

NOTES

Training **ALTERNATIVE PROPULSION**

Quick and safe release
of people from crashed
vehicles.



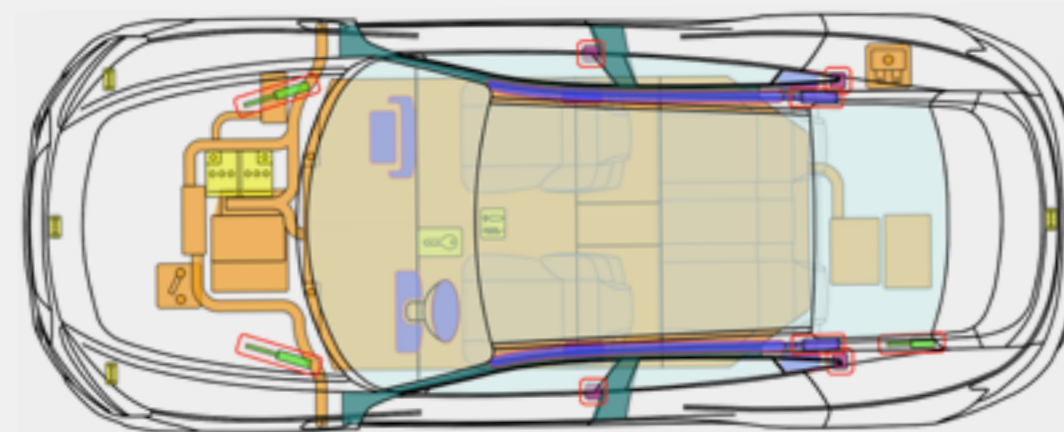
Android



iOS



Windows



CONTENTS

Explanation of the topics to be covered.

1. Purpose of this training

CONTENTS

1. Purpose of this training
2. Overview of alternative propulsion

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1. Purpose of this training
2. Overview of alternative propulsion
3. Safety



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3. Safety
4. CNG and LPG

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5. Hybrid and electric

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5. Hybrid and electric
6. Hydrogen

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2. Overview of alternative propulsion
3. Safety
4. CNG and LPG
5. Hybrid and electric
6. Hydrogen
7. Application of the Crash Recovery System





Chapter 1

THE PURPOSE OF THIS TRAINING

PURPOSE OF THIS TRAINING

GENERAL PURPOSE

- Incident response for alternatively powered vehicles

SPECIFIC GOALS

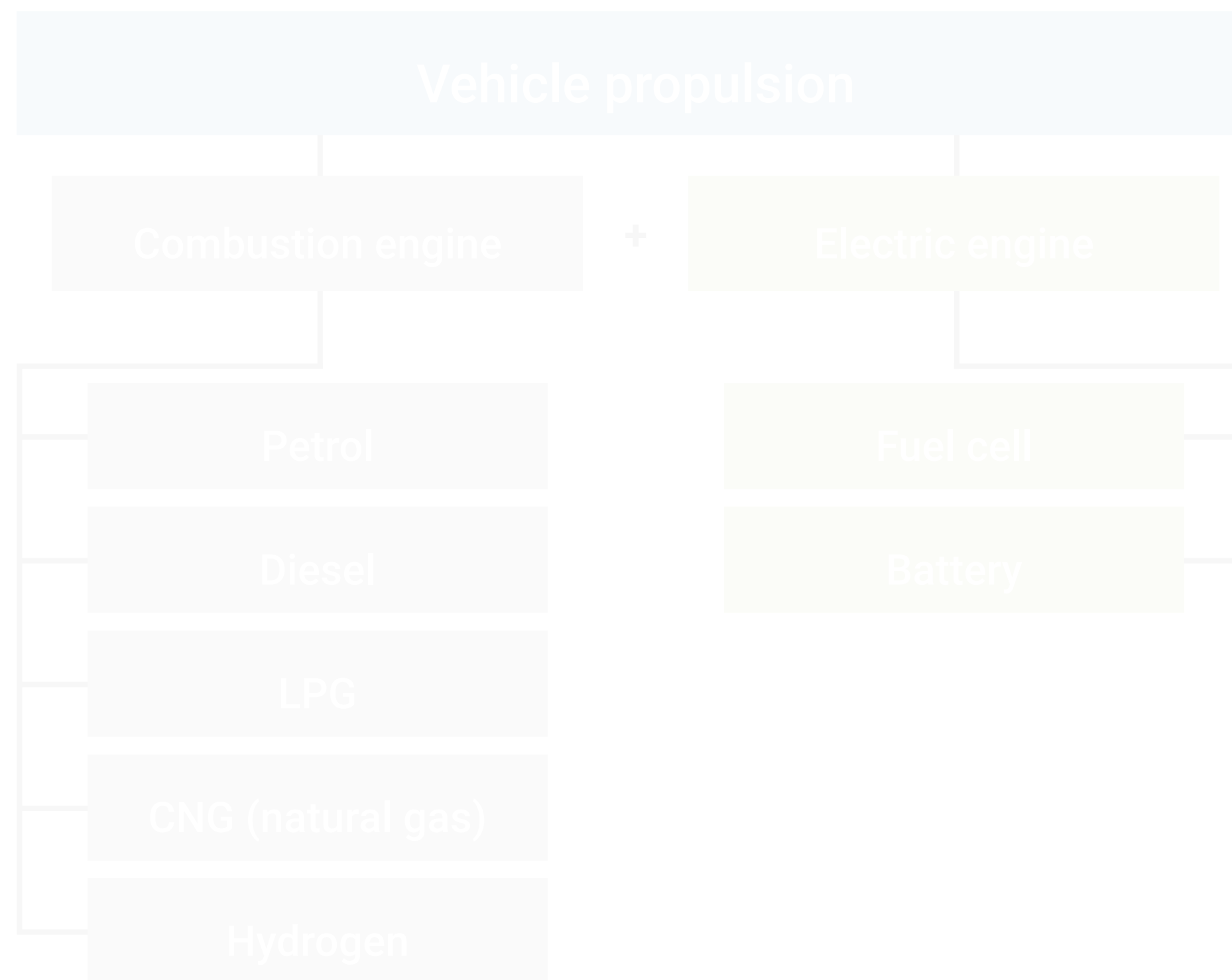
- Requesting vehicle information from the Crash Recovery System
- Basic knowledge of alternative propulsion
- Recognising risks
- Safe and effective incident response

**More and more different fuel and drive combinations have been introduced in recent years.
On the slide there are a number of options, there are also many possible combinations.**

Chapter 2

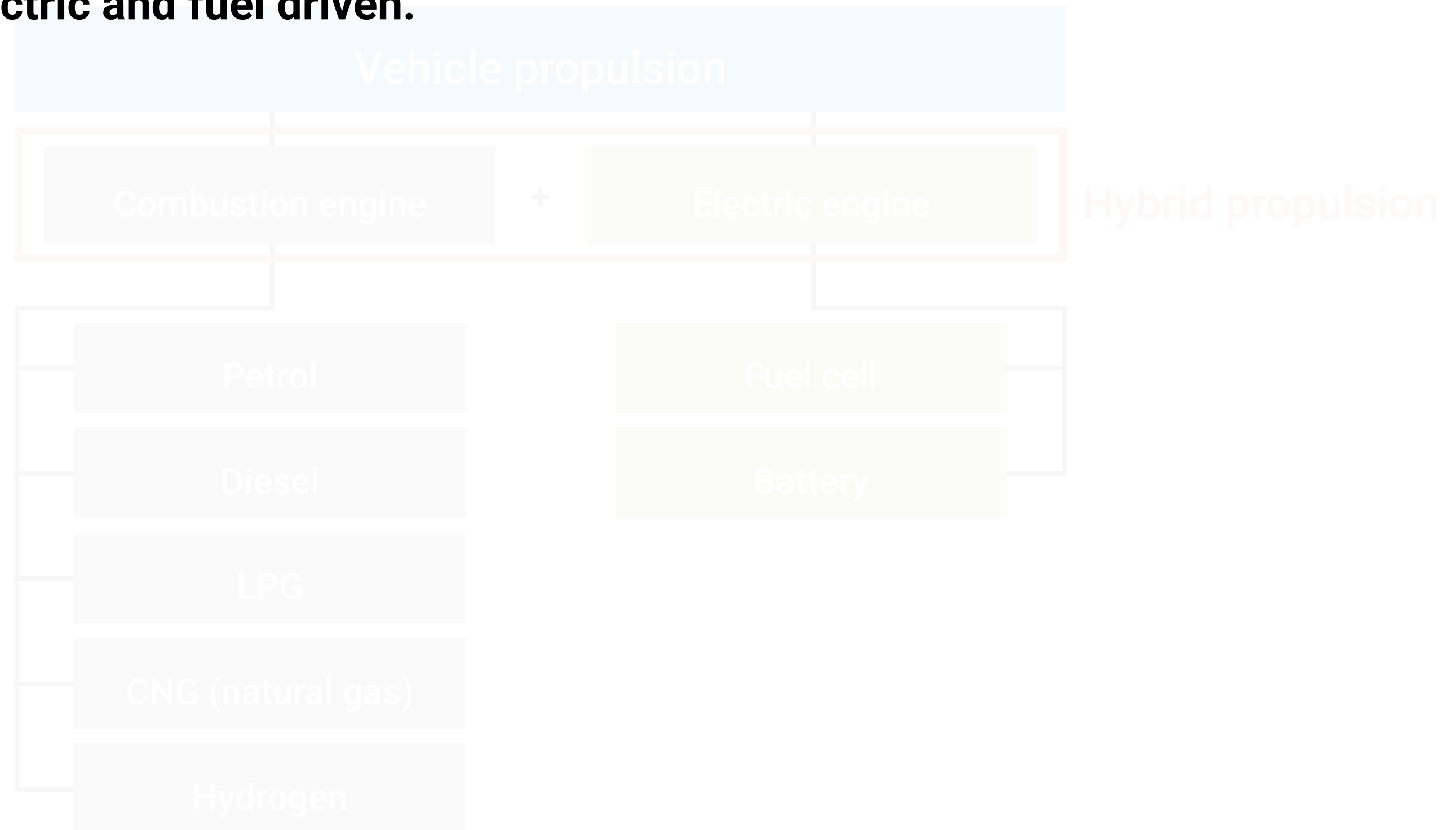
OVERVIEW OF ALTERNATIVE PROPULSION

OVERVIEW OF ALTERNATIVE PROPULSION



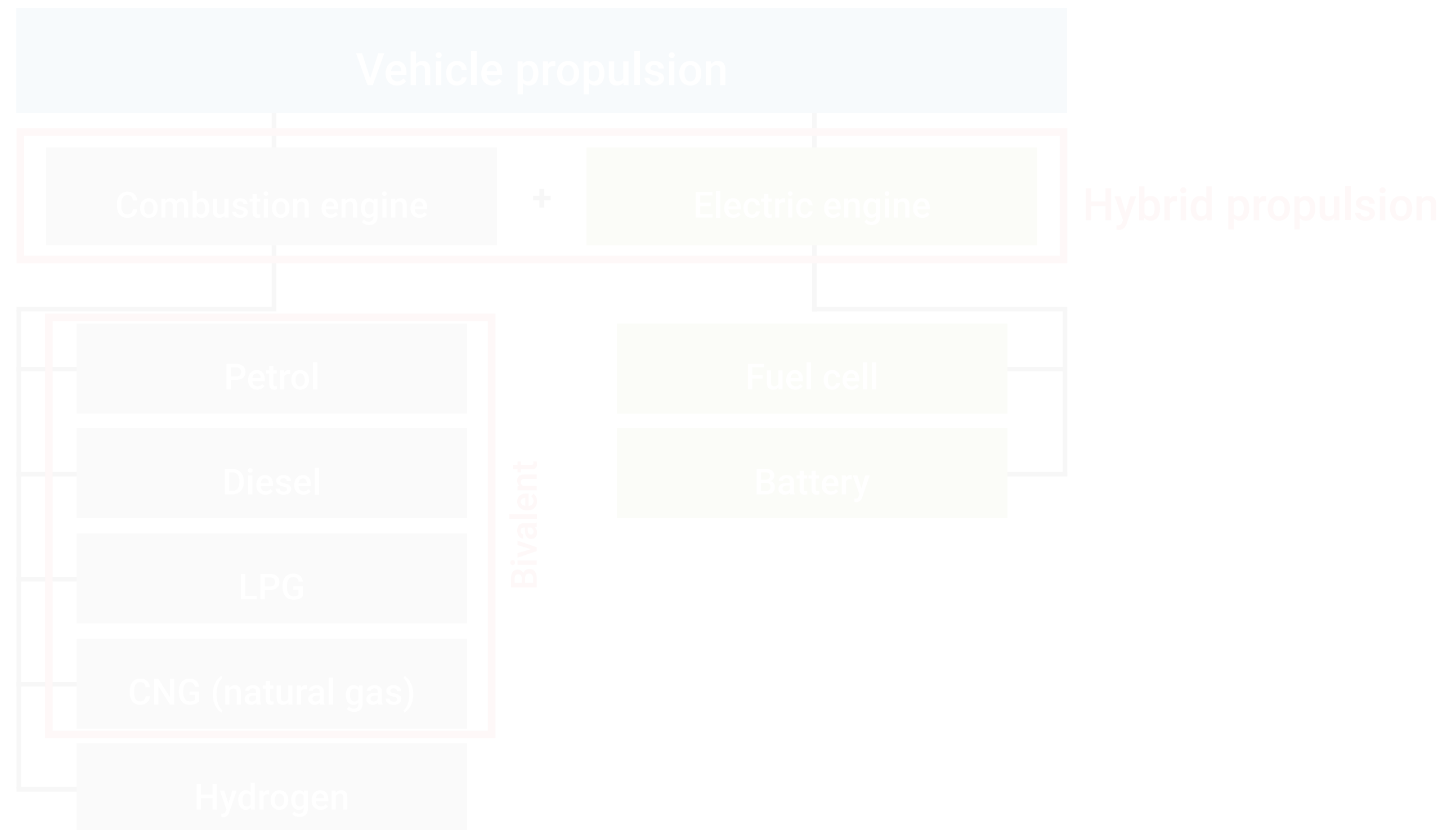
OVERVIEW OF ALTERNATIVE PROPULSION

Hybrid means two, so a hybrid propulsion is a propulsion with two different types, electric and fuel driven.



OVERVIEW OF ALTERNATIVE PROPULSION

A bivalent powertrain is equipped with two types of fuel, also known as dual fuel.



Ask the question; what active and passive safety features do modern vehicles have?

Make a list on a flip chart. After most items have been named, continue with the following slides.

Chapter 3

SAFETY

SAFETY

The safety systems mentioned are explained in the following slides.

SAFETY PRINCIPLES

- Safe installation of the propulsion system and fuel energy storage
- Switching off the propulsion system in the event of accidents and/or leaks
- Preventing explosions

SAFETY

Centre rear of the vehicle between the rear wheels just in front of or behind the rear axle

Safety principles > Safe installation of fuel tanks and HV batteries



Construction of fuel tank - pressure holder - battery pack

SAFETY

Application of bodywork reinforcements to absorb rear impact

Safety principles > Safe installation of fuel tanks and HV batteries



Construction of fuel tank - pressure holder - battery pack

SAFETY

Construction of fuel tank – pressure holder – battery pack, these are reinforced and can absorb a reasonable impact.



Construction of fuel tank - pressure holder - battery pack

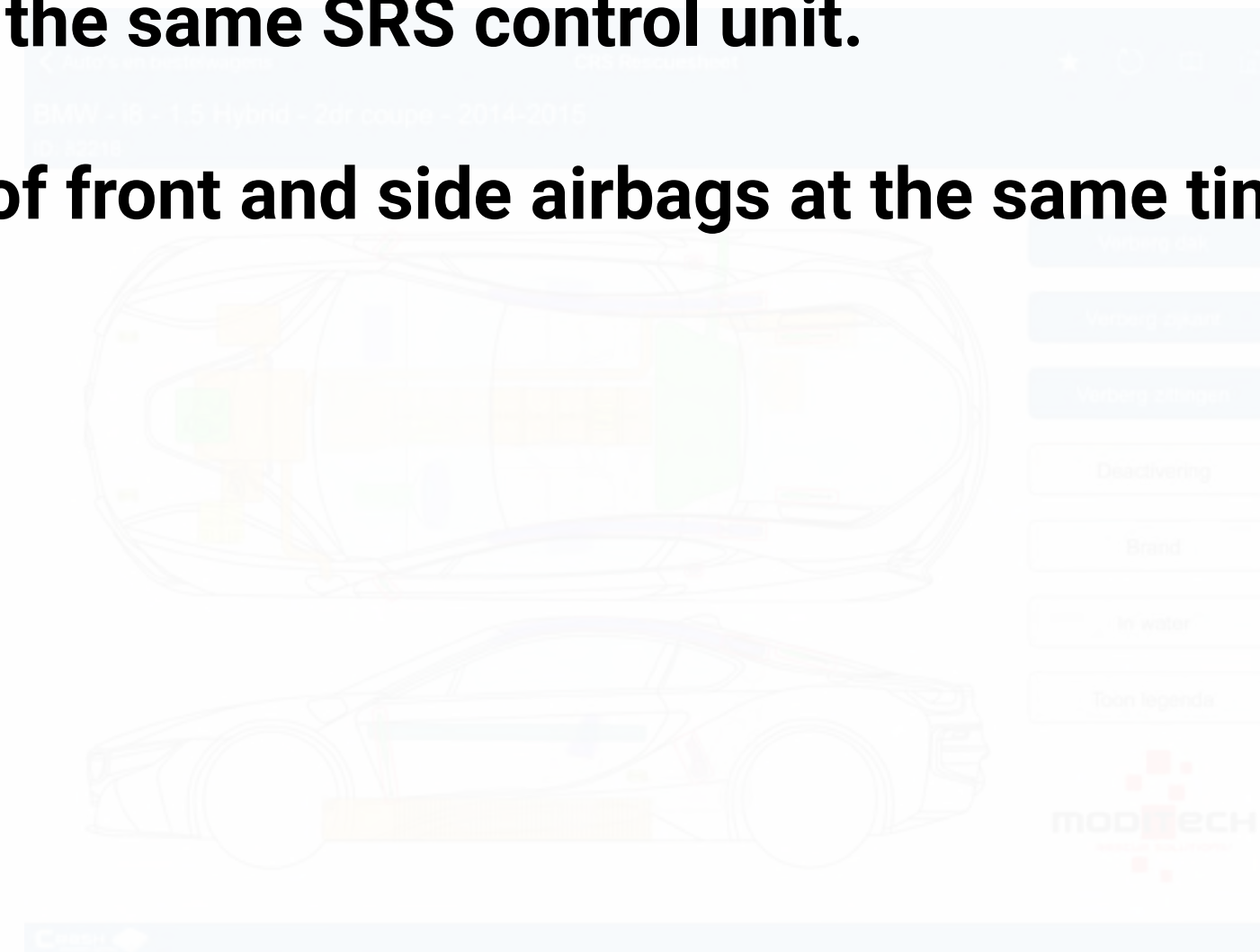
SAFETY

- **Inertia Switch (Black)** This switch contains a metal ball that moves out of place in the event of a collision, which switches off the fuel pump. You can turn that switch back on by pressing the red rubber button.
- **SRS (Supplemental Restraint System)** Activated airbag = accident recognition by the vehicle.

