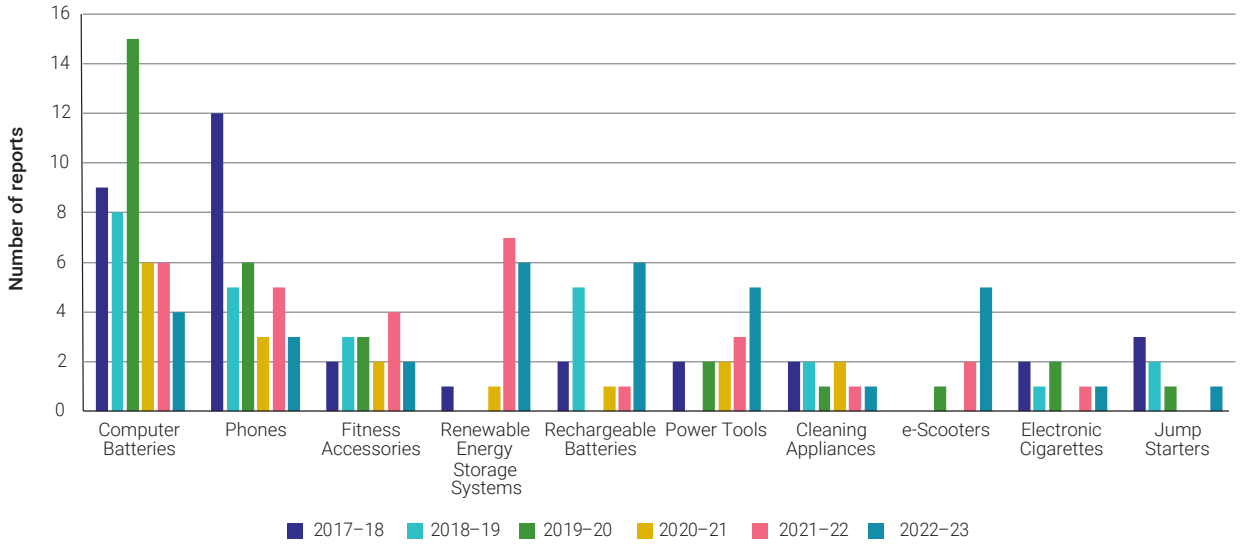


Figure 5 shows the number of safety reports for the 10 most reported Li-ion product categories by year. Although they are the most common product types seen in this incident data, the ACCC has seen a decrease in the number of incidents involving mobile phone and computer batteries over the last 5 years, possibly due to improvements in safety or changes in consumer awareness or behaviour. The absence of some product categories such as e-bikes, which were noted by other stakeholders as generating reports of Li-ion battery related incidents, may also be explained by underreporting, and again suggests this data may not provide a clear picture of the extent and type of Li-ion battery related incidents.

Conversely, there has been an upward trend in reports concerning Li-ion batteries in e-scooters, which accounted for 8 Li-ion battery related reports, with 7 of these in the previous 2 years. All but one report involved spontaneous combustion, overheating or a fire and 4 (50%) of these incidents resulted in an injury to the consumer. While the data is limited, this finding supports anecdotal information provided by Fire Rescue Victoria,[59] the Western Australia Department of Mines, Industry Regulation and Safety (the Western Australian consumer protection agency),[60] and ComTest Laboratories[61] that Li-ion batteries within e-scooters are a significant and growing safety hazard.

Similar incident increases were reported for other products such as energy-saving technology (including residential energy storage), and power tools. Although the total number of incidents has not shown a clear increase over the previous 5 years, there has been a trend towards incidents involving products that have a higher energy capacity (such as e-scooters, residential energy storage and power tools). Stakeholders such as Fire Rescue Victoria indicated that battery size and capacity are significant factors in the severity of a fire.[62]

The Electric Vehicle Council noted the lack of Li-ion battery safety incidents associated with road-registered e-vehicles and attributed this to more robust regulatory coverage of these products.[63] The CSIRO noted that road vehicles are required to meet the Australian Design Rules (Australia's national standards for road vehicle safety) in accordance with the Motor Vehicles

59 Fire Rescue Victoria, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

60 Department of Mines, Industry Regulation and Safety WA, Consumer Protection, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 11.

61 ComTest Laboratories, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 4.

62 Fire Rescue Victoria, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

63 Electric Vehicle Council, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 4.

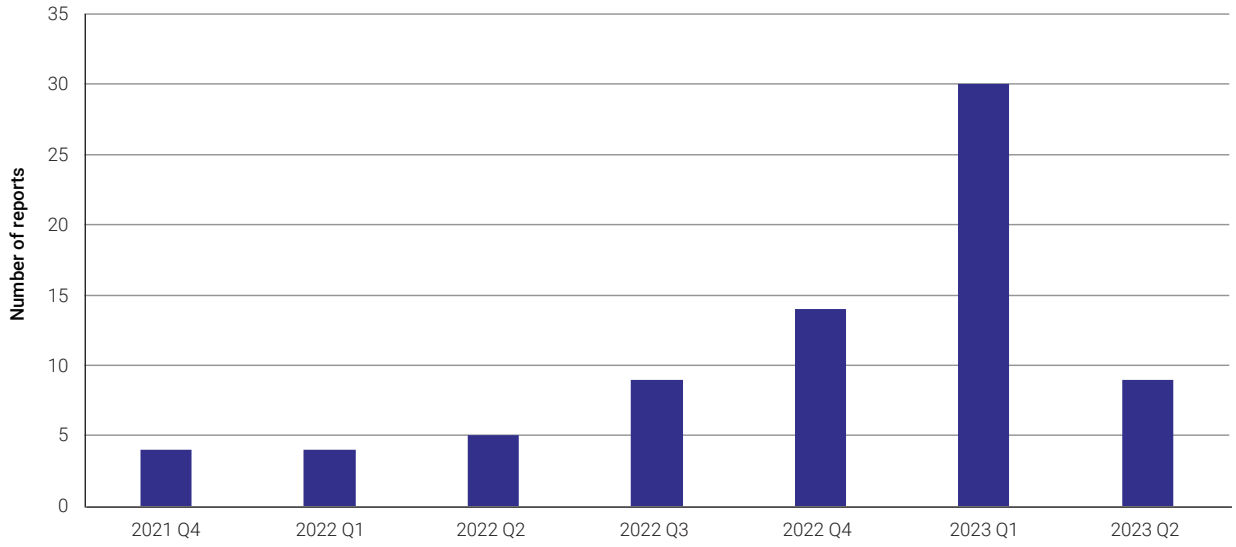
Standards Act 1989.[64] While the ACCC's internal data shows over 200 reports of incidents involving products containing Li-ion batteries, the number may be much higher. As WA DMIRS noted in its submission, in some states there are circumstances where consumers are not required to report certain incidents and injuries.[65] This could mean the risks and hazards of these products are underestimated in the reported incidents. Greater consumer awareness about how and where to report incidents may increase reporting rates and improve visibility of the issue.

The regulatory landscape is inconsistent with several state electrical safety regulators not capturing information relating to incidents involving extra-low voltage products, leading to gaps in data collection. There may also be opportunities for more consistent data collection and information sharing under a nationally consistent framework for electrical safety regulation, as recommended in Chapter 8.

Media Monitoring

The ACCC conducts media monitoring of product safety issues to identify trends and emerging risks. Li-ion battery fires have attracted significant media attention in recent years, highlighting the growing concern that these products pose to the general public.

Figure 6: Media Monitoring reports by quarter



The number of media articles the ACCC observed as identifying Li-ion battery fires increased during 2022–23, as shown in Figure 6. While this may reflect an increase in the number of incidents occurring, it may also be prompted by a growing interest in the risks and hazards of Li-ion batteries.

Media reports of incidents spiked in Q1 2023. This may be due to increased media concern with product safety over the summer holiday period. In addition to news articles about incidents, the ACCC also saw an increase in articles about Li-ion battery safety more generally, such as articles quoting regulators and fire authorities advising consumers how to stay safe over the holiday period.

64 Best et al., *Lithium-ion battery safety*, p 30.

65 WA DMIRS, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

5.1.2 Emergency department injury presentation data

Emergency department injury surveillance in Australia is currently performed by several state and territory governments through the recording of details related to emergency department injury presentations. Injury surveillance data is typically high level, with limited detail relating to products, type, brand, use, misuse or failure. Where product information is recorded, this is typically achieved through a combination of coded and free text fields inputted by clinical staff at the point of triaging a patient. Inconsistencies between states, hospitals and clinical staff in the types of data collected, collection methods used and quality and completeness of the text narrative limit the ability to compare and analyse this data for product safety regulatory purposes.

There is currently no single source of injury data for emergency department presentations in Australia. As such, nationwide injury numbers or trends must be extrapolated from the information that is available.

The Victorian Injury Surveillance Unit and the Queensland Injury Surveillance Unit provided ED presentation data to the ACCC.[66]

Queensland Injury Surveillance Unit and Victorian Injury Surveillance Unit both report on injury surveillance data collected by participating emergency departments. In Victoria, all emergency departments with an overnight facility are mandated to collect level 1 injury surveillance data. In Queensland, participation is voluntary and only a selection of hospitals participate, collecting level 2 injury surveillance data. Level 2 data contains more coded fields and may capture more product information than level 1, depending on the product type.[67]

Due to the voluntary nature of Queensland Injury Surveillance Unit data collection, data completion at Queensland Injury Surveillance Unit sites varies over time. For this reason, Victorian Injury Surveillance Unit data may be more useful for trend analysis. However, limited Queensland Injury Surveillance Unit trend analysis can be performed (where relevant to the product) using data collected at paediatric hospitals which have been long-term participants in data collection.

Because of the way the systems are set up, Queensland Injury Surveillance Unit data systems collect more injury text narrative relative to Victorian Injury Surveillance Unit and this can affect case identification, depending on the product being investigated. Therefore, whilst direct comparison of Queensland Injury Surveillance Unit and Victorian Injury Surveillance Unit case numbers is not useful, the 2 data sets can be used to understand changes in demographics and pattern of injury.

Queensland Injury Surveillance Unit data shows 43 ED presentations for the almost 6-year period 1 July 2017 to 31 March 2023. Within the 43 cases:

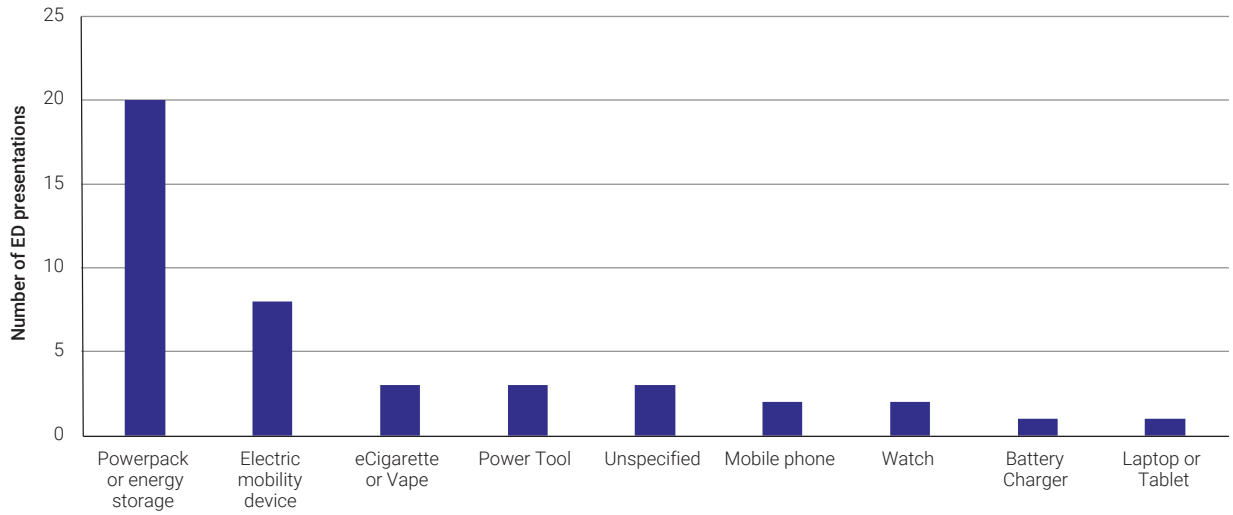
- 84% were identified as Li-ion battery related injuries and 16% were identified as potential Li-ion battery related injuries based on the products involved in the injury
- more than half of the incidents involved burns, with the upper limbs being the most commonly affected body part
- mechanism of injury included explosions, direct burns from hot batteries and fire related injuries from burning batteries and surrounds (burns and smoke inhalation)

66 The Victorian Injury Surveillance Unit data is provided from July 2016 to June 2020 while the Queensland Injury Surveillance Unit data is provided from January 2016 to June 2020. The data provided by the Victorian Injury Surveillance Unit and the Queensland Injury Surveillance Unit does not capture all hospitals with an emergency department. Population demographics and the type of participating hospitals may influence the data captured. For example, children's hospitals may capture more incidents in the younger age groups and hospitals with 24-hour emergency departments may capture more overall incidents than those without. More information on the Victorian Injury Surveillance Unit can be found at https://www.monash.edu/muarc/research/research-areas/home-and-community/visu. More information on the Queensland Injury Surveillance Unit can be found at https://metronorth.health.qld.gov.au/qisu.

67 For more information on Australian Injury Surveillance Data Standards refer to https://www.cdc.gov/nchs/data/ice/ice95v2/c04.pdf.

- individuals between the ages of 25 to 44 were the most common age range affected
- as shown in the below graph, the most common products involved were powerpacks (self-contained, transportable units which store and supply electrical power) or energy storage, followed by e-mobility devices which includes e-bikes and e-scooters.

Figure 7: Queensland emergency department presentations by product type



For the 6 year period starting July 2016 to June 2022, Victorian Injury Surveillance Unit data shows 19 ED presentations for injuries involving or potentially involving Li-ion batteries. Within the 19 cases:

- more than 70% of presentations involved burns
- the wrist and hands were the most commonly affected body region
- approximately one third were admitted to hospital for further treatment.

5.1.3 Specialised burns registry data

The Burns Registry of Australia and New Zealand collects data from 17 designated burns units across Australia and New Zealand. These incidents involved burns that resulted in admission as an in-patient for a period of greater than 24 hours, admission length less than 24 hours where the patient required surgical management, or an admission where the patient died as a result of their injuries. In the period 1 January 2017 to 31 December 2022, the Burns Registry of Australia and New Zealand recorded the following:

- there were 31 admissions in the period relating to Li-ion batteries
- e-cigarettes were the most common product category to cause an injury, causing 16 burns (52%)
- the lower limb (74%) and hands (42%) were the most commonly injured body part.[68]

68 Percentages add up to over 100% as incidents could list multiple body parts.

5.1.4 Fire data

There is a lack of Li-ion battery fire related data available at a national level. The Australasian Fire and Emergency Service Authorities Council (AFAC) is the national council for fire, land management and emergency service authorities in Australia and New Zealand, with 33 members from fire response agencies and 25 affiliate members such as the Bureau of Meteorology, local governments and other emergency response associations. AFAC advised that many fire services introduced reporting codes into their databases in 2021 and 2022 to record Li-ion batteries as a causal factor which will improve available data in the years to come. Verified data for incidents involving Li-ion batteries is not currently available for all fire services.[69] The lack of comprehensive fire related data contributes to the difficulties in assessing the risks that these products may pose to consumers and to identifying trends to inform the management of these risks.

AFAC also submitted that as the uptake of Li-ion batteries increases, the number of incidents reported is expected to increase, consistent with international trends.

The ACCC also received submissions from several state and territory fire authorities:

- Queensland Fire and Emergency Services (QFES) recorded 157 fires between 1 July 2021 and 17 January 2023 caused by Li-ion batteries. QFES indicated there is a strong possibility that this figure is underreported due to the difficulties involved in determining the exact cause of such fires.[70]
- The Western Australian Department of Fire and Emergency Services reported that fires due to Li-ion batteries increased from 21 in 2018 to 81 in 2022.[71]

The ACCC is also aware of a significant increase in Li-ion battery fires responded to by Fire and Rescue NSW). FRNSW reported 149 battery-related incidents between 1 January and 15 September 2023, a 16% increase on the same time last year.[72] Of these incidents:

- 22% involved e-mobility devices, a 94% increase on this time last year
- 41% involved other small portable devices
- 1% involved electric vehicles
- 14% involved stationary energy storage systems
- 21% involved unspecified batteries.

Due to the intensity with which Li-ion battery fires burn and the resulting destruction of evidence, it is often not possible to definitively determine the exact cause of a fire where a Li-ion battery has been present. It is possible that incidents from fire agencies are underreported as a result.

69 Australasian Fire and Emergency Service Authorities Council, Submission to the ACCC Lithium-ion Batteries Issues Paper. A full list of AFAC membership can be found at page 15 in their submission.

70 Queensland Fire and Emergency Services, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

71 WA DMIRS, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

72 Please note due to the difficulty in determining the type of battery after the event, these figures may include some battery fires which did not involve Li-ion batteries.

5.1.5 International incident data

To supplement data on domestic incidents and injuries, the ACCC considered international data sources. These include publicly available information from the London Fire Brigade, United States Consumer Product Safety Commission (US CPSC), and the Organisation for Economic Cooperation and Development.

Data released by the London Fire Brigade indicates e-scooters and e-bikes have become a growing concern over the past 5 years with fires caused by these products rising from 5 in 2018[73] to 116 in 2022[74] – representing a significant increase. The London Fire Brigade reportedly estimates it is now called to an e-bike or e-scooter fire once every 2 days on average.[75] This reflects trends in the growth of e-scooter reports in internal ACCC data as well as anecdotal information in stakeholder submissions.

The United States National Electronic Injury Surveillance System, which provides injury data from a nationally representative sample of hospitals in the United States, reported 217 injuries relating to Li-ion batteries in the period 2018–2022. The most common injury type in this dataset related to burns, which accounted for 41% of reported injuries.[76]

The United States Consumer Product Safety Commission identified 242 product safety incidents involving Li-ion batteries in the period 2018–2022.[77] Approximately 19% of these reports resulted in an injury to people.

