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Evaluating the Risk of Battery Energy Storage Systems at Port Facilities

Welcome

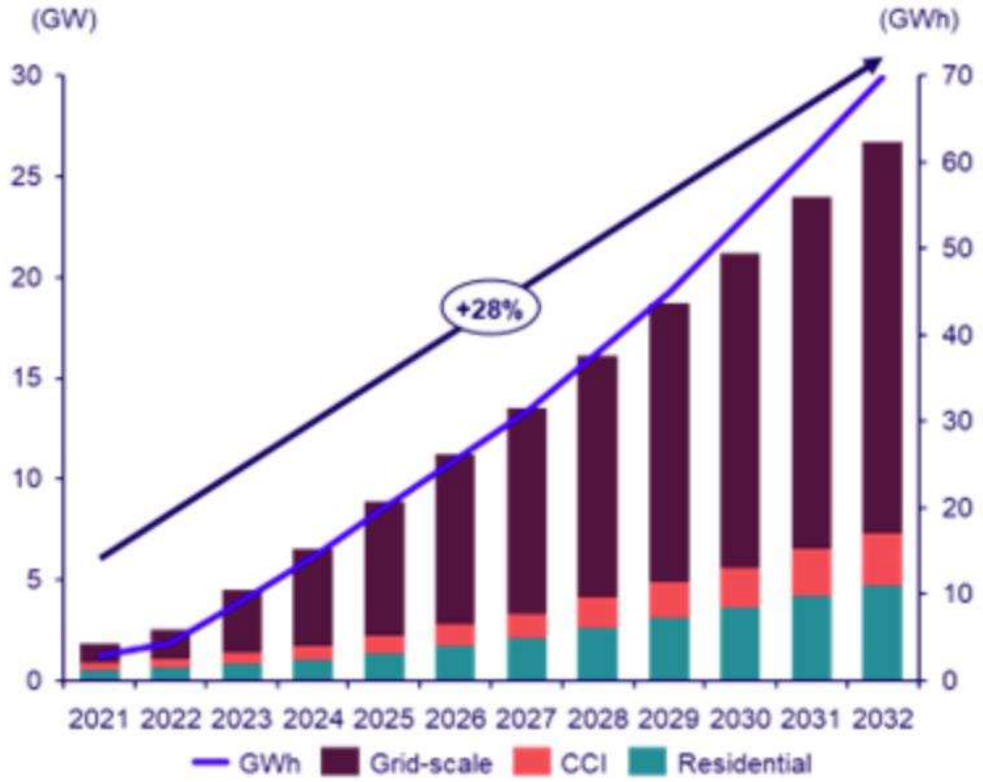
Discussion Topics

- Alignment with UN Sustainable Development Goals
- Outlook of BESS growth in Australia
- Why is this an issue?
- Where LIBs are manufactured
- Thermal Runaway
- Are our ports geared for the risks
- The gap closer / Tackling the risks

Alignment with United Nations Sustainable Development Goals

Robust Infrastructure supports clean energy
Ensuring infrastructure design is capable of mitigating fire risks associated with BESS, whether transported, stored or operational, we contribute to the roll out of clean energy

Forecasted BESS Growth in Australia



Wood Mackenzie (2023) Forecasted growth in Australia's battery storage capacity
https://www.woodmac.com/press-releases/australia-leads-global-market-for-battery-energy-storage-systems//

