Fraunhofer EMI

Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI

Safe operation of home storage systems

Fast Facts

Duration 01/2023 – 12/2024

Funding Programm: Battery research for a competitive and climate-neutral battery ecosystem

Funding Institution: Ministry of Economic, Labor and Tourism Baden-Württemberg

Consortium:

- Hochschule Furtwangen, Professur Sicherheit und Gefahrenabwehr, Furtwangen
- Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, Freiburg

Assoziierte Partner:

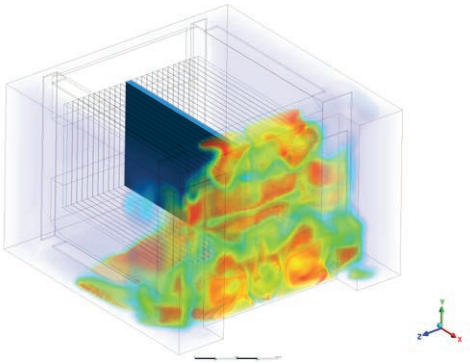
- RCT Power GmbH, Konstanz
- Lion Labs GmbH, Empfingen

Motivation

Photovoltaic systems combined with stationary battery storage are an integral part of the energy transition. In addition to economic and ecological aspects, safety considerations are also relevant when acquiring a battery storage system as home storage in single-family or multi-family houses. In extreme cases, a defective home storage system can lead to a full-blown fire in a residential building. The lithium-ion cells built into it can undergo thermal runaway due to external influences (water, heat, mechanical deformation) or internal influences (defects in the cell, failure of the battery management system). This means that hot, flammable gases and large amounts of heat are released. Since oxygen can also be generated during thermal runaway depending on the cell chemistry, the fire cannot be effectively extinguished by cutting off air. Cooling the battery cells with extinguishing agents represents an effective countermeasure. If the propagation of thermal runaway cannot be effectively prevented, the entire battery system can be completely destroyed. There is a risk that the fire will spread from the home storage system to the building in which it is located. Unlike for oil tanks, there are currently no special fire protection requirements for home storage systems in residential buildings.

Objectives and Approach

The goal of the project is to investigate efficient protective concepts against thermal runaway based on current home storage systems. The associated fire protection measures are to be integrated into the housing of the home storage system. This is intended to strengthen acceptance among operators and insurers. The Fraunhofer EMI and Furtwangen University of Applied Sciences are investigating the thermal runaway of battery modules and corresponding fire protection measures within the housing of home storage systems. Detailed simulation models will be developed to model gas formation and heat release in the battery module, as well as gas outflow and combustion. The basis for this are highly instrumented tests at the battery testing laboratory of Fraunhofer EMI in Efringen-Kirchen. Various fire protection measures against thermal runaway will be examined using the simulation models. Finally, Furtwangen University of Applied Sciences will conduct a fire protection evaluation of the protective concepts.



Simulation of gas combustion in a home storage module during thermal runaway.
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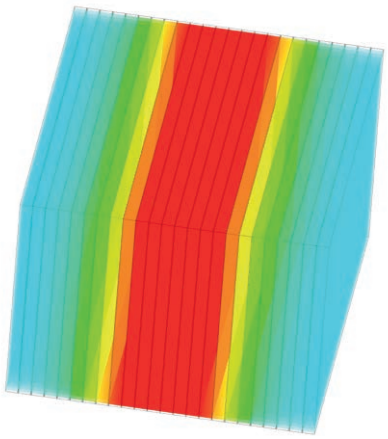
Innovations and Perspectives

It is expected that additional internal fire protection measures will increase the safety level of home storage systems. These research results will serve as a basis for the industry to further develop their products. In addition to the industry partner RCT Power GmbH, other manufacturers will also benefit from the achieved results through the intended publications. It is conceivable that the research findings will be incorporated into proposals for fire protection standards. Fire departments can adapt their operational tactics to the specific requirements of fires involving home storage systems based on the research findings. Furthermore, homeowners and insurers are to be informed and made aware of these issues.



Simulation of heat conduction between several battery cells during thermal runaway.
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Contact

Dr.-Ing. Simon Holz
Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI, Freiburg
Tel. +49 761 2714-311
simon.holz@emi.fraunhofer.de