The Organisation for Economic Co-operation and Development Global Recalls portal records 130 recalls of products containing Li-ion batteries since January 2017, with events such as overheating and fire the main hazard reported.[78]

For similar reasons to the suspected underreporting of domestic products safety incidents, international Li-ion related incidents may also be underreported.

73 London Fire Brigade, *Freedom of Information request reference number: 6768.1*, London Fire Brigade website, 18 August 2022, accessed 1 September 2023.

74 London Fire Brigade, 'Firefighters issue further e-bike warning following flat fire – West Hampstead', London Fire Brigade website, 12 February 2023, accessed 1 September 2023.

75 London Fire Brigade, *E-bike/scooter fires – London*, London Fire Brigade website, 9 April 2023, accessed 1 September 2023.

76 The United States Consumer Product Safety Commission (US CPSC), *National Electronic Injury Surveillance System (NEISS)*, US CPSC website, n.d., accessed 1 September 2023.

77 US CPSC, *Clearinghouse online query tool*, US CPSC website, n.d., accessed 1 September 2023.

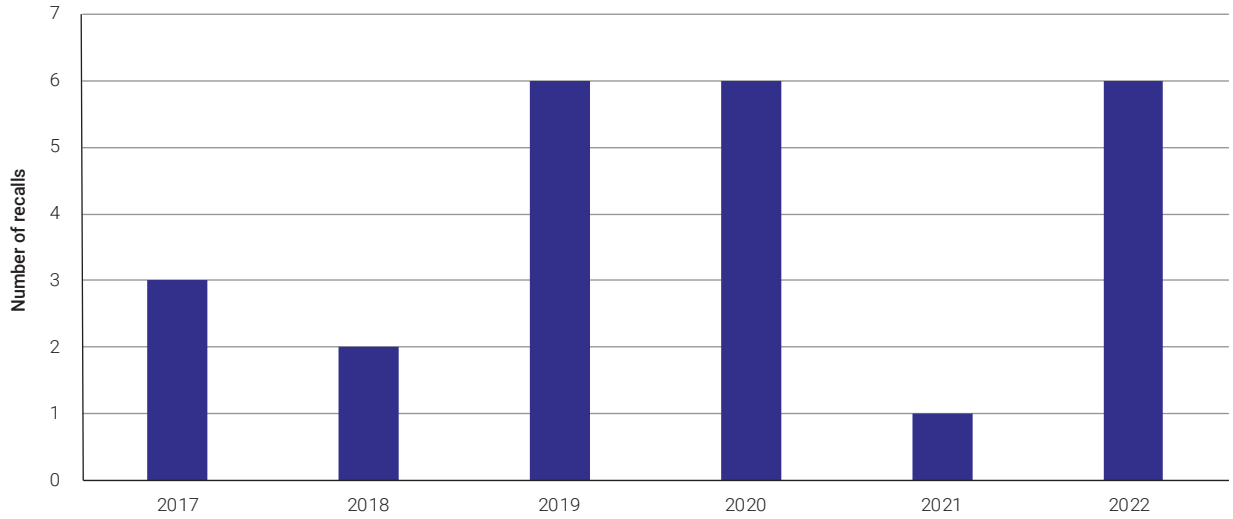
78 Organisation for Economic Co-operation and Development (OECD), *OECD Global Recalls Portal*, OECD website, n.d., accessed 1 September 2023.

5.1.6 Domestic product recalls

Under the Australian Consumer Law, if a product is a risk to safety, or it does not comply with a mandatory standard or product ban, there are provisions for the product to be recalled. A product can be recalled by the business selling the product, or a compulsory recall may be issued by the responsible government Minister.[79]

As shown in Figure 8, there have been 24 recalls, affecting 89,000 products, between 1 January 2017 and 31 December 2022 involving Li-ion batteries and products containing them. The recalls were across a broad range of product categories including products such as laptop batteries and loudspeakers. Most (22) of these recalls involved a defect leading to overheating and/or fire.

Figure 8: Domestic Li-ion battery product recalls – annual figures



79 Federal Register of Legislation, Competition and Consumer Act 2010 (Cth), Schedule 2, accessed 10 May 2023. Australian Consumer Law reference: sections 128, 201 (voluntary recall); 122–127, 199–200 (compulsory recall).

Case Study 2: LG Home battery recall

In August 2020, LG announced a recall of home energy system batteries it manufactured because the batteries can overheat and catch fire. Around 7,800 batteries are currently affected by that recall.

In August 2022, LG advised of an additional 10,300 LG manufactured batteries that can also overheat and lead to fires. LG has proposed to install software in that second cohort of batteries which LG claims can shut down the batteries before they overheat. LG indicated it will refund or replace batteries for consumers shut down by the software.

A total of around 18,000 LG manufactured batteries have now been recalled. These batteries have been responsible for a number of reported incidents in Australia including an incident that caused a house fire that completely destroyed the property. Another incident involving a recalled LG battery caused a smoke inhalation injury.

The ACCC has established and is working with a taskforce of specialist state and territory technical regulators to assess the risks posed by the LG batteries, and LG's response to those risks.

The ACCC has also sought to assist LG in its recall by publicising the recall via media releases, social media posts and highlighting it in other public engagements such as during an appearance on the television program The Morning Show. The ACCC has also written directly to consumers who are likely to have affected batteries to advise them of the recall and what actions to take.

The below image is an example of a LG Home Energy Storage System Battery which failed and caught alight.

Source: Homeowner affected by the incidents arising from an ESS Home Energy Storage System Battery

5.2 Data limitations and improved data collection

As discussed above, a clear picture of the extent of Li-ion related incidents is hard to obtain given the gaps in the data currently available. Accurate and comprehensive data about Li-ion battery incidents is crucial in order to identify trends, provide responses for those areas that present the greatest risk, inform policy and regulatory reform and consumer education campaigns.

There are several limitations around the available Li-ion battery related fire, injury and incident data. These include:

- the short period in which Li-ion batteries have been common features of consumer goods limits the ability to observe long-term trends
- the difficulty identifying Li-ion batteries as causal factors to fires due to the intensity at which these products burn and the resulting destruction of evidence
- a lack of consumer awareness about which products contain Li-ion batteries, impacting reporting rates
- inconsistent collection of incident data across jurisdictions, making it difficult to assess national trends.

Awareness of the data limitations and support for improved data collection is featured throughout several stakeholder submissions. This is identified as an area of concern in 10 submissions from a range of government and industry stakeholders. For example, the Australian Battery Industry Association stated 'improved data collection on lithium-ion battery incidents, such as fires, should be a government policy priority'. The Waste Contractors and Recyclers Association of New South Wales and Australian Council of Recyclers stated ''The incidence of fires caused by batteries in waste and recycling facilities is likely to be severely undercounted.''[80]

In its report, the CSIRO recommended that reliable statistical information be gathered from emergency services, which would be 'harmonised across all services operating in different states and territories to provide the largest set of data possible'.[81]

The ACCC understands there are several initiatives already underway to achieve more consistent and comprehensive datasets in various contexts, including injury surveillance in some states. Recognising that injury surveillance systems are maintained with a broader purpose than the collection of product-related injury data and that they rely on various combinations of coded and narrative data across different states and territories, the identification of all Li-ion battery related incidents from this data is challenging and as a consequence may be underreported.

There is currently no national product safety incident database. The ACCC considers such a database could provide valuable insights to assess and respond to product safety hazards for Australian consumers. A central repository for incident and injury data collection and capability related to all consumer electrical products (not just those containing Li-ion batteries) could provide an effective model on which to leverage a broader national product safety incidents database to support the identification and analysis of consumer hazards more generally. We consider the data obtained by state and territory electrical safety regulators relating to product safety incidents could complement any national product safety incidents database.

80 Australian Battery Industry Association, *Submission to the Lithium-ion Batteries Issues Paper*, p 10; Waste Contractors and Recyclers Association of NSW and Australian Council of Recyclers, *Submissions to the Lithium-ion Batteries Issues Paper*, p 1.

81 Best et al., *Lithium-ion battery safety*, p 5.

5.3 Recommendations

Recommendation 1 (Incident data): Commonwealth, state, and territory governments should improve, expand and standardise data collection practices around the hazards posed by consumer electrical products, including Li-ion batteries.

Wherever practicable and to the extent permitted by law, Li-ion battery incident data should be regularly shared among stakeholders to facilitate a better understanding of emerging risks and hazards.

The ACCC recognises the valuable work underway to capture data reflecting injuries and incidents arising from Li-ion batteries. More consistent and comprehensive datasets will have significant benefits in identifying trends and emerging risks, responding to those areas that present the greatest risks, and informing policy and regulatory reform.

Data collection could be improved in the following ways:

- **A national product safety incident database** – there is currently no national product safety incident database to capture data and support national identification and analysis of consumer product safety hazards. Instead, product safety incident data is fragmented across a range of government and non-government organisations. With appropriate funding, the ACCC considers it is best placed to administer a national product safety incident database and recommends the ACCC is funded to develop and administer this.

  The ACCC supports the inclusion of consumer product safety as part of the Department of Health's National Injury Prevention Strategy and considers that a national product safety incidents database would improve safety for consumers.

  A central repository for incident and injury data collection and analytics related to consumer electrical products (see Recommendation 4) could provide an effective model on which to leverage a broader national product safety incidents database, noting such a database would be costly and time consuming to establish. Centralised data collection supports the identification and analysis of consumer hazards more generally.
- **National injury surveillance** – the ACCC recommends state and territory governments continue to support their respective health services to undertake consistent and comprehensive state injury surveillance, including the standardised collection of product specific injury data. Dedicated injury surveillance units currently operate in some states including Victoria, Queensland and South Australia and the remaining states monitor data—collected in various ways—within state government health departments. Standardisation of injury surveillance data collection should continue to be developed and improved.
- **National fire incident database** – the ACCC recommends the Australasian Fire and Emergency Service Authorities Council (AFAC) continues to support its members in implementing relevant reporting codes to capture Li-ion battery related fires, and develop a national fire incident database – or expand existing systems – to allow state and territory fire authorities to collect and share comprehensive data on Li-ion battery related fires, among other incidents. The ACCC recognises that development and maintenance of such a database requires appropriate resourcing; this recommendation is predicated on funding being made available for this purpose.

For each of these methods to be most effect in addressing risks, sharing incident data will be important.

- **Sharing Li-ion incident data** – the ACCC recommends data collected by emergency services, hospitals, coroners and regulators should be shared to support a holistic understanding of current Li-ion battery hazards by all relevant stakeholders, having regard to privacy obligations and as permitted by law.

6. Consumer Education

6.1 Consumer awareness and behaviour

6.1.1 Consumer expectations

Consumer group CHOICE reported that 79% of Australians surveyed believe businesses are legally required to ensure the products they sell are safe.[82] The ACCC has long supported and advocated for laws that prohibit unsafe consumer goods from being sold in Australia. Such laws do not currently exist.

In the consultation undertaken to inform this report, consumers indicated they expect products they purchase to be safe, and the batteries contained within those products to be of acceptable quality.

Consumers also expect products containing Li-ion batteries to be tested prior to supply (discussed further below at 9.2.1). The Consumers' Federation of Australia (a peak body for consumer organisations advocating in the interests of Australian consumers) submitted that 'consumers expect that manufacturers have not only conducted safety testing but that all products sold are safe and meet minimum safety standards'.[83]

The Consumers' Federation of Australia also noted many consumers are being encouraged to store products such as power tools and e-bikes in unsupervised locations (for example, garages and sheds), which may have a higher ambient temperature and no smoke detectors.[84] The increase of Li-ion battery products in the market and normalisation of Li-ion battery products in consumers' homes suggests many consumers perceive these products are safe, or that they pose an acceptable risk.

Given the benefits of rechargeable technologies, it is important that consumers can access safe and reliable Li-ion battery products. The range of household products in which Li-ion batteries are used continues to grow. The prevalence of rechargeable products in Australian homes are delivering a range of lifestyle benefits for Australian consumers and are also helping to support environmental sustainability objectives by reducing landfill. Many consumers have developed trust in these products through established use practices without incidents or concerns arising. Exposure to Li-ion battery incidents may erode consumers' trust in these products, as demonstrated by one submission to the ACCC in which a consumer reported that a well-maintained battery for a new golf buggy caused an explosive fire, prompting the consumer to question why this occurred and undermining their trust in this and other Li-ion battery products.[85] Safe product designs are a crucial part of reducing the risk of Li-ion batteries failing and leading to incident such as fires, property damage or injuries.

82 CHOICE, *Australia's weak product safety laws*, CHOICE website, 29 March 2023, accessed 6 July 2023.

83 Consumers' Federation Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

84 Consumers' Federation Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

85 Anonymous Response 837487888, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

6.1.2 Consumer awareness

As the number of Li-ion battery powered products in Australian homes continues to increase, it is critically important that consumers clearly understand the risks associated with these products and how to mitigate those risks.[86] Stakeholders highlight the existence of gaps in consumer understanding of Li-ion battery safety related information. The Australian Toy Association indicated '[this] issue is likely to be confusing for consumers as rechargeable Li-ion batteries have been used in high value products including computers and phones for some years, and they are often left on charge for long periods without supervision [without incident'].'[87] This may make it difficult to communicate Li-ion battery hazards, as consumers have become accustomed to certain use habits without incidents arising. Despite many consumers adopting established use practices without incident, it is worth noting that Li-ion battery safety risks can also present in smaller devices, such as phones and watches, as evidenced by recalls of such products prompted by concerns about overheating of batteries over recent years.[88] While the number of incidents arising from Li-ion batteries is limited relative to the number of products, the catastrophic consequences of Li-ion battery fires means it is important that consumers are aware of the risks and appropriate mitigation strategies across all products categories.

6.1.3 Testing expectations

Consumers may assume that products they buy are tested by government and/or manufacturers before they are offered for sale when this is not the case. Consumers may not understand the risks and hazards associated with Li-ion battery products, relying on manufacturers to ensure products are safe for use before purchase.

Several stakeholders raised gaps in consumer awareness about the extent of product testing as an issue. For example, the Consumers' Federation of Australia stated ''consumers expect that manufacturers have not only conducted safety testing but that all products sold are safe and meet minimum safety standards'.[89]

Testing is discussed further at section 9.

6.1.4 Chargers matter

Chargers can play a significant role in the performance and reliability of battery-based systems by providing an appropriate energy throughout the charging process to charge the cells. In some instances, the charger may be required to play the role of the battery management system, ensuring safe functioning of the battery while charging, for small consumer items or products charged from a USB device.[90]

Many stakeholders identified prominent risks associated with charging Li-ion battery products. The Western Australia Department of Mines, Industry Regulation and Safety indicated 'house and building fires typically occur when a battery is being charged'' and similarly the Consumer Electronics Suppliers Association indicated their 'members advise that most incidents occur during charging.'[91]

86 National Retail Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

87 Australian Toy Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

88 Product Safety Australia, *Samsung Electronics Australia Pty Ltd – Samsung Galaxy Note7*, Product Safety Australia website, 6 September 2016, accessed 2 August 2023.

89 Consumers' Federation Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

90 Best et al., *Lithium-ion battery safety*, p 25.

91 Consumer Electronics Suppliers Associated, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

Allianz Insurance provided Electric Vehicle Firesafe specific data noting that 'more than 16% of EV LIB [Li-ion battery] fires happen when connected to the charger'.'[92]

Consumer risks associated with charging Li-ion battery products as raised by stakeholders include:

- **Incompatible chargers:** Using a charger that is not designed for the specific Li-ion battery can cause damage to the battery.[93] This can be due to the charger delivering too much or too little current, or the wrong voltage, which can cause damage to the battery and can potentially lead to fire.[94]
- **Overcharging:** Li-ion batteries with no battery management system or a faulty battery management system can be a major cause of battery failure.[95] Further, if the charger is plugged in for too long or if the charger malfunctions, the battery can overheat.[96]
- **Charging in extreme temperatures:** Charging a Li-ion battery in extremely hot or cold temperatures can cause damage to the battery.[97]
- **Unsupervised charging:** Risks associated with chargers are exacerbated by the fact that the charging process is often not monitored, and may mean missing an opportunity for early intervention.[98]

Although some aftermarket or low-cost chargers have safety specifications to match the product, a lack of safety features such as full disconnect on charge, current limit when hot, or hot plug compliant connection (no output until device connected) can compromise the battery management system, resulting in the risk of catastrophic failure. Battery management system communication with the charger or the ability to fully control the charge is a critical requirement for safe charging.[99] The ACCC recommends that where possible, consumers should use chargers provided with Li-ion battery products. When using replacement chargers, consumers should ensure the charger is suitable for the battery in the product they are charging.

Charging and chargers are a risk factor for Li-ion battery products, however this may not be front of mind for a consumer when charging devices or purchasing chargers. Indeed, the National Retail Association expressed the view that 'Consumers are largely unaware of the safety risks posed by Li-ion overheating.'[100]

92 Allianz Insurance, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

93 Consumer Electronics Suppliers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

94 Battery University, *BU-304b: Making Lithium-ion Safe*, Battery University website, n.d., accessed 11 May 2023.

95 ACT Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

96 National Retail Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

97 Best et al., *Lithium-ion battery safety*, p 27.

98 Australian Toy Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

99 Further technical detail on Li-ion batteries can be found in the CSIRO Report; Best et al., *Lithium-ion battery safety*, p 26.

100 National Retail Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

Case study 3: Charging risks

Charging products with incompatible aftermarket chargers can increase hazards and risks.

In August 2022, a Brisbane apartment was badly damaged after an e-scooter battery charging overnight exploded. The new e-scooter was being charged with a charger not made by the manufacturer. Because of this, the e-scooter was charging at a higher voltage, causing the battery to overheat and explode, damaging windows and the surrounding room.[101]

Supplied: Queensland Fire and Emergency Services – aftermath of e-scooter battery charging failure.

The ACCC is aware of many media reports involving e-scooter and e-bike fires while charging – and the devastating property damage that can result. Greater consumer awareness about safe charging of Li-ion batteries may help to minimise damage to persons or property.