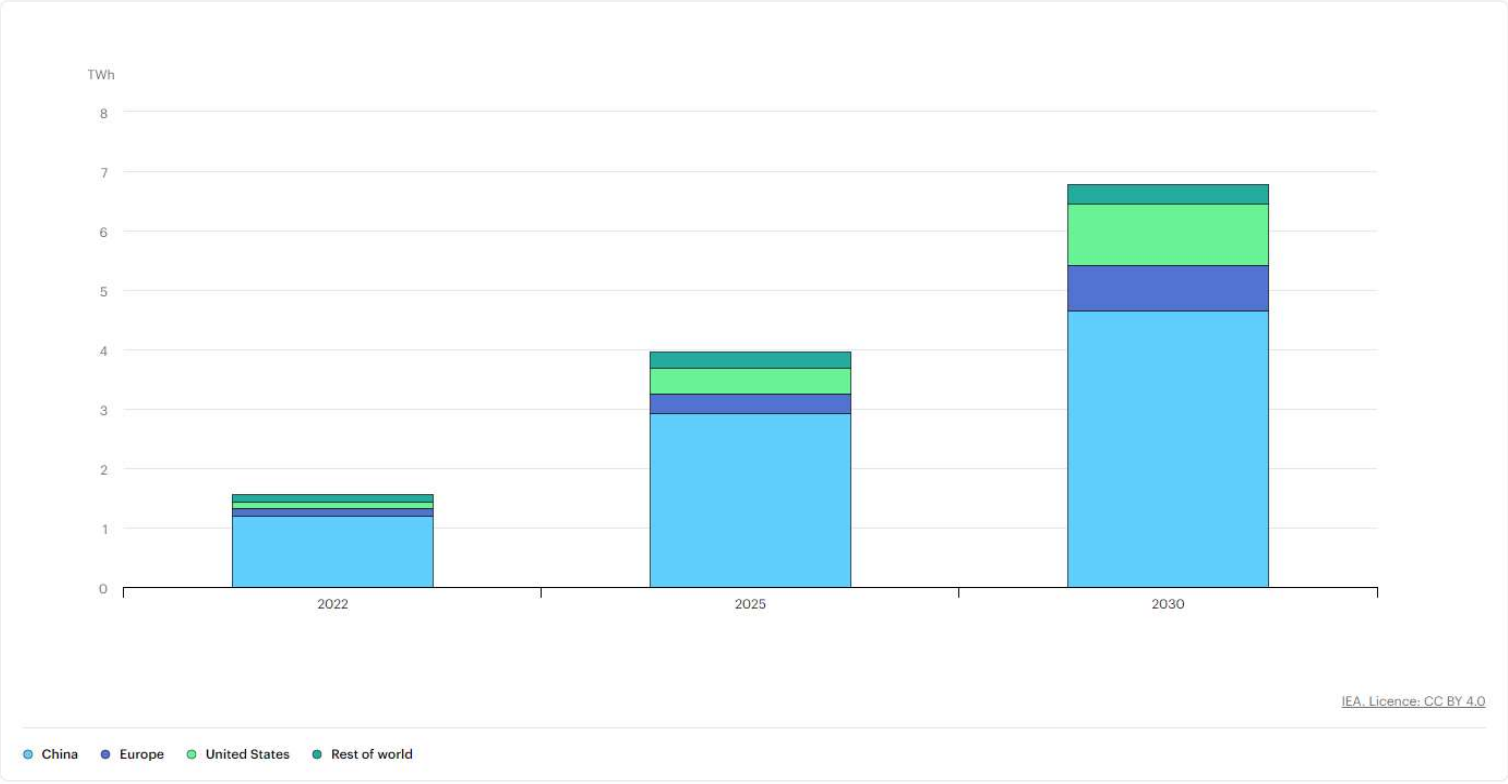
28% increase p/a to Australia's battery energy storage capacity until 2032

What does this mean for our port facilities?

Part 1 – Where are the batteries manufactured

Part 2 – What are the fire related hazards

LIB Manufacturing Capacity



By 2030 at least **95%** of the lithium-ion batteries circulated will still be from overseas

IEA (2023), Lithium-ion battery manufacturing capacity, 2022-2030, IEA, Paris https://www.iea.org/data-and-statistics/charts/lithium-ion-battery-manufacturing-capacity-2022-2030, Licence: CC BY 4.0

