FOR A SAFER ENVIRONMENT OF ELECTRIC AND HYBRID VEHICLES

dafo

vehicle fire protection

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Dafo Vehicle

is introducing a safer environment for electric and hybrid vehicles

There is a global transition to renewable fuels and by that an increasing demand for electric and hybrid vehicles (EV and HEV). As more electric vehicles become operational, their involvement in fire incidents is likely to rise.

The significant fire risks associated with vehicles being powered by batteries and high-power electric engines/devices are not widely understood. For example, the consequence from a malfunctioning Li-ion battery can be very serious, potentially resulting in a thermal runaway situation with rapid fire and heat propagation as well as emission of toxic gasses, posing a great threat to vehicle drivers, occupants as well as the environment in which the vehicle is operating.

From a regulatory standpoint, fire risks in electric and hybrid vehicles are currently being treated as similar to those in traditional combustion engine vehicles. For example, this stance is taken by GRAMKO, the health and safety committee of the Swedish industry organization for mines, mineral and metal producers, stating that fire standards need to be kept/further enhanced when transforming from diesel engines to electrical powertrains.

You could argue that fire risks are actually increasing when introducing electrical vehicles. As an example, a significant part of the fire risks in a traditional combustion engine vehicle is related to the electrical system of the vehicle. These types of risks are further accentuated in an electric vehicle, having more electrical components, more wiring as well as higher power running through the electrical system. In addition, the Li-ion battery adds a whole new risk element to an electric vehicle.

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Through multiple international collaborative research projects in which studies were made of fire risks associated with lithium-ion batteries in vehicles, Dafo Vehicle Fire Protection has developed the Li-IonFire™ fire protection system that addresses and mitigates these risks effectively and safely.

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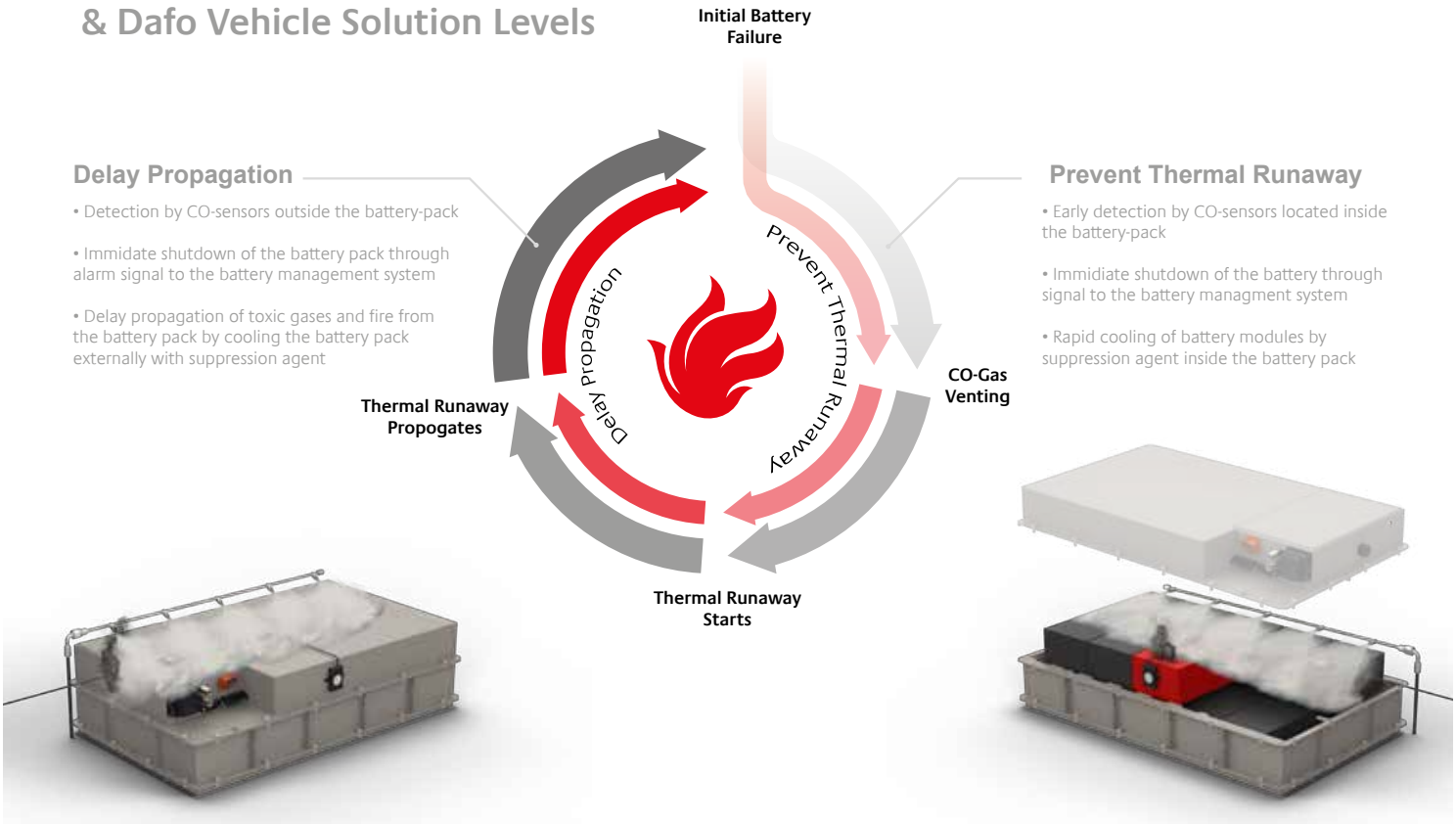
Differences in risks and additional risks between diesel-powered vehicles and EV and HEV