SAFETY

In the event of a collision, the impact is registered by the SRS control unit, which then activates the airbags. (Only the steering wheel and passenger airbags in the direction of travel at an angle of 30 degrees from the longitudinal axis). Laterally, the airbags are controlled by the same SRS control unit.

There can be a combination of front and side airbags at the same time if the vehicle is turning.



Automatic switching off of the propulsion system

SAFETY

Safety principles > Preventing explosions



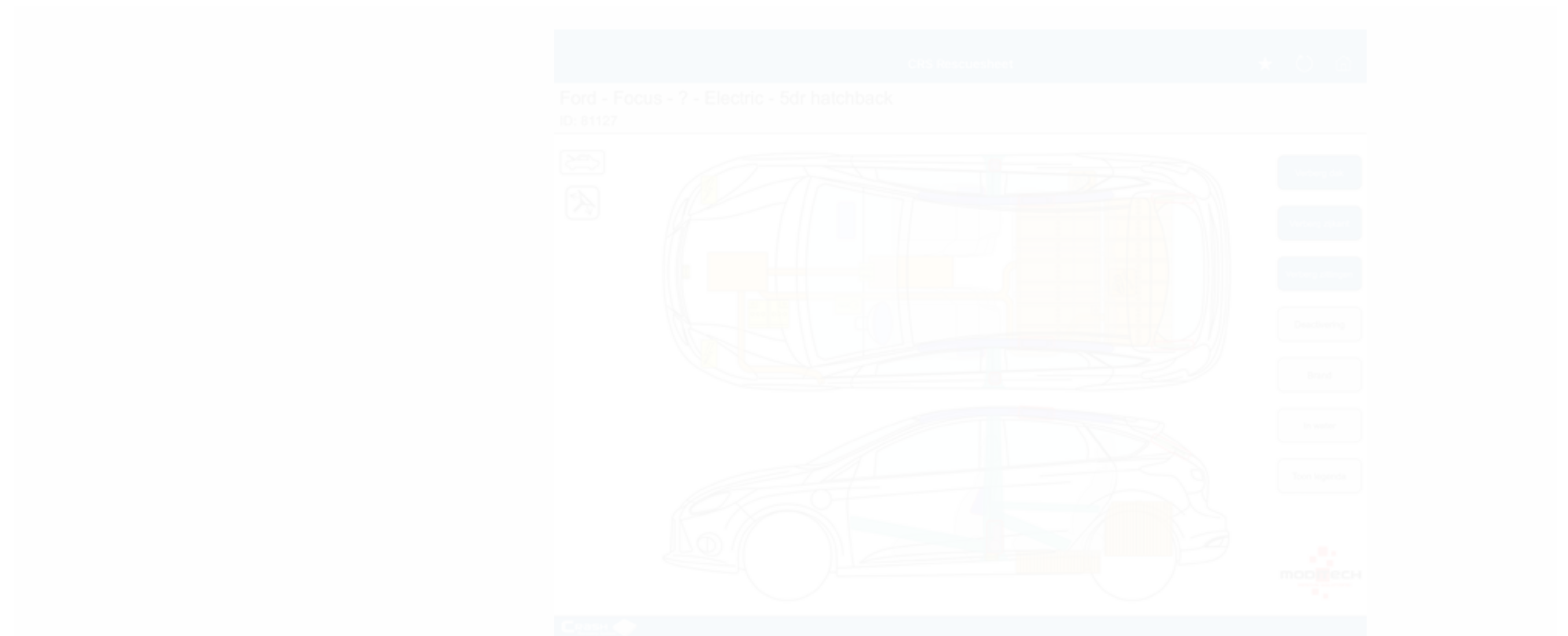
Automatic switching off of the propulsion system

SAFETY

SAFETY

SAFETY

Safety principles > Preventing explosions

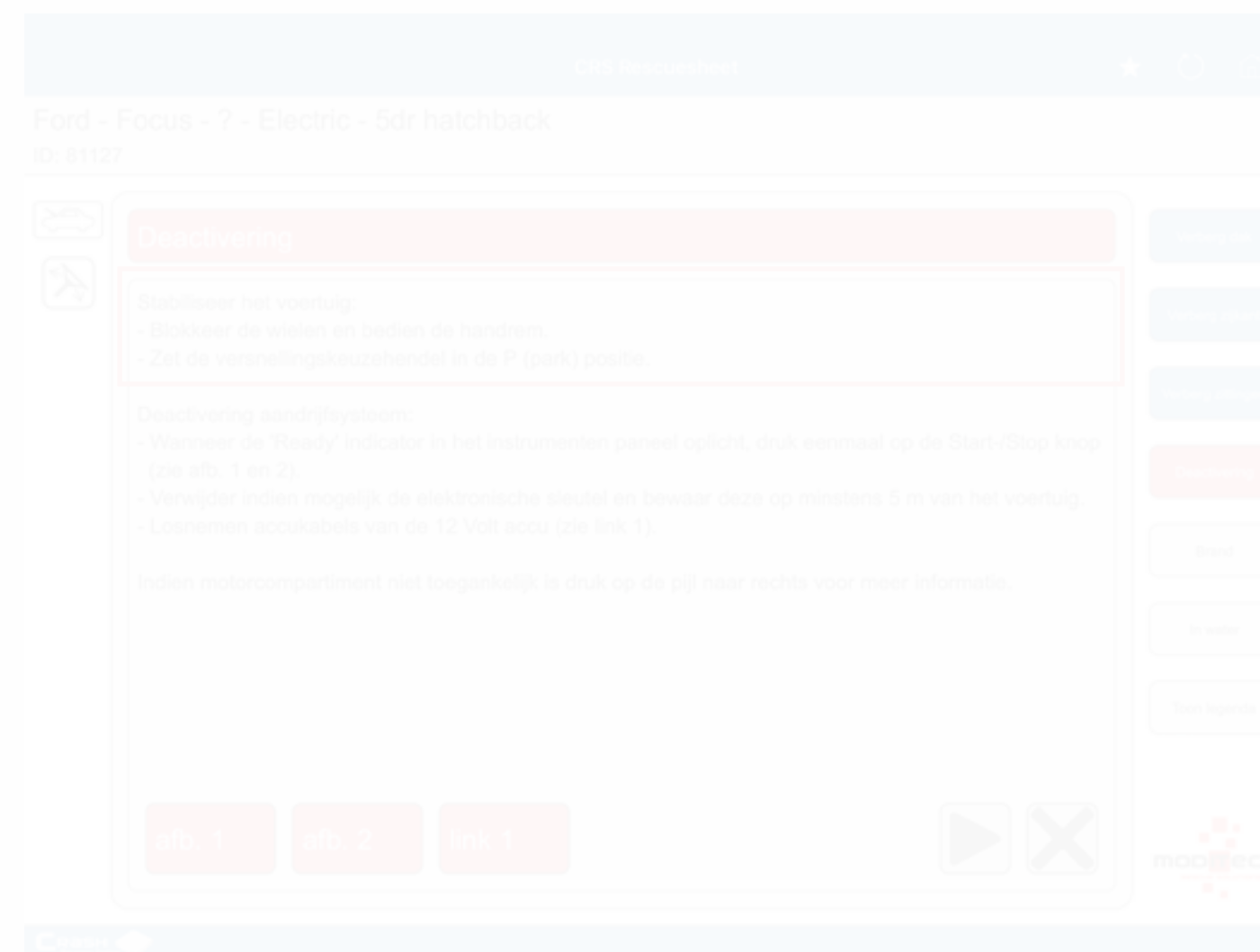


Automatic switching off of the propulsion system

SAFETY

SAFETY

Safety principles > Preventing explosions



Automatic switching off of the propulsion system



Chapter 4

CNG & LPG

CNG & LPG

Where do gases accumulate in the event of a leak in the installation when the car is parked in a car park? Natural gas is lighter, so on the ceiling, LPG is heavier, so on the floor.

CNG

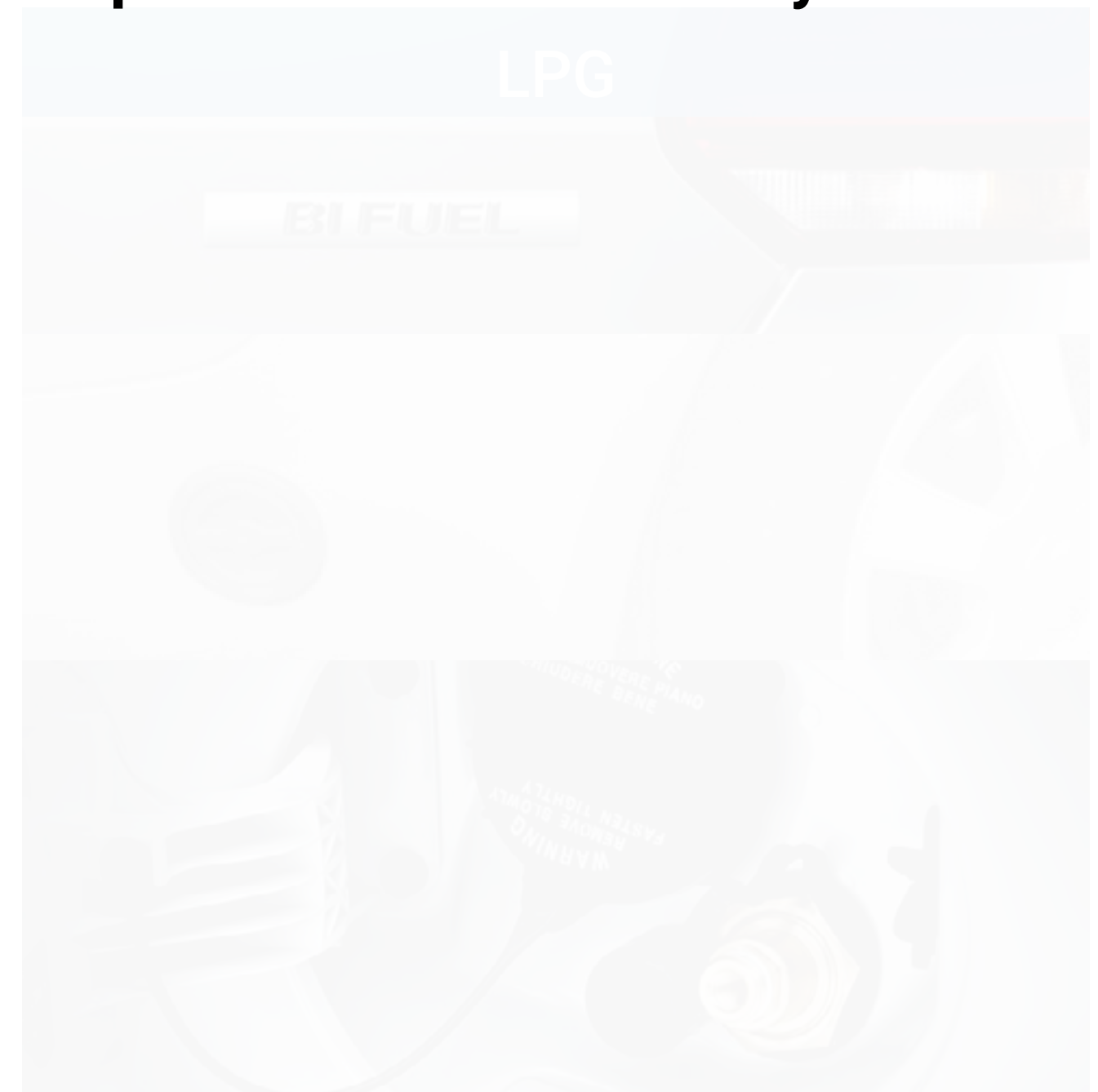
- Compressed Natural Gas
- Methane
- Flammable gas
- Lighter than air
- Odour
- > 200 Bar

LPG

- Liquefied Petroleum Gas
- Propane/Butane
- Flammable gas
- Heavier than air
- Odour
- 6 > 8 Bar

CNG & LPG

There are many types, both factory-fitted and retrofitted. The CRS will help you if you search on the vehicle registration plate data. Be alert, there are also cars that have been built illegally, a new car is only inspected after the fourth year.



CNG & LPG

Combination with petrol or diesel

Storage in pressure holders > 200 Bar Reduced to 6 Bar

Multiple pressure holders in several places and of different contents, there can be 5 to 7 cylinders in delivery vans.

Pressure holder equipped with safety valve for overpressure and a fuse.

CNG & LPG



CNG & LPG



Factory-fitted gas installations

CNG & LPG

Via vehicle registration plate query

Enter vehicle registration plate

Pre-warning, click ok

Click on vehicle

Land: Nederland Wijzig

Kenteken: 46ZGB8 Zoeken

1 2 3 4 5 6 7 8 9 0

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Back % ~ + = / \ ; : ' " < > Back

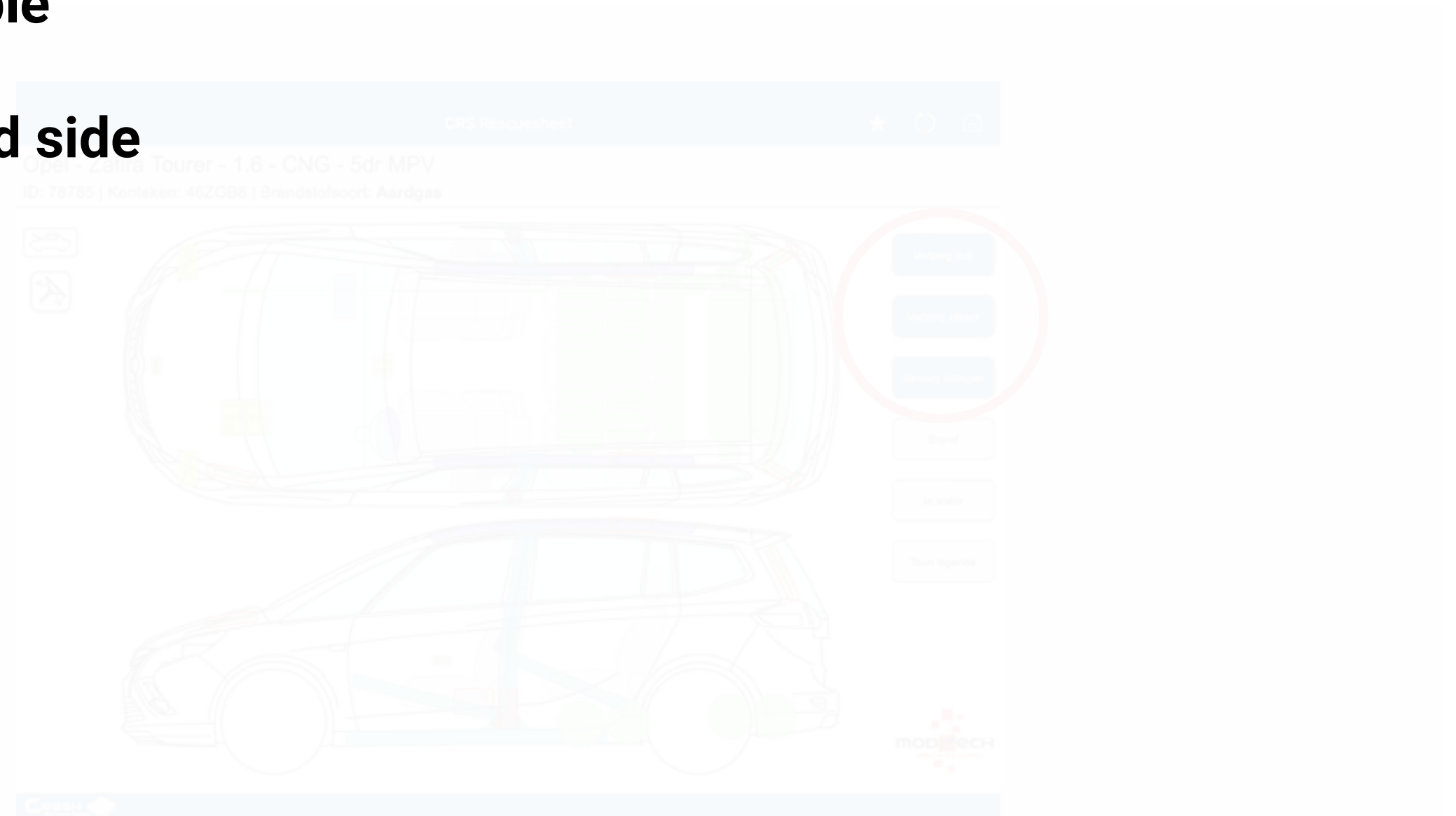
ABC [Globe] [Search] ABC [Globe]