Thermal Runaway

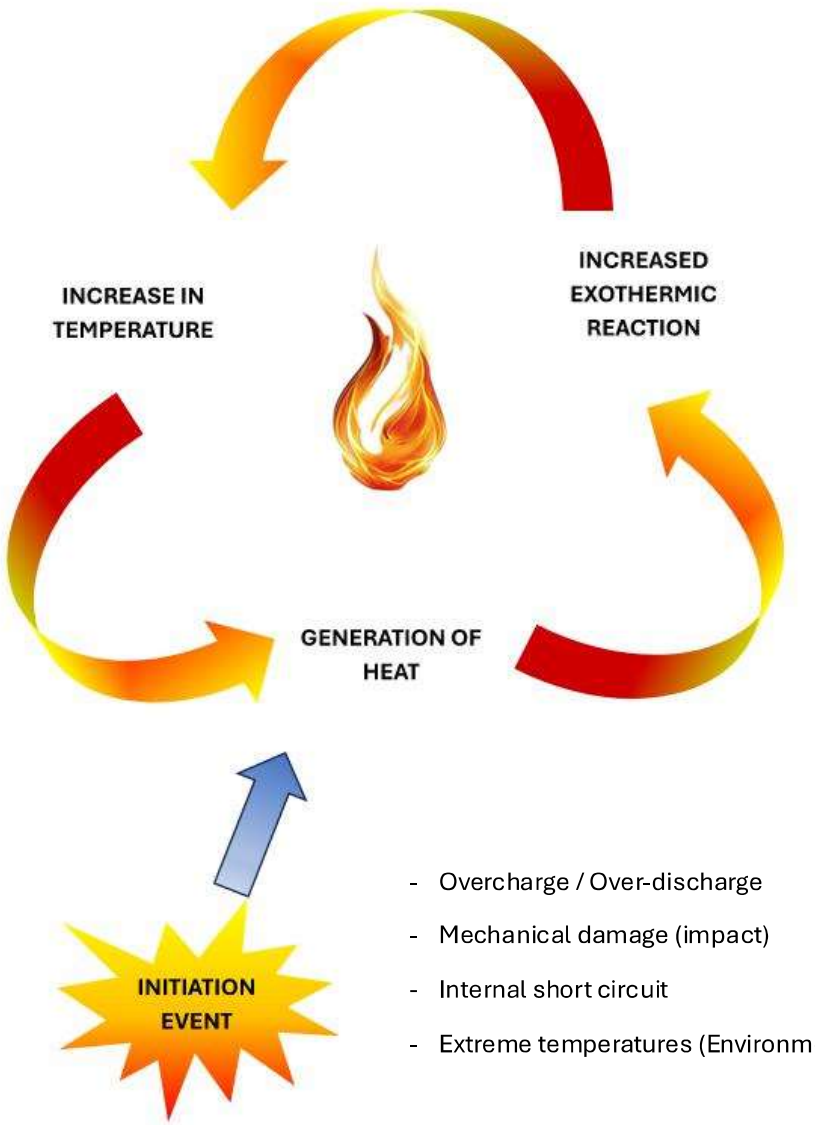
A battery cell that goes into an uncontrollable heating state, *unable to dissipate as much heat as it is generating*

→ Potential for fire and/or explosion

- High temperatures
- Flammable and toxic gas produced

Increased volume of BESS arriving at ports

Thermal Runaway risk with BESS



Are our ports → suitably prepared?

Current Practices - Dangerous Goods

Lithium Ion Batteries are Class 9 Dangerous Goods

- UN3480 Lithium Ion Batteries
- UN3481 Lithium Ion Batteries Packed with Equipment
- UN3536 Lithium Ion Batteries Installed in Cargo Transport Unit (BESS – new 2019)
- UN3171 Battery Powered Vehicle (applies only during international shipping)

AS/NZS 4681: 2000 ***The storage and handling of Class 9 (miscellaneous) dangerous goods and articles***

- Last amendment to AS/NZS 4681 in March 2001 (outdated?) (X)
- Potential gap given recent developments in large-scale battery applications (X)
- Provides no advice on BESS separation/segregation/stacking height/stack sizes (X)
- Identifies the need for a formal Fire Safety Study to be conducted (✓)
- Mandatory in some states and recommended in others (X)

UN3480/UN3481/UN3536 are Dangerous Goods and therefore receive some recognition of their hazards.