The difference between diesel-powered vehicles and EV and HEV from a fire risk perspective is related to the location as well as the character of the potential fire sources. In vehicles with combustion engines, the location of most fire sources is concentrated in the area of the engine compartment. In EV and HEV vehicles potential fire sources are often located in different sections of the vehicle. It means that more protection zones will have to be taken into account. Furthermore, a combination of different extinguishing methods will have to be used due to the different types of fires that might occur, as well as the sensitivity of electrical components.

Challenging risks related to Li-ion batteries

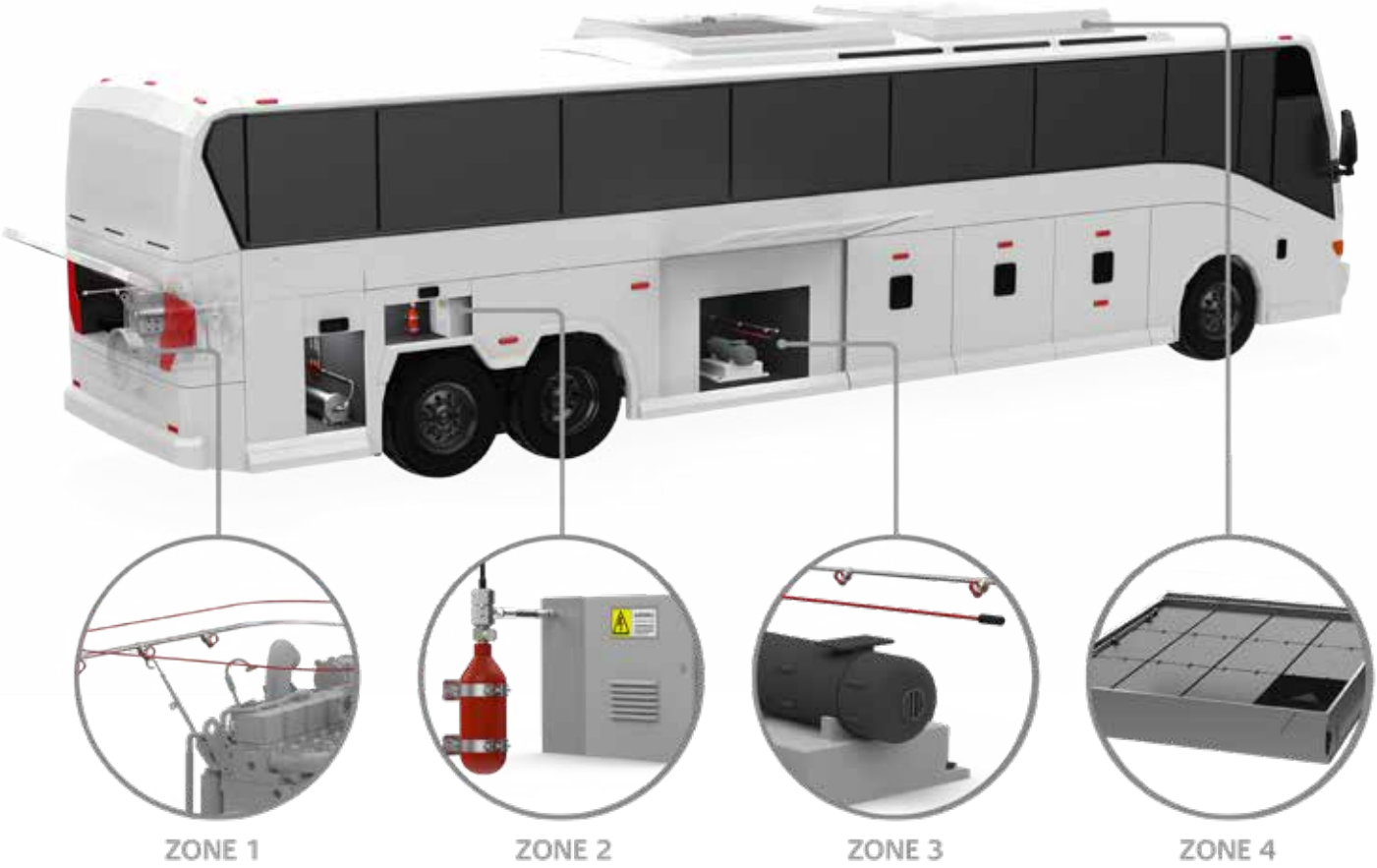
When Li-ion batteries fail through short circuiting, overcharging, high temperatures, mechanical damage and overheating, this might cause thermal runaway. Thermal runaway occurs when a battery cell has reached the temperature at which the temperature will continue to increase on its own and the electrolyte catches fire. Through this it becomes self-sustaining as it creates oxygen which feeds the fire. As the heat source and the fuel are both existing within the battery these fires can develop quickly. The release of flammable electrolyte makes fire extinguishing very difficult and in addition there are a lot of toxic gases being emitted such as hydrogen fluoride, which can cause serious damage to both the skin and the respiratory tract.

Stages of Li-Ion Battery Failure
& Dafo Vehicle Solution Levels



