

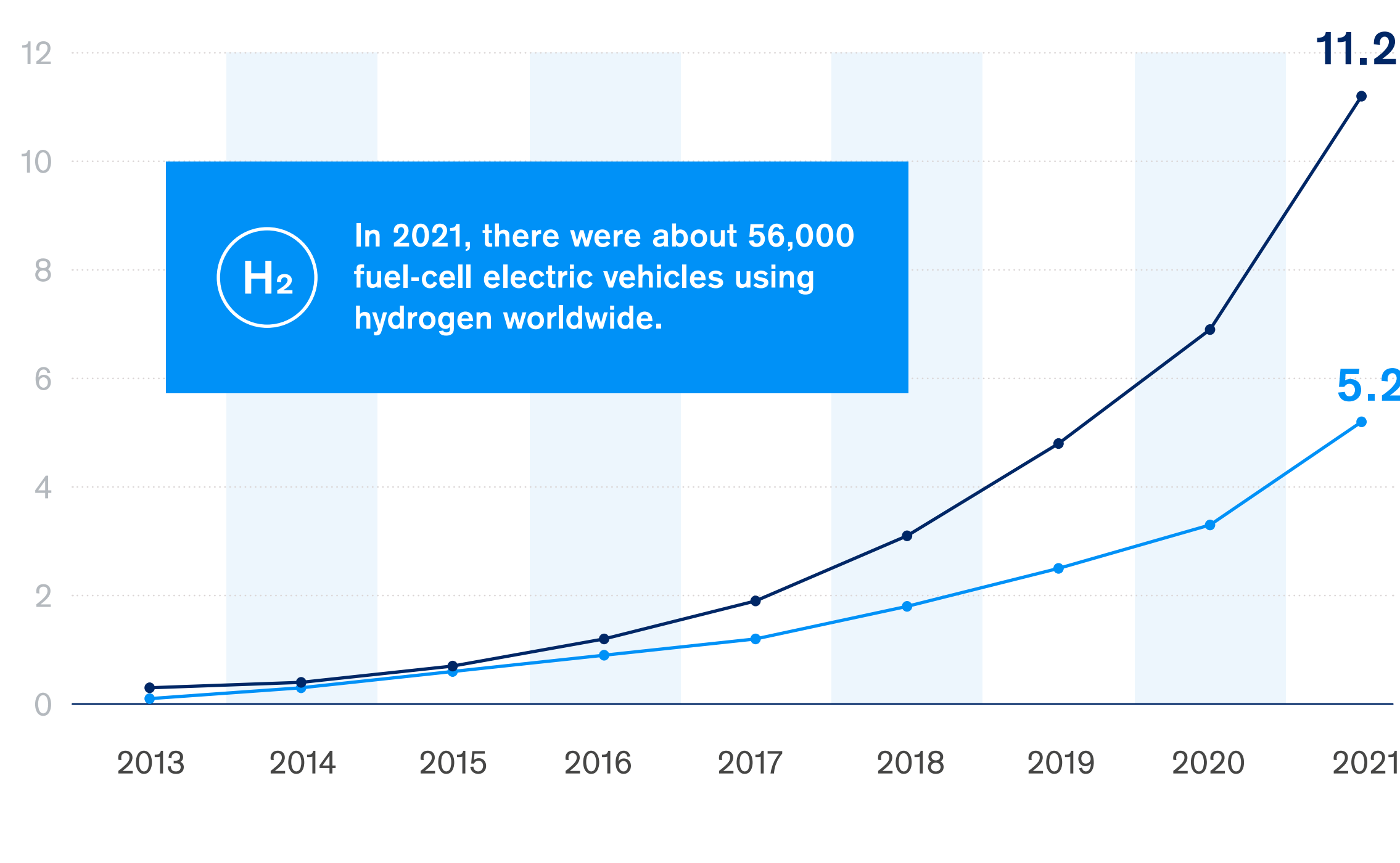
First Responder Safety:

Gas detection considerations for incidents involving vehicles with alternative drive systems

Major growth in alternative drives

Since 2013, battery-electric and plug-in hybrid electric vehicles have experienced a strong growth, especially in China, Europe and the United States.

Global electric car stock in millions



H₂ In 2021, there were about 56,000 fuel-cell electric vehicles using hydrogen worldwide.

New challenges for first responders

In the event of an incident, alternatively powered vehicles can exhibit a wide range of behaviours. Irrespective of the powertrain, one of the main challenges is the potential release of flammable or toxic gases, vapours and liquids. This can happen if the integrity of the tank is compromised and fuel or gas leaks, or if a battery electric vehicle experiences a thermal runaway.

