The **PreLIBS** Project:

What can be Learned from EV Battery Safety

May 2019

Jonathan Buston

The Faraday Challenge

HSE

ISCF Faraday Battery Challenge

£246 million (2017-2021)
Advisory Group, Programme Board

Challenge Director

Research: **£78m** &

- 'Application-inspired' research programme coordinated at national scale
- Creation of the **Faraday Institution** – responsible for coordination of research and training programmes
- Four 'fast-start' projects announced 23rd Jan 2018 (£42m) – Battery Degradation, Multi-scale Modelling, Recycling, Solid State Batteries

Wave 2 call for proposals launched 10/01/19
Outline submissions received 28/02/19

THE FARADAY INSTITUTION

Innovate: **£88m** &

- Innovation programme to support business-led collaborative R&D with co-investment from industry
- Address technical challenges and build UK supply chain
- £38 committed in **Round 1** (2017) to Collaborative **R&D** and **Feasibility Study** projects– projects addressing range of areas from cell materials to pack integration and BMS to recycling
- £22 million **Round 2** to 12 CR&D and Feasibility Study projects announced in June 2018

Round 3 competition due to be announced.

Scale: **£80m**

- Scale up programme to allow companies of all sizes to rapidly move new battery technologies to market
- Develop manufacturing tools and methods for mass production
- Demonstrate production-rate reliability and quality
- **CWLEP & WMG** building open-access scale up facility: **UK Battery Industrialisation Centre**

Planning consent granted for 193,750 sq ft facility.

UK BATTERY INDUSTRIALISATION CENTRE

Faraday Challenge: Technical Gaps

HSE

Cost

NOW: $130/kWh (cell)
$280/kWh (pack)
2035: $50/kWh (cell)
$100/kWh (pack)

Energy Density

NOW: 700Wh/l,
250Wh/kg(cell)
2035: 1400Wh/l,
500Wh/kg(cell)

Power Density/ Fast Charging

NOW:
3 kW/kg (pack)
2035:
12 kW/kg (pack)

Safety

2035:
Eliminate thermal runaway at pack level to reduce pack complexity

1st Life

NOW: 8 years (pack)
2035: 15 years (pack)

Temperature

NOW: -20° to +60°C (cell)
2035: -40° to +80°C (cell)

Predictability

2035:
Full predictive models for performance and ageing of battery

Recyclability

NOW:
10-50% (pack)
2035:
95% (pack)

The PreLIBS Project: Project Aims

- Recognise that the current generations of lithium ion technology is likely to be used in EVs for the next 3-10 years.

