Effective Preliminary Hazard Analysis for Battery Energy Storage Systems

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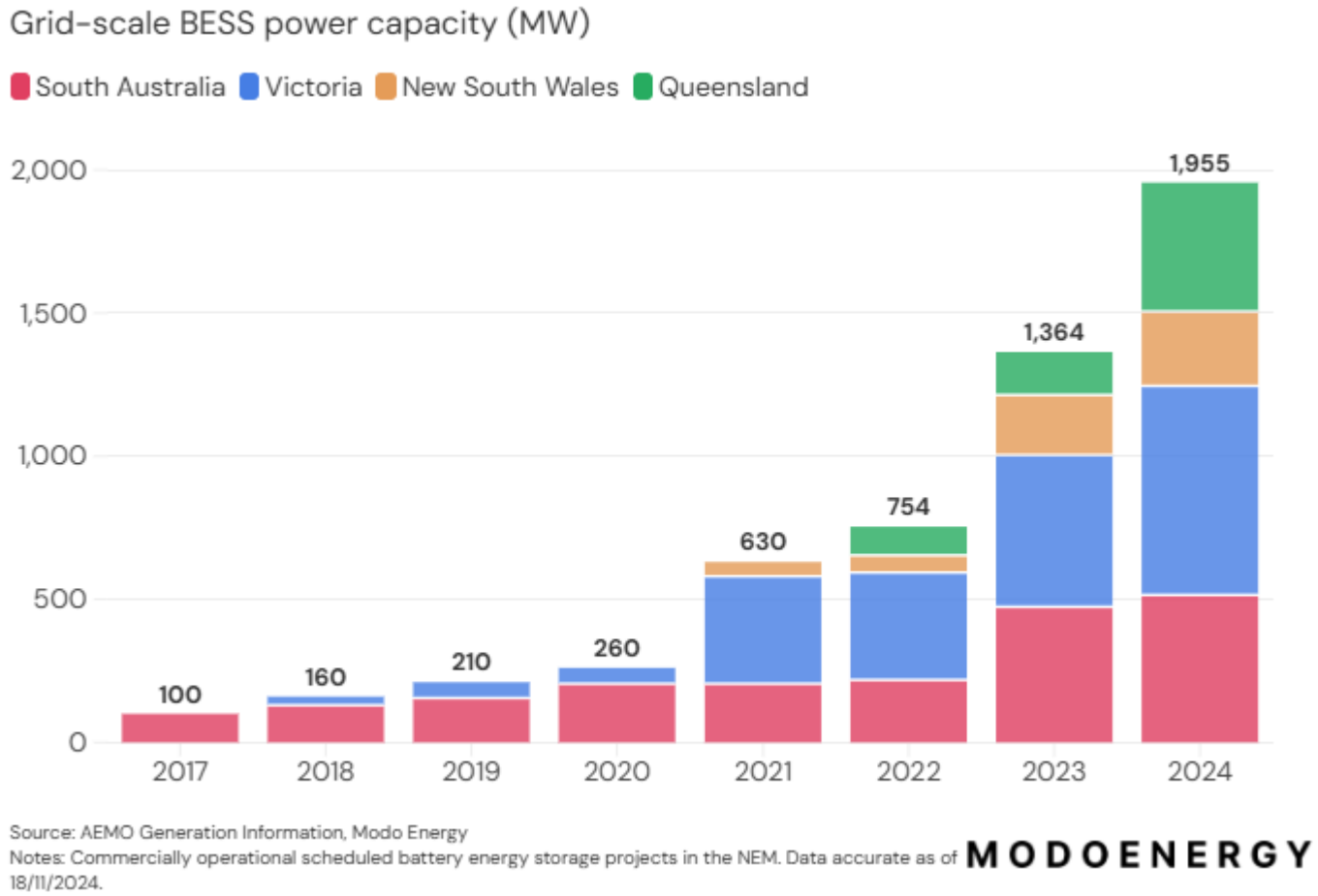
The Rise of Battery Energy Storage Systems

- In 10 years installed capacity of battery energy storage systems (BESS) has grown from 0 to 2 GW
- Next 10 years the Market Operator forecasts installed capacity to further grow to ~12 GW
- Development in areas not historically used for industry



Source: AEMO Generation Information, Modo Energy
Notes: Commercially operational scheduled battery energy storage projects in the NEM. Data accurate as of 18/11/2024.