Factory-fitted gas installations

CNG & LPG

Gas installation visible

Hide roof – seats and side



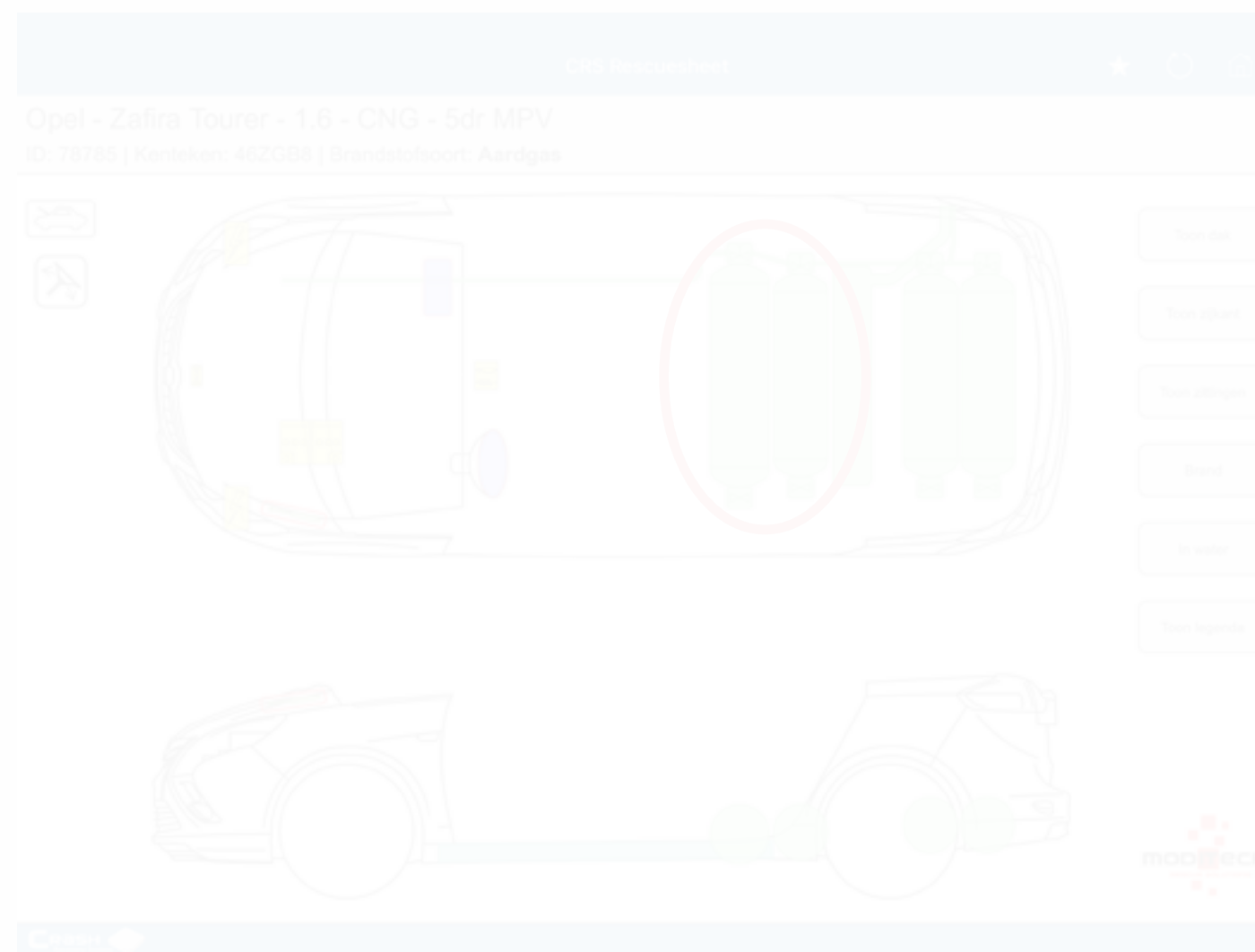
Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG



Factory-fitted gas installations

CNG & LPG

Click on the parts for more information and images



Factory-fitted gas installations

CNG & LPG

To shut off the tank, start by turning off the vehicle with the ignition

Disconnect the 12 volt battery if necessary

You can close the valve manually with a rotary knob or sometimes with an inner hexagonal key.

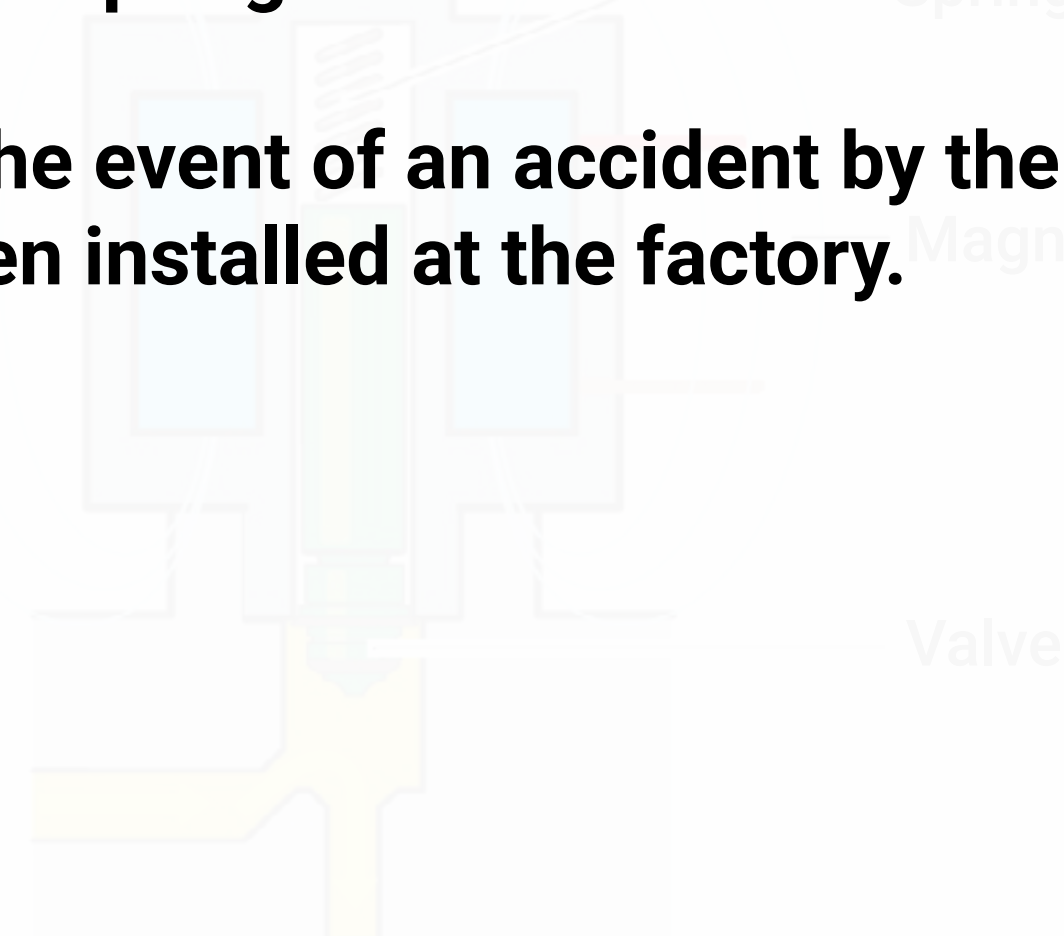
In an emergency when nothing works anymore, a recovery company or the Dutch ANWB roadside assistance is a good help to ask to help you.

CNG & LPG

Operated with the ignition or by disconnecting the 12V battery.

When the power is off, the spring closes the valve.

Automatically closes in the event of an accident by the SRS control unit, but only if the gas system has been installed at the factory.



Solenoid shut-off valve

CNG & LPG

Follow the prompts in the CRS to manually close the throttle.



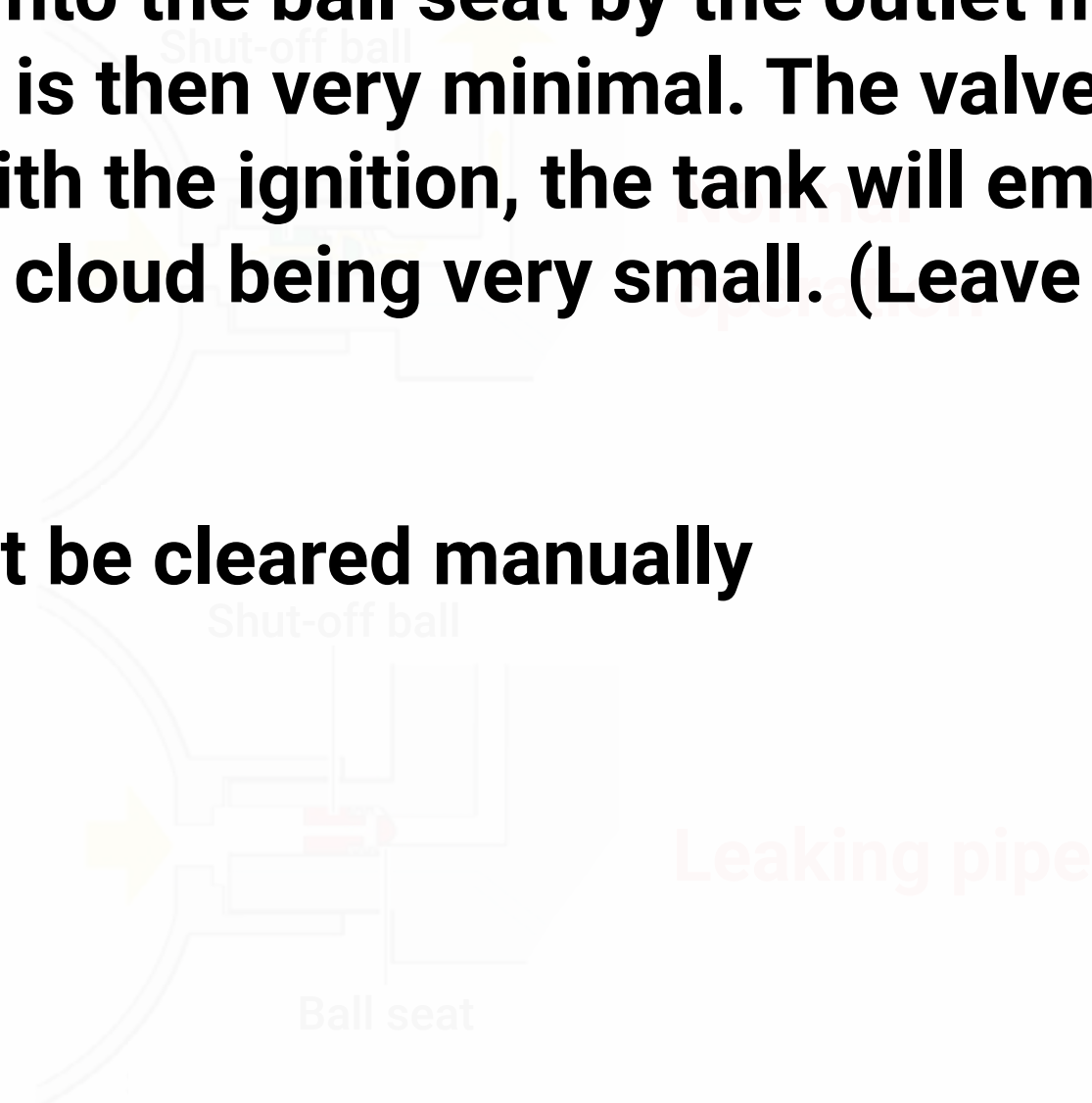
Manual shut-off valve

CNG & LPG

Comes into operation in the event of a leak (pipe rupture protection), the shut-off ball will be pressed into the ball seat by the outlet if there is a leak in the high-pressure pipe. The flow is then very minimal. The valve can then no longer be operated manually or with the ignition, the tank will empty very slowly, with the risk of a dangerous gas cloud being very small. (Leave outside of course)

Caution!

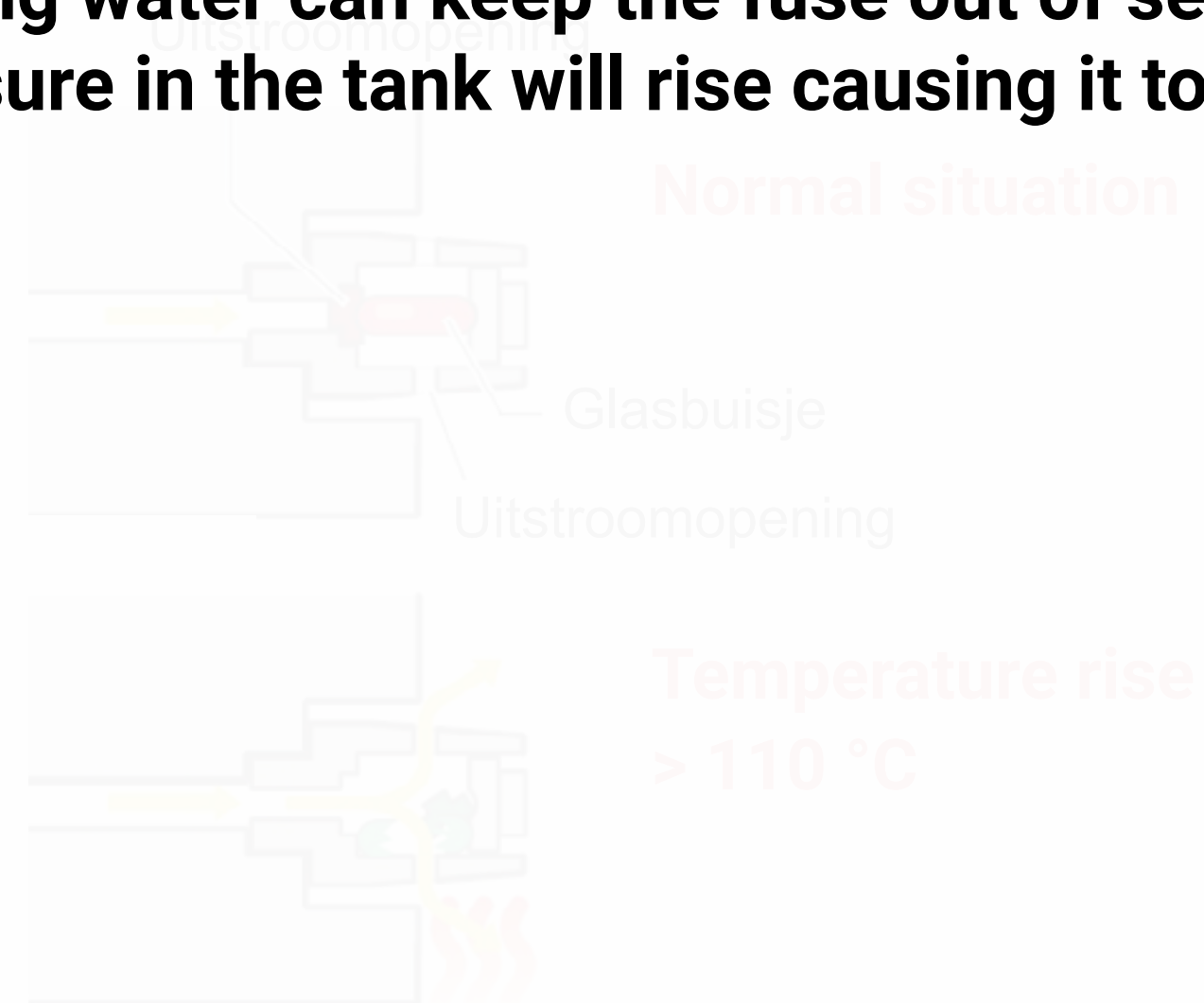
This malfunction cannot be cleared manually



Flow restrictor

CNG & LPG

Due to the fuse, extinguishing/cooling the valve in a burning vehicle is NOT safe, since the extinguishing water can keep the fuse out of service, and there is then a chance that the pressure in the tank will rise causing it to collapse.