Current Practices - Dangerous Goods

UN3171 Battery Powered Vehicle (applies only during international shipping)

- UN3171/Class 9 Dangerous Good designation does not apply once EVs unloaded
- EV fire/explosion hazard still exists

Concerns

- BESS and EVs have similar hazards (fire and explosion)
- But handled differently in the port (separation/segregation/fire protection)
- Hazards and event knock-on potential associated with Lithium Ion Batteries not recognized
- Can Port's fire protection and Emergency Response handle current/future BESS and EV throughput.

How do we manage these risks?

Fire Safety Study - Bridging the Gap

Objective: Ensure that a sites fire prevention, detection, protection and firefighting measures are suitable for the specific hazards

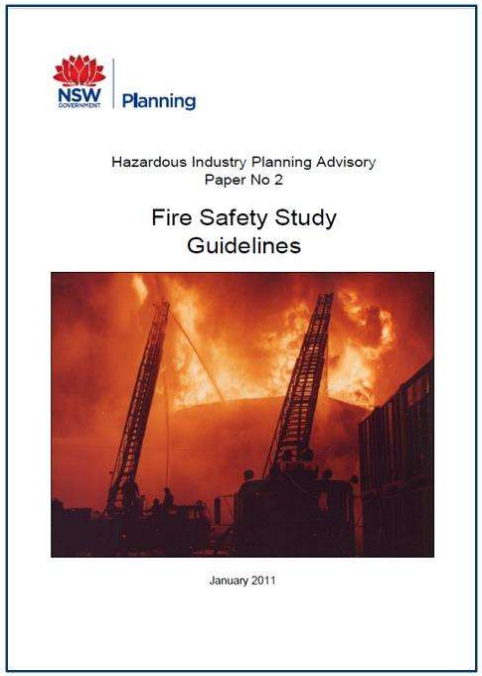
- **Identification of hazards**

  Thermal runaway, fire, explosion, toxic gas released
- **Assess consequence of fire hazard scenarios**

  Consider storage location, separation, segregation, knock-on impacts
- **Assess adequacy of fire safety systems**

  Detection, suppression, water supply, fire water management
- **Provide recommendations for risk mitigation**

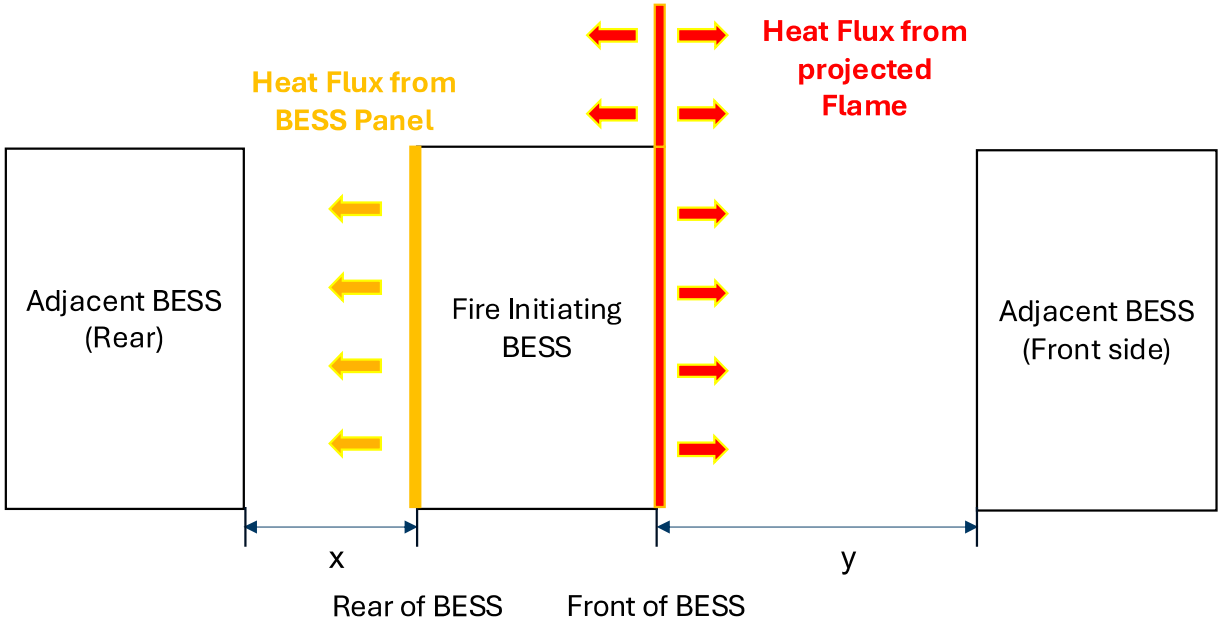
  Separation/segregation distances, active/passive fire systems