MODOENERGY

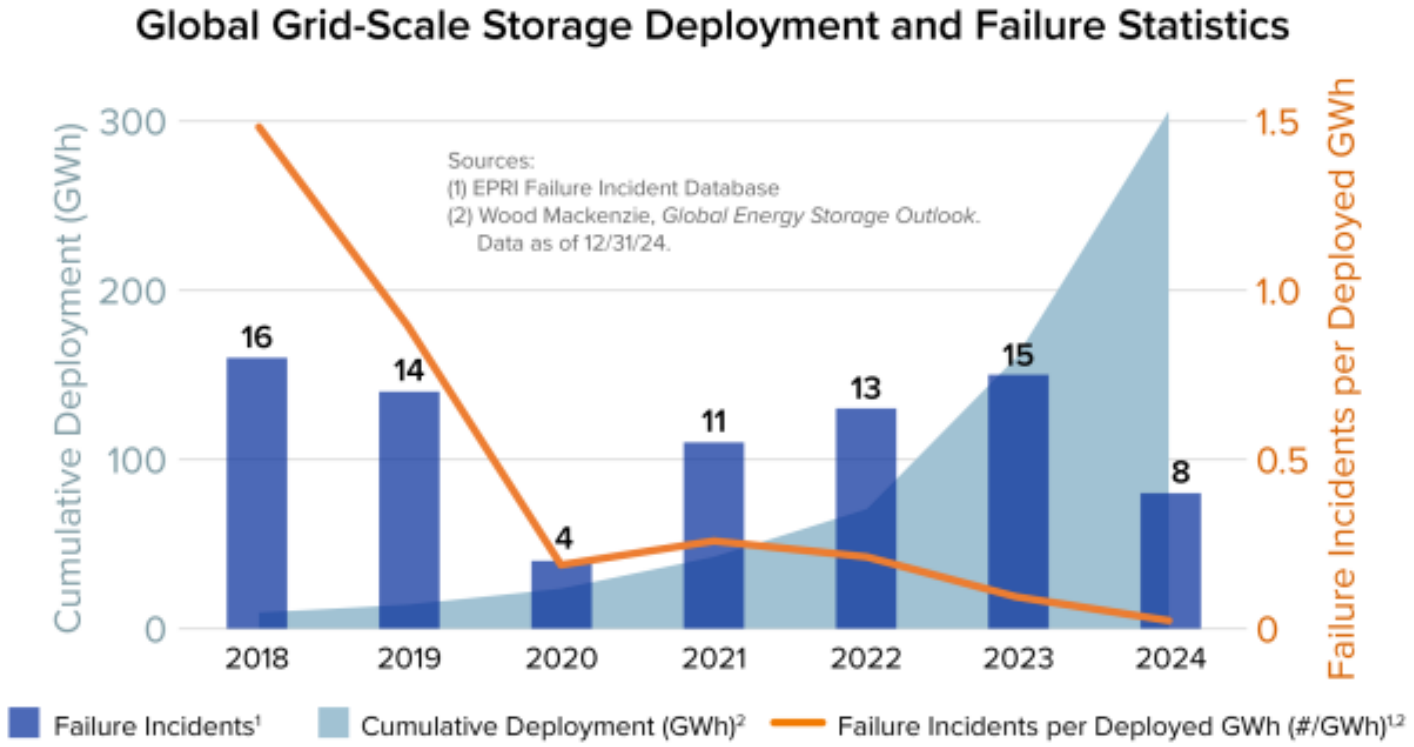
Hazards associated with BESS

- Thermal runaway reaction
  - Fire, explosion
- Firefighting challenges
  - Self-oxidizing material
  - Stranded energy
  - Toxic smoke / run-off
  - Explosion hazard
- Toxic smoke can impact nearby land uses