Greater consumer education about best practice for charging Li-ion battery products will assist with risk mitigation. Consumers need to be aware of the risks of these products as well as the steps and tools available to them to reduce those risks.

Steps consumers can take to reduce the likelihood of charging related incidents include:

- ensure the charger is suitable for the battery in the product being charged
- monitor charging times of Li-ion battery products and disconnect products from chargers once they are fully charged (consider setting timers as a reminder to unplug devices)
- do not use batteries or devices if products are overheating or showing signs of failure such as swelling, leaking or venting gas. In these cases, place leaking or damaged batteries in a clear plastic bag (after they have cooled down) and contact your local council for disposal options
- charge batteries and devices away from combustible materials (such as beds, sofas or carpet)
- store batteries and Li-ion battery products such as e-scooters in cool, dry places and out of direct sunlight, including while charging
- allow time for batteries to cool down after use and before recharging.

101 Information provided by the Queensland Fire and Emergency Services.

These steps can help avoid charging related incidents. When using replacement chargers, consumer should ensure the charger is suitable for the battery in the product they are charging

The CSIRO recommended the development of a star rating for all charging products, to inform consumers about the quality of the product they are purchasing. The ACCC supports this recommendation as an example of a tool which would assist consumers.

6.1.5 Misuse and environmental factors

Misuse and environmental factors are common causes of failure in Li-ion batteries and are associated with exposure to extreme weather conditions such as storms, hot weather, flooding, water, humidity, exposure to heat or misuse and damage.[102] Given the range of Australian climatic conditions, many consumer products may be exposed to these conditions.

Environmental factors increase the chance of overheating and battery damage, placing consumers at risk. Consumers may not fully appreciate these hazards and know how to mitigate them.

The Tasmanian Consumer, Building and Occupational Services Department (Tasmania's building and consumer law regulator) indicated that Li-ion batteries 'can be dangerous if they are damaged and are sensitive to high temperatures.'[103] Li-ion batteries are sensitive to high temperatures and may overheat when subjected to high external temperatures, that exceed its safe operating range, causing leakage of the flammable/corrosive electrolyte solution or fire.[104] For example, a mobile phone left in a hot car can quickly reach very high temperatures. This type of extreme temperature can lead to thermal runaway and the battery can start to release large amounts of gas and heat.[105]

Failure can also occur with physical damage to Li-ion batteries, for example when a battery is subject to crushing or puncture such as in a car accident or when misused.[106] Broken or cracked batteries allow moisture to seep in causing heat reactions which can lead to fires and explosions.[107] Penetrating the battery pack deliberately or through an accident can cause a short circuit and ignition.

The CSIRO notes the likelihood of these risks increases in consumer products such as electric scooters and skateboards, as these products may be subject to significant wear-and-tear, and exposure to a range of conditions.[108] This was also recognised by the Strata Community Association, which noted that 'e-bikes, e-scooters and electric skateboards are the type of devices that are easily damaged during use and have been the main source of fires worldwide.'[109] The ACCC recognises there are gaps in available data to support strong anecdotal evidence about high risk products categories.

102 WA DMIRS, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

103 Tasmanian Department of Justice, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

104 Y Chen, Y Kong, Y Zhao, L Wang, J Liu, Y Li, Z Liang, X He, X Li, N Tavajohi and B Li, 'A review of lithium-ion battery safety concerns: The issues, strategies, and testing standards', Journal of Energy Chemistry, August 2021 59:83-89, doi: 10.1016/j.jechem.2020.10.017.

105 Best et al., *Lithium-ion battery safety*, p 21.

106 Best et al., *Lithium-ion battery safety*, p 22.

107 Best et al., *Lithium-ion battery safety*, p 22.

108 Strata Community Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

109 Strata Community Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

6.1.6 Repurposed batteries, second-hand and retrofitted devices

As more consumer products containing Li-ion batteries have entered the market, there has also been a surge in repurposing and retrofitting batteries.[110] These deviations from the manufacturer's intended use can pose serious risks.[111]

Repurposing batteries relates to using or taking a battery from a product and using it for a purpose other than the use intended by the manufacturer.

Retrofitting relates to the process of modifying something after it has been manufactured.

The Victorian Government reported 'an increase in Li-ion batteries in electric vehicles being re-purposed for use in other domestic products' further noting 'this presents new challenges and risks'.[112] Specific to the automotive environment, Allianz Insurance noted that repurposing or modifying Li-ion batteries as one of the most dangerous stages of the battery lifecycle'.[113]

While there may be cost incentives for consumers to repurpose or retrofit devices and some environmental benefits, the risks are significant. Li-ion battery chargers and battery systems are not readily interchangeable. This is because 'batteries, their battery management system, and their charger are a single integral system' and accordingly are dangerous to experiment with.[114]

Consumers should be cautious when purchasing second-hand Li-ion batteries and products. The risks with second-hand Li-ion batteries and products are exacerbated due to a lack of information about the previous care of the product and its battery health (including the remaining capacity, as a percentage, of the initial rated battery capacity).[115] Where it is possible to purchase a suitable replacement battery from the original manufacturer, the refurbishment process should be undertaken by the original manufacturer or an experienced professional.

110 Best et al., *Lithium-ion battery safety*, p 35.

111 Best et al., *Lithium-ion battery safety*, p 35; Allianz Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

112 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

113 Allianz Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

114 Anonymous Response 151984455, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

115 Best et al., *Lithium-ion battery safety*, p 37.

Case study 4: Retrofitting batteries can be dangerous

In 2022, an Adelaide family home was badly damaged after an e-bike battery caught fire while being stored inside. The fire spread rapidly and caused estimated damage of $150,000 to the property. The battery had been purchased online and retrofitted to an existing bicycle.[116]

Dining room damage bike position

Supplied: SA Metropolitan Fire Service

The CSIRO report highlights these concerns, noting it is difficult to assess the condition of a Li-ion battery when it is either sold in a second-hand product (for example, a used e-vehicle) or repurposed for a 'second life' (for example, a damaged e-vehicle Li-ion battery is repurposed into a home energy storage system battery and used by another consumer).[117] In each case, the second owner lacks visibility of the Li-ion battery's condition and therefore its safety.

The CSIRO report indicates relevant factors affecting a Li-ion battery's condition include incidents of shock, impact, or vibration or exposure to extreme heat or cold.[118] These incidents may occur during relatively normal use of many products, particularly e-vehicles and personal transport devices like e-bikes and e-scooters.

The CSIRO report states that consumers should avoid purchasing personal transportation devices like e-bikes and e-scooters second-hand and avoid purchasing or using Li-ion batteries as repurposed second life batteries.[119] The ACCC considers these products may pose an increased risk when their condition and use history cannot be determined. As such, it is important that consumers are cautious about purchasing these products and should consider available information about the safety risks of the product.

116 Information by the South Australian Metropolitan Fire Service.

117 Best et al., *Lithium-ion battery safety*, p 27.

118 Best et al., *Lithium-ion battery safety*, p 32.

119 Best et al., *Lithium-ion battery safety*, p 27.

6.2 There is an immediate need for consumer guidance to address safety risks

As discussed later in this report, the existing regulatory framework for electrical products is made up of different state and territory laws, which are administered by specialist electrical safety regulators in each state and territory. The fragmented regulatory landscape poses challenges in a number of areas including the absence of a single clear authority or resource that consumers can rely on for information about Li-ion battery hazards.

A transition to a nationally consistent regulatory framework is needed to better protect consumers. As discussed later in this report, harmonising state and territory electrical safety laws will produce a range of benefits, including a single point of contact for consumers and industry to report issues and seek safety information about electrical products.

In the interim and in response to the immediate risks posed to consumers, the ACCC considers there is an immediate need to communicate to Australian consumers the risks and mitigation strategies needed to empower them to make safe choices when using these products.

During consultation for this report, there was strong support expressed by stakeholders for a public education campaign on Li-ion battery safety. As highlighted by the Australian Battery Industry Association, reminders about safe usage are key to reducing the risks of fires in homes.[120]

The CSIRO report recommended the development of an Australian website that provides easy to access information on smaller consumer battery products and chargers, larger home energy storage systems, e-vehicles and more. The ACCC agrees it is important that consumers have clear and accessible resources on Li-ion battery safety and recommends that it delivers a targeted safety and education campaign on practical steps consumers can take to mitigate the risks associated with Li-ion batteries (see Recommendation 1). Following this campaign and informed by the collection of better data, consideration should be given to the delivery of further education initiatives targeting higher risk products or user groups.

Recognising the established use practices that exist in many Australian homes and the prevalence of these products in consumers' everyday lives, this advice must be realistic and easy to implement, while covering the key risk factors identified by technical evidence to be effective. While it is important that consumers are supported with sufficient safety information, the responsibility of preventing Li-ion battery related incidents rests with participants at several stages of the supply chain. Notably, manufacturers have a responsibility to supply products that are safe and fit for purpose, and importantly providing instructions for their safe use. Consumer education should form part of a multifaceted and practical risk prevention and mitigation strategy.

120 Australian Battery Industry Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

6.3 Recommendations

Recommendation 2 (Consumer safety): Consumers should have clear and accessible educational resources on Li-ion battery safety.

It is vital that consumers have clear and accessible guidance on the practical steps they can take to help mitigate safety risks associated with Li-ion batteries.

The ACCC and stakeholders will enhance consumer awareness through a targeted safety and education campaign on Li-ion battery safety. This will be led by the ACCC with assistance from government, fire agency and industry stakeholders to amplify consumer messaging, having regard to the common interest these groups have in promoting Li-ion battery safety. The education campaign will focus on increasing consumer awareness about:

- how to select, use, store and dispose of Li-ion batteries safely
- how to identify when batteries are at risk of being unsafe
- practical steps and risk mitigation strategies consumers can take to help stay safe.

Following the consumer safety and education campaign above, the ACCC will assess whether there is a need for further educational activities, including activities focused on specific product categories. Such activities may be led by stakeholders other than the ACCC.

This recommendation is linked to other recommendations:

Recommendation 1 (improved data collection practices) and the sharing of this data among stakeholders which will inform the need for further educational activities.

Recommendation 6 (a nationally consistent regulatory framework) which includes improved guidance for consumers through a single point of contact to report issues and seek safety information about electrical products.

7. Disposal and end-of-life

7.1 Key disposal issues

As noted earlier in this report, the disposal of Li-ion batteries in household rubbish or recycling bins poses risks to people, the environment and property, and can cause fires resulting in significant damage during the waste disposal process. Addressing risks associated with the incorrect disposal of Li-ion batteries, ensuring there are adequate disposal options and facilitating recycling of Li-ion batteries where possible, are crucial aspects of mitigating safety risks and reducing the environmental impacts of these products. This is contingent on the ongoing viability of disposal and recycling facilities; supported by factors including access to insurance for these facilities and sufficient infrastructure to manage the increase in battery numbers.[121]

Reports of fires in the waste environment are rising. Standard processes used in the disposal of general rubbish and recycling, including compaction, loading, bailing, and shredding, expose Li-ion batteries to conditions that can cause them to ignite – such as physical damage, water ingress and excessive heat.[122]

Consumers need to know how, where and why to correctly dispose of Li-ion batteries and disposal options need to be easy to use and access.[123] The ACCC will include information about correct disposal methods in its education resources.

121 Waste and Recycling Industry Queensland, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

122 Waste Contractors and Recyclers Association of NSW and Australian Council of Recyclers, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 1; Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, pp 7–9; Battery Stewardship Council, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 7.

123 Waste Contractors and Recyclers Association of NSW and Australian Council of Recyclers, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2; Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8; New South Wales Environment Protection Authority, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, pp.3–5; Lithium Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 4.

Case study 5: Reports of incorrect battery disposal

Incorrect disposal of batteries in household recycling is believed to have caused the fire which destroyed Canberra's recycling plant on Boxing Day 2022, according to an investigation conducted by the Australian Capital Territory Fire & Rescue.

'The investigation revealed evidence that the presence of multiple batteries of varying types, identified in the remains of the waste compacter, caused a thermal runaway which ignited the fire,' said Minister for Transport and City Services Chris Steel.

'The ACT Fire & Rescue report specifically points the finger at lithium batteries. Lithium is found in many household batteries such as non-rechargeable AA and AAA batteries, and also in rechargeable batteries in devices like laptops, mobile phones, and cameras.[124]

Image sourced from ACT Emergency Services Agency [125]

This phenomenon is not unique with similar reports of battery fires across the globe, including in the United States [126]and New Zealand.[127]

In February 2023 Brisbane Lord Mayor Adrian Schrinner was quoted 'In some cases, we've seen whole loads of collected rubbish needing to be dumped on the side of the road to avoid collection vehicles catching alight.'[128] This is an increasingly prevalent issue with a reported '32 rubbish-related fire incidents in Brisbane in 2022, compared to 18 in 2020.'[129]

124 ACT Government, *Investigation released into fire at Hume recycling facility* [media release], ACT Government, 6 April 2023, accessed 16 June 2023.

125 ACT Emergency Services, 'Structure Fire – Hume', *ACT Emergency Services website*, 27 December 2022, accessed 7 July 2023.

126 Cole Behrens, 'Garbage truck fire caused by lithium-ion battery in laptop,' *Dispatch News*, 8 February 2023, accessed 2 June 2023.

127 NZ Herald, '*Vape batteries set recycling trucks alight*', NZ Herald, 24 February 2023, accessed 4 June 2023.

128 Inside Local Government, 'Brisbane records spike in 'hot load' fires', Inside Local Government, 28 February 2023, accessed 4 June 2023.

129 Inside Local Government, 'Brisbane records spike in 'hot load' fires' 22 February 2023.

In some cases, consumers may not be aware that a product they are disposing of in household bins contains Li-ion batteries, or the batteries may be difficult to remove from the product.[130] In addition to broader education and awareness raising measures, there is an opportunity for manufacturers to address this at the design stage of the product and instructions. Valuable improvements could be made in the design of some products so Li-ion batteries can be safety removed and recycled.

A further gap identified by the CSIRO is a shortfall in recycling or disposal options for damaged Li-ion batteries, and information about how damaged batteries should be handled.[131] The CSIRO considers that this needs to be addressed urgently.

Manufacturers of Li-ion batteries and products must take action to support consumers to correctly dispose of, or recycle products, and protect the safety of people involved in recycling. This could include improved labelling of their products so consumers and recycling workers can clearly identify Li-ion batteries, and designing products to support safer recycling.[132] This should be considered as part of Recommendation 5, which relates to the importance of consistent labelling requirements.

7.2 The Li-ion battery disposal ecosystem

Table 3 sets out the key entities in the consumer Li-ion battery product disposal ecosystem. The ACCC's role in this space is focused on product safety education and advocacy. In addition to this, pursuant to its power to authorise businesses to undertake activities that may otherwise breach competition laws, the ACCC has authorised the Battery Stewardship Scheme to establish and operate a national stewardship scheme for managing many types of end-of-life batteries (excluding lead-acid batteries and other battery types that are currently included in an existing stewardship or recycling scheme). This scheme is currently operated by the Battery Stewardship Council (a not-for-profit industry organisation that has designed and managed battery stewardship in Australia) via B-cycle. Regular household and standard size handheld rechargeable batteries of all chemistry types up to 5kg can generally be recycled through B-cycle.

Management of waste is primarily the responsibility of state and territory governments, and the Australian Government (primarily the Department of Climate Change, Energy, the Environment and Water) is responsible for national legislation, strategies and policy frameworks for waste and recycling. State and territory requirements for disposal of Li-ion batteries differs. For example, under Victoria's environment protection framework the Victorian Environment Protection Authority enforces requirements for recycling operators who accept Li-ion batteries.[133]

130 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

131 Best et al., *Lithium-ion battery safety*, p 27.

132 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, pp 8–10; Waste and Recycling Industry of Queensland, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

133 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

Table 3: Li-ion battery product disposal ecosystem

Li-ion battery product disposal ecosystem

Battery and electronics recycling operators

Organisations in the battery and electronic product recycling supply chain, such as recycling collection point operators, transporters, storers and processors. Li-ion batteries should be recycled with these operators.

National product stewardship schemes

There are multiple existing national schemes for Li-ion batteries and products containing Li-ion batteries and whose membership includes major Li-ion battery and product manufacturers. A key focus of these schemes is to provide drop-off points for consumers to dispose products for recycling. Appendix 4 of this report sets out the current product stewardship schemes for Li-ion batteries and products.

Household rubbish and general recycling operators

Local councils, kerbside waste collection businesses, landfill operators and general recycling processors. These organisations want to keep electronic waste including Li-ion batteries and products out of general rubbish and general recycling to help keep workers safe.

Household rubbish and recycling processes are not designed to deal with Li-ion batteries and may expose the batteries to conditions that can cause them to ignite, including compaction, penetration, heat, and moisture.

State and territory government environment protection agencies

These agencies help protect people's health and minimise harm to the environment from pollution and waste, including via the licensing and regulation of waste and recycling operators.

They seek to ensure recycling operators who accept hazardous materials like Li-ion batteries operate safely and effectively.

For example, under Victoria's environment protection framework the Victorian Environment Protection Authority enforces requirements for recycling operators who accept Li-ion batteries.

Consumers

Consumers dispose Li-ion batteries and products. It is best practice to dispose of these through battery and electronics recycling operators, but consumers face several barriers, such as:

- not knowing how or where to correctly dispose of their products
- not having convenient access to collection points
- not understanding the serious risk to people, the environment and property from incorrectly disposing of their products in household bins
- concern about privacy of data held on devices.

7.3 What are product stewardship schemes?

Product stewardship schemes require a levy from suppliers of particular products to fund and reduce the negative environmental, health and safety impacts of those products. This can involve measures like:

- providing rebates to recyclers to allow them to accept and recycle products
- funding infrastructure like drop-off points where consumers can take products for collection by recyclers
- requiring manufacturers to design products to last longer and be easier to repair and recycle.[134]

Existing product stewardship schemes for electronic products in Australia and overseas focus on diverting products away from landfill to reduce environmental impacts. The schemes often do this by creating a dedicated collection and recycling stream to facilitate efficient and effective recycling. This involves a network of drop-off locations where consumers can take their old products for collection instead of disposing them in their general household rubbish or recycling bins.