Thermal protection or fuse protection

CNG & LPG

Glass tube

Uitstroomopening

Normal situation



Temperature rise
> 110 °C

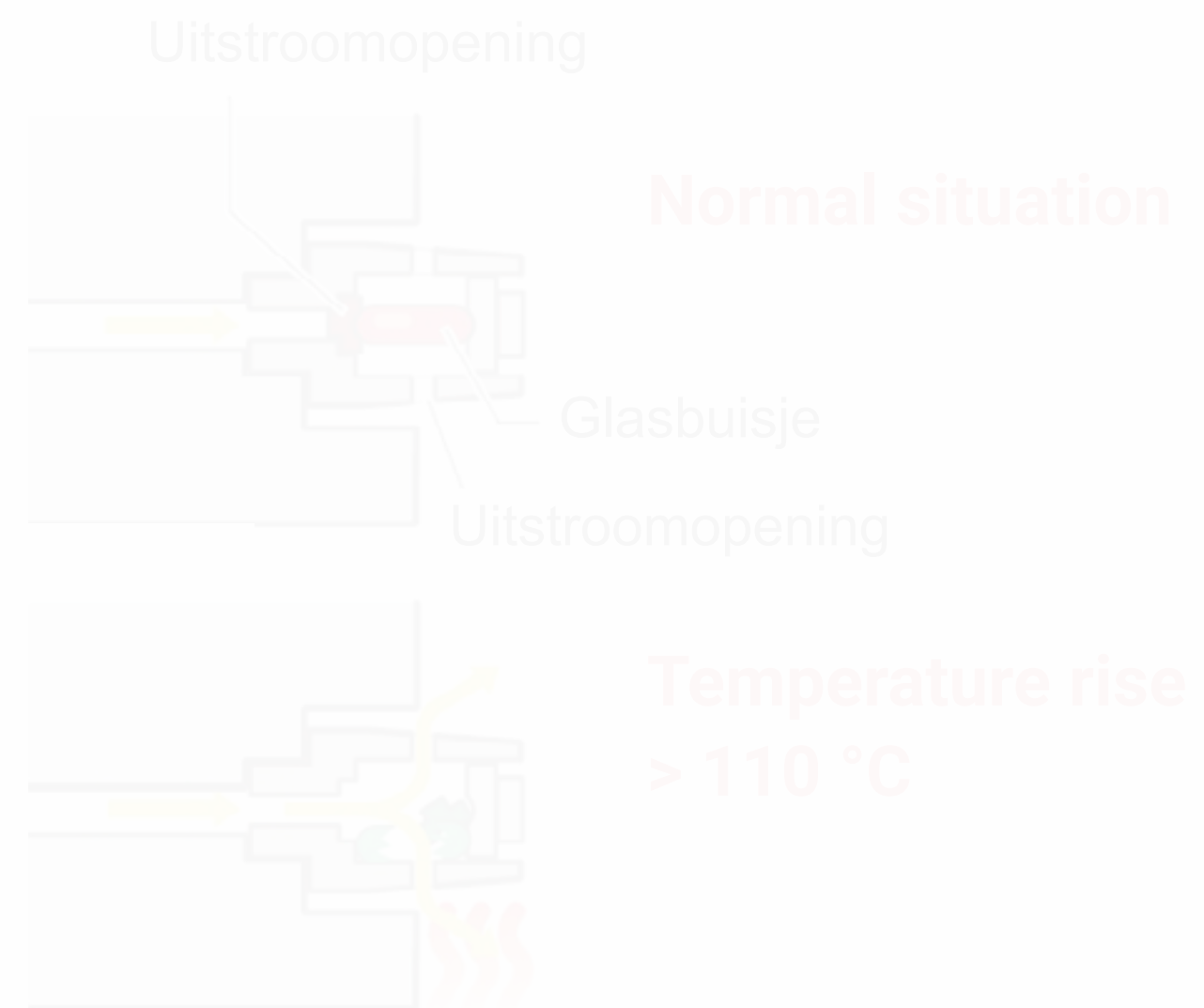


Thermal protection or fuse protection

CNG & LPG

Glass tube

Lead bullet



Thermal protection or fuse protection

CNG & LPG

Glass tube

Lead bullet

Gas is extinguished in one go



Thermal protection or fuse protection

CNG & LPG

Via vehicle registration plate query

CNG & LPG

Pre-warning natural gas

Press OK

Land:

Nederland

Wijzig

Kenteken:

HJ919P



Zoeken

Volvo - V70 - T5 - 5dr s

OK

CNG & LPG

Approved installation by the RDW (Dutch Vehicle Authority)

Click on vehicle

No installation visible

CNG fuel listing

No link with the CRS!



Retrofitted gas installation

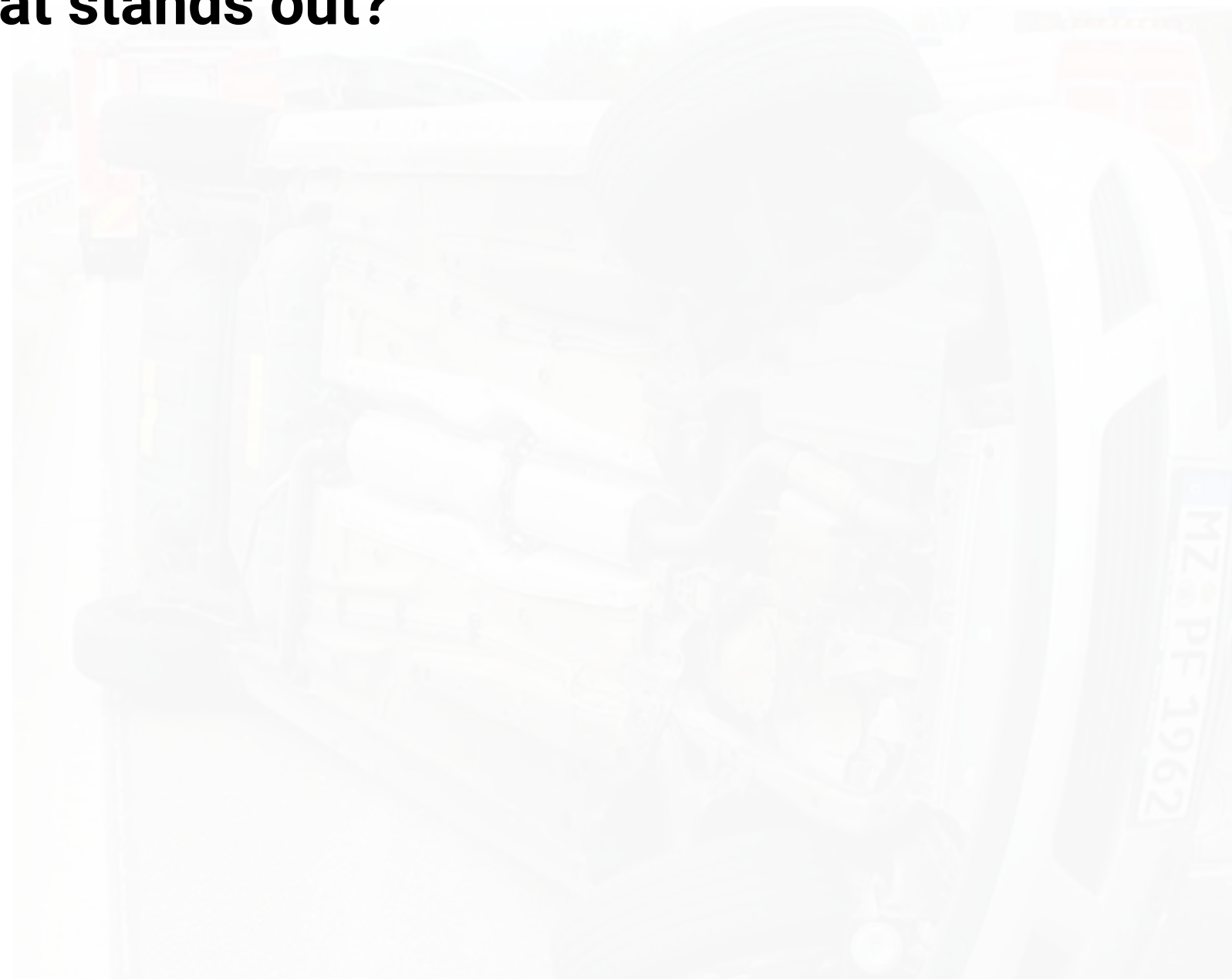
CNG & LPG



Practical example 1

CNG & LPG

What stands out?



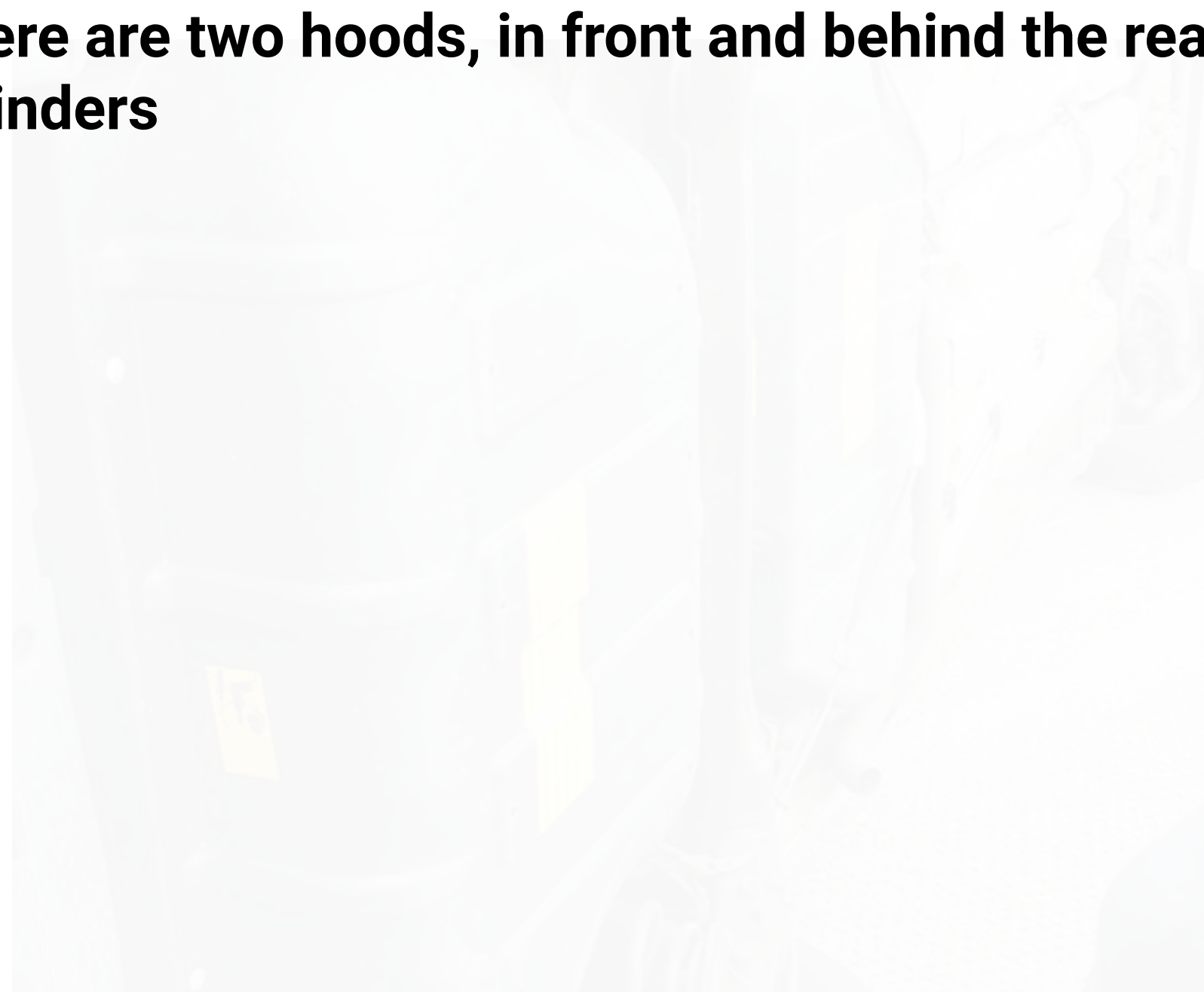
What stands out?

Practical example 1

CNG & LPG

There are two hoods, in front and behind the rear axle, these cover the CNG cylinders

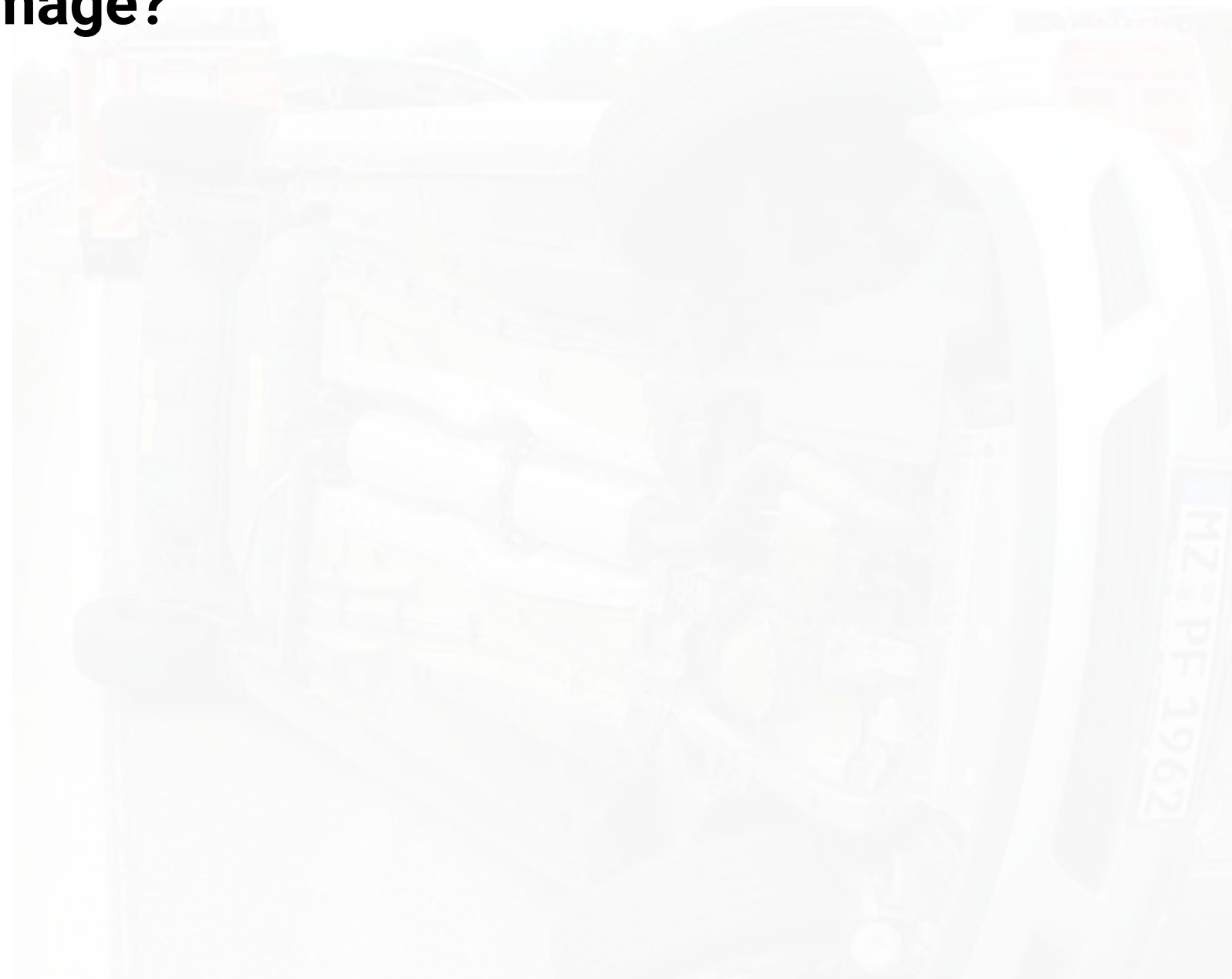
What stands out?



Practical example 1

CNG & LPG

Damage?



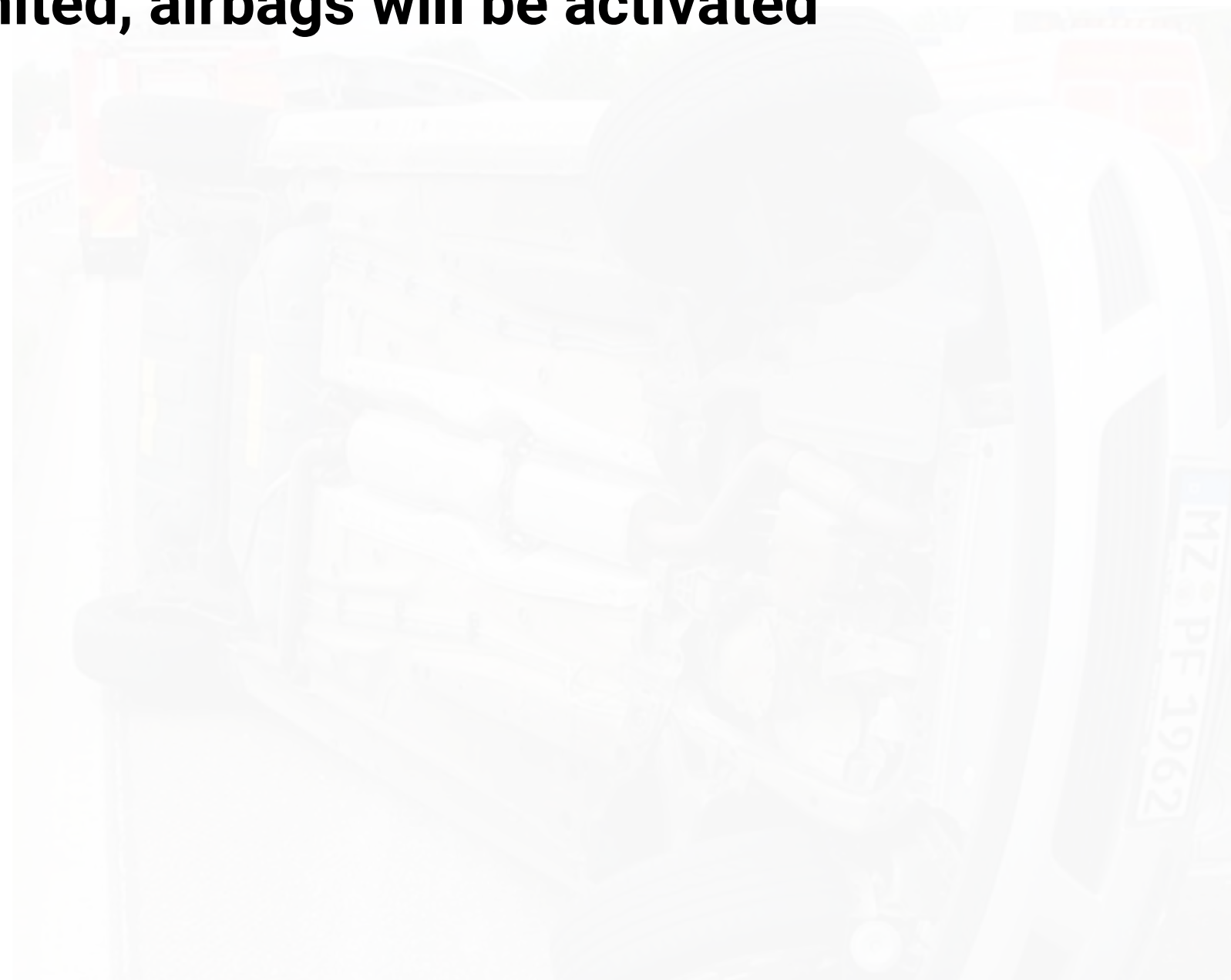
What stands out?