So what does a consequence assessment look like and how does it help?

Thermal / Fire events

Radiative heat flux modelling for a BESS enclosure fire (worst case)

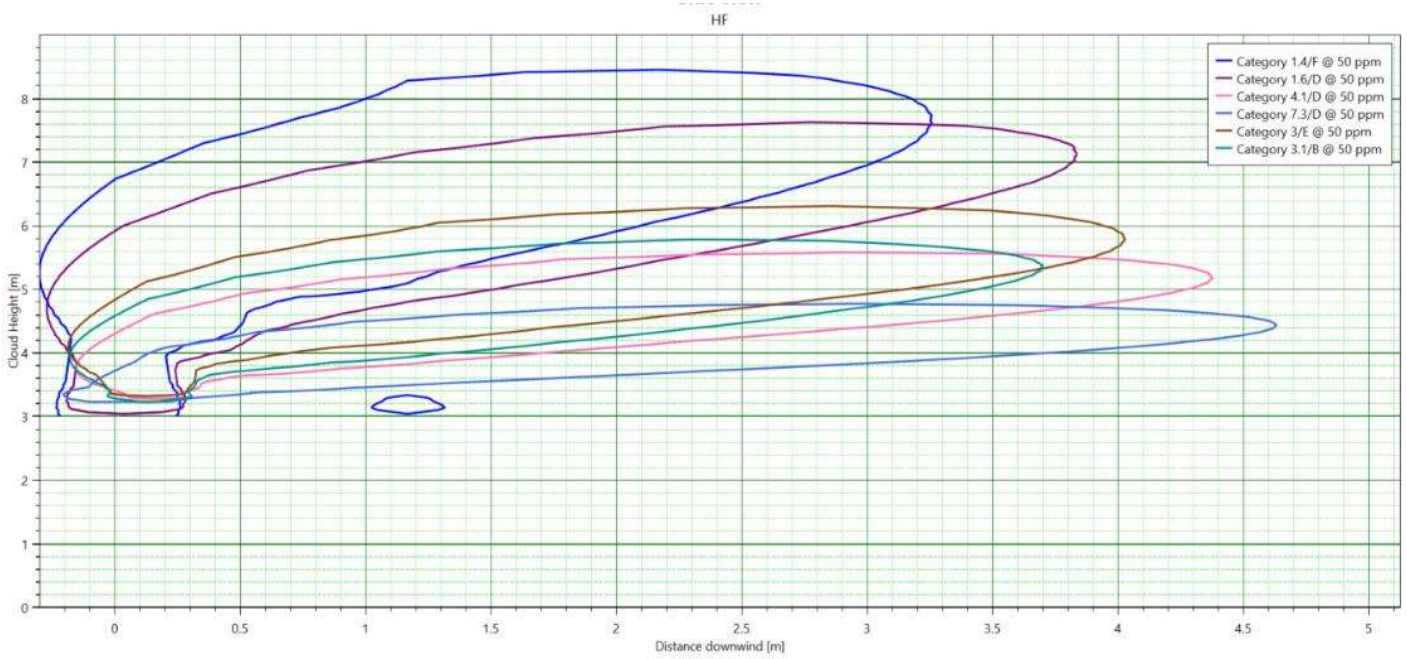


Inputs: Temperature, Heat Flux, Flame Height from OEM Testing

Assists with:
Informing requirements to minimise loss from a single event

Modelling of Toxic Gas Released

Undertake dispersion modelling to assess potential impact to occupants based on composition of gas released



