



COLLABORATIVE RESEARCH PROGRAM

Safety of Alternative and Renewable Energy Technologies (SARET)

Presented by:

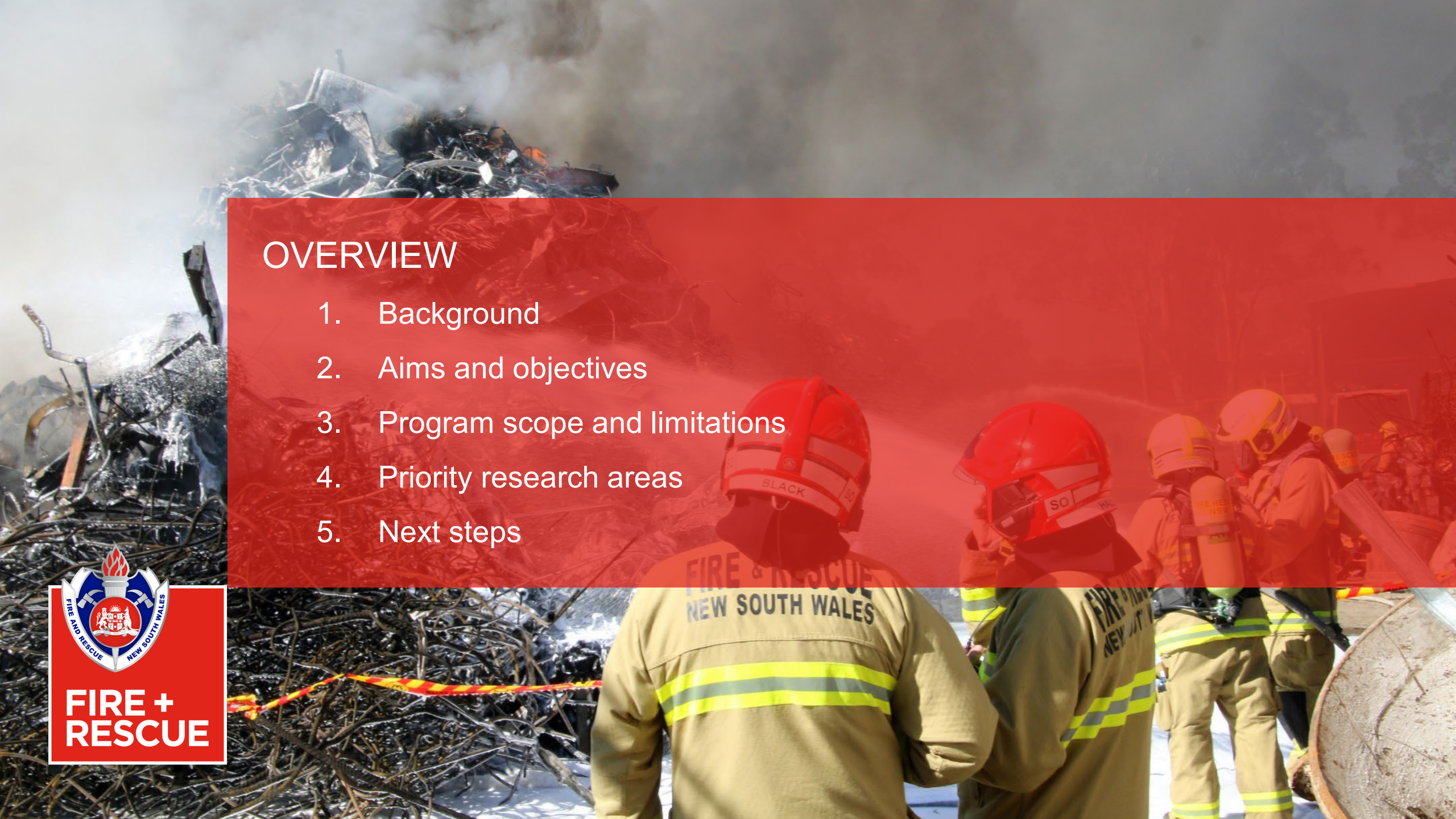
KIM THAI

SARET PROGRAM COORDINATOR

SENIOR RESEARCH OFFICER

FIRE SAFETY POLICY UNIT

COMMUNITY SAFETY DIRECTORATE

The background image shows a fire scene with thick smoke rising from a pile of debris. In the foreground, several firefighters in yellow and red gear are visible, with their backs to the camera. The text 'OVERVIEW' is overlaid on a red semi-transparent rectangle.