This can result in:

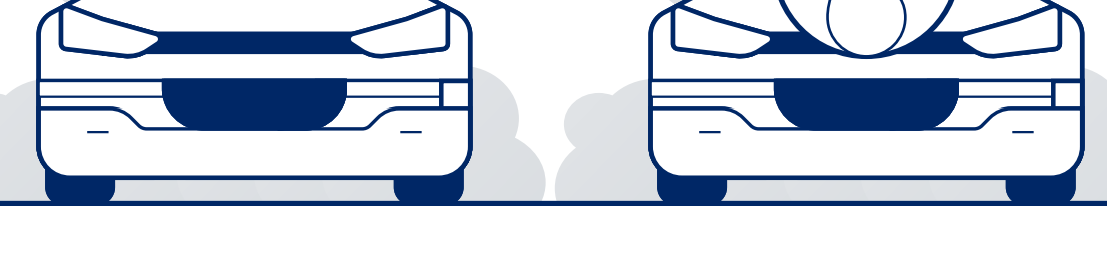
- Exposure to toxic substances for personnel or casualties without PPE
- Risk of jet flames and deflagration
- Increased risk of explosion where gases and vapours can accumulate in poorly ventilated areas (e.g. tunnels, garages)



Thermal runaway

Battery-cell thermal runaway refers to the overheating of the cell due to a self-reinforcing heat-generation process. This process can be triggered by a cell failure. This includes mechanical damage, penetration, overcharge, short circuit and internal defects. Thermal runaway often results in fire or explosion. During incidents, clouds of toxic and flammable gases and vapours are released from the cells. These flammable vapour clouds can be sometimes mistaken for smoke or steam. In order to keep first responders safe the risk of deflagration or explosion needs to be detected.

In an incident involving an alternative drive vehicle there are **2 possible scenarios**:



Scenario 1 - without flames

In the event of an incident involving an alternatively powered vehicle, the release of toxic and flammable emissions must be considered to ensure the safety of first responders.

The following table gives an overview of the properties, hazards and detection strategies for alternative drivetrains.

- Flammable gas or vapours
- Toxic
- Lighter than air
- Heavier than air
- Lighter or heavier than air

| Drivetrain | BEV/PHEV | H ₂ | CNG | LPG |
|-----------------------------------|---|---|---------------------------|---|
| Symbol according to ISO 17840-4 | | | | |
| Properties of leaks or off-gasing | Visible white vapour and dark smoke, aromatic odour Loud hissing and popping sounds indicate a thermal runaway | Non-odourised, colourless | Odourised, colourless | Liquid evaporates faster than petrol, odourised |
| Hazards | | | | |
| Released substances | Mixture of various substances, e.g. Hydrogen, Methane, various heavier hydrocarbons, CO, NO ₂ , SO ₂ , HCL, HCN, HF, and various VOCs | Hydrogen | Methane | Butane and Propane |
| Special considerations | Flammable and toxic vapour cloud may be mistaken for steam | Hydrogen flames may be invisible to the eye H ₂ is not detectable by IR-Ex sensors | | |
| Simple detection strategy* | Multigas detector with Cat-Ex sensor calibrated for n-Nonane to detect all combustible mixtures, O ₂ , CO | | | |
| Advanced detection strategy* | X-am 8000** with Cat-Ex sensor with selectable measurement gas to adapt quickly to the specific scenario | | | |
| | Methane Butane Additional sensors for O ₂ /CO, NO ₂ , HCL and VOCs X-am 5100 HF/ Dräger Tubes HF | Methane Additional sensors XXS H ₂ HC for the specific measurement of H ₂ | Methane | Butane |

* The selected substances have been chosen based on current knowledge to cover the most basic needs of firefighters to be able to make an initial assessment of imminent threats posed by flammable and toxic gases. BEVs in particular may release a multitude of varying substances based on cell type, chemistry and state of charge.

** Firmware 01.04.12 or higher

Scenario 2 - visible flames

In the event of an accident involving a fire, emergency personnel must take special protective precautions due to the inherent hazards of a burning vehicle.

- Toxic and irritant emissions** from burning fuel, plastic, and rubber (e.g. CO, HF, HCL, HCN, SO₂, NO₂, and PAHs)
- It is essential to always use **SCBA and full PPE** due to these emissions
- Elevated levels of **hydrogen fluoride and metal particles and ions** have been observed for burning battery-electric vehicles
- Substances can accumulate on firefighters' protective gear and skin, making **proper post-incident hygiene** critical



Personnel not under SCBA need to **maintain a safe distance from the vehicle** in order to not be exposed to hazardous emissions. A gas detector can help to determine this parameter.

Our solutions

Dräger has a selection of solutions which, when combined, protect the health and safety of firefighters and first responders.

Gas detection to detect the release of flammable and toxic substances

X-am 2800 and 5800

X-am 8000

X-am 5100

Gas detection tubes

Thermal imaging camera to detect invisible flames by H₂ and detect and monitor a thermal runaway

Dräger UCF Firevista

Dräger FireCore

PPE (personal protective equipment) to protect first responders and victims

Dräger HPS® SafeGuard

Dräger PSS® AirBoss

Dräger PARAT® 5500***

Dräger RPS® 3500 and rescue hood

*** Filter solution - may not provide protection from all released substances

Would you like to know more?

> Get in touch!