Toxic gas can include:

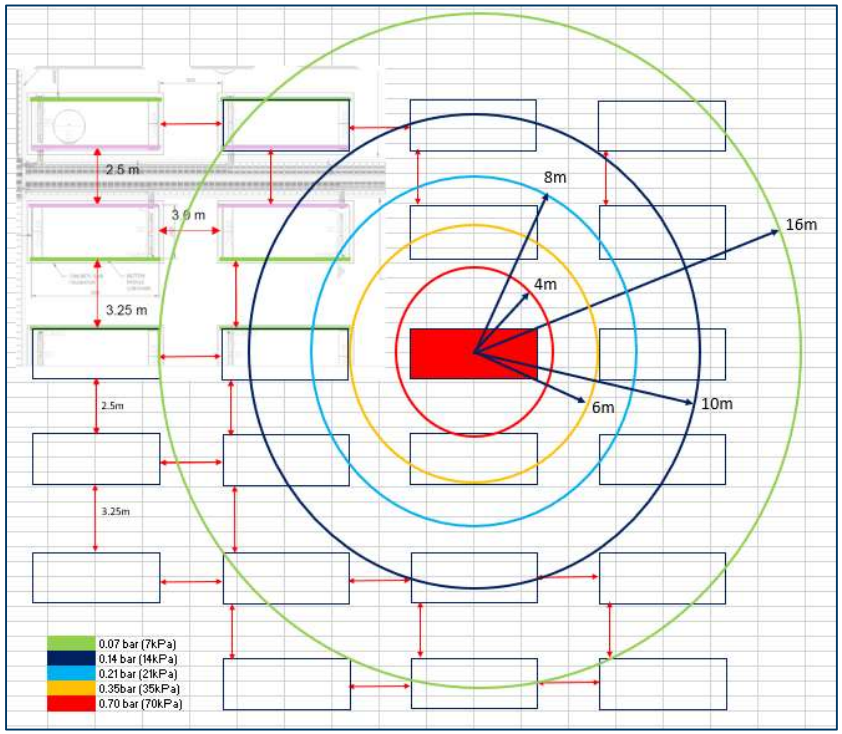
- Hydrogen Fluoride
- Hydrogen Chloride
- Carbon Monoxide
- Hydrogen Cyanide

Assists with:

Informing emergency response plans

Overpressure events

Assess blast overpressure consequences for <u>unmitigated</u> scenarios based on off-gas composition



Assists with:

Informing emergency response plans

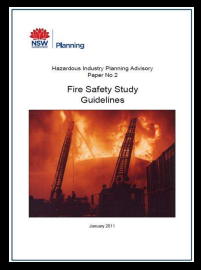
Explosion Overpressure	Effect
7 kPa	- Damage to internal partitions and joinery - Probability of injury is 10%. No fatality
14 kPa	- House uninhabitable and badly cracked
21 kPa	- Reinforced structures distort - Storage tanks fail - 20% chance of fatality to person in a building
35 kPa	- House uninhabitable - Wagons and plant items overturned - Threshold of eardrum damage - 50% chance of fatality for a person in a building and 1.5% chance of fatality in the open
70 k Pa	- Threshold of lunch damage - 100% chance of fatality for person in a building or in open - Complete demolition of houses

Closing Remarks

Increased volume of BESS arriving at ports

Thermal Runaway risk with BESS & EV's

Potential gaps in storage and handling of Class 9 DG's



Fire Safety Studies bridge the gap;

- Minimising risk of catastrophic events
- Minimising loss of assets
- Inform emergency response procedures

→ Thank you