In the case of Li-ion batteries that can be hazardous to waste workers, successfully diverting these batteries into dedicated recycling streams mitigates the risk of fires.

The Australian Government and industry have developed product stewardship schemes and initiatives to facilitate the correct disposal of loose Li-ion batteries, mobile phone and computer products that contain Li-ion batteries. As mentioned above, the ACCC has authorised the Battery Stewardship Scheme to establish and operate a national stewardship scheme for managing many types of end-of-life batteries. A number of organisations have sought accreditation with B-cycle, Australia's official battery recycling scheme, and are taking active steps to promote product stewardship. Product stewardship schemes play an important role in diverting batteries from landfill. For example, in the first 6 months of operation the B-cycle program reported it had collected more than 900,000kg of batteries for recycling and launched more than 3,200 drop off locations.[135]

The current product stewardship schemes exclude a broad range of products with embedded Li-ion batteries other than mobile phones and computer products.[136] 'Embedded' means the battery is sealed within the product (such as rechargeable devices including headphones, toys and smart watches) and not designed to be removed or replaced by the consumer. To dispose of these products correctly, consumers currently need to find a recycling facility or other collection point in their area that accepts electronic waste.[137] The ACCC acknowledges that this can be a difficult task for consumers and can be a barrier to recycling some products. Initiatives such as the Recyclemate website are using technologies such as artificial intelligence to help consumers identify their best local recycling and disposal options for specific products. Similarly, B-cycle is considering options to address embedded batteries.

The introduction of product stewardship arrangements for e-waste broadly, would substantially close this coverage gap, particularly for Li-ion batteries and products that may otherwise be prone to being disposed of into household bins.[138] The Department of Climate Change, Energy, the Environment and Water is exploring a regulated product stewardship scheme for e-products including small electrical

134 Department of Climate Change, Energy, the Environment and Water, *Product stewardship in Australia*, DCCEEW website, 8 November 2022, accessed 9 May 2023.

135 B-cycle, *Positive Charge Report*, *B-cycle website*, 2022, accessed 12 June 2023.

136 Battery Stewardship Council, *Fact Sheet 002 – What batteries are in scope?*, Battery Stewardship Council website, 2021, accessed 10 May 2023.

137 For example: NSW Environment Protection Authority, *Community Recycling Centres*, NSW Environment Protection Authority website, 14 February 2020, accessed 10 May 2023.

138 Former Department of Agriculture, Water and the Environment, *Stewardship for Consumer and Other Electrical and Electronic Products, Discussion Paper*, Former Department of Agriculture, Water and the Environment website, December 2021, accessed 1 September 2023.

and electronic equipment containing embedded Li-ion batteries.[139] The National Electric Vehicle Strategy also recognises disposal of electric vehicle batteries will be an increasing issue for industry which has committed to mitigation efforts.

One of the difficulties in recycling Li-ion batteries is the variation in their size and application. There are variable costs in collecting, aggregating and transporting batteries to recyclers, and different battery applications need to be managed appropriately. Initiatives to increase Li-ion battery recycling rates should be carefully designed and managed to avoid increased battery costs.

7.3.1 Effectiveness of existing arrangements for Li-ion batteries and products

Product stewardship schemes are performing crucial work in creating a closed-loop lifecycle for batteries. However, the schemes are relatively young, and are faced with the exponential growth of Li-ion battery applications.

Indications that the existing product stewardship schemes should be complemented by other measures to mitigate the risk of incorrect Li-ion battery disposal include:

- ongoing media reports of waste fires involving incorrectly disposed of Li-ion batteries[140]
- information in stakeholder submissions citing incorrect disposal of Li-ion batteries as a significant cause of fires in waste and recycling facilities
- gaps in consumer awareness about how to correctly dispose of Li-ion batteries, reflected in stakeholder submissions and in response to the ACCC's Li-ion battery consumer survey
- reports that consumers are holding onto old devices due to concerns about data privacy, with this being one of the most common reasons for people not recycling their old phones[141]
- the rate for recycling loose Li-ion batteries is low. Less than 10% of Australia's Li-ion battery waste was recycled in 2021[142] (noting the Battery Stewardship Scheme only began in 2022). For e-waste products broadly, only 54% of Australian e-waste is estimated to have been collected for recycling in 2019.[143]

As part of the ACCC's consumer survey 39% of respondents indicated they did not know how to correctly dispose of a Li-ion battery, or found it difficult to do so.[144]

In addition, some consumer responses on battery disposal included:

- *'It's really hard to dispose of lion batteries…Especially the pouch style ones.'*
- *'Too many people just throw them out. They don't care which batteries they throw out in the bin.'*
- *'How do I dispose of my old laptop and drill batteries! Can't find anyone to take them and I don't want to throw them in the bin.'*

139 Department of Climate Change, Energy, the Environment and Water, *Wired for change: Regulation for small electrical products and solar photovoltaic systems*, DCCEEW website, published 20 June 2023, accessed 1 September 2023.

140 Cleanaway, *The waste industry's fight for fire safety*, Newsroom, 9 February 2023.

141 Mobile Muster, *Insights into mobile phone use, reuse and recycling 2020*, Mobile Muster website, September 29 2020, accessed 10 May 2023.

142 CSIRO, https://www.csiro.au/en/research/technology-space/energy/energy-in-the-circular-economy/battery-recycling, Lithium-ion battery recycling, 1 September 2023.

143 Former Department of Agriculture, Water and the Environment, *E-Product Stewardship in Australia – Executive Report*, Former Department of Agriculture, Water and the Environment website, 2021, accessed 15 May 2023, p 3.

144 ACCC, *Lithium-Ion Battery Product Safety Survey*, accessed 16 June 2022. The ACCC conducted a survey in late 2022 to understand consumer awareness about lithium-ion batteries and their safety.

The ACCC considers it important that the stewardship initiatives continue to be supported and provide consumers with easy access to safe disposal options. This is fundamental in ensuring that batteries are disposed of correctly.

There are different approaches to the management of Li-ion battery waste internationally. For example, the European Union[145] and some jurisdictions in the United States[146] have adopted extended producer responsibility policies to address Li-ion batteries. This is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle.[147] By placing responsibility for a product's end-of-life environmental impacts on producers, extended producer responsibility policies are also expected to push industry to design products to minimise the environmental impact.

7.4 Recommendations

Recommendation 3 (Disposal and end-of-life): The Australian Government and industry should continue to develop infrastructure, regulation and supporting policies to enable the safe and efficient collection and recycling of Li-ion batteries.

The development of infrastructure, policies and regulations related to disposal of Li-ion batteries should be led by the Department of Climate Change, Energy, the Environment and Water, recognising its current work to develop options for e-waste product stewardship.

Industry should engage with government to seek opportunities to engage in product stewardship initiatives. All stages of the life cycle of a Li-ion battery and products containing Li-ion batteries should be considered **by industry** from design for recyclability through to end-of-life management, including for damaged Li-ion batteries.

With sufficient infrastructure, safe disposal and recycling becomes more sustainable and scalable.

145 European Parliament, *Batteries: deal on new EU rules for design, production and waste treatment*, European Parliament website, 9 December 2022, accessed 20 June 2023.

146 Crosscut, *Washington could soon have a battery stewardship program*, Crosscut website, 20 April 2023, accessed 20 June 2023.

147 Organisation for Economic Co-operation and Development, Extended Producer Responsibility, OECD website, n.d., accessed 20 June 2023.

8. Regulatory Landscape

8.1 History of calls for harmonisation of the electrical safety framework

The existing regulatory framework for electrical products is made up of different state and territory laws, which are administered by specialist electrical safety regulators in each state and territory. The need for harmonisation of electrical safety laws is a long-standing issue that was identified by the Productivity Commission in its 2017 report on Australia's consumer law enforcement and administration.[148] The report found that coordination and consistency was poor and recommended states and territories move to agree on nationally consistent laws on electrical safety. Similarly, the House of Representatives Standing Committee on Economics' 2019 report on impediments to business investment also recommended that through the Council of Australian Governments, jurisdictions develop and adopt a set of nationally consistent laws on electrical safety.[149]

8.2 Existing regulatory framework

Consumer product safety regulation in Australia is a joint responsibility between the ACCC and state and territory consumer protection agencies. There are over 15,000 types of consumer products available in Australia.[150] The ACCC and state and territory consumer protection agencies regulate the safety of general consumer products.

The Australian Consumer Law is economy-wide legislation that contains provisions relating to the safety of consumer goods and product-related services. This includes provisions for imposing mandatory standards, permanent or temporary bans and compulsory recalls. The product safety provisions in the Australian Consumer Law do not however contain the full suite of tools needed to effectively regulate specialist products as they require a tailored approach. Instead, some types of products are regulated by specialist product safety regulators, which can provide that tailored approach as well as in-depth technical expertise, and ongoing focus needed to manage the specific risks associated specialist products. This includes chemicals (Australian Industrial Chemicals Introduction Scheme), food (Food Standards Australia New Zealand), therapeutic goods (Therapeutic Goods Administration) and electrical products (state and territory electrical safety regulators). As the existing regulatory framework for electrical products is made up of different state and territory laws, with varying powers and scope, these differences between jurisdictions results in inconsistencies in regulation, including in respect of extra-low voltage products which encompasses most products containing Li-ion batteries. This poses several challenges for consumers, government agencies and businesses, particularly where products are supplied nationally. A fragmented and incomplete electrical safety regulatory framework is unsustainable in Australia's modern economy.

The ACCC considers the most significant challenges concerning the safety of electrical consumer products are the lack of regulatory coverage for extra-low voltage products including those containing lithium-ion batteries, and the lack of uniform compulsory recall powers across the jurisdictions (Table 4).

148 Productivity Commission, *Consumer Law Enforcement and Administration*, Productivity Commission website, n.d., accessed 29 May 2023.

149 House of Representatives Standing Committee on Economics, *Report on the inquiry into impediments to business investment*, Trove website, April 2019, accessed 29 May 2023.

150 National Retail Association, *Product safety and standards*, National Retail Association website, n.d., accessed 26 May 2023.

8.2.1 Electrical Regulatory Authorities Council

The Electrical Regulatory Authorities Council is the national strategy, policy and reform organisation responsible for coordinating activities between Australian and New Zealand electrical safety authorities. The Electrical Regulatory Authorities Council is made up of representatives of the regulatory authorities responsible for electrical safety, supply and energy efficiency in each jurisdiction. The Electrical Regulatory Authorities Council meets twice a year and regularly corresponds with industry stakeholders on regulatory issues with a view to developing recommendations for consistent operational policy across jurisdictions. However, it is not an enforcement agency and does not have regulatory powers.

8.2.2 Electrical Equipment Safety Scheme

The Electrical Equipment Safety System is a regulatory framework aimed at increasing consumer safety in household electrical equipment through the application of risk-based registration and certification requirements. The Electrical Regulatory Authorities Council introduced the registration and certification system in 2013 to improve harmonisation of electrical equipment safety requirements in Australia. The system's website has a publicly accessible national database for Responsible Supplier registration and equipment registrations, which allows consumers and businesses to verify that electrical products meet the applicable safety requirements.

As part of the Electrical Equipment Safety System registration and certification process there is a Ministerial Oversight Committee which acts as a national policy and governance body. The Committee has oversight of the legislative framework, funding arrangements and all aspects of the system. There is also a Standing Committee of Officials, which is a collaborative governance forum responsible for managing and coordinating the day-to-day administration and operation of the registration and certification system.

Currently, only Queensland, Victoria, Tasmania, and Western Australia have signed the intergovernmental agreement on the governance of the Electrical Equipment Safety System (Table 4). The remaining jurisdictions have not yet signed the intergovernmental agreement to commit them to formally adopt the Electrical Equipment Safety System into law. The lack of national adoption of the Electrical Equipment Safety System places a considerable regulatory burden on businesses. For example, suppliers need to obtain 2 different certificates to supply their products nationally. One certificate applies to those states and territories that accept the Electrical Equipment Safety System for compliance purposes and the other is for NSW, which has not adopted the scheme and does not accept the Electrical Equipment Safety System for compliance purposes.

The Electrical Equipment Safety System captures electrical equipment that is for household, personal and similar use. Extra-low voltage electrical equipment (operating below 50 Volt alternating current AC RMS or 120 Volt ripple-free direct current) is not in-scope of the Electrical Equipment Safety System. This means that many extra-low voltage lithium-ion battery operated products (such as e-bikes and e-scooters, power tools, camping and gardening equipment, mobile phones, laptops and smart wearable devices) do not have regulatory coverage under the scheme.

The lack of consistent and comprehensive regulation for extra-low voltage equipment increases the risk of electrical safety incidents and increases the reliance on the ACCC to intervene when there is a safety issue. The ACCC considers that all extra-low voltage electrical products, like all electrical products, should be included in scope in the Electrical Equipment Safety System and reflected in state and territory electrical safety regulatory frameworks. It may however be possible to consider exempting any extra-low voltage products that have longstanding evidence of posing a very low safety risk (e.g., AA batteries) to help minimise any regulatory burden.

Table 4: Comparison of jurisdictional electrical safety legislation by compulsory recall powers, comprehensive extra-low voltage coverage and signing the IGA on the EESS[151]

	ACT	NSW	SA	WA	QLD	VIC	NT	TAS
Compulsory recall powers	✓	✓	✓	✗	✓	✓	✗	✓
Comphensive ELV coverage	✗	✗	✗	✗	✗	✓	✗	✗
Signatory to the IGA on the EESS	✗	✗	✗	✓	✓	✓	✗	✓

8.3 Challenges

8.3.1 Consumers

Consumers expect electrical products including extra-low voltage and battery-operated products to be safe and approved by the relevant regulator. Under the existing framework, extra-low voltage products are not subject to the same level of safety regulation in all states and territories. There is also no single point of contact for consumers to seek information or report safety issues with electrical products because of this lack of coverage of all electrical consumer products.

Nationally consistent post-market surveillance and enforcement is essential to the identification and rapid rectification of safety risks associated with electrical consumer products. Coordinating these types of activities under the existing framework is difficult because of the inconsistent state and territory approaches to regulation. This increases the risk of unsafe and non-compliant products entering the market and can delay the removal of unsafe products from the market.

8.3.2 Industry

The existing electrical safety regulatory framework requires businesses supplying electrical products nationally to comply with different laws and deal with multiple regulatory regimes. Suppliers need to dedicate extra resources to navigate the different compliance regimes and separate stock to meet the requirements of different laws. This regulatory complexity imposes unnecessary constraints on businesses and may disincentivise expansion into new markets and investment in new products. It could also create barriers for overseas businesses seeking to sell electrical products in Australia.

The National Retail Association, Australian Industry Group, Australian Retailers Association and the Consumer Electronics Suppliers' Association cited several challenges with the existing regulatory framework. For example, the National Retail Association stated that 'inconsistent regulatory approaches are causing trade barriers between jurisdictions, unnecessary costs, commercial risks, and market confusion, ultimately impacting rates of non-compliance'.[152]

151 *Electricity Safety Act 1971 (ACT); Gas and Electricity (Consumer Safety) Act 2017 (NSW); Energy Products (Safety and Efficiency) 2000 (SA); Electricity Act 1945 (WA); Electrical Safety Act 2002 (QLD); Electrical Safety Act 1998 (VIC); Electricity Industry Safety and Administration Act 1997 (TAS); Electrical Reform Act 2000 (NT)* – the *Electrical Safety Act 2022* (NT) comes into force on 1 July 2024. The Act will adopt the Electrical Equipment Safety System and allow the Minister to make a recall order. Victoria is the only jurisdiction that has comprehensive regulation for extra-low voltage equipment. New South Wales and Queensland are considering regulation of extra-low voltage equipment as part of their own legislative reviews.

152 National Retailer Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 7.

Stakeholders noted that inconsistent supplier registration and post-market compliance monitoring increases the risk of unsafe products entering the market, which may put responsible suppliers at a disadvantage compared to their competitors.

8.3.3 Government

Under the existing regulatory framework, the scope of regulatory coverage for certain types of electrical products differs between jurisdictions, and state and territory regulators are equipped with different powers to deal with safety and non-compliance issues. This inconsistent approach creates regulatory gaps and leads to confusion and duplication of responsibilities across jurisdictions. For example, under the existing framework, there is a lack of uniform compulsory recall powers across the jurisdictions (see Table 4), which creates an increased reliance on the ACCC to intervene in a specialist product safety regime.

The regulatory gaps in the existing framework have resource implications for government agencies and impact the progress of other important product safety activities. The lack of coordination and consistency in the regulatory approach of jurisdictions hinders rapid and informed national responses to product safety risks. The need for ACCC intervention is also inefficient and contrary to the Australian Government's Statement of Expectations, which expects the ACCC to avoid duplicating the work of specialist regulators.

Case study 6 – Hoverboards and the adoption of mandatory safety standard

Hoverboards (self-balancing scooters) were a popular Christmas gift in Australia and internationally in 2015. Shortly after Christmas, several house fires and other incidents occurred which were linked to defective electrical circuitry and substandard lithium-ion batteries in some hoverboards. On 5 January 2016 Energy Safe Victoria issued a public warning and some hoverboards were recalled.

At the time these issues emerged, the states and territories did not have uniform laws to enable a nationally consistent approach to regulating extra-low voltage electrical products. They had also not uniformly identified extra-low voltage products, such as hoverboards with lithium-ion batteries, as a safety risk. This created confusion among consumers and retailers about the safety status of hoverboards, and ultimately led to a reliance on the ACCC to intervene in a specialist regulatory regime.

The ACCC introduced an interim ban under the Australian Consumer Law on self-balancing scooters in March 2016, followed by a safety standard in July 2016 (initially for a period of 2 years). It was envisaged that these interim measures would provide state and territory governments time to amend their laws to cover extra-low voltage products. Following several iterations between 2016 and 2019, the standard was amended to apply indefinitely due to the lack of progress by jurisdictions to implement a single national approach to regulating extra-low voltage electrical products.