Damage?

Practical example 1

CNG & LPG

Limited, airbags will be activated



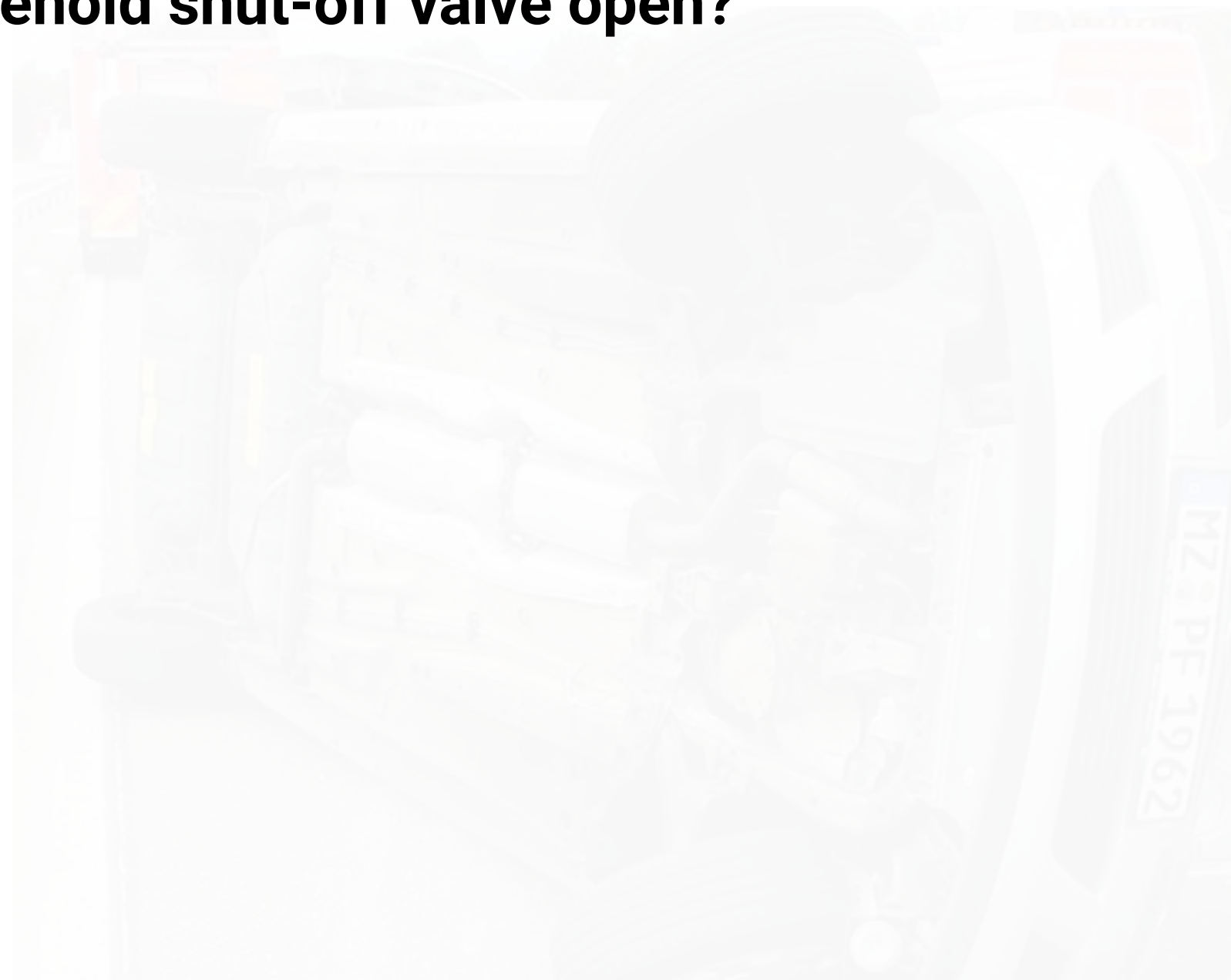
What stands out?

Damage?

Activated airbag?

CNG & LPG

Solenoid shut-off valve open?



What stands out?

Damage?

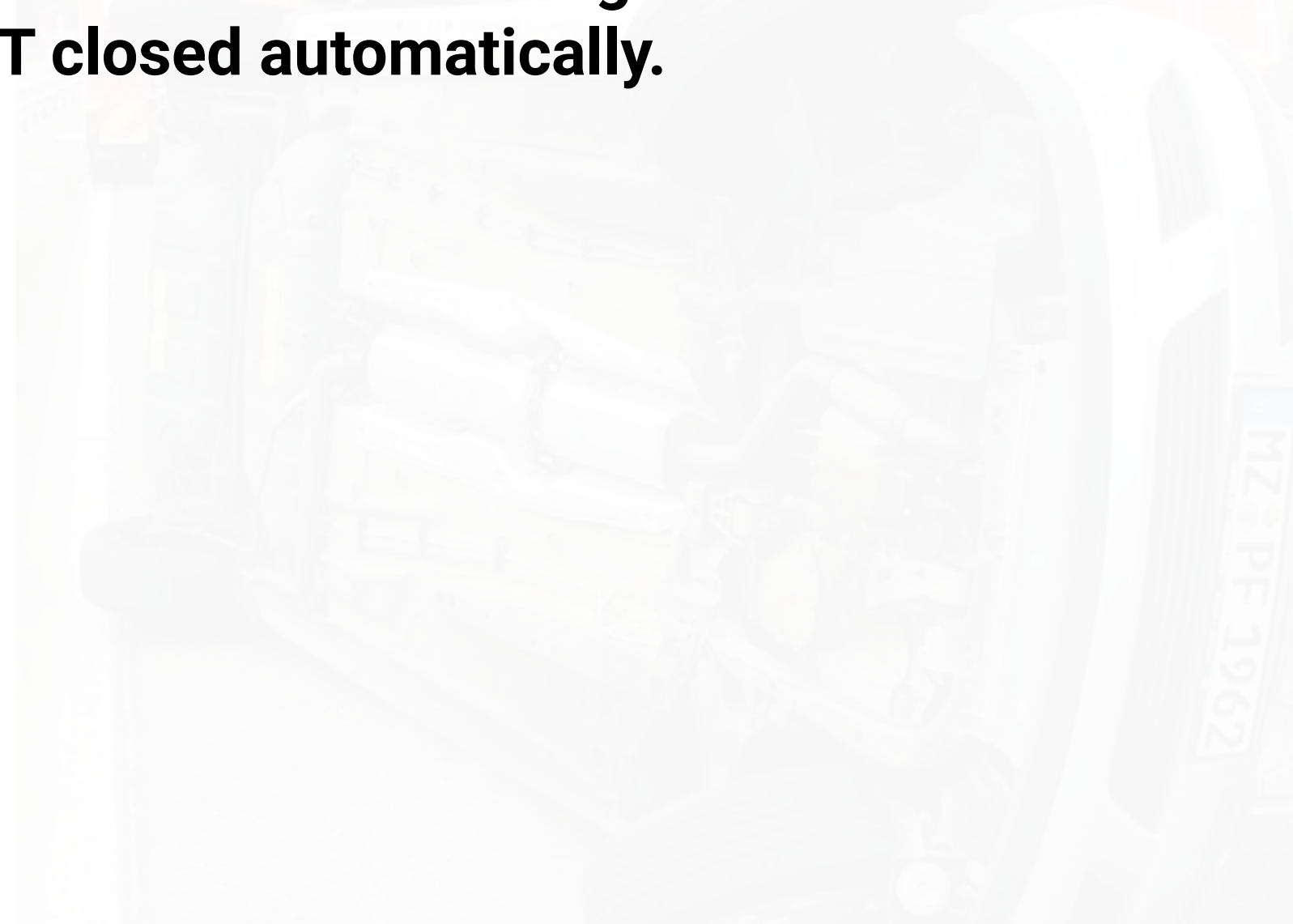
Activated airbag?

Solenoid shut-off valve open?

Practical example 1

CNG & LPG

**When ex-factory installed, the SRS unit will close the valves.
In the case of retrofitting there is NO connection to the SRS unit, then the valve is NOT closed automatically.**



Damage?

Activated airbag?

Solenoid shut-off valve open?

How to close this?



Practical example 1

CNG & LPG



CNG & LPG



Car has come off the road

Practical example 2

CNG & LPG

What type of gas is involved? LPG, because the cloud is heavier than air!



Car has come off the road

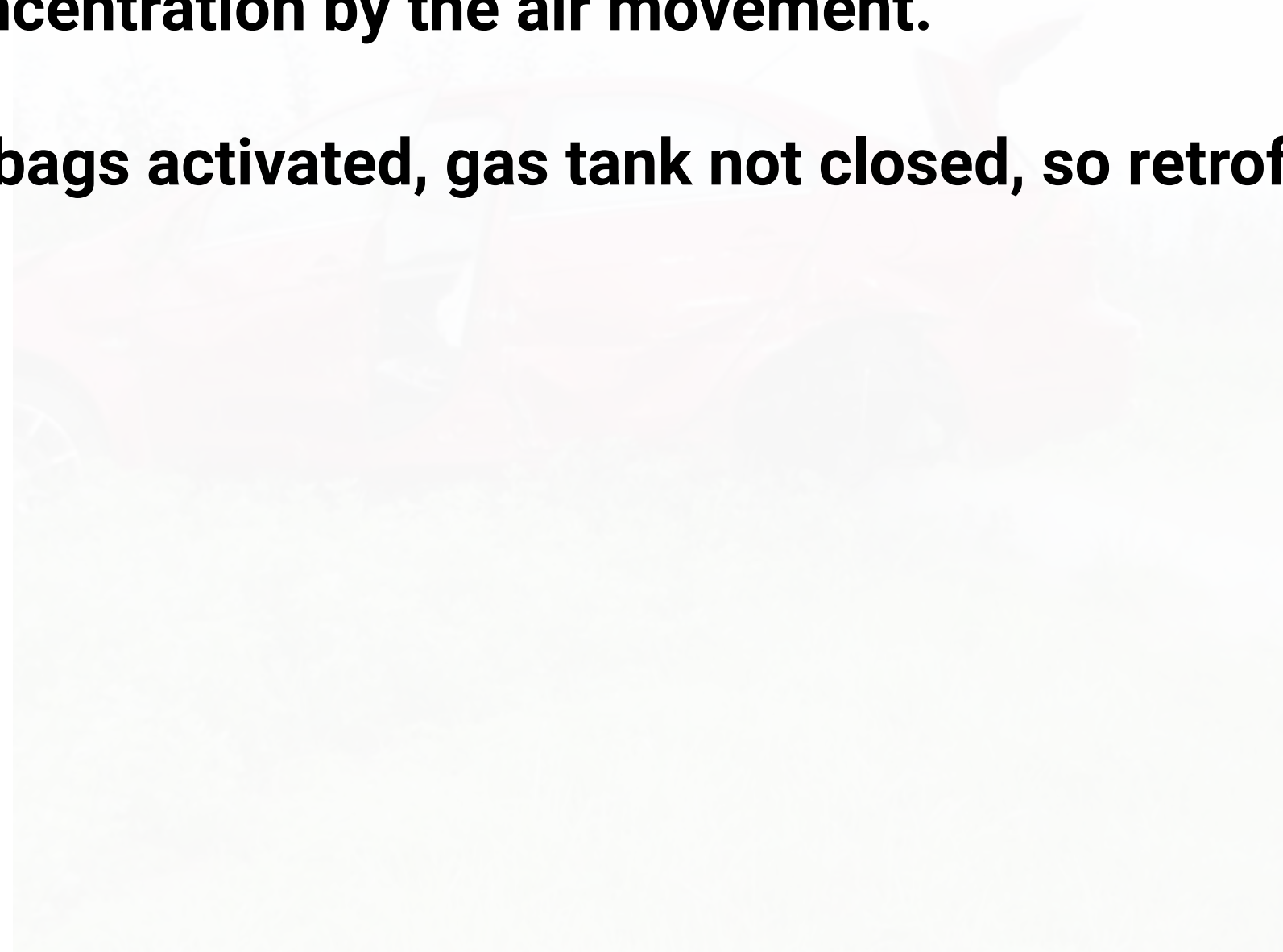
When putting it back on four wheels, the following happened

Practical example 2

CNG & LPG

You cannot precipitate the gas with a water jet, but you can dilute the concentration by the air movement.

Airbags activated, gas tank not closed, so retrofit.



Car has come off the road

When putting it back on four wheels, the following happened

Nominate an action plan to secure the incident



Practical example 2

CNG & LPG

Module
LPG



CNG & LPG

Procedure for requesting vehicle
information same as that of CNG



Factory-fitted gas installations

CNG & LPG

Procedure for requesting vehicle information same as that of CNG

Gas tank installation location



Factory-fitted gas installations

CNG & LPG

Procedure for requesting vehicle information same as that of CNG

Gas tank installation location

Hide roof, side and seats



Factory-fitted gas installations

CNG & LPG

Procedure for requesting vehicle information same as that of CNG

Gas tank installation location

Hide roof, side and seats

Click on gas tank and/or safety valve for information and images



Factory-fitted gas installations

CNG & LPG

Procedure for requesting vehicle information same as that of CNG

Gas tank installation location

Hide roof, side and seats

Click on gas tank and/or safety valve for information and images



Factory-fitted gas installations

CNG & LPG

Solenoid shut-off valve

Manual shut-off valve

Pressure relief valve (with the holes in the side)

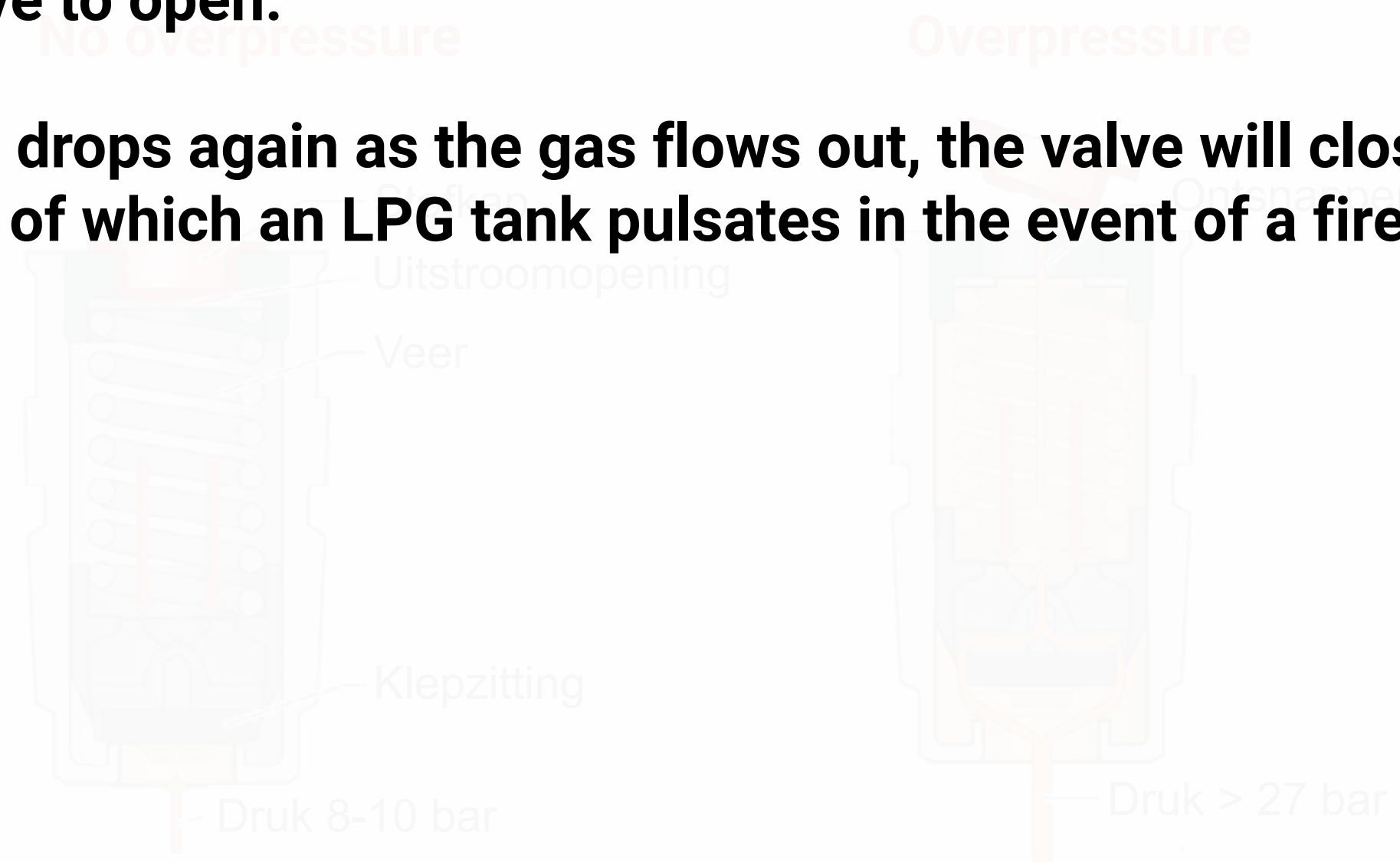
80% filling pipe



CNG & LPG

An LPG tank has no fuse! The pressure increase due to the fire will cause the pressure relief valve to open.