Dafo Vehicle has developed a full coverage multi-zone fire protection solution in response to the urgent need for risk mitigation in EV and HEV vehicles. The suppression agent Forrex EV™ is used as one part of the complex system solution and it provides effective cooling capacity to slow the fire development for allowing safe evacuation of passengers. In order to cover all risk areas in the EV or HEV vehicle, the main risk scenarios are typically divided into four protection zones.

The different protection zones are then protected in various ways by robust detection and suppression systems – both liquid based and gas-based solutions.



Zone 1
Engine compartment

Protection applied for combustion engine (HEVs) and compartment with electrical components (EVs) based on Dafo Vehicle's well proven liquid based fire suppression system.

• Liquid based FORREX agent.

• Robust detection/ suppression technology.

• Prevents re-ignition.

Zone 2
Electrical hazards

Electric systems are a common failure source on conventional vehicles that now increases in risk with the addition of high voltage, high power traction systems.

• Detection using heat or smoke detection or combination of both.

• Clean extinguishment without any residuals through our PFK system with agent gas FK-51-2-12.

Zone 3
Traditional hazards

Many of the traditional hazards still exists and has to be taken into account. Heaters, AC units and hydraulic systems all present a potential fire hazard.

• General system feature.

• Liquid based FORREX agent.

• Robust detection suppression.