- Understand these safety issues

Project Partners

JAGUAR
LAND ROVER

POTENZA

HEALTH & SAFETY LABORATORY

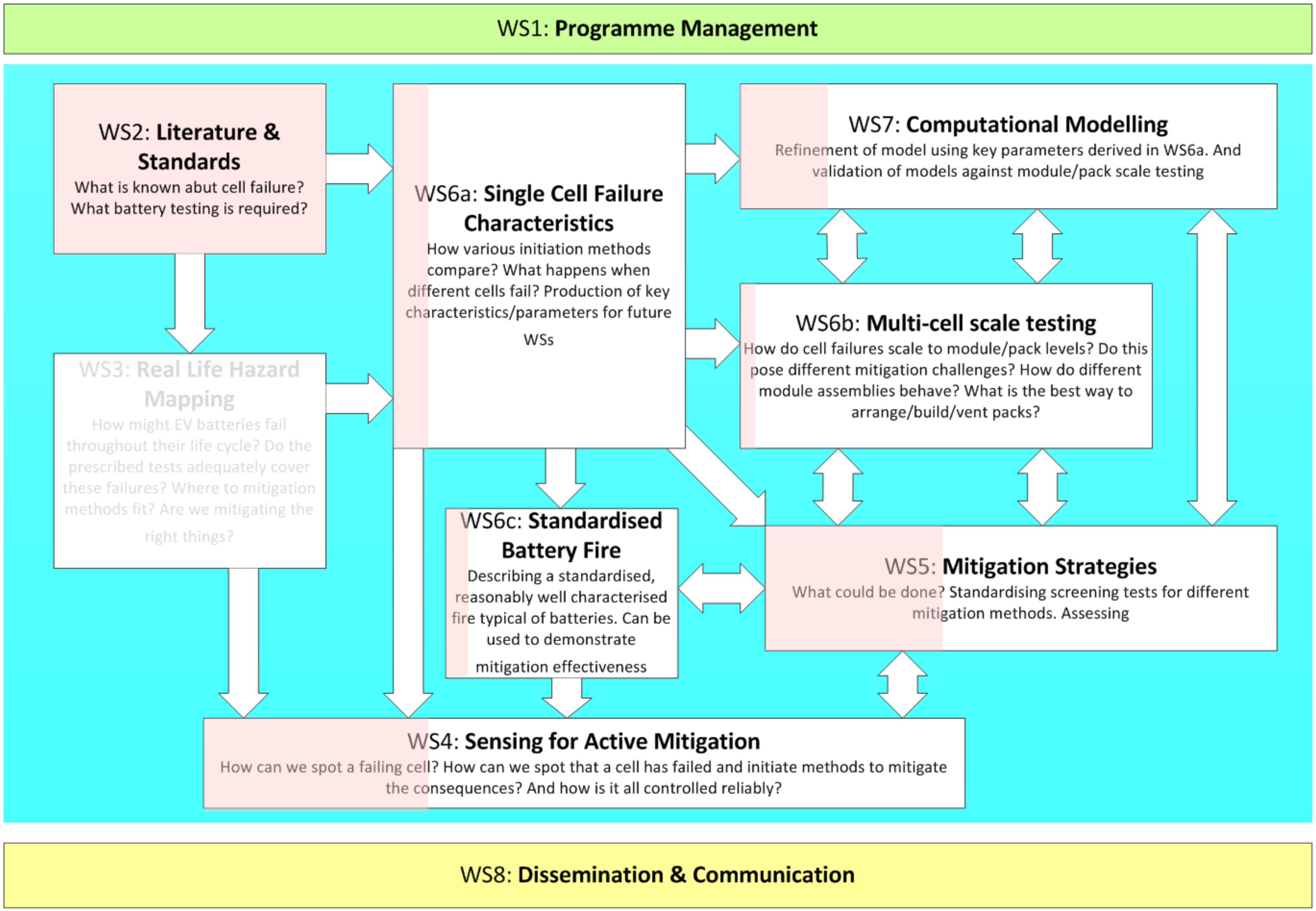
WMG
THE UNIVERSITY OF WARWICK
Warwick Manufacturing Group

lifeline
Fire & Safety Systems Ltd.

3M

Warwick FIRE
Warwick University

Project Outline



Project Aims

- Understanding the consequences of:
    - Thermal Runaway
    - Thermal Propagation
- Sensing the start of Thermal Runaway
- Hindering or Mitigating the effect of Thermal Propagation
    - Active mitigation
    - Passive mitigation
- Validated Computation Modelling

Project Aims

- One Example: the proposed thermal propagation test

Thermal Propagation Test

- New developments from the Chinese Standards

- Key Requirement:
    - Alarm of a ‘thermal event’ 5 minutes before the event impacts upon the passenger compartment

Thermal Propagation Test

- Reliable detection of an event
- ‘Managing’ the event for 5 minutes
- Developing a testing strategy to reliably put a pack into thermal propagation, according to the standard specifications

Cell Size

18650
Up to 3.5 Ah

21700
Up to 5 Ah

What does the event look like?

Some videos of EH1

What does the event look like?