Fire at Moss Landing BESS (Liza Azil)

Risk to Health and Safety

- Rate of failure incidents has dropped significantly
  - Standards/regulations being developed
- BESS fires/explosion have limited potential to cause far-field fatality
  - **No reported off-site fatalities**



High Level of Perceived Risk

- Failures are very visible and make compelling news

A Net-Zero Chernobyl: California Battery Fire Releases Tons of Carcinogenic Metals and Toxic Gases 2

Toxic materials blanket communities, farms, and a sensitive estuary

FEB 20 • TUCO'S CHILD AND GENE NELSON, PH.D.

- Failures have resulted in first responder injury & fatality

UPDATE: Moss Landing Battery Storage Facility Reignites a Month after First Fire

Officials advise residents to close doors, windows

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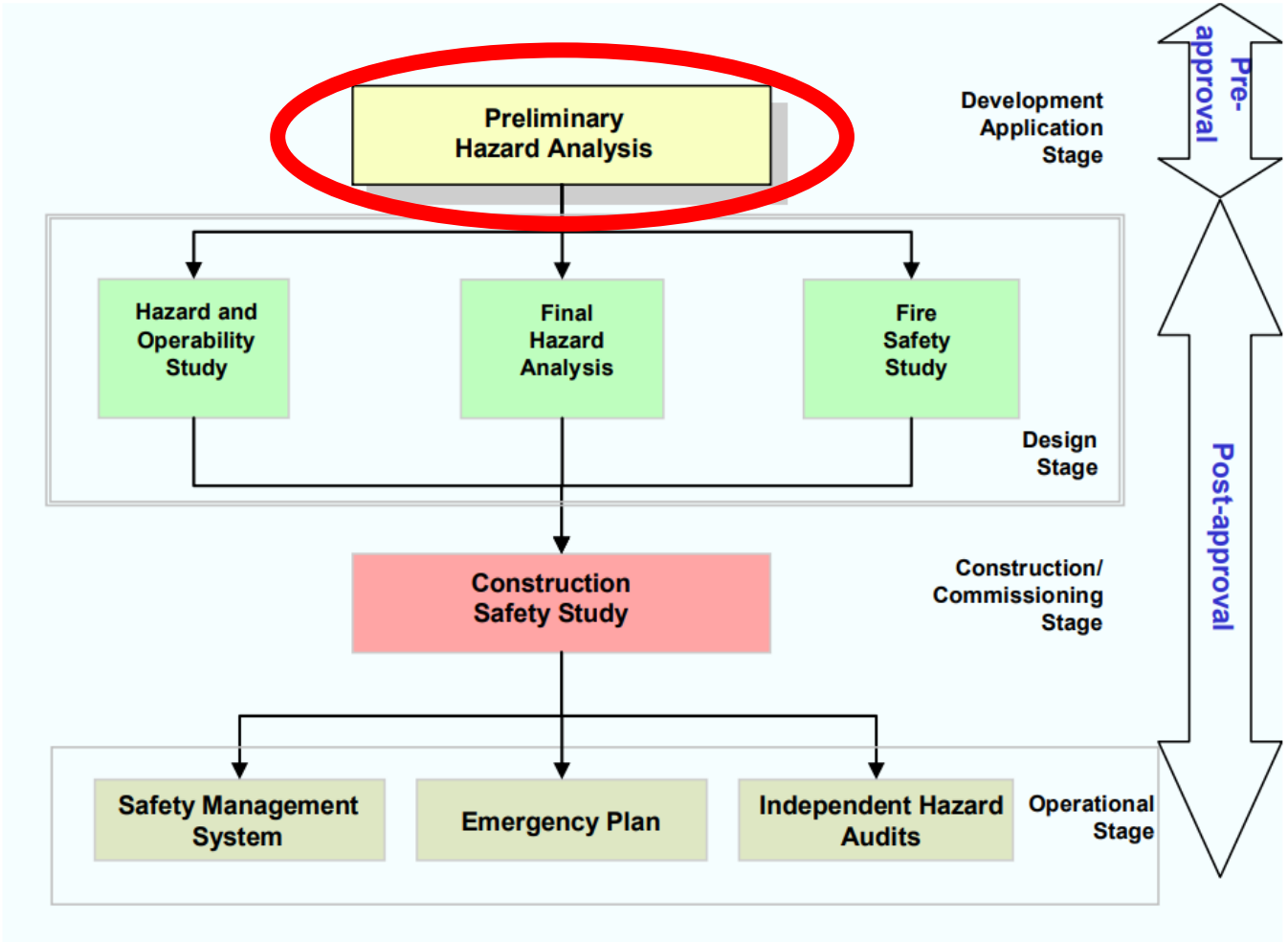
- New technology, new risks