Despite ongoing engagement by the ACCC and the relevant Australian Consumer Law Minister, in 2023 regulatory coverage for extra-low voltage products remains nationally inconsistent and the Australian Consumer Law continues to be used to address these regulatory gaps, creating duplication and inefficiencies and potentially putting consumers as risk.

8.4 Harmonisation of electrical safety laws

The current approach to electrical safety regulation is unsustainable. A nationally consistent regulatory framework is needed to better protect consumers, alleviate the regulatory burden on businesses and enable governments to regulate more efficiently.

The ACCC considers that specialist electrical safety regulators are best placed to regulate electrical consumer products because they possess the required in-depth technical expertise, infrastructure and ongoing focus in electrical safety that the ACCC is not able to provide. Parliaments have identified enhanced public risk or the need for particular expertise when they established specialist electrical safety regulators. The ACCC as the generalist product safety regulator cannot bring the same level of attention and expertise. For example, the ACCC does not have the expertise or infrastructure to administer pre-market approval, registration or certification requirements for electrical products. It would also change the way the ACCC could deliver consumer protection across other product categories. While the ACCC can and does provide strategic interventions in important matters, it is not a substitute for the role of specialist electrical regulators.

In addition to the technical expertise and focus specialist regulators provide, the regulation of consumer electrical products is also closely related to other functions and responsibilities of the specialist electrical safety regulators. This includes certification and registration of products, licencing of people conducting electrical work and property inspections, as well as work health and safety. State based specialist electrical safety regulators also have strong connections with industry participants, as well as other related state and territory regulators (such as building safety regulators) to enable effective coordination on overlapping issues. They are also well placed to identify local electrical product safety trends.

Harnessing the expertise and focus of the specialist electrical safety regulators, the way forward should be a collective effort between the Australian Government and state and territory governments to build a harmonised regulatory framework for electrical consumer products. This is particularly important for products that are supplied nationally to ensure coordination between all regulators. A modern, fit-for-purpose harmonised framework should aim to resolve the following issues:

- the regulatory gap for extra-low voltage products, including those containing Li-ion batteries
- a lack of uniform compulsory recall powers across the jurisdictions
- inconsistent state and territory pre-market and post-market controls for electrical consumer products
- no central repository for incident and injury data collection and capability related to consumer electrical products
- no single point of contact for consumers and businesses to report issues and seek safety information about electrical products
- the need for national ministerial oversight and decision making involving all jurisdictions to ensure the regulatory framework is fit for purpose and can adapt to emerging challenges
- the need for greater clarity of the roles and responsibilities for the Commonwealth and the states and territories in relation to electrical safety regulation.

The ACCC considers adoption of the Electrical Equipment Safety System to be a viable and necessary step towards building a nationally consistent framework and encourages all jurisdictions to sign the intergovernmental agreement and formally adopt the Electrical Equipment Safety System into their legislation. While national adoption of the Electrical Equipment Safety System is important, the System also requires improvements as it, for example, currently does not cover extra-low voltage products.

The Electrical Equipment Safety System is expected to be reviewed in the near future, which could go some way to addressing issues such as the regulatory gap for extra-low voltage products. However, the other regulatory gaps and inconsistencies in the existing regulatory framework emphasise the need for a broader national review. A review could explore how to achieve national adoption of the Electrical Equipment Safety System, clarify the role of the Commonwealth and states and territories, ensure appropriate Ministerial oversight involving all jurisdictions, establish a single point of contact for consumers and businesses to access electrical safety information, and establish a central repository for incident reports and injury data.

Industry have signalled strong support for a harmonised electrical safety framework. The Australian Retailers Association stated that a national framework for electrical product regulation would ensure consistent mandatory testing, certification and registration.[153] The Ai Group highlighted that Australia only occupies 2% of the world market for electrical products and cannot afford overlapping and duplicative regulatory schemes.[154]

Harmonising state and territory electrical safety laws will also have a net positive impact on the Australian economy and support broader initiatives including the National Electric Vehicle Strategy, National Battery Strategy, and Digital Economy Strategy. As Australia transitions to a more sustainable future and the electrification of consumer products grows, the need for change to the electrical safety regulatory framework is critical.

153 Australian Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

154 Ai Group, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 1.

8.5 Recommendations

Recommendation 4 (Regulatory landscape): State and territory governments to build a fit-for-purpose, nationally consistent regulatory framework for electrical consumer products, supported by the Australian Government.

A national framework for electrical safety regulation that provides a consistent approach across states and territories is integral to addressing safety risks associated with electrical consumer products including those containing Li-ion batteries.

A nationally consistent regulatory framework should include:

- national adoption of the Electrical Equipment Safety System into law to provide consistent pre-market controls
- uniform compulsory recall powers for all states and territories
- comprehensive regulatory coverage for extra-low voltage products, including those containing Li-ion batteries
- consistent post-market controls for electrical products that enable effective surveillance and enforcement
- a single point of contact for consumers and businesses to report electrical safety issues and seek safety information about electrical products
- a central repository for incident and injury data collection and capability related to consumer electrical products to support broader work in this area for consumer product safety
- National Ministerial oversight and decision making involving all jurisdictions and spanning the entire regulatory framework (including but not limited to the Electrical Equipment Safety System)
- clearly defined roles for jurisdictions and the Commonwealth to prevent regulatory duplication.

9. Product standards and the Australian Consumer Law

9.1 The Li-ion battery standards environment is complex

In Australia there is currently no single mandatory safety standard for Li-ion batteries or products containing Li-ion batteries. Other than a few limited exceptions, manufacturers and suppliers of Li-ion batteries and products may consider whether to comply with any one of several voluntary standards published by a range of standards bodies. To complicate this further, while some suppliers already adhere to relevant voluntary standard(s), it is not always clear to consumers when a product has been certified to a standard, or what the certification means in practice.

9.1.1 Voluntary and mandatory standards

There are several Australian and international standards making bodies in operation. Apart from Standards Australia, there are other overseas standard making bodies which include the ASTM International (formerly known as American Society for Testing and Materials), European Norm, the American National Standards Institute and the International Organization for Standardization. These bodies publish voluntary standards.

Voluntary industry standards are published documents that establish technical specifications and procedures designed to ensure products, services and systems are safe. This is done through requirements for the design, construction, performance, and information and testing of products. A number of voluntary standards (or parts of them) are also referenced in legislation, making them mandatory.

In addition, the ACCC administers a range of mandatory safety standards, which set out the requirements for specific products in order to prevent or reduce the risk of injury. Mandatory standards are generally based on certain parts of a relevant voluntary standard. The ACCC does not currently enforce a general Li-ion battery safety standard.

A list of standards relevant to Li-ion battery safety is in Table 5, indicating the breadth of standards that may apply to Li-ion batteries or products containing them. These standards range from those that target individual cells and batteries to product-specific standards aimed at specific applications and use cases. Knowing which standards apply to which products can be difficult for manufacturers, importers and retailers, particularly when considering the broad range of Li-ion battery applications.

The adoption and enforcement of standards also varies across international jurisdictions adding an additional level of complexity for manufacturers and suppliers operating in a global market. For instance, there are United States and European Union specific standards that may also apply to Li-ion products exported to Australia.

The CSIRO's report indicates standards published to address Li-ion batteries may be categorised as either performance or safety standards or may include aspects of both.[155]

While performance standards enable an assessment of whether the battery operates as intended, the focus of this section is on safety standards. These safety standards address the risks faced by the user due to reasonably expected conditions during a cell or battery's service life.[156] Safety standards tend to utilise 'abuse test methods' in which the batteries or cells are subject to conditions to simulate actual use environments and test the ability to resist damage. Table 5 notes the existing standards and test methods.

155 Best et al., *Lithium-ion battery safety*, p 29.

156 Best et al., *Lithium-ion battery safety*, p 30.

Table 5: Existing standards and included test methods/type for abuse testing of Li-ion batteries[157]

Test type	UN 38.3	IEC 62133-2	IEC 62281	IEC 62660-2	IEC 62619	UN 1642	UL 2054	UL 2271	UL 2580	ANSI C 18.5	SAE J2464	JIS C8714
External short circuit	X	X	X	X	X	X	X	X	X		X	X
Abnormal/overcharge	X	X	X	X	X	X	X	X	X		X	X
Forced discharge	X	X	X	X	X	X	X	X	X		X	
Crush		X		X		X	X	X	X		X	X
Impact	X		X		X	X	X		X	X		
Shock	X	X	X	X		X	X	X	X	X	X	
Vibration	X	X	X	X		X	X	X	X			
Heating	X	X		X	X	X	X	X	X		X	X
Temperature cycling	X		X	X		X	X	X	X	X	X	
Altitude	X	X	X			X		X				
Projectile						X	X	X	X			
Drop		X	X		X			X	X		X	X
Penetration								X	X		X	
Internal short circuit		X			X						X	X
Fire exposure						X	X		X			

157 Best et al., *Lithium-ion battery safety*, p 33.

While some standards relate to batteries alone, others also consider the battery management system.[158] This is important, as faults arising from an inadequate battery management system may otherwise not be detected, leading to a less safe product overall.

Ideally, voluntary and mandatory standards provide industry consistency and a threshold for safety and quality. The CSIRO's report recommends the suitability of the current standards and regulations should be assessed, considering likely risks of products that include Li-ion batteries to ensure they are fit for purpose. However, due to limited incident data, it is difficult to quantify these risks.[159] The CSIRO considers it important for further work to be done in this field, to ensure the voluntary and mandatory standards are working as intended.

To improve the safety of Li-ion batteries, the CSIRO's report recommended compliance with standards including IEC 62133 (*portable applications*) and/or AS IEC 62619 (*industrial applications*) with additional guidance from standards such as AS 62368.1 (*audio/video, information and communication technology equipment safety requirements)*. The ACCC agrees these standards may be considered by manufacturers and suppliers, and adopted as appropriate. These standards may also be considered by electrical safety regulators in full or part, or be factored into any national regulatory framework.[160]

The CSIRO makes a series of recommendations related to the standards environment. Broadly these recommendations call for:

- better compliance with existing standards
- improved data collection to enable evaluation of the existing standards
- testing of the battery management system in line with AS IEC 62619 or other appropriate 'system' standards
- enforcement of existing requirements in the Australian Dangerous Goods Code, which prescribes requirements for the transportation of dangerous goods by road and rail
- further guidance for the selection of test methodologies.

The ACCC agrees these measures would support an improved voluntary standards regime, provide greater certainty for suppliers and improve safety outcomes for consumers. These recommendations should be considered by state and territory electrical safety regulators, given their specialty remit and technical expertise. The ACCC recognises under the Electrical Equipment Safety System, suppliers of certain classes of goods are required to demonstrate compliance to relevant 'voluntary' standards.[161]

9.2 Testing requirements in Australia are not nationally consistent

Stemming from the ambiguity in applicable standards, there is a lack of nationally consistent requirements for testing. Testing requirements would usually be dictated within applicable safety standards. A lack of consistent testing makes it difficult for consumers to have confidence in the quality or safety of the products they are purchasing.

In its report, the CSIRO outlined several test methods that Li-ion batteries may undergo when tested to standards. These test methods are designed to simulate actual use and misuse conditions that may trigger an event such as fire, or battery disassembly. The CSIRO notes these tests do not

158 Best et al., *Lithium-ion battery safety*, p 34.

159 Best et al., *Lithium-ion battery safety*, p 35.

160 The regulatory framework is discussed in Chapter 2 of this report.

161 Electrical Equipment Safety System, *Relevant Standard*, Electrical Equipment Safety System website, n.d., accessed 19 July 2023.

examine environmental conditions that may be commonly found in Australia around stationary energy storage systems. The environmental conditions include long periods of high temperature and humidity, often in conjunction with corrosive environments.[162] Testing standards for Australian specific conditions should be considered as Australia's testing capacity increases.

9.2.1 Domestic testing capacity

To demonstrate compliance with any particular standard, the supplier must ensure relevant testing has occurred as prescribed by that standard. Industry stakeholders commented on the significant expenses associated with testing products to relevant standards, noting this could significantly impact smaller businesses. This is due in part to the lack of testing facilities currently available in Australia.

The Future Battery Industries Cooperative Research Centre has awarded grant funding to the Queensland University of Technology to conduct the 'Establishment of the National Battery Testing Centre' project to support the generation of domestic capability to enable local battery system manufacturers to certify their products to Australian and international standards.[163] It is part of the Future Battery Industries Cooperative Research Centre that brings together 50 partners from Australian industry, Australian, state and territory governments.[164] Cooperative Research Centres are jointly funded by the Federal Government, industry participants and research organisations to support Australian industries to solve critical issues, develop new technologies, products and services and compete on the world stage.[165]

While still in its infancy, the National Battery Testing Centre project provides services for testing of battery systems at cell, module and pack level.[166] The National Battery Testing Centre project provides testing facilities to a growing list of Australian manufacturers and distributors of batteries and battery components.[167] However, the Australian Battery Industry Association noted that it is unclear whether the National Battery Testing Centre project will fill the gap in independent testing facilities in Australia and whether the fees for testing will be commercially viable.

Further funding has been committed to developing testing capabilities of Li-ion batteries within Australia from Federal, state and territory governments. In May 2023, the Queensland government committed $15 million to expand testing and commercialisation support for battery manufacturing in Queensland. This will see the establishment of the Queensland Energy and Storage Technologies Hub (QUEST Hub) which will be co-located with the National Battery Testing Centre project at the Queensland University of Technology.[168]

UN 38.3 is the prevailing United Nations standard required for the safe transport of Li-ion batteries. Compliance with The Australian Dangerous Goods Code requires that a Li-ion battery satisfies the requirement of UN38.3 prior to transport. Accreditation for testing to UN38.3 does not currently exist in Australia. As addressed in the CSIRO report, the testing of products under UN 38.3 for the purpose of transport is often only performed at a cell-level, rather than at a pack or product level. The CSIRO considers that if the battery management system is not tested, faults within the battery management system may not be detected if a battery is subject only to the UN 38.3 testing requirements.[169]

---

162 Best et al., *Lithium-ion battery safety*, p 34.

163 Future Battery Industries, *National Battery Testing Centre*, Future Battery Industries website, n.d., accessed 31 May 2023.

164 Future Battery Industries, *National Battery Testing Centre*.

165 Future Battery Industries, *What is a CRC?*, Future Battery Industries website, n.d., accessed 8 August 2023.

166 Department of Environment and Science, Queensland Government, *National Battery Testing Centre*, Department of Environment and Science, Queensland Government website, 22 June 2023, accessed 18 July 2023.

167 Future Battery Industries CRC, *Activity report 2022*, Future Battery Industries CRC website 2022, accessed 19 July 2023, p 11.

168 Queensland Government, *Queensland new-industry development strategy*, Queensland Government website, 29 August 2023, accessed 1 September 2023, p 21.

169 Best et al., *Lithium-ion battery safety*, p 47.

Additionally, testing of assembled packs is unlikely to be realised due to Australia's limited testing capacity.[170] The ACCC agrees with the CSIRO that testing should be conducted for both the cells and battery management system of a Li-ion battery.

To demonstrate compliance to the UN 38.3 standard, Australian manufacturers are required to ship Li-ion battery products overseas for certification, which is a difficult and expensive process.[171] The lack of suitable domestic testing facilities for batteries and cells may pose issues for suppliers and regulators in establishing compliance with mandated requirements. As battery manufacturing increases as part of the National Battery Strategy, investment in Australian testing facilities will be essential to reducing barriers for Australian manufacturers and ensuring Li-ion batteries are compliant with standards and regulation.

Currently, in-scope equipment under the Electrical Equipment Safety System excludes extra-low voltage products. The ACCC considers that state and territory electrical safety regulators should introduce, administer and enforce clear requirements for testing of Li-ion products and batteries. Uniform testing requirements will make it easier for state and territory electrical safety regulators to take enforcement action against those suppliers that fail to test their products prior to supply. All requirements for testing of Li-ion batteries should be consistent across all jurisdictions.

9.3 Li-ion battery labelling – warnings and compliance markings

Labelling of products is important to facilitate the identification of quality products that have been tested against applicable standards and for consumers to understand that there are risks and hazards associated with Li-ion products. Labelling can be used to support identification of:

- safety hazards and risks
- product quality or certification
- battery composition
- how to recycle or dispose of the product.

While there is no single, universal labelling requirement for Li-ion batteries, stakeholders frequently referenced the Regulatory Compliance Mark commonly applied to electrical products.

The Regulatory Compliance Mark is a symbol (see below in Figure 9) that represents compliance with 2 independent schemes; the Electrical Equipment Safety System and the Australian Communications Media Authority's labelling requirements, and is a trademark owned by these bodies.[172] The Australian Communications and Media Authority is Australia's regulator for broadcasting, radiocommunications, telecommunications and certain online content.[173] The Electrical Equipment Safety System Registration Database for Responsible Supplier registration is jointly used by the Australian Communications and Media Authority and participating jurisdictions of the Electrical Equipment Safety System. Australian Communications and Media Authority requires products it regulates to be labelled with the Regulatory Compliance Mark. Despite the labelling schemes sharing the same Regulatory Compliance Mark, the 2 schemes are not related.[174]

170 Best et al., *Lithium-ion battery safety*, p 41.

171 Best et al., *Lithium-ion battery safety*, p 43.

172 The electrical safety regulatory authorities are the Australian and New Zealand government departments or agencies responsible for the administration of electrical equipment safety legislation and regulations, and who provide certification services.

173 Australian Communications and Media Authority, *Compliance and enforcement policy*, Australian Communications and Media Authority website, 28 July 2023, accessed 28 August 2023.

174 Electrical Equipment Safety System, *ACMA vs EESS Level*, Electrical Equipment Safety System website, n.d., accessed 4 August 2023.

Figure 9: Regulatory Compliance Marking

The Australian Standard *AS/NZS 4417.1 and AS/NZS 4417.2 Marking of electrical products to indicate compliance with regulations – General rules for use of the mark* provides general requirements for the use of the Regulatory Compliance Mark. The Electrical Equipment Safety System requires all in-scope electrical and electronic equipment to be marked with the Regulatory Compliance Mark before being placed onto the market.[175] Examples of these products include sewing machines, washing machines and microwave ovens.