Snapshot of Results- Gas Detection

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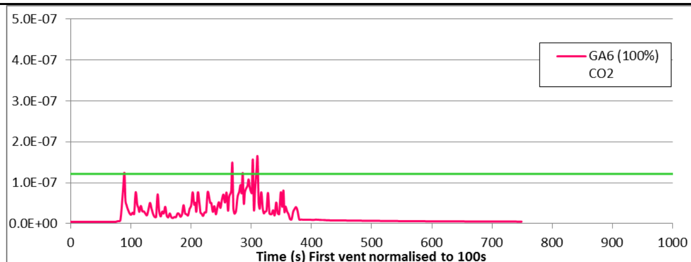
<tr><td>100%</td><td>
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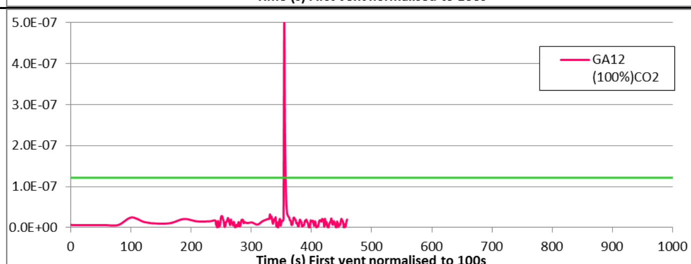
<tr><td>100%</td><td>
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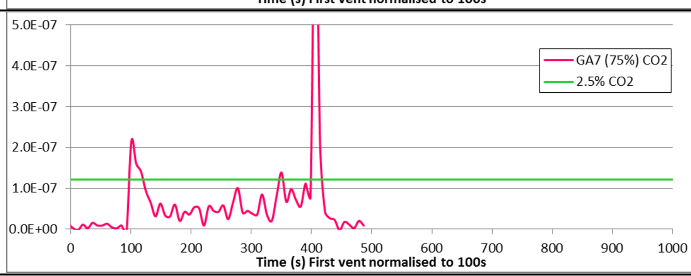
<tr><td>75%</td><td>
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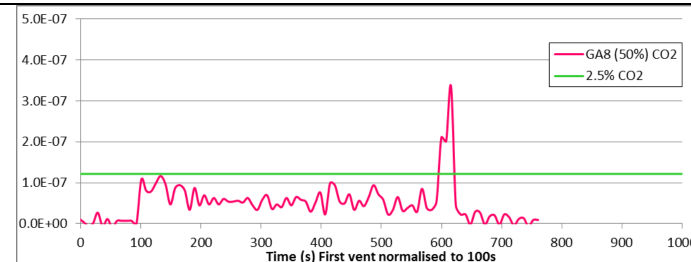
<tr><td>50%</td><td>
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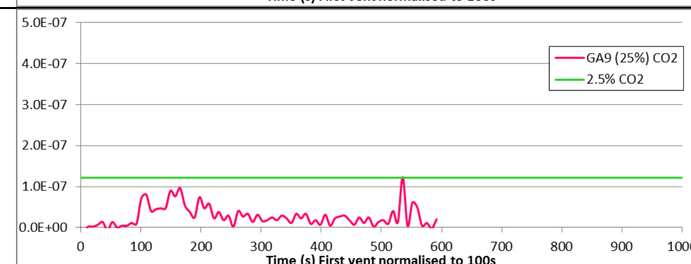
<tr><td>25%</td><td>
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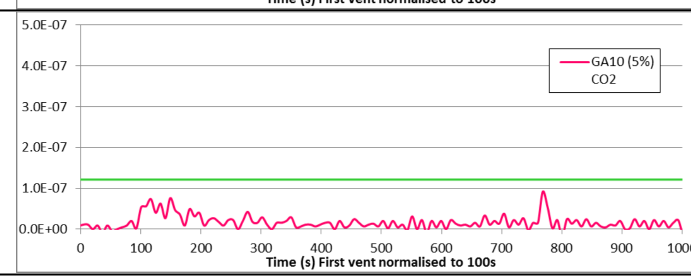
<tr><td>5%</td><td>
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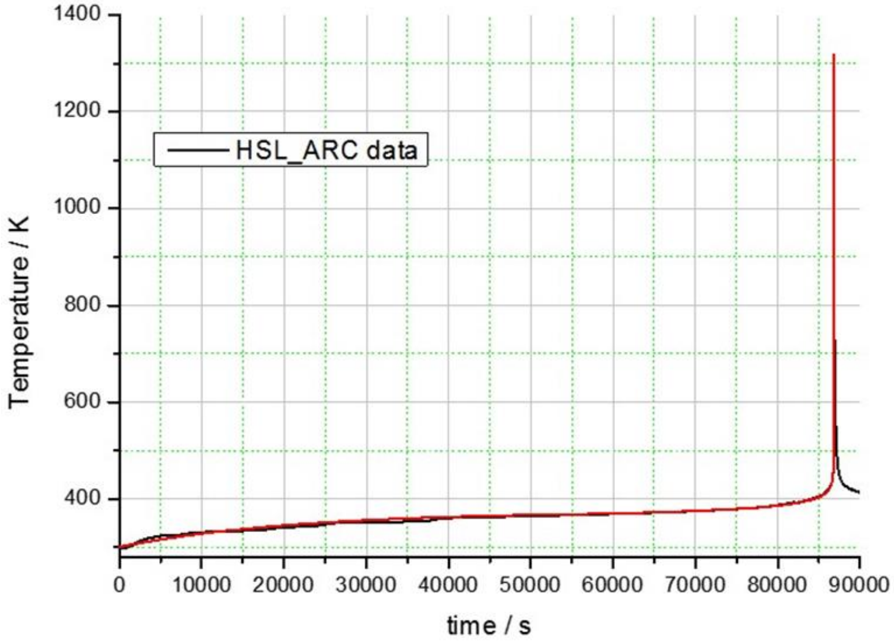
Snapshot of Results- Initiation methods