When the pressure drops again as the gas flows out, the valve will close again for a while, as a result of which an LPG tank pulsates in the event of a fire.



LPG pressure relief valve

Chapter 5

HYBRID AND ELECTRIC



HYBRID AND ELECTRIC

48 Volt battery in connection with greater power consumption

Shock absorbers and rear wheels electronically controlled

Start-stop is also powered from the system power

If the battery also supports the propulsion through the dynamo, we refer to a 'mild hybrid'

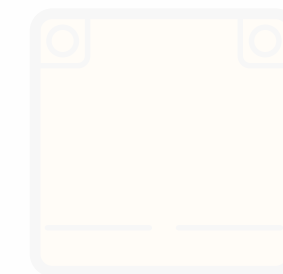
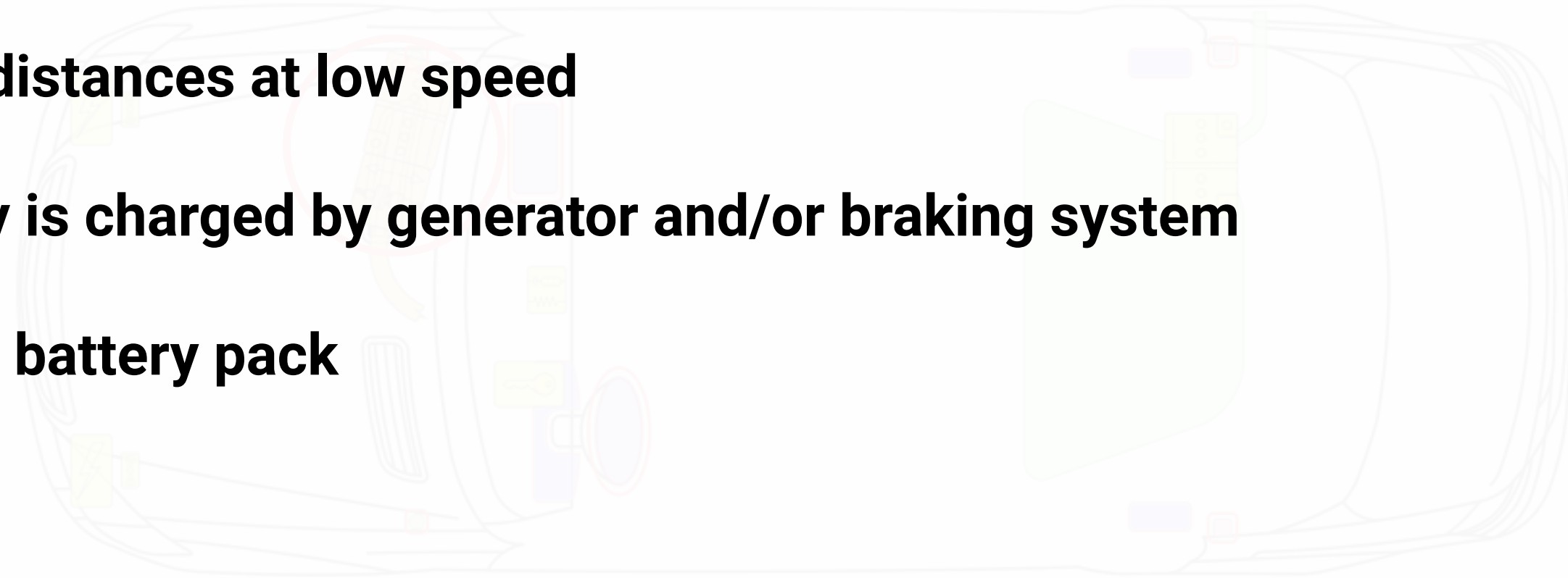
HYBRID AND ELECTRIC

Electric motor supports combustion engine when more power is required

For short distances at low speed

HV battery is charged by generator and/or braking system

Small size battery pack



Mild Hybrid

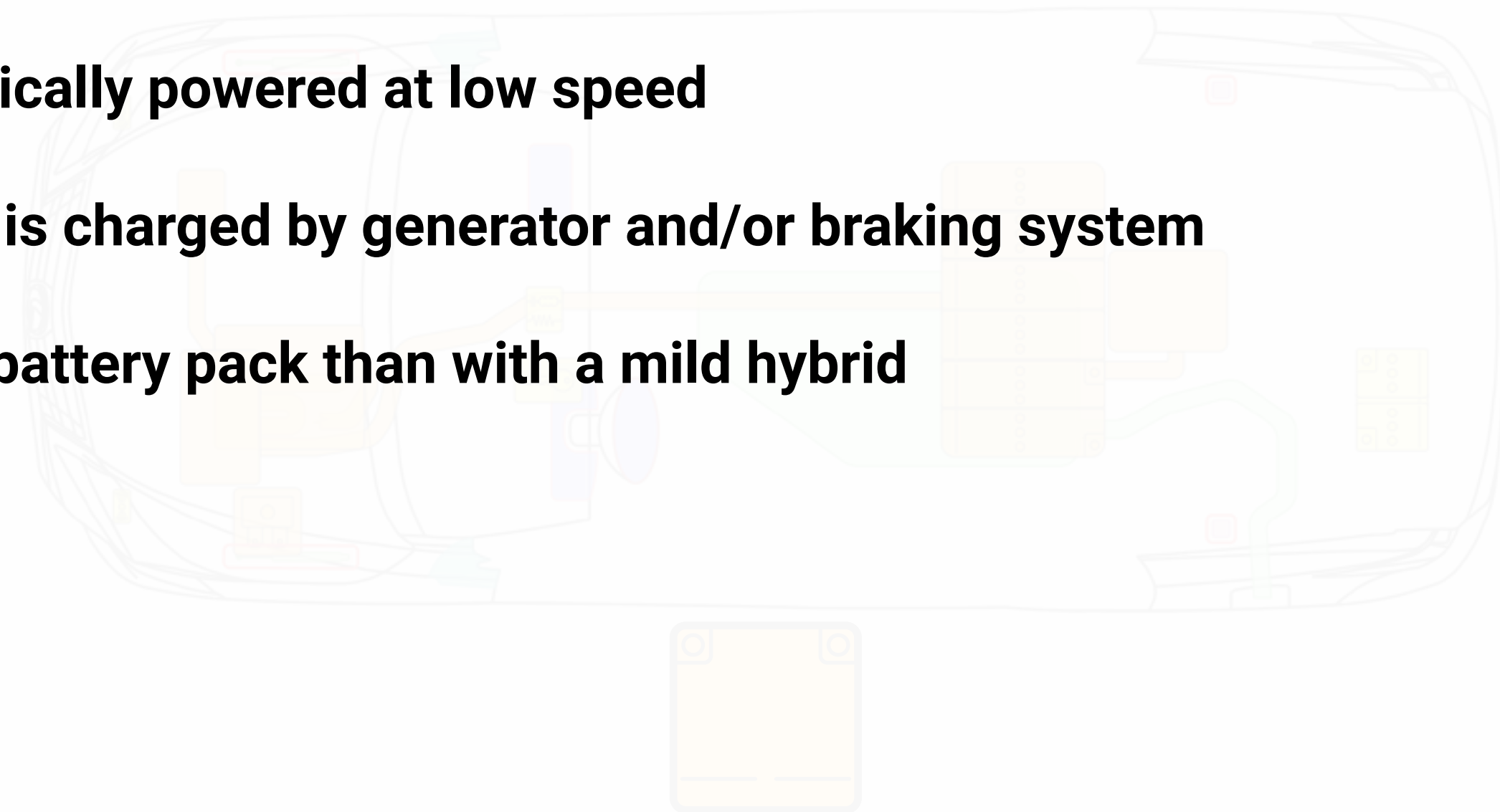
HYBRID AND ELECTRIC

Combustion engine and electric motor operate separately or simultaneously

Fully electrically powered at low speed

HV battery is charged by generator and/or braking system

Larger HV battery pack than with a mild hybrid



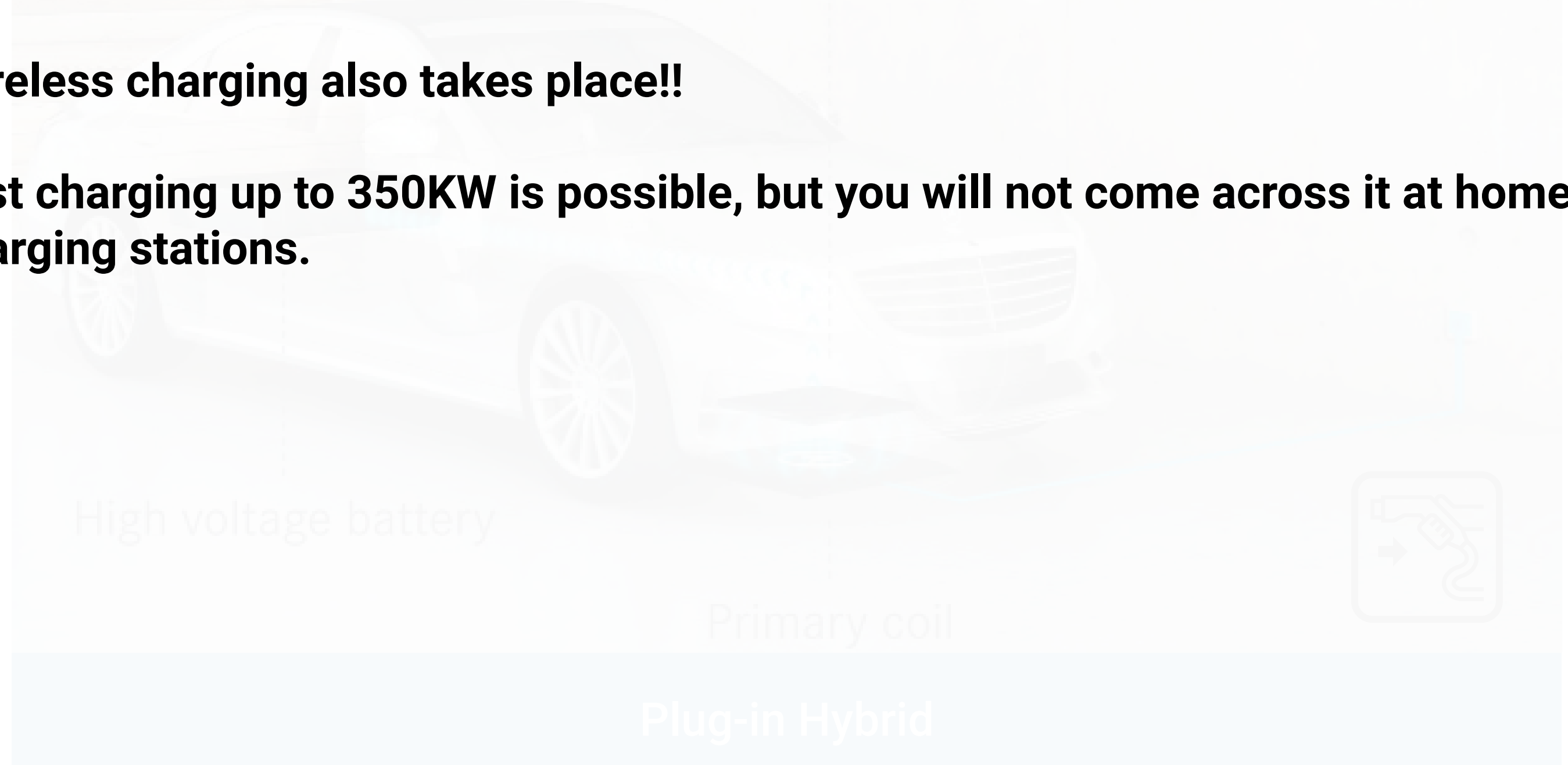
Full Hybrid

HYBRID AND ELECTRIC

HV battery is charged through a charging point with a plug of 230 or 400 volts alternating current or a direct current charging station.

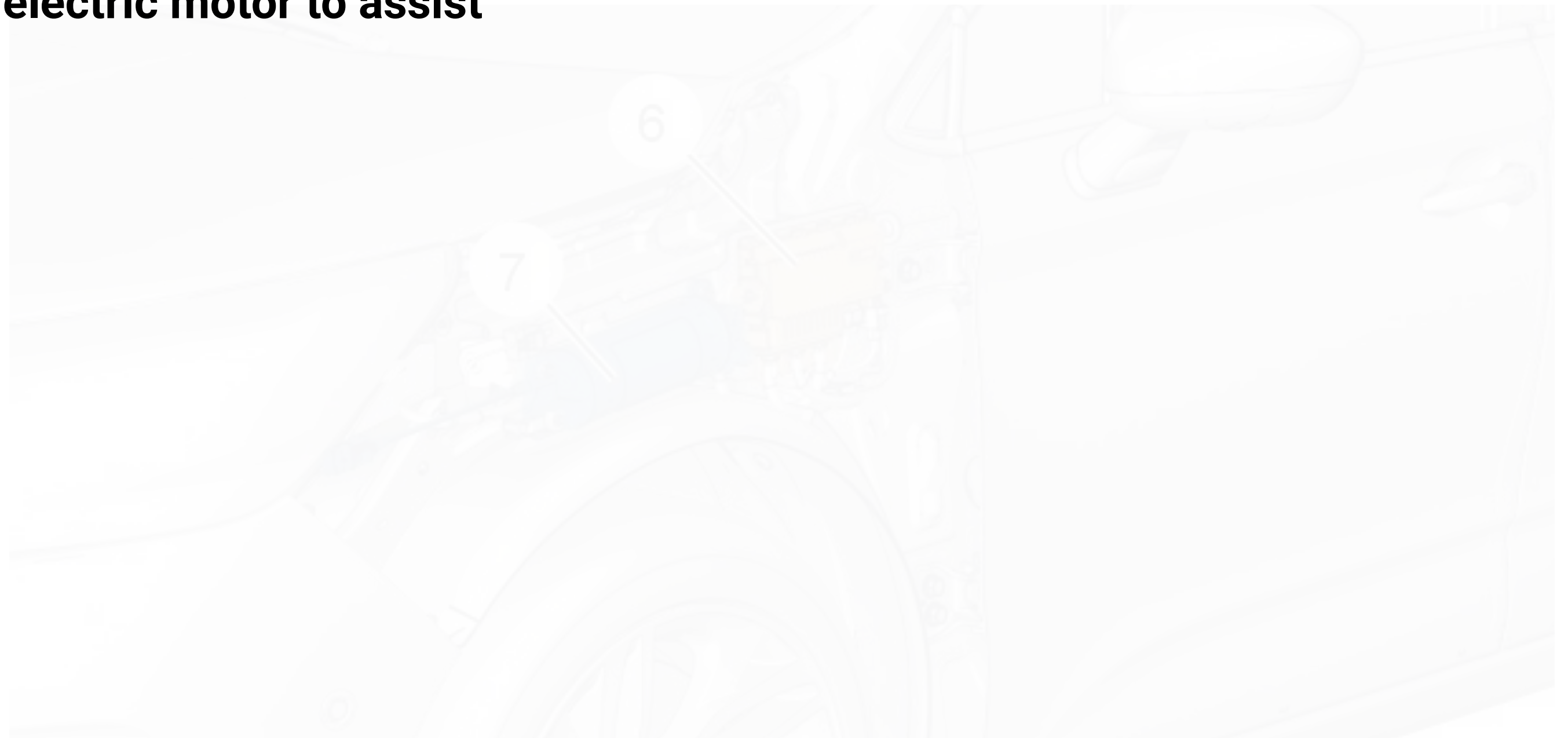
Wireless charging also takes place!!

Fast charging up to 350KW is possible, but you will not come across it at home charging stations.