Zone 4
Batteries

Dafo Vehicle's liquid based fire suppression system is used to protect battery pack from external fires as well as to provide maximum cooling in case of a thermal runaway battery fire in order to create sufficient time for evacuation of passengers.

• High sensitive gas detection for early warning.

• Robust Dafo Vehicle linear detection.

• Double amount of liquid compared to normal combustion engine application is used.

Early warning detection

As a solution to specific risks related to batteries Dafo Vehicle has developed an early warning detection system solution. The system will detect potential battery failure, at the earliest possible stage and take immediate action by cooling, using the suppression agent Forrex EV™. This will effectively stop, or delay, a potentially hazardous situation without the fire developing further.

Depending on the protection level that needs to be achieved the early warning detection system solution can either be applied outside the battery packs or as an integrated part of the packs. The solution can also be limited to detection only without the suppression application.

Battery pack

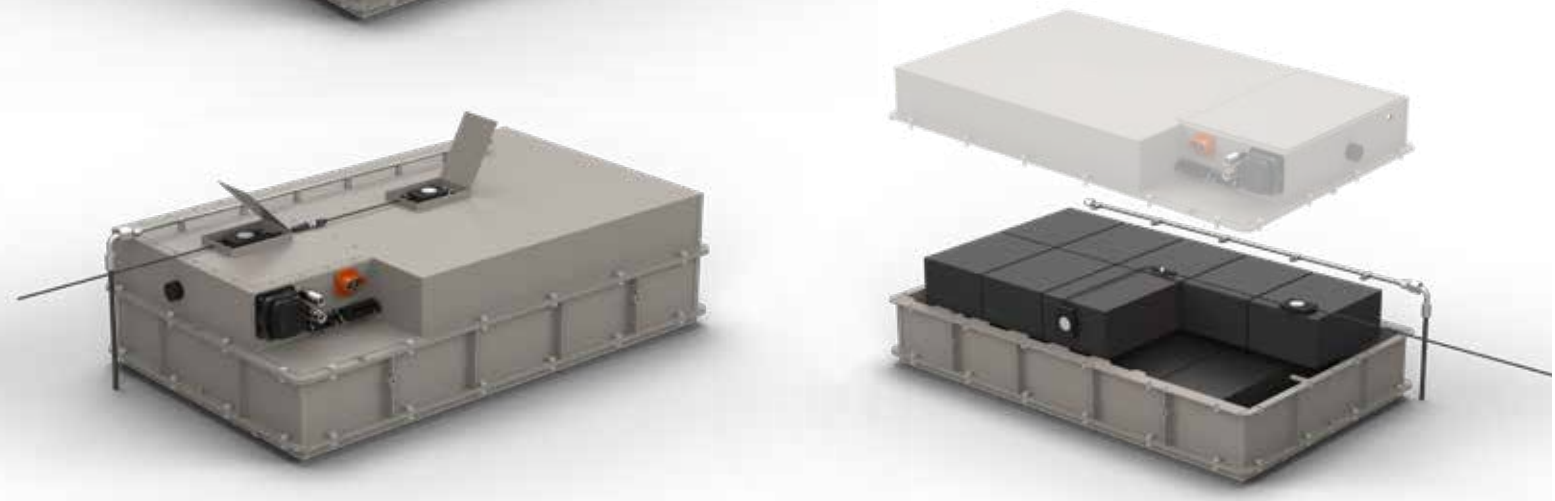
High-sensivity CO sensor

Distributed detection and suppression thanks to full bi-directional CANbus communication. The extinguishing agent is only deployed at the detected risk area.

Possibility to set multiple alarm and suppression criterias.

Easy to customize to the customer-specific needs and type of vehicle.

CO sensor application together with cooling agent distribution system



Examples of integrated applications

State-of-the-art graphical user interface.