Many products containing Li-ion batteries are extra-low voltage and are not covered by the Electrical Equipment Safety System. Due to inconsistent coverage of the Electrical Equipment Safety System (as discussed in Section 8.2.2, only Queensland, Victoria, Tasmania, and Western Australia have signed the intergovernmental agreement on the governance of the Scheme), therefore the Regulatory Compliance Mark is not recognised by all jurisdictions. The Regulatory Compliance Mark does not apply to electrical products that are not in scope, including most products containing Li-ion batteries.[176] The lack of consistency across jurisdictions on the use of the Regulatory Compliance Mark leads to confusion, posing difficulties for consumers to make informed choices when purchasing products containing Li-ion batteries. Adoption of extra-low voltage products to the Electrical Equipment Safety System could allow for the Regulatory Compliance Mark to be applied to products containing Li-ion batteries.

Some stakeholders commented that the lack of enforcement may enable misuse of labels with suppliers falsely claiming compliance with various regulations or standards. One stakeholder submitted that 'Many e-bike and scooter batteries entering Australia currently have CE and UN38.3 labelling on them, yet most manufacturers cannot provide certificates to support the labelling, when they do, many are for other batteries, or from other companies'.[177]

There was broad support for battery labelling and certification requirements in the stakeholder submissions The suggestions from stakeholders around the type of labelling included alternatives such as support for the Regulatory Compliance Mark as noted above, providing clear instructions and information of safety on packaging[178] and clarity of a Li-ion battery's application within the labelling to prevent misuse.[179] Fire and Rescue NSW noted that warning labels and advice on how to handle, store, use and dispose of batteries was an action that supply chain participants could take to mitigate the risks presented by Li-ion batteries.[180] The Victorian Government, indicated improved labelling

175 Electrical Equipment Safety System, *The Regulatory Compliance Mark (RCM) (General)*, Electrical Equipment Safety System website, n.d., accessed 2 August 2023.

176 Nation Energie, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2; Comtest Laboratories, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

177 Club Logistics Services, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

178 Australian Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

179 Australian Battery Industry Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 16.

180 Fire and Rescue NSW, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

could help consumers identify Li-ion batteries and 'enable separation of batteries at end-of-life to support consumers in appropriately discarding of battery waste.'[181]

The CSIRO recommended improvement to battery labelling stating *'Mandatory labelling for all lithium-ion battery products is recommended to inform consumers for safe use and care of the battery' and 'Chargers should come with warnings attached to their cables and/or packaging.'*

The ACCC agrees with the CSIRO's recommendation to improve battery labelling. As noted in Recommendation 5 the ACCC considers state and territory electrical safety regulators should introduce, administer and enforce clear requirements for labelling of Li-ion batteries and products containing Li-ion batteries. This would allow for easier identification of Li-ion products and provision of safety warnings to consumers. These requirements should be consistent across all jurisdictions.

9.4 Regulatory complexity and the standards environment

Standards are an important tool to create consistent safety and quality benchmarks. They are a mechanism to enable quality control in manufacturing and design processes, resulting in safer products. Flaws in design and manufacturing are a risk factor in Li-ion incidents, and may be addressed by the uptake of quality and safety standards.

The current regulatory environment places the burden of selecting and applying relevant safety standards (for products that do not have a mandatory safety standard) on the manufacturer, supplier or importer of the product.[182] Practically, this involves complying with the Australian Dangerous Goods Code, state and territory electrical safety regulations, and potentially also voluntary standards.

The CSIRO report describes the complexity of the current standards environment noting, 'the electrical safety regulatory environment for consumer products may be described as being based on self-declaration of conformity to relevant standards. In the absence of any form of mandatory product compliance regime as applies to some product types[183], it is generally impossible to identify which batteries, or products containing them, claim compliance to any particular standard'.[184]

Manufacturing and retail stakeholders explained the difficulty they face in navigating the inconsistent regulatory environment in Australia and overseas. As an example, the Ai Group (a national employer association) indicated there are already specific requirements that must be met, dependent on the relevant international sales market.[185] This could include labelling requirements under the European Union Battery Directive[186] or certain technical standards required by the Japanese Electrical Appliance and Material Safety Law.[187] Many industry stakeholders indicated they were already compliant to a number of voluntary standards, which vary depending on the product type.[188] Stakeholders reflected that the multitude of requirements increased both inefficiencies and compliance costs. Voluntary standards play an important part in reducing risks posed by Li-ion batteries, however inconsistency in supplier application of those standards may limit their effectiveness.

181 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

182 Best et al., *Lithium-ion battery safety*, p 35.

183 Product Safety Australia, *Mandatory Standards*, Product Safety Australia website, n.d., accessed 10 May 2023.

184 Best et al., *Lithium-ion battery safety*, p 34.

185 Ai Group, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

186 EUR-Lex, *Consolidated text: Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC*, EUR-Lex website, 4 July 2018, accessed 5 July 2023.

187 Ministry of Economy, Trade and Industry, *Electrical Appliances and Materials Safety Act*, Ministry of Economy, Trade and Industry website, 13 April 2023, accessed 5 July 2023.

188 Lighting Council Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

While the regulatory inconsistencies have downstream impacts on all stakeholders, it is most recognised by industry, manufacturing and retail stakeholders. Industry bodies indicated that a more consistent regulatory landscape would be important in improving product safety.[189] Stakeholder submissions noted this complexity in their responses to the Issues Paper.

The Ai Group agreed in principle that a market intervention is needed to adequately mitigate the risks and recommended that: 'a rigorous discussion is needed between the ACCC, specialist regulators, consumers and industry to develop a standards based mandatory framework through the existing Electrical Equipment Safety System'.[190] The Electrical Equipment Safety System currently stipulates 3 levels of equipment types with different registration and certification requirements (with the relevant voluntary standard) for each level, based upon the assessed risk of that equipment type.[191] It is the responsibility of suppliers to choose the relevant standard and seek certification with such. As noted elsewhere in this report, the Electrical Equipment Safety System currently does not require registration and certification of extra-low voltage products including Li-ion batteries.

Other industry stakeholders also considered that regulations were an important factor in improving the safety of Li-ion batteries. For example, the National Retail Association stated 'retailers have demonstrated a common desire to improve electrical equipment safety regulations to better protect consumers. While electronic goods are already subject to a complex array of safety standards, the differences between jurisdictions disadvantages sellers and consumers. The National Retail Association strongly supports state-based regulations being rationalised into a national framework, in the first instance'.[192]

9.4.1 There is an appetite for mandatory standards

In response to the Issues Paper, 23 stakeholders supported the adoption of mandatory standards. However, there was significant variation in the standards identified as potentially appropriate. Several standards were mentioned, including UN 38.3, and IEC 62133. These are both broad, battery standards that can apply to a range of different products. A number of stakeholders also mentioned product-specific standards, particularly those standards that relate to residential energy systems, including AS 5139, IEC 62619 and IEC 62933.

Standards, certification and testing bodies indicated that current compliance mechanisms have not kept up with availability of Li-ion products, but held mixed views on the adoption of a mandatory standard. ComTest Laboratories indicated a new compliance mark, or expansion of the in-scope equipment for the current Regulatory Compliance Mark should be considered.[193] CertAssure, an independent Australian product assessment, certification and consulting organisation, stated that Li-ion batteries in products and discrete Li-ion batteries need to be regulated, suggesting IEC 62133-2 as an appropriate cell level standard.[194] UL Research Institutes indicated there is a vast range of relevant standards, and high quality manufacturers already seek appropriate safety and quality certification.[195] Standards Australia recommended the Australian government work with them and industry experts to develop or adopt nationally consistent standards that are internationally aligned to promote the safe manufacturing or use of Li-ion batteries.[196]

189 Australian Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*.

190 Ai Group, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, pp 2–3.

191 Electrical Equipment Safety System, *Relevant Standard*, Electrical Equipment Safety System website, n.d., accessed 2 August 2023.

192 National Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

193 Comtest Laboratories, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

194 CertAssure, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

195 UL Research Laboratories, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

196 Standards Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

Manufacturers and retailer stakeholders including the Australian Retailers Association and the National Retail Association expressed the view that government intervention is appropriate, and regulatory harmonisation should be considered. They noted that further consultation is required if a mandatory standard were to be seriously considered by the ACCC.[197]

Consumer advocate stakeholders were broadly supportive of government intervention, noting any standard should address safety concerns such as overcharge and end-of-life risks.[198] This stakeholder group noted that any mitigation strategy should also be directed by the incident data. Consumers discussed a range of applicable standards the ACCC could consider and some stakeholders assumed Li-ion products were already regulated. Other consumers advocated for mandatory and enforced regulation of Li-ion batteries and products.

A range of state and Australian government entities each submitted views on government intervention and the adoption of a mandatory safety standard. Broadly this group indicated that while there was an absence of a current standard that could form the basis of an effective preventative measure, it is the role of government to work with industry to develop nationally consistent standards or guidelines. The Victorian Government also noted that development of product specific safety standards lags behind the introduction of new technologies, and industry codes and industry led guidance could be an option to support regulation.[199] The ACT Government indicated it supports coordinated regulatory action to protect consumers being led at the Commonwealth level, recognising it is difficult for any Australian jurisdiction to regulate in isolation, and consistency in approach supports both businesses and consumers.[200]

In addition to the voluntary standard landscape, there are jurisdiction and application specific regulations for a discrete number of Li-ion and electrical products. As noted above, historically, the ACCC has been forced to intervene when other regulators do not have regulations in place to respond to unsafe electrical goods (see Case Study 6).

197 Australian Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2; National Retailers Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

198 Consumers' Federation of Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

199 Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

200 ACT Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

9.5 What is the international experience?

There are relatively few international examples of mandatory Li-ion battery regulation. New York City is one jurisdiction that has recently worked to regulate Li-ion battery products in response to a spate of Li-ion battery fires.

9.5.1 New York City Regulations

In March 2023, New York City Mayor Adams announced Charge Safe, Ride Safe: New York City's Electric Micromobility Action Plan. The plan aims to 'protect New Yorkers from fires caused by lithium-ion batteries and promote safe electric micromobility usage'.

The plan focuses on 4 key areas:

- promoting and incentivizing safe battery use
- increasing education and outreach to electric micromobility users
- advocating for additional federal regulation of these devices
- expanding enforcement against high-risk situations.

Mayor Adams also signed 5 bills into law to further regulate Li-ion batteries sold in New York City and strengthen fire safety related to battery fires.'[201] One of these bills will require the New York City Department of Consumer and Worker Protection, in consultation with the Fire Department of the City of New York, to publish materials that provide guidance on the safe use and storage of powered mobility devices.[202]

Another component of the legislation will make it unlawful to assemble or recondition a Li-ion battery using cells removed from used storage batteries and make it unlawful to sell Li-ion batteries that use cells removed from used storage batteries. Another key part of legislation would require electric micromobility devices, and the batteries these devices use, sold in the city to be certified by an accredited testing laboratory for compliance with relevant safety standards.

It is too early to see the impact of this legislation on Li-ion battery incidents, and while the reform has been praised by regulators and first responder agencies, right to repair advocates have questioned the restrictive nature of the legislation.

201 The Official Website of the City of New York, *Mayor Adams Announces Plan to Combat Lithium-Ion Battery Fires, Promote Safe Electric Micromobility Usage*, The Official Website of the City of New York, 20 March 2023, accessed 10 May 2023.

202 The City of New York, *Mayor Adams Announces Plan to Combat Lithium-Ion Battery Fires, Promote Safe Electric Micromobility Usage*, The City of New York website, 20 March 2023, accessed 1 August 2023.

9.6 There are issues with a mandatory standard under the Australian Consumer Law

The Australian Consumer Law product safety provisions set out how the Australian Government and the state and territory governments can regulate consumer goods and product-related services to address safety hazards.[203] These can include:

- imposing mandatory safety standards or information standards for consumer goods or product-related services
- banning consumer goods or product-related services, either on an interim or permanent basis
- issuing a compulsory recall notice requiring suppliers to recall consumer goods.

In relation to Li-ion battery hazards, seeking to rely on the Australian Consumer Law mandatory safety and information standards would be a stop-gap measure. The Australian Consumer Law does not prescribe mandatory standards for extra-low voltage products by default. The ACCC is a generalist, whole of economy regulator and is not best placed to address a broad electrical safety issue in circumstances where specialist electrical safety regulators exist. The development of a mandatory standard under the Australian Consumer Law is a complex process involving extensive consultation and analysis, which typically takes more than 18 months to achieve. Should the responsible Minister decide to make a mandatory safety or information standard under the Australian Consumer Law, the ACCC and state and territory consumer protection agencies would monitor and enforce it, rather than electrical safety regulators. There are issues with this approach for the state and territory consumer protection agencies, including inconsistent mandatory recall powers. State and territory electrical safety regulators are the agencies which possess technical expertise and already have mechanisms to administer pre-market approval, registration and certification requirements for electrical products.

The ACCC recognises calls made by a number of stakeholders for better adoption of voluntary safety standards, and the appetite for enforced mandatory standards. However, at this time the ACCC does not recommend a mandatory standard is adopted under the Australian Consumer Law framework. Instead, the ACCC recommends a nationally consistent electrical safety regulatory framework is developed with comprehensive coverage of extra-low voltage products (see Chapter 8). This will avoid further fragmentation to the regulatory environment.

203 ACCC, *Australian Consumer Law*, Product Safety Australia website, n.d., accessed 12 June 2023.

10. Market insights and innovations

10.1 Emerging technologies

10.1.1 Research and development into alternatives

Li-ion batteries are currently the most economical and efficient batteries for low voltage products. Some substitutes to standard Li-ion batteries are currently available in the market.

Stakeholders listed various emerging alternatives to Li-ion batteries which are not currently available in the market and are still in the research and development phase. These alternatives may be safer than standard Li-ion batteries, with examples including:

- solid-state lithium batteries
- lithium-sulphur batteries
- batteries based on other metals including magnesium and zinc
- lithium-polymer batteries.

Countering potential safety advantages, there are also downsides with these alternatives technologies. Lithium-polymer batteries are more expensive and have a shorter lifetime and lower energy density than standard Li-ion batteries.[204] Lithium sulfur batteries offer higher energy density, however there remains significant challenges in preventing short circuiting of the cell and failure of the device.[205] For example, there are challenges with the control of the lithium metal anode structures which can potentially lead to short-circuit of the Li-ion cell and failure of the device.[206]

Stakeholders that manufacture batteries also gave examples of new technologies they are developing. For example, Nation Energie is in the process of 'establishing operations to deliver safer, competitively priced, and more environmentally sustainable battery energy storage technology – sodium-ion'.[207]

The CSIRO notes some start-ups are developing new electrode materials and cell chemistries.[208] Many of these chemistries are 'high risk, high reward' (that is, high technical risk, high commercial reward). They are also targeted towards emerging markets, particularly the mobility space, such as autonomous cargo planes.[209] The CSIRO further notes technologies which use a lithium metal anode, such as lithium sulfur batteries, may have higher energy density, making them candidates for these new emerging applications.[210] The Consumers' Federation of Australia consider that lithium-polymer batteries tend to be used by manufacturers in high-end devices, suggesting a market premium is being placed on the safer battery option.[211]

204 Consumers' Federation Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.
205 Best et al., *Lithium-ion battery safety*, p 10.
206 Best et al., *Lithium-ion battery safety*, p 10.
207 Nation Energie, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 1.
208 Best et al., *Lithium-ion battery safety*, p 10.
209 Best et al., *Lithium-ion battery safety*, p 10.
210 Best et al., *Lithium-ion battery safety*, p 10.
211 Consumers' Federation Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

10.1.2 Emerging technologies may have downsides

There can be a trade-off between safety and performance and capacity features of Li-ion batteries for manufacturers to consider. A 'safer' battery may not provide the same performance as a Li-ion battery or be fit for purpose.[212]

The ACCC considers the present and short-term risks of Li-ion batteries will need to be managed given these new alternative technologies are not yet available in the market. It is likely that the safety concerns identified in this report will persist in the medium term as new technologies develop and Li-ion technology is refined. New technologies that could act as substitutes to Li-ion batteries may result in new safety issues emerging. Any new safety issues arising from new battery technologies will require consideration by regulators, industry and consumers to mitigate safety risks.

Various stakeholders, such as government departments and testing bodies, noted that while there are benefits to Li-ion batteries, there are also downsides given the increased risk of fire and ignition of surrounding material in a very short period of time.[213]

10.2 Imported Li-ion batteries and products containing Li-ion batteries

The ACCC is concerned about low-quality imported Li-ion batteries and products, and the safety risks they present. Lithium Australia a technology company focused on building more sustainable sources of battery precursor materials indicated that poorly constructed toys and mobility devices, for example, often contain inferior battery management systems, under-rated wiring, and poor workmanship.[214] ComTest Laboratories, which offers compliance management including testing services, is concerned about the amount of untested unsafe products being offered online.[215]

Poorly constructed products may contain inferior battery management systems leading to a higher risk of incidents arising from those products.[216] The CSIRO suggests a battery management system rating classification system containing minimum requirements for various product categories. This could be adopted and implemented by regulators and standards bodies to inform consumers of the quality of the battery management system in a Li-ion battery. The classification system may provide a helpful guide to industry on best practice inclusions in any battery management system and be a helpful tool for consumers to identify high quality battery management systems. The ACCC considers state and territory electrical safety regulators could consider adopting this classification system in their legislation.

Many stakeholders expressed support for government and regulatory intervention to prevent the importation of low-quality products available on online marketplaces and websites.[217] Currently all battery cells are imported to Australia (mainly from China, Korea and Japan) as there is no local cell manufacturing capability in Australia.[218] The casing of batteries and the battery management system are currently manufactured either overseas or in Australia.[219]

212 Australian Battery Industry Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 14.

213 See for example, CertAssure, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5 and Victorian Government, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 2.

