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# **FIRE SPRINKLER INTERNATIONAL 2023 AMSTERDAM**

**LI-ION BATTERY FIRE TESTS WITHIN SUVEREN**

# AGENDA

01

Lithium-Ion Battery Fires

02

SUVEREN Research Project

03

Solutions for Car Parks and  
Energy Storage Systems

04

Outlook

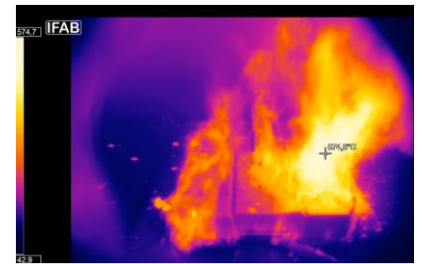
05

Q&A

# LITHIUM-ION BATTERY FIRES

## Background

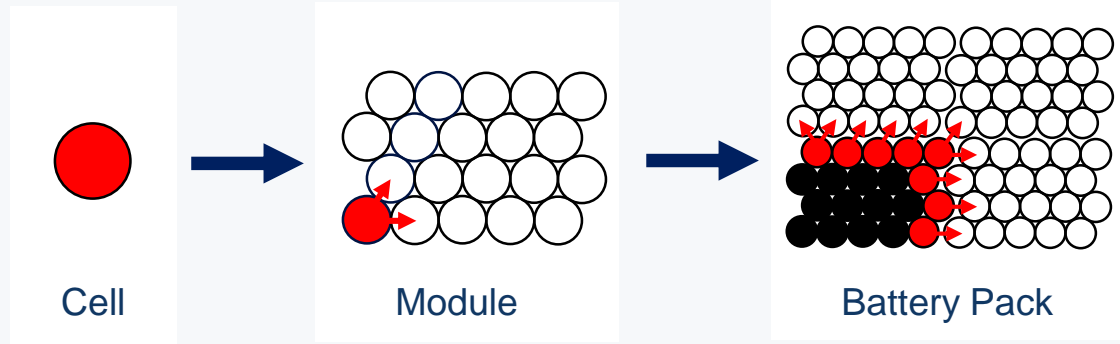
- Thermal runaway starts at approx. 80 - 100 °C
- Thermal runaway is an exothermal reaction resulting in propagation of thermal runaway and a rapid spread of fire
- Cells burst and emit toxic, flammable and explosive venting gases
- Temperatures over 1000°C
- Self-ignition is possible



Source: feuertrutz & suveren

# LITHIUM-ION BATTERY FIRES

## Thermal Runaway



● Thermal Runaway: reaction on cell level

● Burnt cell

➔ Thermal Runaway propagation



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# RESEARCH PROJECT

# SUVEREN<sup>2</sup>use

Safety of urban underground structures due to the use of New Energy Carriers



## Partners



[www.suveren-nec.info](http://www.suveren-nec.info)

Supported by:



Federal Ministry  
of Education  
and Research

on the basis of a decision  
by the German Bundestag

## Fire Test Laboratories



## Associated Partners and Scientific Advisory Board



Lithium-Ion Battery Fire Tests within SUVEREN



# PROJECT **SUVEREN**

Safety of urban underground structures due to the use of New Energy Carriers

- Identification of risks related to the use of new energy carriers
- Fire testing with different Lithium-Ion batteries
- Evaluation of different detection methods and firefighting agents
  - High-pressure and low-pressure water mist
  - Sprinkler
  - Foam
  - F500
  - N<sub>2</sub>
  - CO<sub>2</sub>
  - NOVEC
  - Aerosol