Touch Screen

Informative

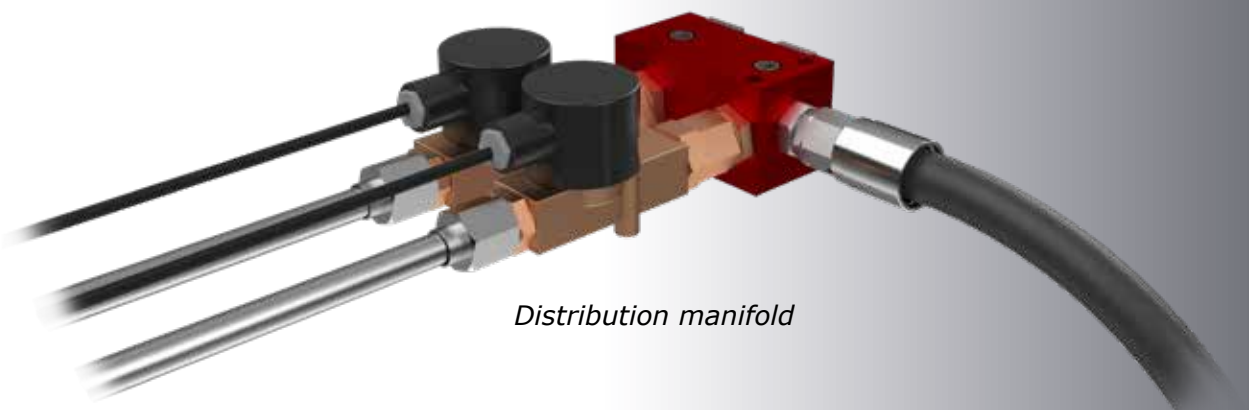
Alerting

Optional Features

Internal Data logger

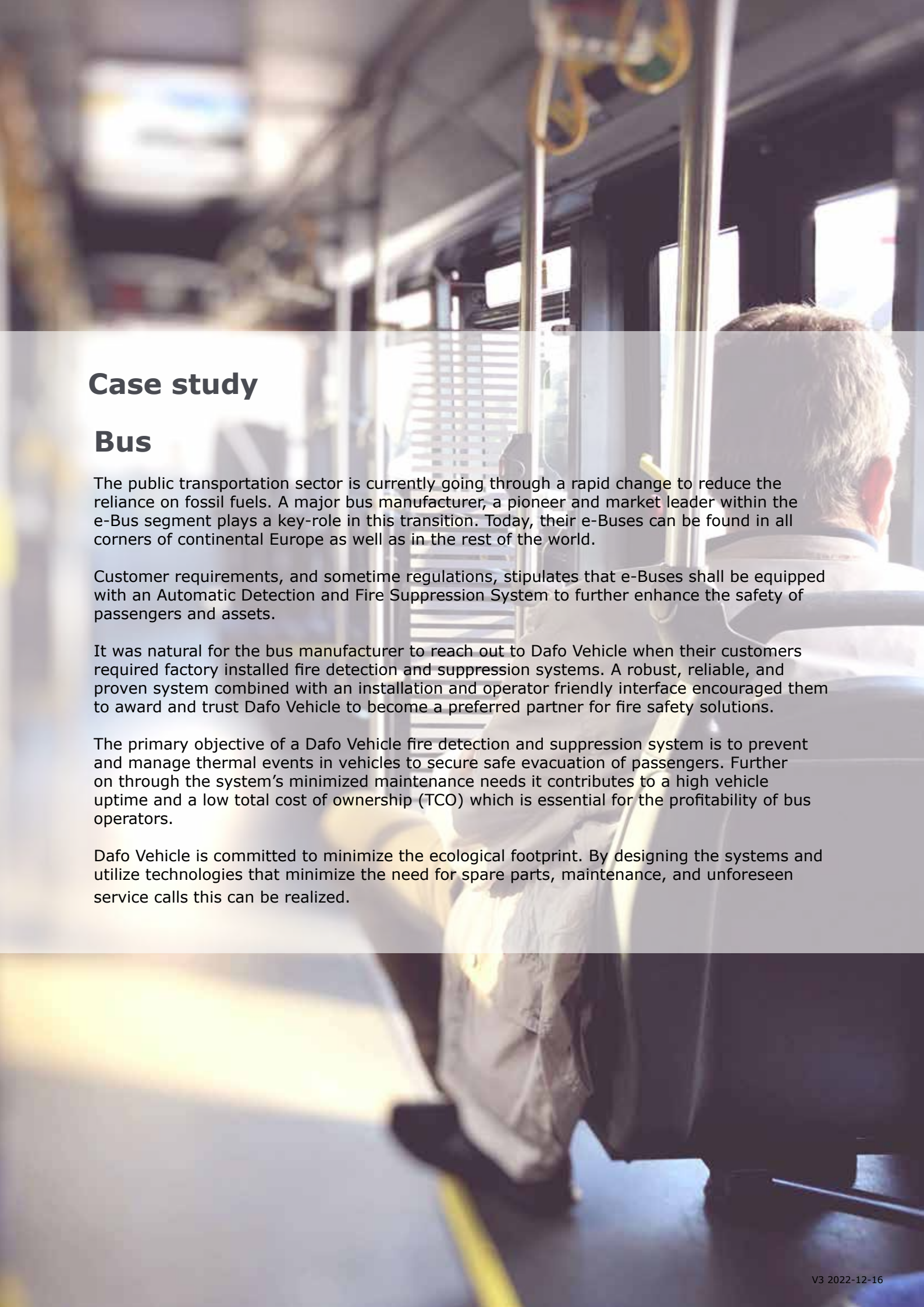
The battery pack should be cut-off upon detection and discharge of the system.