214 Lithium Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

215 Comtest Laboratories, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 3.

216 Lithium Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

217 Lithium Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

218 CSIRO, *Surge in demand for Australian lithium-ion batteries*, CSIRO website, 19 April 2022, accessed 16 June 2023.

219 ABIA, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 14.

The Australian Product Safety Pledge was developed by the ACCC and has been implemented to protect Australian consumers from safety risks when shopping online by strengthening product safety measures across online platforms.[220] Pledge participants must report annually to the ACCC on their performance to actively improve product safety online.[221] The commitments made by signatories under the pledge aim to establish mechanisms to quickly remove unsafe products and to proactively identify unsafe products prior to supply. The ACCC will continue to work with online platforms, including signatories to the Australian Product Safety Pledge, to identify and address high priority product safety risks arising with Li-ion batteries in consumer products sold online. Other state and territory regulators may also leverage established relationships with online marketplaces. Energy Safe Victoria noted that it has begun exploring potential risk mitigation strategies with online marketplaces such as agreed minimum requirements for listings.[222]

10.3 The transportation and storage of Li-ion batteries may present various risks

10.3.1 Transportation

Li-ion cells and batteries must comply with the United Nations international standard UN38.3 to receive certification for safe transport in Australia. While this is a key standard in the regulation of safety Li-ion products, it is not mandatory or enforceable and does not address the range of safety issues identified in relation to Li-ion batteries.

Li-ion batteries are categorised as Class 9 Miscellaneous dangerous goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail.[223] Accordingly, Li-ion batteries and Li-ion products may only be transported if they meet certain requirements of the Code.[224] This includes requirements relating to the testing, design and manufacture of Li-ion cells or batteries.[225]

WA Department of Mines, Industry Regulation and Safety considers the transportation of damaged Li-ion batteries to disposal sites is problematic.[226] The risks at the transportation stage of the life cycle of a Li-ion battery are higher where products are improperly stored in bulk.

The transportation of Li-ion products can present difficulties for consumers in exercising their consumer guarantee rights. For example, consumers have complained to Consumer Protection WA that they cannot return defective batteries to suppliers because they are dangerous goods.[227] It is important for industry to provide guidance as to transportation of Li-ion batteries and support consumers in circumstances where they are required to return faulty goods, such as providing documentation that Li-ion products have been tested under the Australian Code for the Transport of Dangerous Goods by Road and Rail.

220 ACCC, *Australian Product Safety Pledge*, Product Safety Australia website, n.d., accessed 16 June 2023.

221 ACCC, *Product Safety Pledge removes thousands of dangerous items from online marketplaces*, ACCC website, 24 February 2023, accessed 31 July 2023.

222 Victorian Government, *Submissions to the ACCC Lithium-ion Batteries Issues Paper*, p 4.

223 National Transport Commission, *Australian Code for the Transport of Dangerous Goods by Road and Rail*, National Transport Commission website, 2022.

224 National Transport Commission, *Australian Code for the Transport of Dangerous Goods by Road and Rail*, National Transport Commission website, 2022.

225 National Transport Commission, *Australian Code for the Transport of Dangerous Goods by Road and Rail*, National Transport Commission website, 2022.

226 WA DMIRS, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

227 WA DMIRS, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 6.

10.3.2 Storage

The storage of Li-ion batteries can be hazardous when Li-ion batteries are stored in a way where the battery terminals are not covered or isolated.[228] The National Retail Association indicated suppliers of Li-ion products have identified the appropriate handling and storage of returned and damaged products as the biggest challenge.[229] This highlights that incorrect storage of Li-ion batteries is a common issue across industry, and suppliers may also benefit from additional guidance on this.

The differences across Li-ion products may also lead to diverse issues for the storage of Li-ion batteries. Some Li-ion products are more likely to be stored in harsher environments (such as e-bikes and e-scooters) making them more susceptible to damage from water and heat for example.

Case Study 7 – e-Bikes Storage in New York City

In 2022, the New York City Public Housing Authority considered a new rule that would ban tenants and guests from storing electric bikes inside its 177,000 apartments across the city. The move came after a series of fires in New York that were caused by e-bike batteries.[230] However, while the proposed rule was aimed at improving safety, advocates argued it could create challenges for food delivery workers who rely on e-bikes for their jobs and who often store them in their living space.[231] Following consultation and feedback received, the New York City Public Housing Authority confirmed it would not be moving forward with the blanket ban.[232] However, as stated above, New York has introduced a suite of regulations relating to e-bike safety, including guidance on storage.

Bicycle Industries Australia indicated the storage of damaged batteries is a particular concern for the bicycle sector.[233] This is because many bicycles are delivered for repair of items unrelated to the electrical management system (including the battery), but the history of the battery is unknown to the repairer.[234] Another example is the storage of mobility scooters in aged care facilities and homes. As the CSIRO indicated, mobility scooter fires can have serious consequences where occupants may have limited mobility, impacting the likelihood of evacuation. These devices should be stored on non-combustible surfaces in a cool, dry place.[235]

Storage requirements for Li-ion batteries and products containing Li-ion batteries should be introduced, administered and enforced by state and territory electrical safety regulators. The requirements should be consistent across all jurisdictions. As an immediate response, the ACCC will provide consumer education material on how to store Li-ion batteries and products containing Li-ion batteries.

228 VIC Environmental Protection Authority, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 7.

229 National Retail Association, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 5.

230 Patrick Adcroft, *NYCHA considers ban on storing e-bikes inside its buildings*, Spectrum News, 8 July 2023, accessed 1 August 2023.

231 Patrick Adcroft, *NYCHA considers ban on storing e-bikes inside its buildings*.

232 Julianna Cuba, *EXCLUSIVE: NYCHA Backs Down From Banning E-Bikes on its Property*, Streetsblog NYC, 21 October 2022, accessed 1 August 2023.

233 Bicycle Industries Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

234 Bicycle Industries Australia, *Submission to the ACCC Lithium-ion Batteries Issues Paper*, p 8.

235 Best et al., *Lithium-ion battery safety*, p 25.

10.4 Recommendations

Recommendation 5 (Regulations): State and territory electrical safety regulators should introduce, administer and enforce clear requirements for the testing, labelling transportation and storage of Li-ion batteries and products containing Li-ion batteries. These requirements should be consistent across all jurisdictions.

Addressing product safety risks associated with Li-ion batteries requires mitigating risks at various stages of the supply chain including importation; transportation and storage; and testing, certification and labelling. State and territory electrical safety regulatory possess the required technical expertise and industry connections to mitigate these risks.

State and territory electrical safety regulators should introduce, administer and enforce clear and consistent requirements for the testing, labelling, transportation and storage of Li-ion batteries and products containing Li-ion batteries. Effective enforcement of these regulations will serve to deter the supply of low-quality Li-ion products in Australia, which pose particular risks to the safety of Australian consumers.

The requirements should incorporate:

- Safety standards and practices relating to transport and storage of Li-ion batteries, including a requirement to comply with UN38.3 (the prevailing United Nations standard that lithium batteries must meet to receive certification for safe transport globally).
- Requirements that products be labelled as containing Li-ion batteries including marking the products with a recognised hazard and danger symbol.
- Introduction of a new compliance mark or expansion of the Regulatory Compliance Mark in-scope equipment list (AS/NZS 4417.2, which provides general requirements for the use of the Regulatory Compliance Mark) to include products containing Li-ion batteries to alert consumers to the risks posed by Li-ion batteries and to help inform consumers as to products that meet certain requirements.

Recommendation 6 (Online platforms): Regulators including the ACCC and state and territory consumer protection agencies and electrical safety regulators should work with online platforms regarding risks and hazards arising from products containing Li-ion batteries sold online.

The Australian Product Safety Pledge was introduced by the ACCC to help protect Australian consumers from safety risks when shopping online by strengthening product safety measures across online businesses through voluntary good practice commitments. Where Li-ion products are identified as posing significant risks and hazards, such as where there is an increasing trend in reports to the ACCC about safety issues with products containing Li-ion batteries, the ACCC will use its established channels with online platforms to address consumer product safety concerns.

State and territory consumer protection agencies and electrical safety regulators should also continue to work with online platforms to address risks and hazards arising from products containing Li-ion batteries. Electrical safety regulators should act where they identify Li-ion products available for supply on online platforms that may pose a risk to consumers.

Appendix 1 – Recommendations from the CSIRO report and ACCC views

CSIRO recommendations	ACCC views
General recommendations	
1. Development of an Australian website that provides easy to access information on smaller consumer battery products and chargers, larger home energy storage systems, e-vehicles and more. The website should illustrate examples of failures and how consumers should avoid such hazards, as well as provide practical advice on purchasing battery powered products. Mandatory labelling for all lithium-ion battery products is recommended to inform consumers for safe use and care of the battery.	The ACCC agrees with the CSIRO. This is referenced in Section 6.2 and Recommendation 4 (Regulatory landscape).
2. All lithium-ion cell chemistry is recommended to be electronically managed by the battery management system, for safety due to the potential misuse or exposure to abnormal conditions that can cause cell damage and possible catastrophic consequences. Due to lithium-ion battery chemistry innovation and development, problems will continue to escalate as manufacturers continue to store more energy (increased energy density) in their products.	The ACCC agrees with the CSIRO. This is acknowledged in Section 6.1.6 and Recommendation 5 (Regulations).
3. Standards bodies and regulators should consider how to adopt and implement Table 3 (within the CSIRO's report) to inform consumers of the quality of the battery management system that is managing the battery.	The ACCC agrees with the CSIRO. Refer to Section 10.2 and Recommendation 5 (regulations).
Charger recommendations	
4. Original Equipment Manufacturers (OEMs) should provide accessible consumer advice (e.g., websites, help files on devices, instruction manuals, or other paper documentation) inside products stating to always use chargers and cables sold for/with the products rather than using generic chargers and cables.	The ACCC agrees with the CSIRO but notes there are various factors impacting the ease with which consumers can follow this advice. Refer to Section 6.1.4.
5. Software updates from suppliers can recognise whether their device is charging with OEM product(s). If the device is charging with a non-OEM product it may inform the consumer and issue a warning, via the interface, requesting user to acknowledge that the device is being charged with a generic charger and/or cable and that damage and/or failure could potentially occur for the device i.e., phone, laptop, or other interface device.	The ACCC agrees with the CSIRO but has not made specific recommendations about the design of products containing Li-ion batteries. Refer to Recommendation 4 (Regulatory Landscape).

CSIRO recommendations	ACCC views
6. Develop a star rating for all charging products, to inform consumers about the quality of the product that they are purchasing. Standards bodies and regulators should consider a rating system on a scale of 1 to 5 for respective charger controls and managements systems.	The ACCC agrees with the CSIRO. Refer to Section 6.1.4.
7. Chargers should come with warnings attached to their cables and/or packaging that the products should not be used indoors, confined spaces or left unattended for extended periods, i.e., 3 hours, due to the potential risk of failure and resultant fires.	The ACCC agrees with the CSIRO but notes there are various factors impacting the ease with which consumers can follow this advice. Refer to Section 9.3 and Recommendation 5 (Regulations).
8. If consumers recognise that a battery pack or device has been impacted either by an external force such as being dropped, lightning or other events, they should have the device inspected by the manufacturer or technician/electrician to ensure that all battery management system components are operating correctly prior to charging.	The ACCC agrees with the CSIRO. Refer to Section 6.1.5 and Recommendation 2 (Consumer safety).
9. Consumers have responsibility to care for charging cables to ensure that batteries can be safely charged at all times. Where intermittent charging is observed or clear evidence of damage to the cable is noticeable, the cable should be discarded and replaced with a manufacturer specified cable.	The ACCC agrees with the CSIRO but notes there are various factors impacting the ease with which consumers can follow this advice. Refer to Section 6.1.4 and Recommendation 2 (consumer safety).
10. Issues relating to the use of home electric vehicle chargers and implications for home safety have not been considered in this report. There are many variables related to the age of a home, the electrical wiring within it, the position of the charging point of the car, charging point to be either fixed or standalone, 10 Amp or 15 Amp General - Power Outlets (GPO). This may be the subject of a further report for standards and regulatory bodies to consider.	The ACCC has not specifically considered different product categories in this report.
Hazards	
11. In the event of battery off-gassing, smoke or fire in a confined space, move to safety and call Triple Zero (000) to alert authorities of the fire. Where possible, callers should also clearly state it is a battery fire and identify the item type.	The ACCC agrees with the CSIRO. Consumers are advised to contact Triple Zero in the event of an emergency. This is also reflected in ACCC's proposed consumer messaging.
12. Where it is possible to fight a small battery fire, use a foam extinguisher such as CO2, ABC dry chemical, powdered graphite, copper powder or soda (sodium carbonate) as you would extinguish other combustible fires. Call Triple Zero (000) to inform of the fire.	To avoid injuries, consumers are advised to contact Triple Zero in the event of an emergency.
13. If a person(s) does inhale lithium-ion battery vent gases or smoke or has physical contact with liquids or solid products from the fire, they should immediately report to a hospital emergency department for treatment.	The ACCC agrees with the CSIRO. Consumers are advised to contact Triple Zero in the event of an emergency.

CSIRO recommendations	ACCC views
14. Batteries should be charged on non-combustible surfaces and away from combustible items.	The ACCC agrees with CSIRO. Refer to Section 6.1.4. This is also reflected in In the ACCC's proposed consumer messaging.
15. Consumers should not modify products with larger or additional batteries due to risk of significant catastrophic failure. Products should be used in strict accordance with manufacturer guidelines and operating instructions.	The ACCC agrees with the CSIRO. Refer to Section 6.1.6.
Recycling and end-of-life	
16. Methods and approaches for the disposal of damaged batteries are developed to inform how a battery should be handled at EOL. At present, there are no readily available methods and sources of information that the public can adopt to allow them to safely manage a damaged battery and places for appropriate disposal/ recycling. There is an urgent need to address this problem.	The ACCC agrees with the CSIRO. Refer to Section 7 – disposal and end-of -life and Recommendation 3 (Disposal and end-of-life).
17. No batteries (especially damaged or EOL) should be disposed into household rubbish, due to the risk of fire in household rubbish bins and garbage collection trucks. Batteries, which are intact, should be disposed of at a recycling station.	The ACCC agrees with the CSIRO. Refer to Section 7.1.
18. Battery disposal collection points need both standards and regulation to define the minimum requirement for safe collection, storage, and transport to recycling depots. Current collections are done in public places and stores which can pose a hazard to people and property in the event of fire. There should be national standards and regulations to manage these issues.	The ACCC agrees with the CSIRO. Refer to Recommendations 3 (Disposal and end-of- life) and 4 (Regulatory landscape).
19. National harmonisation of battery recycling standards and regulations to ensure higher collection rates, but also to inform best practice for the collection, storage, and transportation to recyclers	The ACCC agrees with the CSIRO. Refer to Recommendations 3 (Disposal) and 4 (Regulatory landscape).

CSIRO recommendations	ACCC views
Standards	
20. Demonstrable compliance of lithium-ion batteries to either IEC 62133 (portable applications) and/or AS IEC 62619 (industrial applications) is promoted through a combination of additional guidance in standards (such as in AS 62368.1) and regulatory enforcement options such as the establishment of mandatory certification (by JASANZ accredited bodies, etc.[236]) of products containing lithium-ion batteries to relevant standards for their product type and/or application. This approach could facilitate improved quality control of the manufactured products, reducing the likelihood of random faults resulting in hazards during a product's lifetime, and provide an elevated level of assurance that batteries are able to withstand normal and foreseeable abnormal conditions during their lifetime. With increased levels of (demonstrated) compliance are established, the suitability of the standards/criteria applied will be more apparent through analysis of statistics of fault events (e.g., fires). In other words, if the number of such unwanted events does not decrease with increased levels of compliance, the existing standards may be further assumed to be inadequate and require revision.	The ACCC agrees with the CSIRO recommendation. Refer to Section 9.1.1 and Recommendation 4 (Regulatory landscape)
21. Enforcement of existing requirements of the ADGC to ensure that cells and batteries imported into Australia, and potentially integrated into new equipment, meet the requirements of UN 38.3. The overlap between requirements of IEC 62133, AS IEC 62619 and UN 38.3 will simplify the required compliance (i.e., testing) pathway for manufacturers, importers and potentially regulators.	Refer to Recommendations 4 (Regulatory landscape) and 5 (Regulations).
22. Additional testing facilities are funded and established within Australia to provide sufficient capability to conduct tests on imported products to the standards nominated above, and to assist manufacturers demonstrate compliance of Australian-produced cells and batteries. The availability of local testing options will reduce the barrier to market to manufacturers who currently need to send products overseas for testing, which is difficult and expensive due to limitations and hazards related to transport. Ensured access to UN 38.3 test capability within Australia will provide a method to comply with existing transport regulations, which may be currently being avoided through ongoing production and shipping of prototype products.	The ACCC agrees with the CSIRO recommendation. Refer to Section 9.2 and Recommendation 4 (Regulatory landscape).