Preliminary Hazard Analysis

- Preliminary Hazard Analysis is conducted at development application
- Identifies potential land use conflicts and demonstrates that they can be managed
- Opportunity to implement additional risk controls before final design / construction



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Case Study – QLD BESS Development

- 500 MW / 2GWh BESS
- Located in rural Queensland
- Zoned as rural land use

- Council requested preliminary hazard analysis considering the criteria described in State Code 21

Image: AdobeStock

State Code 21 – Queensland Guidance

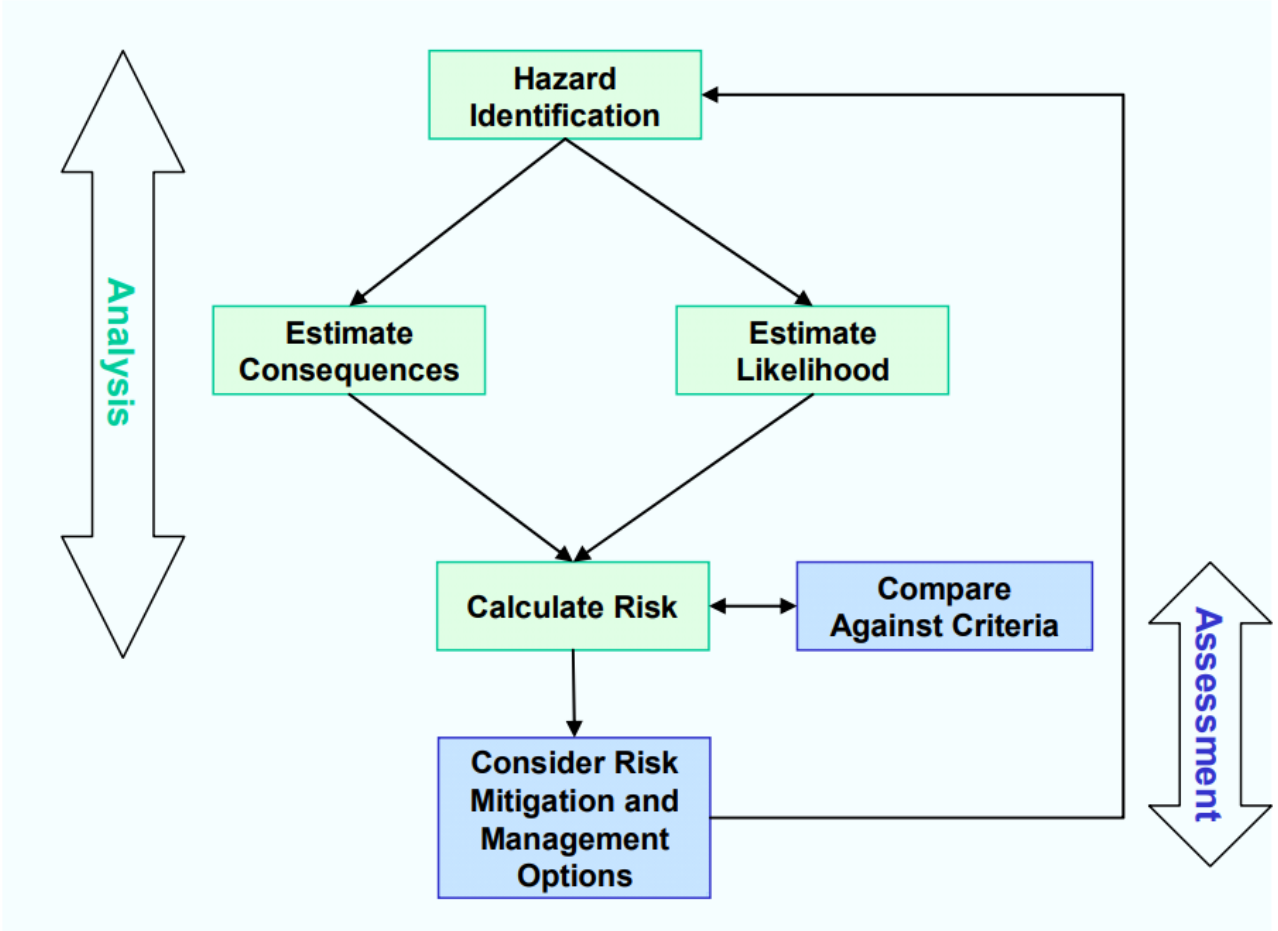
- Queensland State Code 21 describes 11 land use planning performance outcomes for hazardous chemical facilities
  - Five relate to off-site impact/risk
  - Four relate to DG storage & handling
  - Two relate to facility siting and design