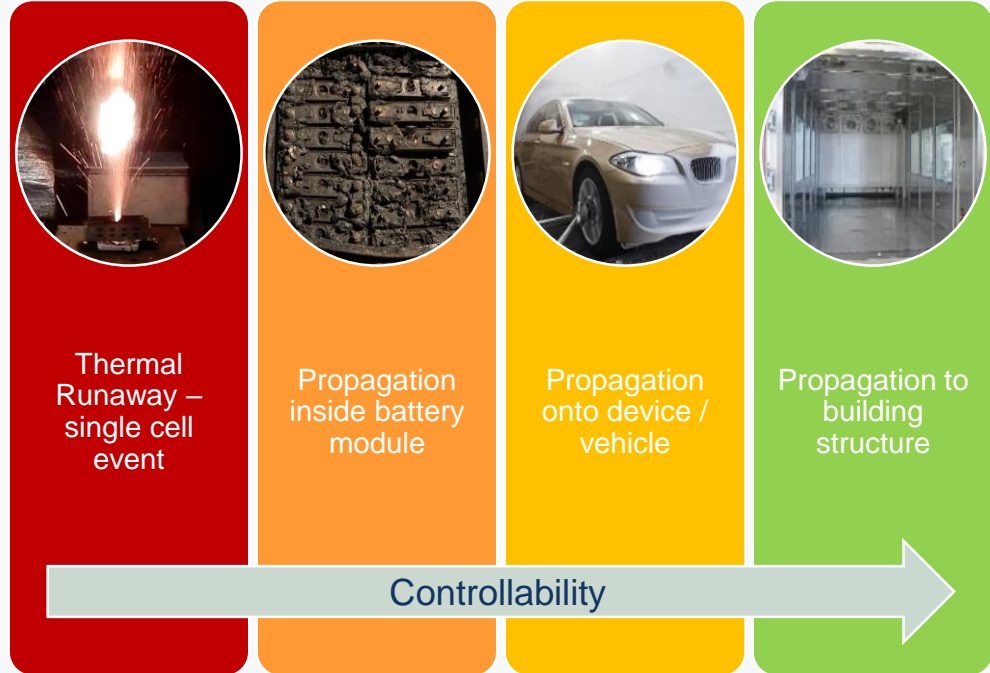


Fire test with lithium-batteries in SUVEREN test chamber

# LITHIUM ION BATTERY FIRE PROTECTION

## Protection objectives

- Thermal Runaway is taking place on a cell level
- Usually lasts less than 1 minute
- Thermal Runaway inside a cell cannot realistically be extinguished
- Objectives in order of importance
  1. Prevention of secondary fires
  2. Prevention of device or vehicle fire
  3. Slowing down / interrupting thermal runaway propagation within the battery

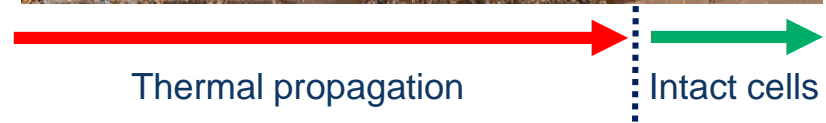




# LITHIUM ION BATTERY FIRE PROTECTION

## Controlling the Thermal Runaway propagation

- Cooling of the battery pack is the only way to retard Thermal Runaway propagation
- Water is the best cooling agent
- 50% of all energy from a battery fire is caused by the combustion of electrolyte gases
- Reduction of heat slows down the Thermal Runaway propagation and prevents secondary fires