Video EH1 vs EH17

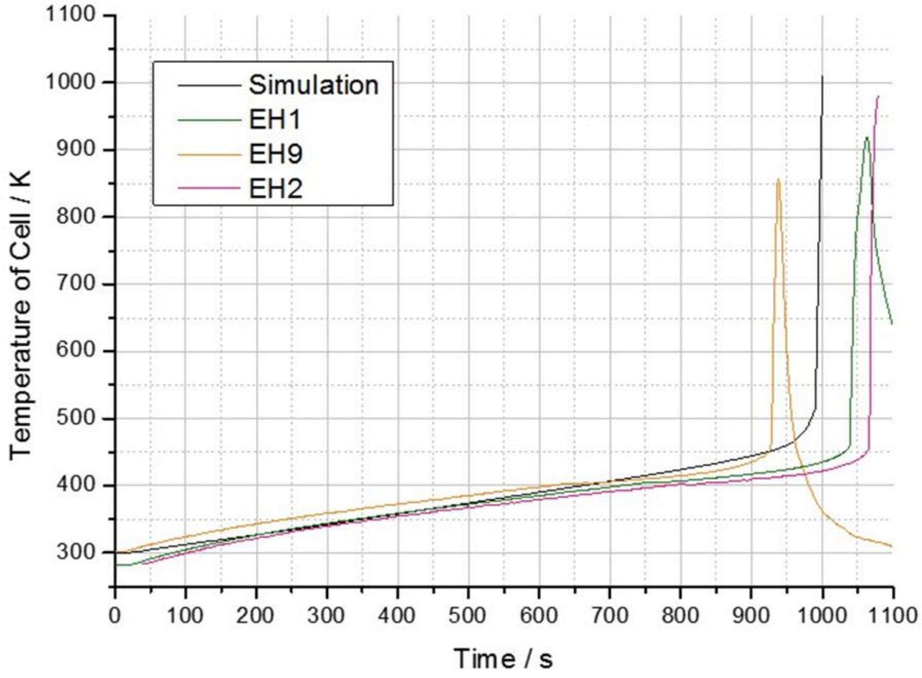
Snapshot of Results- Initiation methods

Video EH1 vs EH6

Snapshot of Results- Modelling



Modelling against
'ARC' data



Modelling against
open field data

Snapshot of Results- Active Mitigation

Video with water extinguisher

Snapshot of Results- PassiveMitigation

Box with flame

Thanks to

All project partners

HSE Staff

Jason Gill

Dan Howard

Rhi Williams

Caroline Adams

Keith Tremble

jonathan.buston@hse.gov.uk

+44 203 028 2037

HSL: HSE's Health and Safety Laboratory