- Compliance with the code is demonstrated by compliance with performance outcomes or demonstration of risk reduced ‘so far as is reasonably practicable’

- Application is normally triggered by quantities of scheduled materials as per Major Hazard Facility regulation

Application of Preliminary Hazard Analysis to Battery Energy Storage System

- Preliminary Hazard Analysis had dual focus:
  - Demonstrate lack of land use conflict per State Code 21 criteria
  - Demonstrate that on-site and off-site people risk is acceptable
- Risk assessment was qualitative
  - 5x5 risk matrix



HIPAP 3, NSW Department of Planning and Infrastructure

Hazard Identification

- Hazard Identification
  - Review of literature / industry history, local natural hazards
- Hazards Identified
  - Natural Hazards
  - Electrical hazards
  - Power station hazards
  - Battery hazards
- Examples:
  - Moisture ingress, high ambient temperature, control system failure, manufacturing defects

Consequence Assessment

- Consequence Assessment
  - Assigned on-site / off-site consequence severity
  - Based on severity, identified potential for MI (i.e. fatality or permanent disability)

- Results
  - Several events with potential for Major Incident on-site
    - Driven by impact of transformer explosion and electrocution
  - NO events with potential for Major Incident off-site
    - BESS fire not potential to result in off-site fatality

Likelihood Assessment

- Identified design preventative / mitigative controls
  - **Standard Preventative:** Battery cooling systems, battery management system with thermal runaway protection, high-level BESS management system
  - **Standard Mitigative:** Smoke / fire detection, sprinkler system, hydrogen gas detection and ventilation, fire-rated BESS walls

- Identified standard site controls which should be implemented as part of the Safety Management System
  - **Standard Preventative:** Preventative maintenance program, safe work practices, equipment design standards, site security, emergency preparedness plans, etc.
  - **Standard Mitigative:** Emergency response plan, pre-incident plans, emergency stops, etc.

Risk Assessment & Code Compliance

- Risk Assessment
  - Determine ‘risk rating’ based on likelihood and severity
  - Found that risks were controlled very well by vendor design and typical Safety Management System

- State Code 21 Compliance
  - Assessment of compliance against 11 Performance Outcomes
  - Demonstrated that off-site impact was not credible

Outcomes?

- Demonstrated compliance with State Code 21
- Provided local council / community overview of risk profile
- Provided operator with independent review of design safety
- Identified hazards / potential risk controls early in project lifecycle

Questions

image: Flaticon.com