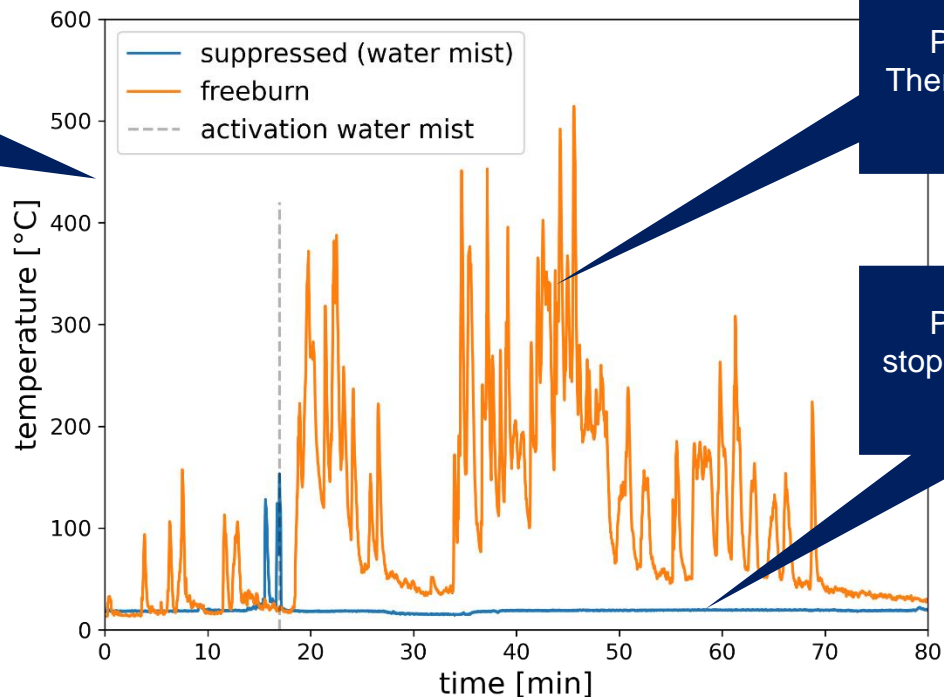


# FIRE TEST RESULTS



Water mist performance versus free burn

Prismatic cells  
with 22,5 kWh

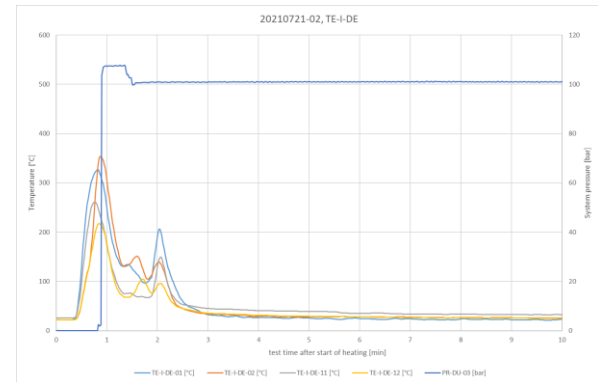


Peaks show  
Thermal Runaway  
of cells

Propagation  
stopped with water  
mist

# FIRE TESTS FOR BATTERY TEST BENCHES

- Specific fire tests for test benches
- Fire scenarios developed based on SUVEREN research project
- Real Li-Ion batteries with up to 120 kWh capacity
- Results independently certified by IFAB and TÜV



Temperature development during fire test

# FIRE TESTS FOR BATTERY TEST BENCHES



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FIRE PROTECTION

*Green Protection for New Energies*

Research Project

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04

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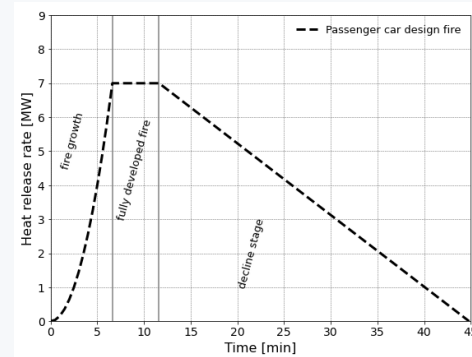
Q&A



# SUVEREN GUIDELINE FOR CAR PARKS

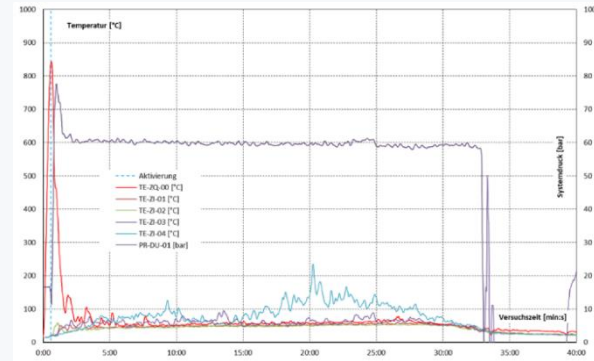


- Guideline based on SUVEREN research project
- Description of fire behavior of modern passenger cars
- Definition of Li-Ion battery vehicle fire with 7 MW HRR
- Fire prevention and suppression measures
- Performance-based design (full scale fire test validation)
- Fire protection concepts for parking and charging areas



# FIRE TEST FOR PARKING AND CHARGING AREAS OF E-VEHICLES

- Fire tests for areas with electric vehicles and with ceiling mounted nozzles
- Fire scenarios developed based on SUVEREN research project
- New Li-Ion battery vehicle fire with 7 MW HRR
- Results independently certified by IFAB and TÜV



Temperature development during fire test

# COMPARISON FIRE TESTS FOR AREAS WITH E-VEHICLES

The central image shows a large number of fire test equipment components, likely fire detectors or sensors, arranged in rows. The FOGTEC logo is prominently displayed in the center, with the tagline "Green Protection for New Energies" below it. The background is a light, slightly blurred image of the same equipment.