HYBRID AND ELECTRIC

No electric motor to assist



Micro Hybrid

HYBRID AND ELECTRIC



Micro Hybrid

HYBRID AND ELECTRIC

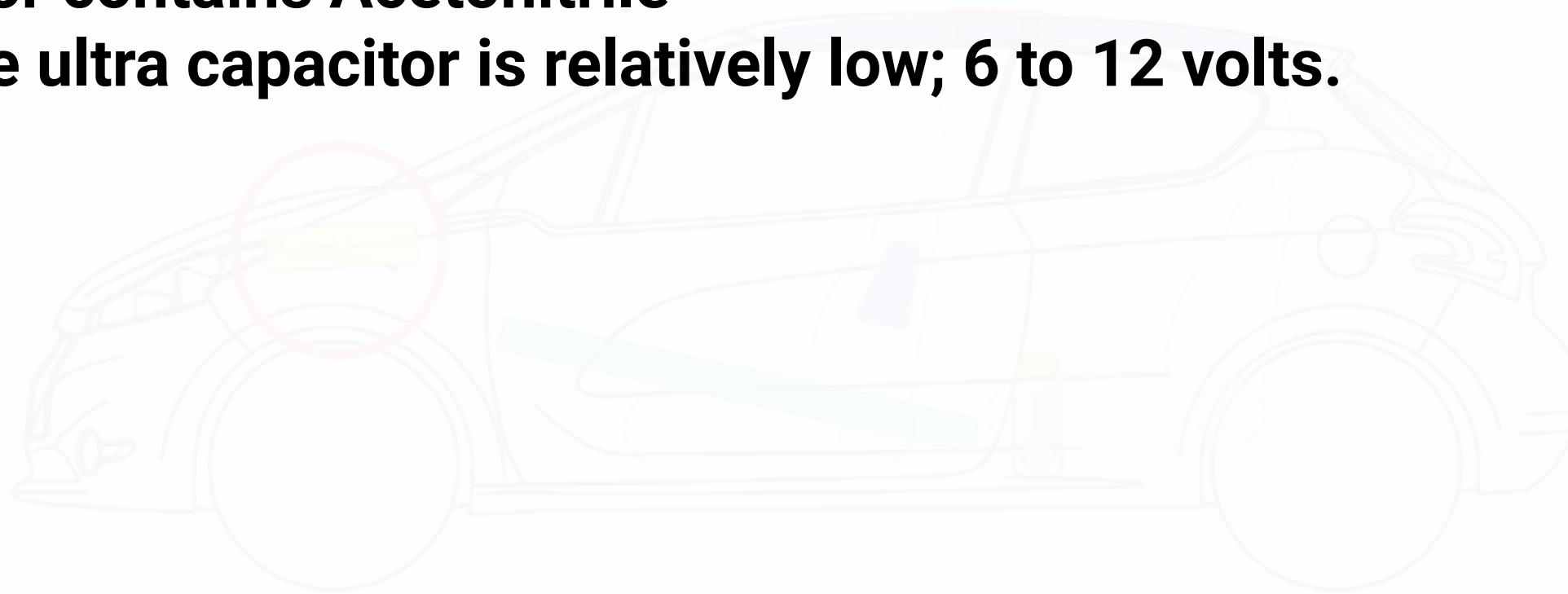
Micro hybrid cars have a Start-Stop system



Micro Hybrid

HYBRID AND ELECTRIC

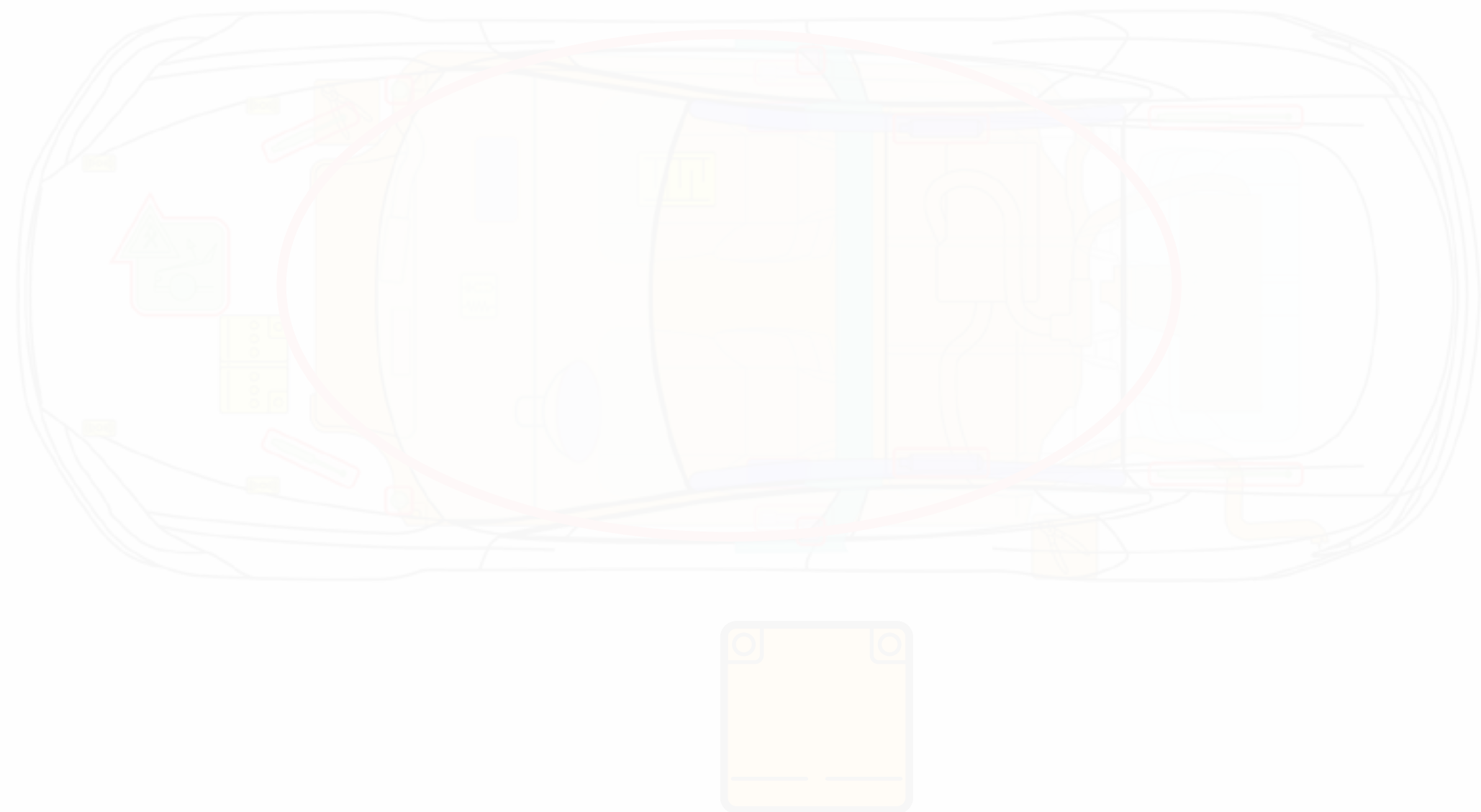
Caution!
Ultra capacitor contains Acetonitrile
Voltage in the ultra capacitor is relatively low; 6 to 12 volts.