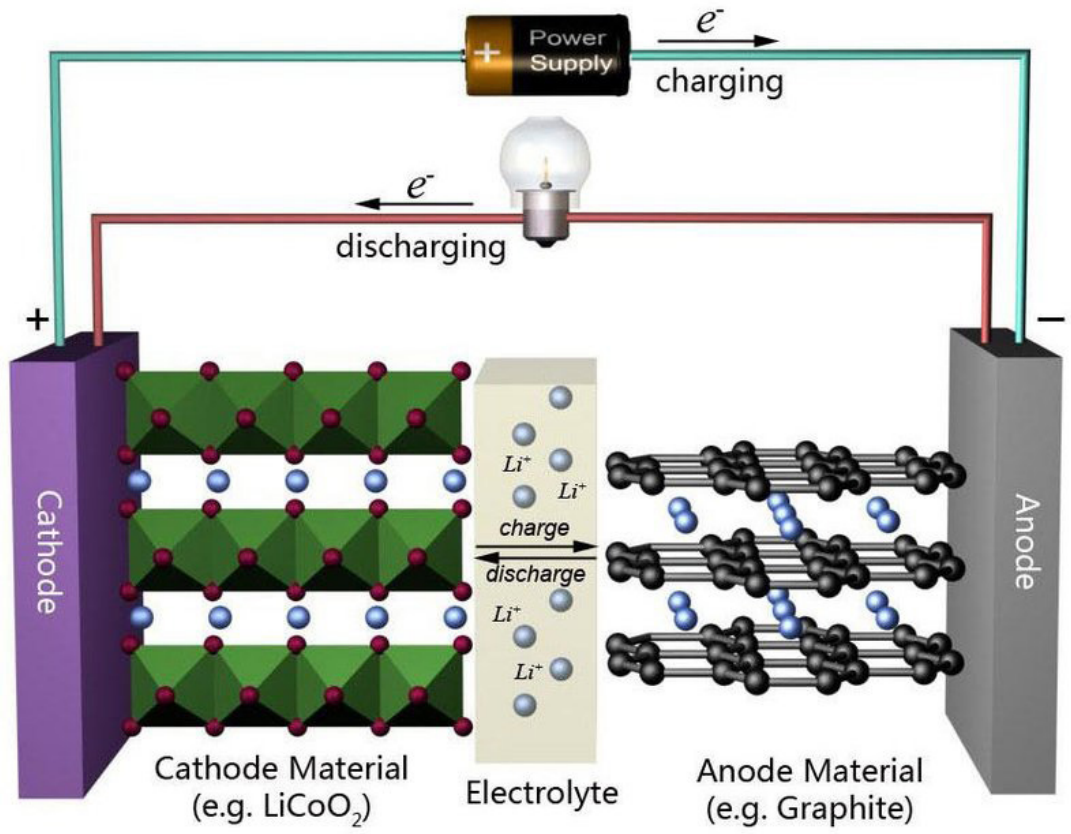
236 JASANZ is the Joint Accreditation System of Australia and New Zealand which provides internationally recognised accreditation services. For further detail visit the website: https://www.jasanz.org/.

CSIRO recommendations	ACCC views
23. Capability for the required tests for assessment of fire hazard such as UL9540A, from cell to unit level, is widely developed to support Australian manufacturing R&D, and safe expansion of the uptake of residential and commercial battery energy storage systems. Module-level1 testing requires substantial infrastructure due to the potential safety hazards involved in large-scale testing.	The ACCC agrees with the CSIRO. Refer to Section 9.2, Recommendations 1 (Incident data) and 4 (Regulatory landscape).
24. Reliable statistical information is gathered from emergency services to provide an accurate estimate of the risk to the community arising from battery-related incidents (i.e., fires). The information should, if possible, include the number of events, types of products commonly involved and battery sizes/capacities found to present the highest risk. While likely very difficult, the compliance of involved products should be determined to assist in the review of the suitability of existing standards. The collection of information would be ideally harmonised across all services operating indifferent states and territories to provide the largest set of data possible.	The ACCC agrees with the CSIRO. Refer to Recommendation 1 (Incident data).
25. Where a battery management system is provided as part of a product, the system should be tested accordingly, as described by AS IEC 62619 or other appropriate 'system' standard.	The ACCC agrees with the CSIRO. Refer to Recommendations 4 (Regulatory landscape) and 5 (Regulations).
26. Overarching safety standards, such as AS/NZS 62368.1, should include more guidance for the selection of test methodologies for lithium-ion batteries integrated within electrical products. Requirements for mandatory (compliance) marking of batteries may assist in the forensic determination of fault events as described in Point 1 above.	The ACCC agrees with the CSIRO. Refer to Recommendations 4 (Regulatory landscape) and 5 (Regulations).
27. The requirements of the ADGC are limited to testing (to UN 38.3) of individual cells or batteries prior to transport. Consideration to mandating the testing of assembled packs, if that is the form in which they are transported, should be given.	The ACCC agrees with the CSIRO. Refer to Recommendations 4 (Regulatory landscape) and 5 (Regulations).

Appendix 2 – Technical Information

Li-ion batteries contain cells that store (charge) and release (discharge) energy by a reduction/oxidation reaction that causes electrons to flow from the cathode (positive electrode) to the anode (the negative electrode) through an external wire circuit which powers devices connected to that circuit. These electrodes are separated by a medium and sit in a fluid called electrolyte. An electric current is created when electrons are transferred from one electrode to the other.

Figure 10: Basic diagram of a Li-ion battery cell

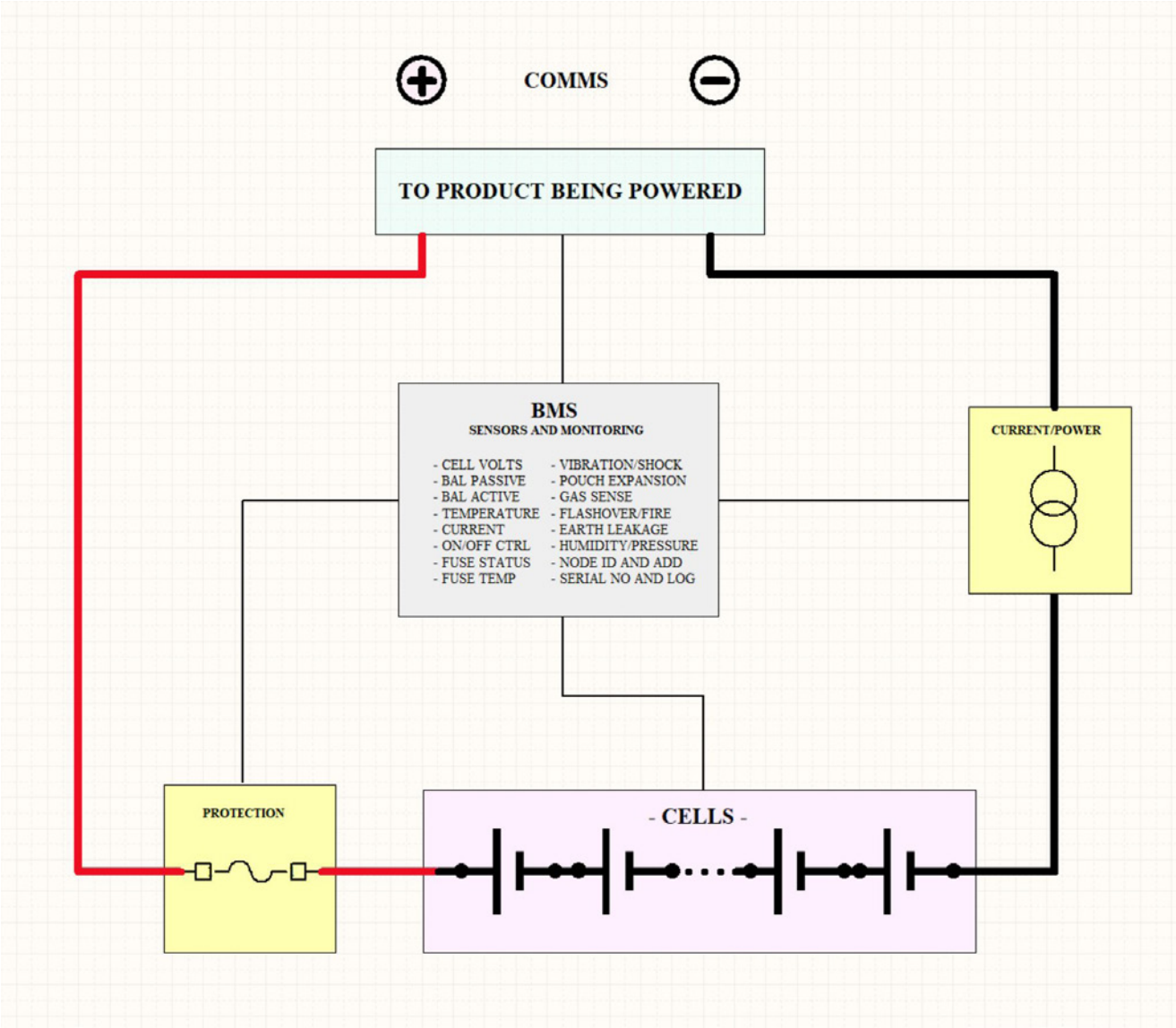


A Li-ion battery is comprised of several components including:

- cell(s)
- wiring
- external connection and
- depending on the size of the device, potentially an active or passive cooling system.

A key feature of a Li-ion battery pack is the battery management system. The battery management system plays an important role in managing the performance, efficiency, and safety of the battery system, especially for high energy density and long lifespan products. Figure 11 shows the basic schematic of a battery management system.

Figure 11: Basic schematic of a battery management system



Appendix 3 – Product stewardship schemes for Li-ion batteries and products

Type	Scheme	Details
Current schemes		
Voluntary[237]	B-Cycle	A national industry-led scheme coordinated by the Battery Stewardship Council.[238] It provides a network of sites for collection of hand-held batteries, and imposes a levy on imported batteries to fund rebates for recycling operators.[239] As the scheme only covers loose batteries and not the products that use them, it only applies to removable Li-ion batteries.[240]
Voluntary	Mobile Muster	A recycling program that covers mobile phones, plus their batteries, chargers, and accessories. It provides 3,000 public drop off points across the country and a free post back option. It is industry-led via the Australian Mobile Telecommunications Association and accredited under the Australian Government's *Recycling and Waste Reduction Act 2020*. It is funded by the Australian telecommunications industry.[241]
Co-regulatory[242]	National Television and Computer Recycling Scheme (NTCRS)	Li-ion batteries and products covered include portable devices like laptops and tablets plus rechargeable peripherals. The scheme provides consumers and small businesses with free drop off points for recycling. The *Recycling and Waste Reduction Act 2020 and the Recycling and Waste Reduction (Product stewardship—televisions and computers) Rules 2021* provide the regulatory framework for this scheme. The legislation sets outcomes for the scheme to meet and the Department of Climate Change, Energy, the Environment and Water monitors compliance.[243]

237 Voluntary product stewardship schemes are industry-led and can operate independently or be accredited by the Australian Government. See, e.g. Former Department of Agriculture, Water and the Environment, *Stewardship for Consumer and Other Electrical and Electronic Products, Discussion Paper*, December 2021, p 7.

238 Battery Stewardship Council, *Australia's official battery recycling scheme ramping up a network with new look: B-cycle* [Media release], 23 September 2021.

239 DCCEEW, *Battery Stewardship Scheme*, DCCEEW website, 18 July 2022, accessed 10 May 2023.

240 Battery Stewardship Council, *Fact Sheet 002 – What batteries are in scope?*, Battery Stewardship Council website, 9 June 2021, accessed 10 May 2023.

241 Mobile Muster, *About Us*, Mobile Muster website, n.d., accessed 28 April 2023.

242 Co-regulatory product stewardship schemes occur when government provides the regulatory framework that sets the outcomes for industry to meet. See, e.g. Former Department of Agriculture, Water and the Environment, *Stewardship for Consumer and Other Electrical and Electronic Products, Discussion Paper*, December 2021, p 7.

243 DCCEEW, *National Television and Computer Recycling Scheme*, DCCEEW website, 4 April 2023, accessed 10 May 2023.

Type	Scheme	Details
Proposed stewardship initiatives		
In development	E-waste	The Department of Climate Change, Energy, the Environment and Water is currently developing options for product stewardship for e-waste broadly.[244] With respect to Li-ion batteries and products, the scope of this work covers most Li-ion batteries and products not currently covered by an existing scheme, particularly those small enough for consumers to incorrectly dispose of into their household bins. In June 2023, the Department of Climate Change, Energy, the Environment and Water released the *Wired for Change: Regulation for small electrical products and solar photovoltaic systems waste* discussion paper. This paper details a proposed regulatory approach to product stewardship for 2 categories of electrical/electronic-products (e-products), solar photovoltaic systems and small electrical and electronic equipment including embedded Li-ion batteries.[245]
In development	E-vehicles and other large format batteries	The National Electric Vehicle Strategy includes preparing for a recycling, reuse and stewardship initiative for e-vehicles and other large format batteries.[246]
In development	National Battery Strategy	The Australian Government is developing a National Battery Strategy to support battery industries in Australia. The National Battery Strategy Issues Paper includes consideration of recycling and safe disposal of batteries, including Li-ion batteries.[247]

244 Former Department of Agriculture, Water and the Environment, *Stewardship for Consumer and Other Electrical and Electronic Products, Discussion Paper*, Former Department of Agriculture, Water and the Environment website, December 2021, pp 1, 8–9.

245 DCCEEW, *Wired for change: Regulation for small electrical products and solar photovoltaic systems*, DCCEEW website, published 20 June 2023.

246 DCCEEW, *National Electric Vehicle Strategy*, DCCEEW website, 2023, accessed 10 May 2023, p 4.

247 Department of Industry, Science and Resources, *National Battery Strategy Issues Paper*, Department of Industry, Science and Resources website, 3 February 2023, accessed 20 June 2023.

Appendix 4 – Overview of relevant standards

Voluntary Standard	Scope and relevance of the standard
UN 38.3: Transportation Testing for Lithium Batteries and Cells	This is a key mandatory standard for the transport of Li-ion batteries (either transported on their own or installed in a device) and is referenced in the ADG Code.[248] The ADG Code states that lithium cells can only be shipped by air if they comply with the requirements in UN 38.3. While the test requirements extend to Li-ion batteries as a whole, it is unlikely that this is currently implemented with suppliers relying on compliance at a cell-level rather than a battery-level. As UN 38.3 is required for air transport, compliance with the standard is required for global market access. **Included**: Li-ion batteries transported either on their own or in a device.
IEC 62133-2:2017+AMD1:2021: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems	This standard specifies requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolyte, under intended use and reasonably foreseeable misuse. This is a cell-level standard, i.e., it focusses on the battery on its own rather than its interaction with the product as a system. This standard is currently referenced in the Energy Safe Victoria guidance for extra-low voltage products.[249] **Included**: Many Li-ion batteries that used in portable consumer electronics.
AS/NZS 5139-2019 Electrical installations - Safety of battery systems for use with power conversion equipment	This voluntary standard sets out the general installation and safety requirements for some battery energy storage systems where the battery system is installed in a location, such as a dedicated enclosure or room, and is connected with power conversion equipment to supply electric power to other parts of an electrical installation. **Included**: Battery energy storage systems
AS/NZS 60335.1:2022 Household, and similar electric appliances – Safety general requirements	The standard covers electrical appliances in general and for household and similar purposes (including appliances powered by rechargeable batteries), their rated voltage being: ▪ not more than 250 Volts (V) for single-phase appliances, and ▪ 480 V for other appliances. Its objective is to provide manufacturers, designers, regulatory authorities and testing labs with safety requirements to protect users against hazards. **Included**: Household Electrical Equipment such as Toasters, Blenders, Coffee Grinders, etc when they are powered by rechargeable batteries.

248 National Transport Commission, *The Australian Dangerous Goods Code (Edition 7.8)*, National Transport Commission website, 2022, accessed 1 May 2023.

249 Energy Safe Victoria, *Equipment*, Energy Safe Victoria website, 2022, accessed 31 May 2023.

Appendix 5 – Submissions to the Lithium-ion Batteries Issues Paper

Submissions to the Lithium-ion Batteries Issues Paper where consent has been given to publish the responses are listed below.

Stakeholder Name	Stakeholder Type
ACT Government	Government
Ai Group	Industry body
Allianz Australia	Industry
Astec Services	Manufacturer/Retailer
Australasian Fire and Emergency Service Authorities Council (AFAC)	Government/industry council
Australian Battery Industry Association	Industry body
Australian Mobile Telecommunications Association	Industry body
Australian Retailers Association	Industry body
Australian Council of Recycling	Industry body
Australian Toy Association	Industry body
Battery Stewardship Council	Government/industry council
Bicycle Industries Australia	Industry body
British American Tobacco Australia	Manufacturer/Retailer
Caravan Industry Association of Australia	Industry body
CertAssure	Testing/Laboratory
Club Logistics Services	Manufacturer/Retailer
Comtest Laboratories Pty Ltd	Testing/Laboratory
Consumer Electronics Suppliers Association	Industry body
Consumers' Federation of Australia	Consumer advocacy group
Department of Mines, Industry Regulation and Safety WA, Building and Energy Division ,	Government
Department of Mines, Industry Regulation and Safety WA, Consumer Protection	Government
Electric Vehicle Council	Industry Body
Federal Chamber of Automotive Industries (FCAI)	Industry body
Fire Rescue Victoria	State fire agency
Fire and Rescue NSW	State fire agency
Government of South Australia, SA Health	Government
Graphene Manufacturing Group	Manufacturer
LG Energy Solution Australia Pty Ltd	Manufacturer/Retailer
Lighting Council Australia	Industry body

Lithium Australia	Manufacturer/Retailer
NSW Environmental Protection Authority	Government
Nation Energie	Manufacturer
National Retail Association	Industry body
No More Butts	Charity
PowerPlus Energy	Manufacturer/Retailer
Queensland Consumers Association	Consumer advocacy group
Queensland Fire and Emergency Services	State fire agency
Smart Energy Council	Industry body
Solaverdi	Manufacturer/Retailer
Standards Australia	Industry body
Strata Community Association (Vic)	Industry body
Techtronic Industries Pty Ltd	Manufacturer/Retailer
Tesla Motors Australia	Manufacturer/Retailer
UL Research Institutes	Academic organisation
UL Solutions	Testing/Laboratory
Victorian Government	Government
Waste Contractors and Recyclers Association of NSW	Industry body
Waste Management and Resource Recovery Association Australia	Industry body
Waste and Recycling Industry of Queensland	Industry body
Zipidi	Consulting body
Zoomo	Manufacturer/Retailer
eBay Australia	Online platform
Response 1015788287	Consumer
Response 1051125257	Consumer
Response 129559706	Consumer
Response 151984455	Consumer
Response 206480922	Consumer
Response 224543779	Consumer
Response 232829002	Consumer
Response 257992524	Consumer
Response 278491303	Consumer
Response 519174739	Consumer
Response 524554432	Consumer
Response 573352870	Consumer
Response 643098758	Consumer
Response 78689820	Consumer
Response 837487888	Consumer


AUSTRALIA


ACCC
AUSTRALIAN COMPETITION
& CONSUMER COMMISSION