**FOGTEC<sup>®</sup>**  
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*Lithium-Ion Battery Fire Tests within SUVEREN*



# PROTECTION CONCEPT

## Parking and Charging Areas

- Automatic fire suppression with automatic nozzles in parking areas
- Early fire detection in combination with open nozzles in charging areas
- Protection of adjacent vehicles and the building structure
- Reduction of smoke gases
- Support of the rescue forces
- Less collection of contaminated water



# WHITE PAPER FOR ENERGY STORAGE SYSTEMS

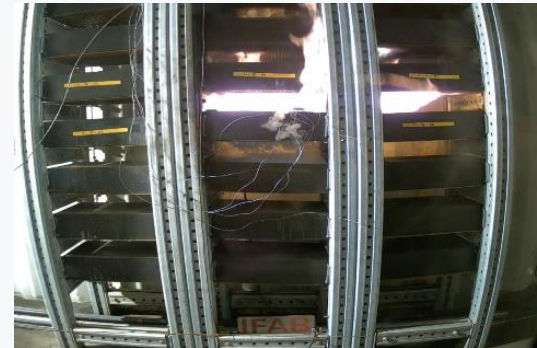


- White Paper based on SUVEREN research project
- Description of fire risk
- Fire test results of different firefighting agents
- Fire prevention and suppression measures
- Performance-based design (full scale fire test validation)
- Fire protection concepts and recommendations for ESS



# FIRE TESTS FOR ENERGY STORAGE SYSTEMS

- Specific fire tests for energy storage containers
- Tests conducted in a 20' container
- Fire scenarios developed based on SUVEREN research project
- Real Li-Ion battery modules with each 2,3 kWh capacity
- Results independently certified by IFAB and TÜV



# FIRE TESTS FOR ENERGY STORAGE SYSTEMS

## Fire Protection for Stationary Energy Storage Systems (ESS)

Comparison between different Fire Suppression Agents  
High Pressure Water Mist vs Nitrogen vs Aerosol

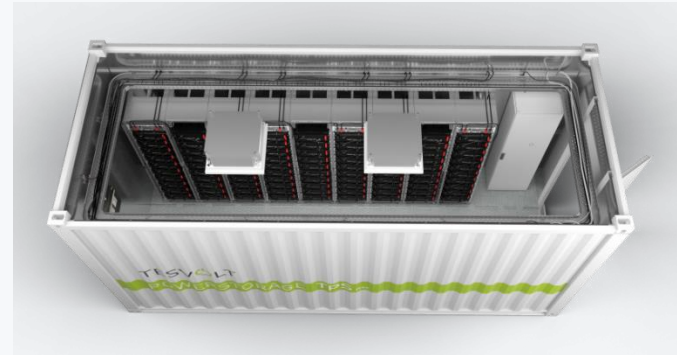


*The Smarter Way Of Fire Fighting*

# FOGTEC PROTECTION CONCEPT

## Energy Storage Containers

- Early fire detection in combination with open nozzles
- Protection of the energy storage infrastructure
- Limiting fire spread to adjacent batteries modules in the container
- Reduction of venting gases



Source: Tesvolt

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# RESEARCH PROJECT




Fire fighting systems and emergency concepts for the safe handling of battery fires over the entire product life cycle

## Industrial Partners



<https://suveren2use.de>

Supported by:



Federal Ministry  
for Economic Affairs  
and Climate Action

on the basis of a decision  
by the German Bundestag

## Scientific Partners



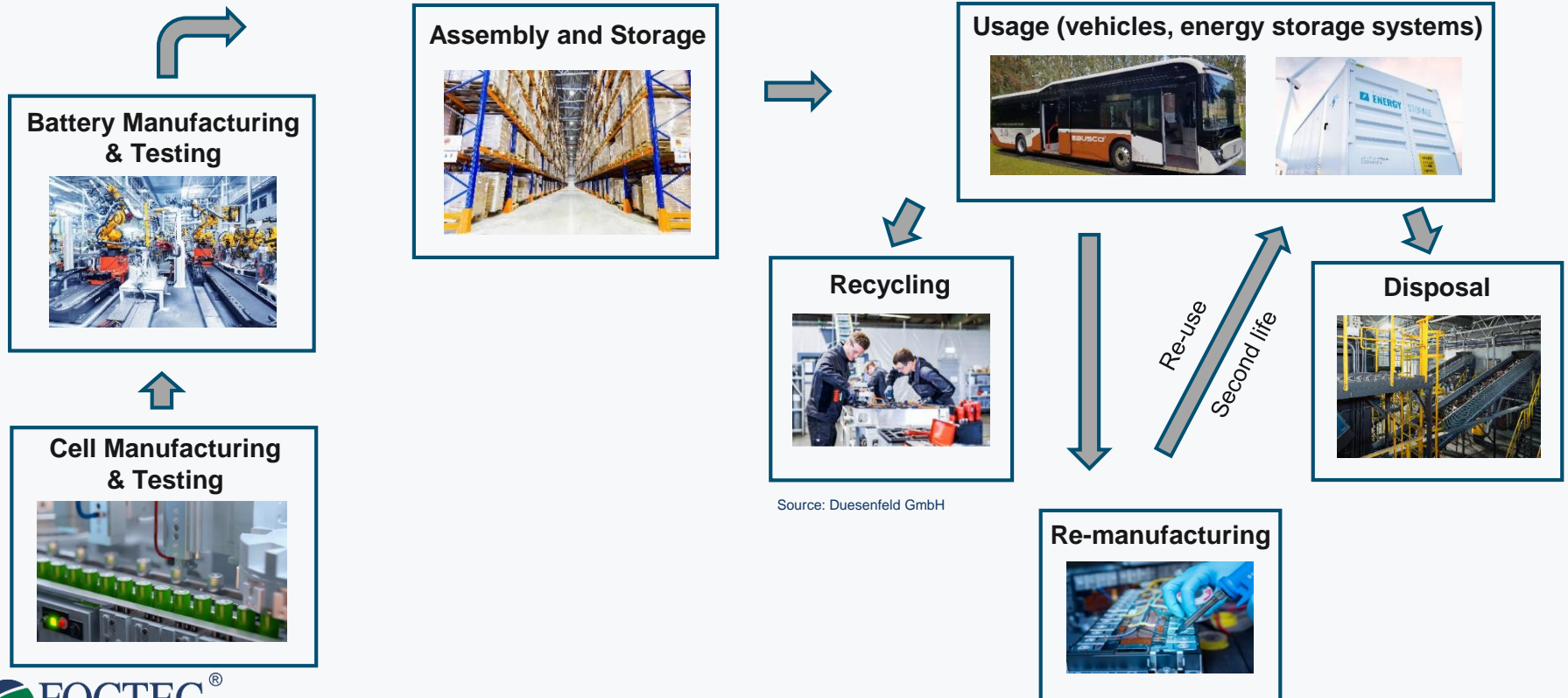
## Associated Partners and Scientific Advisory Board

### Fire Test Laboratory





# LITHIUM-ION BATTERY VALUE CHAIN



Source: Duesenfeld GmbH

# PROJECT RELEVANCE



## Increasing Production and Usage of Lithium-Ion Batteries

- Regulatory and normative gaps
- Safety-critical incidents
- Growing waste stream

## Need for

- Safety (particularly fire safety)
- Recyclability
- Safe handling of waste materials

## Development of

- Fire detection and firefighting systems for the entire value chain
- Concepts for dealing with fire residues from fire incidents

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THANK YOU FOR  
YOUR ATTENTION



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ANY QUESTION?