Other extinguishing agents such as powder, gas and aerosols are unsuitable due to the lack of cooling effect. Furthermore, non-aqueous agents like powder could in some cases make a fire scenario worse by encapsulating the hazard and shielding it from further firefighting actions.



Distribution manifold

Li-IonFire™ will dramatically boost the safety of drivers and passengers by allowing safe evacuation as well as boosting the protection of valuable assets.



Case study

Bus

The public transportation sector is currently going through a rapid change to reduce the reliance on fossil fuels. A major bus manufacturer, a pioneer and market leader within the e-Bus segment plays a key-role in this transition. Today, their e-Buses can be found in all corners of continental Europe as well as in the rest of the world.

Customer requirements, and sometime regulations, stipulates that e-Buses shall be equipped with an Automatic Detection and Fire Suppression System to further enhance the safety of passengers and assets.

It was natural for the bus manufacturer to reach out to Dafo Vehicle when their customers required factory installed fire detection and suppression systems. A robust, reliable, and proven system combined with an installation and operator friendly interface encouraged them to award and trust Dafo Vehicle to become a preferred partner for fire safety solutions.

The primary objective of a Dafo Vehicle fire detection and suppression system is to prevent and manage thermal events in vehicles to secure safe evacuation of passengers. Further on through the system’s minimized maintenance needs it contributes to a high vehicle uptime and a low total cost of ownership (TCO) which is essential for the profitability of bus operators.

Dafo Vehicle is committed to minimize the ecological footprint. By designing the systems and utilize technologies that minimize the need for spare parts, maintenance, and unforeseen service calls this can be realized.

Safe with Dafo Vehicle

Active fire protection is an integral part of systematic and effective fire prevention. Together with Dafo Vehicle Fire, you'll always get the most effective solution so that you can limit fire damage, reduce downtime and increase productivity.

Since the start back in 1919, Dafo Vehicle has developed into a modern, high-tech company committed to offer the very best solutions to our customers.

Dafo Vehicle has three main business areas:

Integration (Fire suppression systems integration into OEM production line, Retrofit (Fire suppression systems installed at final customer) as well as Service & Maintenance.

The Dafo Vehicle group today consist of several subsidiaries and Dafo dealers – Dafo Vehicle Fire Protection Finland OY, Dafo US, Dafo Vehicle Estonia, Dafo Deutschland, Dafo France, Dafo Russia, Dafo Asia, Dafo Spain, Dafo Australia, Dafo UK & Ireland, Dafo Brasil, Dafo Middle East & Dafo Chile.

Do not compromise safety – contact Dafo Vehicle Fire Protection already now!

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