OVERVIEW

1. Background
2. Aims and objectives
3. Program scope and limitations
4. Priority research areas
5. Next steps



Background

In October 2021, the Australian Government committed to achieving **net zero emissions** by 2050 and \$20b to support alternative and renewable energy technologies.

Lithium-ion battery (LiB)-related technologies have proliferated over the past decade and have been associated with an increased fire and explosion risk. In Q1 2022, approximately 1 in every 100 FRNSW fire calls involved LiBs in thermal runaway.

LiB-related incidents pose a number of new challenges to fire and emergency services, including:

- Fire intensity
- Exposure to toxic gases and effluents
- Explosion risk in confined environments
- Stranded electrical energy
- Protracted extinguishment and cooling
- Risk of secondary ignitions
- Rendering safe
- Containment of contaminated fire water
- Handling, transport and disposal/recycling of fire affected batteries



Aims and objectives

Why?

- Foster new and strengthen existing research collaborations
- Avoid duplication of effort
- Maximise return and output
- Ensure safe practices

Research gaps:

1. How do we mitigate the risks related to **stranded electrical energy** when responding to battery-related incidents?
2. How do we best **extinguish** fires involving alternative energies such as those related to Lithium-ion batteries and battery systems?
3. What are the risks related to **toxic effluents**, including venting gases and containment of fire water run-off?
4. How do we mitigate the risks related to **secondary ignitions** in Lithium-ion battery fires and how they can be rendered safe following fire service response?
5. What **fire safety measures** and requirements are appropriate for buildings and infrastructure housing Lithium-ion battery systems including electric vehicles?



Program scope and limitations

What?

Program of experiments designed to address our research questions in a number of priority areas and applications. Projects to be prioritised based on stakeholder interest, availability of resources and funding.

Where?

FRNSW Fire Testing and Research Facility in Londonderry, NSW

When?

From June 2022 – 2024 with possibility of extension

Who?

FRNSW Research and Project Team and Research Partners engaged through the Call for EOI.

Note: FRNSW does not engage in commercial R&D projects and will not endorse any products used in testing. As such, the Program will be limited to projects that will contribute to organisational and public knowledge and be utilised for public good.



Program scope and limitations

FRNSW Capabilities:

- Experience in experimental design and data analysis
- Test facilities, including the CSIRO-built Destructive Battery Testing Facility, ISO 9705 room, buoyancy calorimeter and various structures
- Firefighting and HAZMAT equipment and capability
- Fire testing equipment, including:
 - A 250+ channel NI data acquisition system
 - Over 100 probe-type and surface-type thermocouples
 - Heat flux sensors
 - Load cells and platforms
 - Optical sensors
 - Fire detection control and indicating equipment
 - Flow meters
 - Pressure sensors
 - Weather stations
 - High resolution thermal imaging equipment
 - High resolution video cameras and 3D camera
 - 3 x Fourier Transform Infrared Spectroscopy (FTIR) gas analysers
 - Portable Gas Chromatograph Mass Spectrometer (P-GCMS)



Program scope and limitations

FRNSW is currently gathering support in:

- Research gap analysis, literature reviews ✓
- Review of incident data ✓
- Research design, review of test protocols, risk analysis ✓
- Fire modelling and data analysis ✓
- Batteries and battery systems for testing ✓
- Vehicles, including electric vehicles for testing ✓
- Charging equipment ✓
- Smoke and off-gas detection equipment ✓
- Set up of conditioning rooms ✗
- Air handling equipment ✗
- Suppression equipment and agents – fixed and portable ✓
- Specialised tools and equipment – e.g. vehicle fire blankets ✓, fognails and piercing nozzles ✓, immersion systems ✓, DC voltage detectors ✓, emergency plugs ✓, wheel stops ✗, etc.
- Chemical analysis and specialist testing services ✓
- Construction and fabrication services ✗
- Consumables – e.g. building materials ✗, extra sensors ✗
- Test set up and technical support ✓
- Waste removal / recycling services ✓
- Funding ✓

✓ Sufficient support

✓ Need further support

✗ Not yet sourced



**FIRE +
RESCUE**

Fire and Emergency Service Partners



NFCC
National Fire
Chiefs Council





Government Partners



Research Partners



Industry Partners



Research topic areas

Areas of interest for FRNSW:

- Efficacy of various extinguishing agents and methods on LiB-related fires
- Efficacy of specialty tools and equipment for use in the management of LiB-related incidents
- Performance of first responder personal protective clothing and equipment in LiB-related incidents
- Electric vehicle fire behaviour and fire brigade response in parking garages
- Fire propagation in energy storage systems
- Impact protection requirements for stationary battery energy storage systems
- Lithium-ion battery-related fire and explosion risk in battery recycling collection programs
- Safe handling, storage and transportation of damaged LiBs and battery systems



Proposed programs

Program 1

FIRE SERVICE RESPONSE TO LIB FIRES

Program 2

END-OF-LIFE LIB HAZARD MANAGEMENT

Program 3

ELECTRIC VEHICLE FIRES IN STRUCTURES

Program 4

FIRE PROPAGATION IN ENERGY STORAGE SYSTEMS



P1. FIRE SERVICE RESPONSE TO LIB FIRES

- **Size up considerations:**
 - How do we know that a LiB is involved? What are the identifiers?
 - What information is available to emergency responders? What is needed? How do we use it?
 - What do we need to check for? Temperatures? Gases? Are current FF tools appropriate?
- **Emergency procedures:**
 - How do we ensure firefighters are not exposed to stranded electrical energy?
 - What ventilation procedures should be used for confined and underground spaces to prevent dangerous deflagration events?
 - What agents should be used for extinguishment, especially where copious amounts of water is not available? What are their effects on various battery chemistries and when there is poor access to the cells?
 - What specialist tools are available for the management of incidents and are they effective, practical, safe, compatible with existing equipment and fleet?
 - Are existing PPC/PPE effective in protecting firefighters from exposure to toxic effluents from LiB fires?
 - What cooling techniques need to be employed to prevent secondary ignitions?
- **Handover procedures:**
 - How do we “make safe” after a fire?
 - What are the environmental considerations?



P2. END-OF-LIFE LIB HAZARD MANAGEMENT

- **Hazards related to end-of-life, second life, and damaged / fire affected LiBs**
 - What are the likely causes of failure in EoL LiBs?
 - What information / guidance is needed for the public to prevent incidents from occurring?
- **Safe collection, handling, storage, transport and management of end-of-life LiBs**
 - How do we safely manage consumer mixed battery collection programs where LiBs are becoming more prevalent?
 - How do we minimise the risks of exposure and secondary ignitions to firefighters, fire investigators and to people who may be involved in handling and managing EoL LiBs who may not have similar protections?
 - What tools and equipment are available? Are they effective and practical?



P3. ELECTRIC VEHICLE FIRES IN STRUCTURES

- **EV vs ICEV fires**
 - Differences in:
 - fire development and intensity
 - Vapour / gas development
 - Fire water contaminants
- **Response considerations for EV fires within structures**
 - Vehicle charging and isolation procedures
 - Smoke and vapour composition and volume, ventilation effects
 - Effects of suppression systems
 - Extinguishment and cooling requirements
 - Making safe
- **Building fire safety considerations**
 - Detection, suppression and air handling equipment performance
 - Fire propagation and spread between vehicles
 - Building effects and fire resistance
 - Stacker configurations and sprinkler performance



P4. FIRE PROPAGATION IN ENERGY STORAGE SYSTEMS

- **Impact protection requirements for stationary BESS**
 - What happens when systems sustain mechanical impact?
 - What are the requirements for impact protection and separation?
- **Fire development in BESS installations**
 - Difference between fires:
 - Originating in a cell
 - Due to failure of secondary systems
 - Due to fire impingement
 - Different configurations – residential, community hubs, data centres, commercial/grid scale
 - Scalability of tests
 - Effects of ambient conditions on detection systems and gas/vapour production/concentration
 - Ventilation / air handling requirements to minimise risk of vapour cloud explosions
 - Protection, separation, detection and suppression requirements



NEXT STEPS

- **Technical Working Group meetings in May to start project planning:**
 - TWG1 Meeting on 11th May
 - TWG2 Meeting on 12th May
 - TWG3 Meeting on 17th May
 - TWG4 Meeting on 18th May
- **SARET Program Steering Committee meeting on 2nd June**
- **Follow-up TWG Meetings mid-June**
- **Collaborative Research Agreements to be finalised by 30th June 2022**



THANK YOU

KIM THAI

KIM.THAI@FIRE.NSW.GOV.AU

RESEARCH@FIRE.NSW.GOV.AU