Micro Hybrid

HYBRID AND ELECTRIC

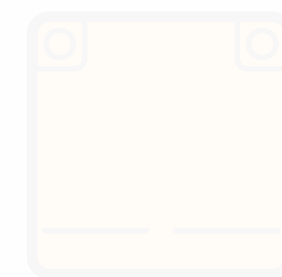
Large battery pack



Electric

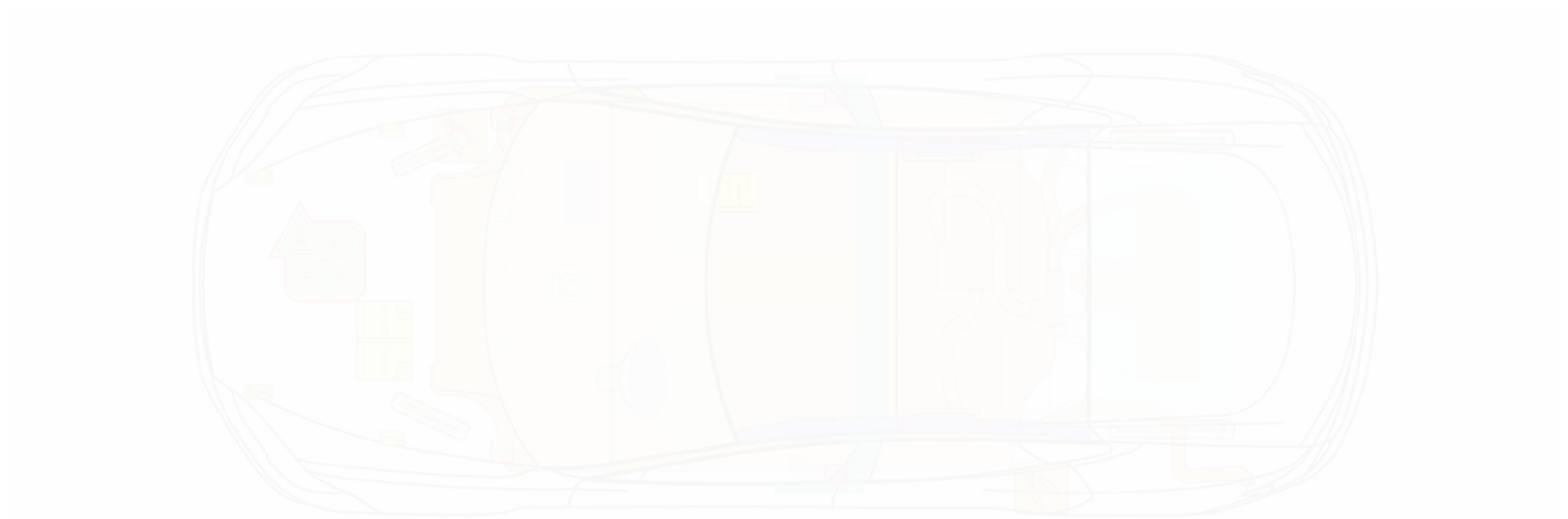
HYBRID AND ELECTRIC

Entire base plate



Electric

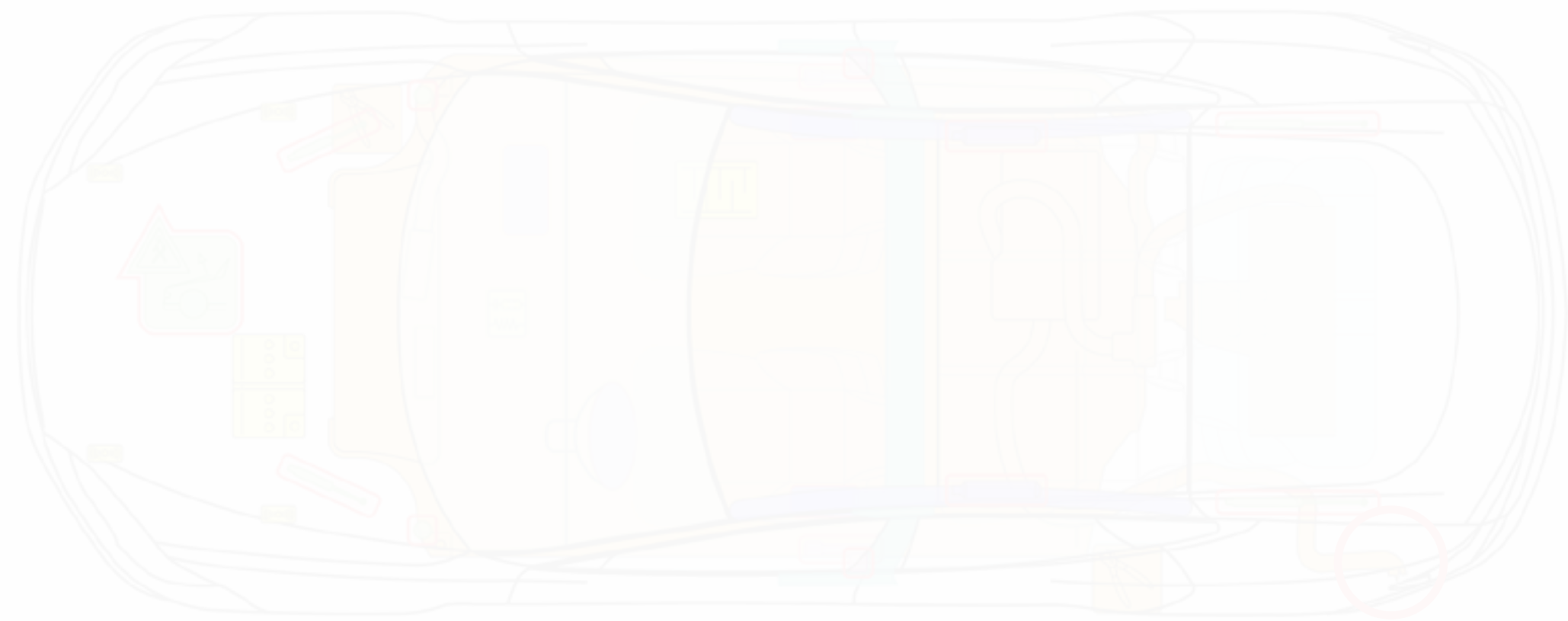
HYBRID AND ELECTRIC



Electric

HYBRID AND ELECTRIC

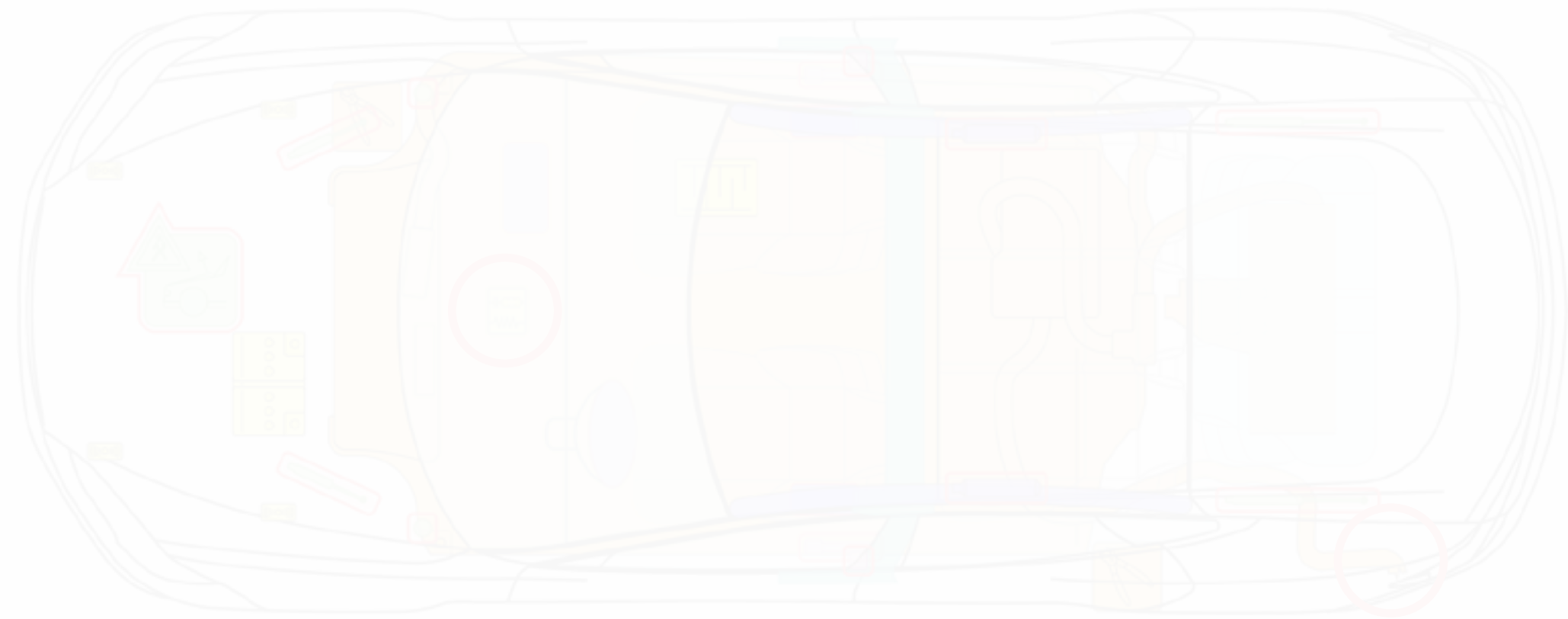
Charge through plug connection point



Electric

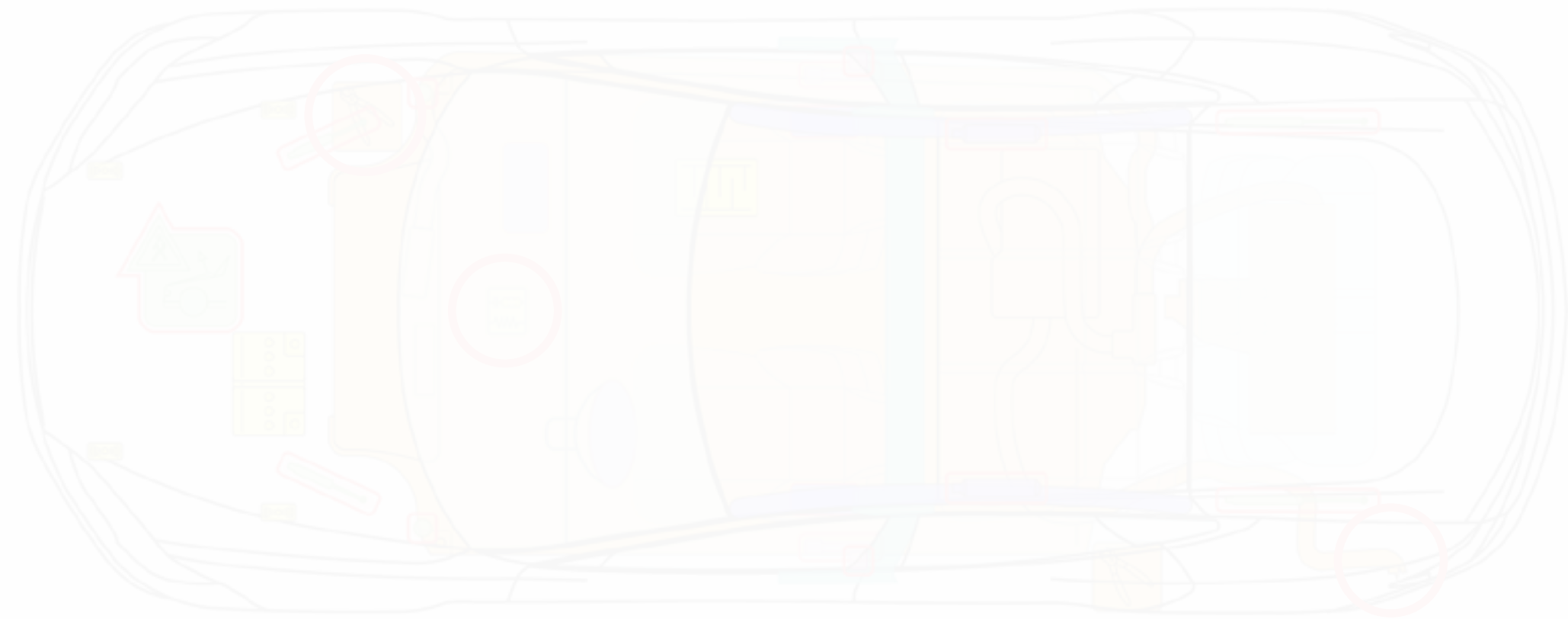
HYBRID AND ELECTRIC

Switch off HV battery automatically by activation of SRS



HYBRID AND ELECTRIC

Emergency deactivation cable or multiple deactivation options

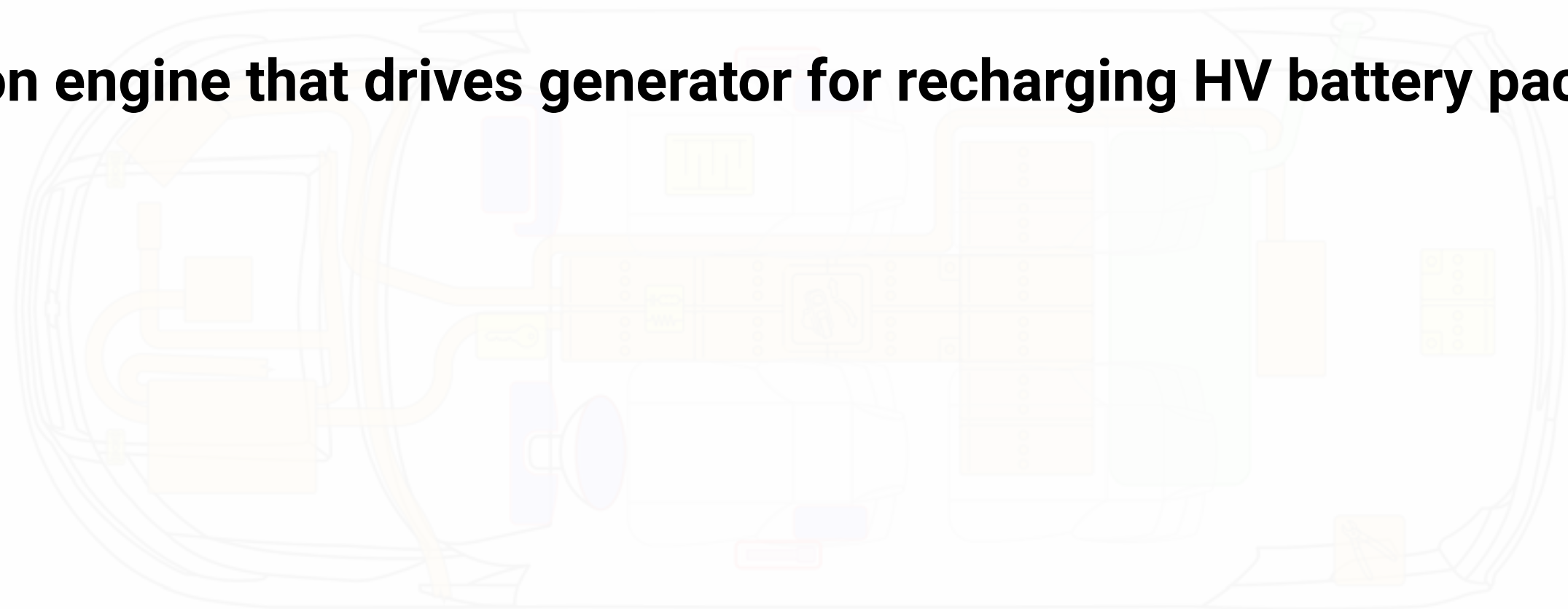


Electric

HYBRID AND ELECTRIC

Electric propulsion

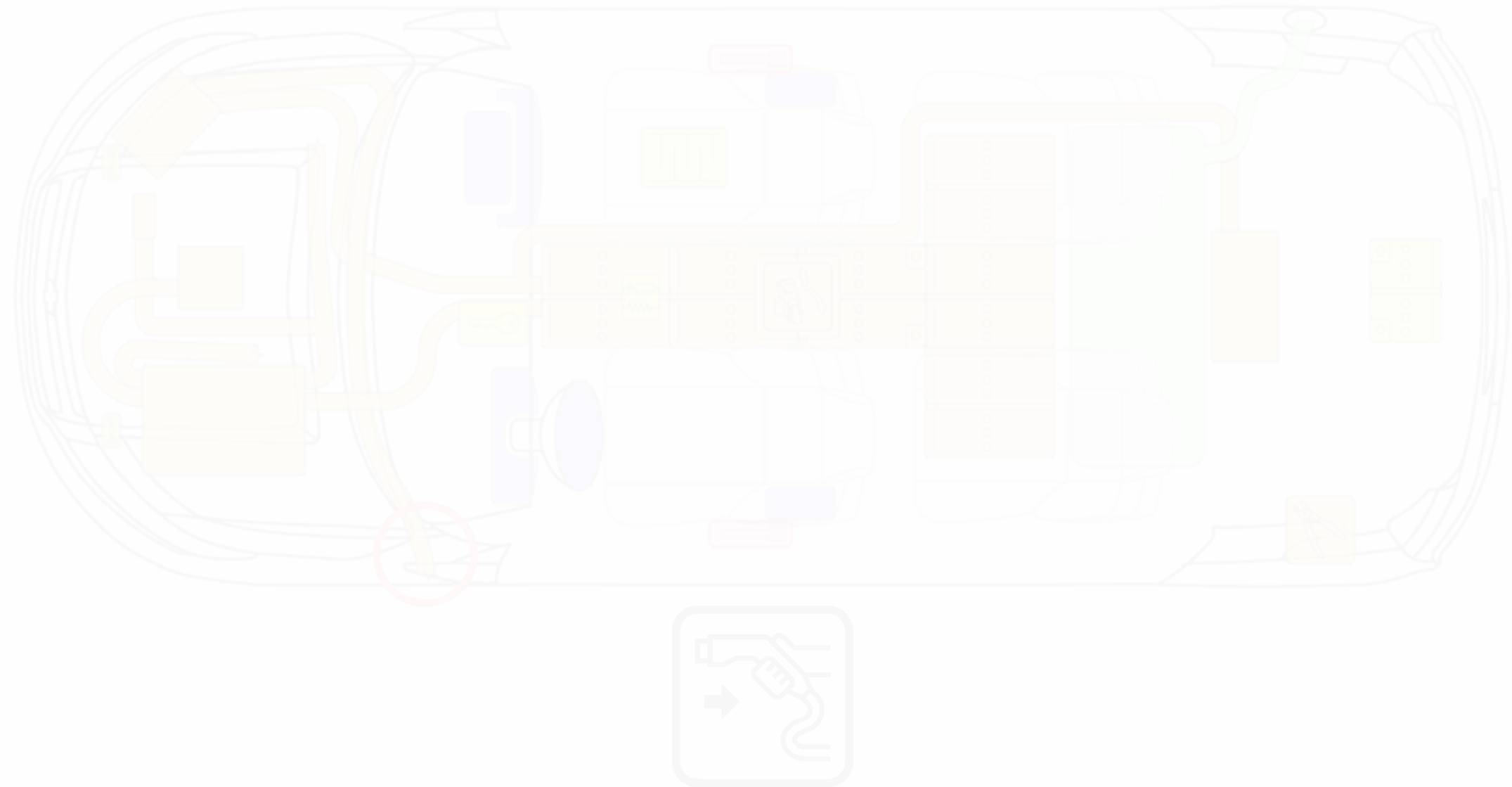
Combustion engine that drives generator for recharging HV battery pack



Range-Extender

HYBRID AND ELECTRIC

Plug connection point for charging station

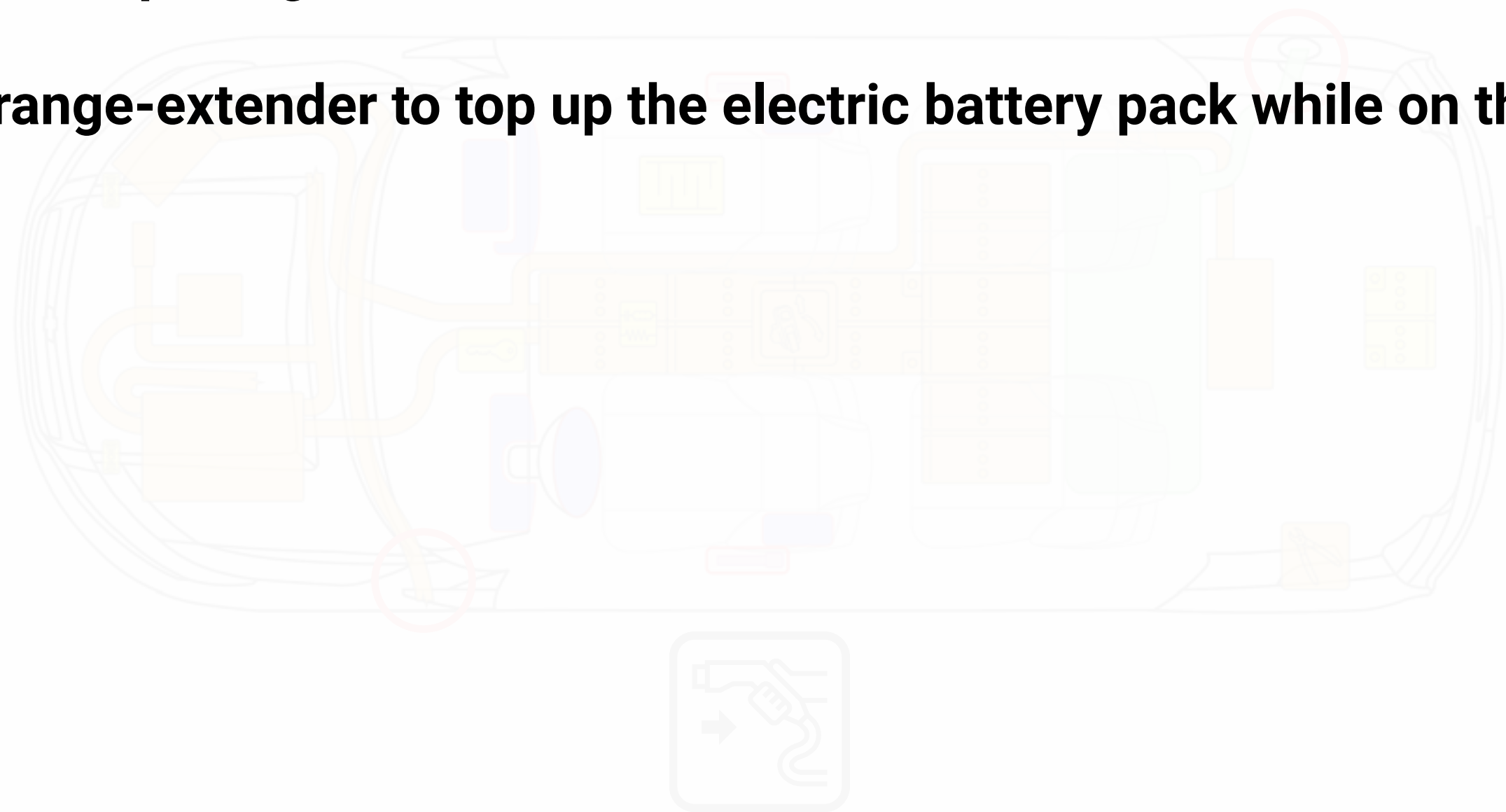


Range-Extender

HYBRID AND ELECTRIC

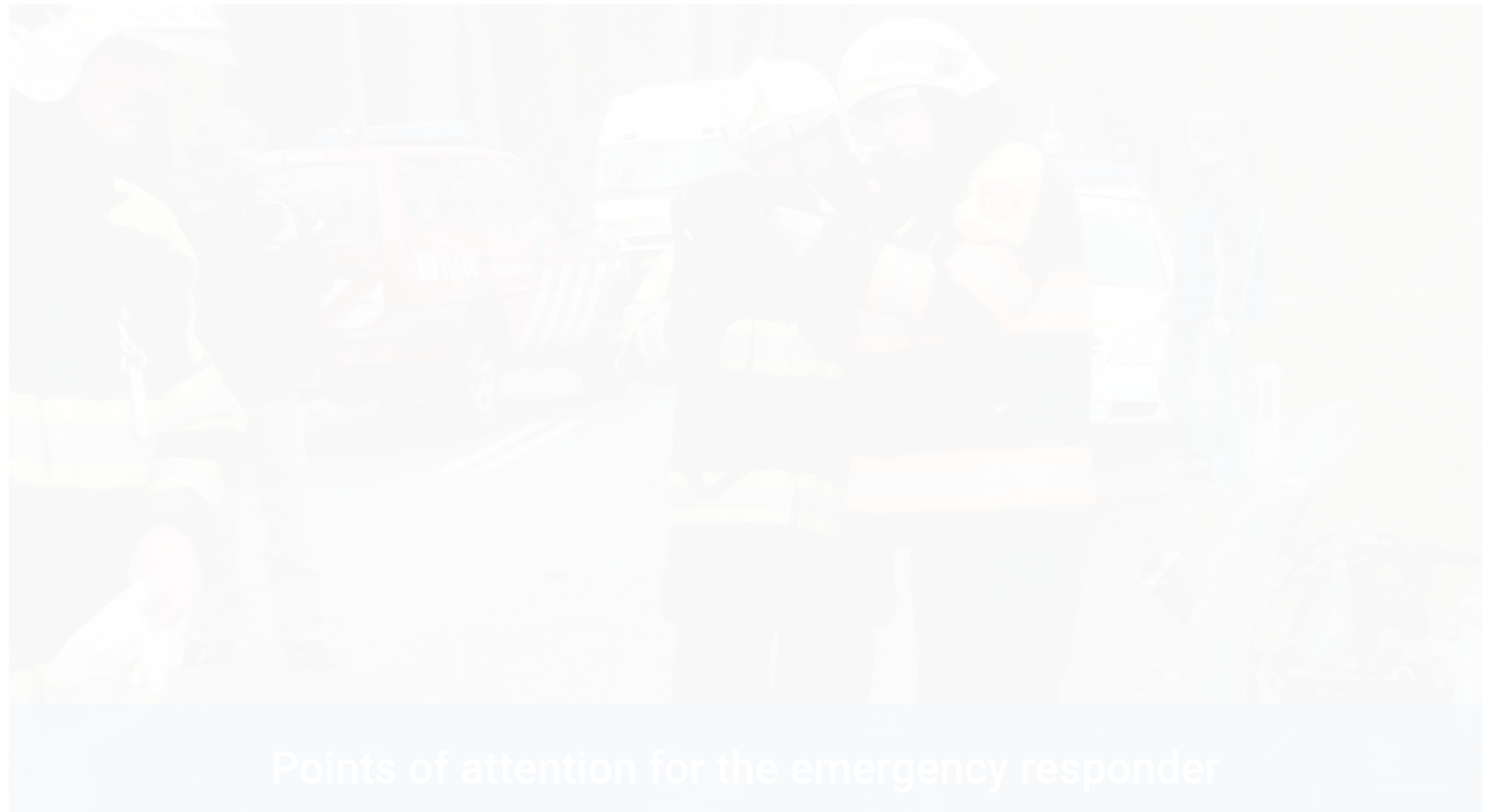
Fuel tank filler opening

You use a range-extender to top up the electric battery pack while on the road.



Range-Extender

HYBRID AND ELECTRIC





HYBRID AND ELECTRIC



TECHNICAL

Points of attention for the emergency responder

HYBRID AND ELECTRIC

TECHNICAL

- Depending on the type of car, the voltage in hybrid and electric cars is between 12 V and 800 V

Points of attention for the emergency responder

HYBRID AND ELECTRIC

TECHNICAL

- Depending on the type of car, the voltage in hybrid and electric cars is between 12 V and 800 V

INCIDENT RESPONSE

Points of attention for the emergency responder

HYBRID AND ELECTRIC

TECHNICAL

- Depending on the type of car, the voltage in hybrid and electric cars is between 12 V and 800 V

INCIDENT RESPONSE

- No audible engine noise

Points of attention for the emergency responder

HYBRID AND ELECTRIC

TECHNICAL

- Depending on the type of car, the voltage in hybrid and electric cars is between 12 V and 800 V

INCIDENT RESPONSE

- No audible engine noise
- Fast and powerful acceleration through high torque

HYBRID AND ELECTRIC

TECHNICAL

- Depending on the type of car, the voltage in hybrid and electric cars is between 12 V and 800 V

INCIDENT RESPONSE

- No audible engine noise
- Fast and powerful acceleration through high torque
- Highly toxic fumes from a vehicle fire



HYBRID AND ELECTRIC



HYBRID AND ELECTRIC

HV cables often out of sight

Orange cables



HYBRID AND ELECTRIC

Orange cables

Warning stickers



Safety

HYBRID AND ELECTRIC

The bodywork is not part of the HV system. The HV plus and minus cables are NOT connected to the bodywork. When an HV cable is damaged and touches the bodywork, the leakage current will be measured and the HV relay will open automatically. This also happens when the HV cables touch each other with the plus and minus.

There is NO earth, it is a 'floating' net.

DO NOT measure yourself, only specialists from the vehicle brand garage know what and where they can measure.

HYBRID AND ELECTRIC



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

- > High voltage battery
- > 330 Volt, 16 kWh
- > Total weight: 230 kg



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

Construction of the HV battery
pack



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

Construction of the HV battery pack

- > 12 Modules
- > 10 x 8 cells
- > 2 x 4 cells



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

Construction of the HV battery pack

- > 12 Modules
- > 10 x 8 cells
- > 2 x 4 cells
- > 88 cells of 3.7 V



Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

Construction of the HV battery
pack

Installation location
HV battery pack



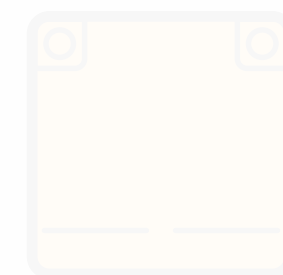
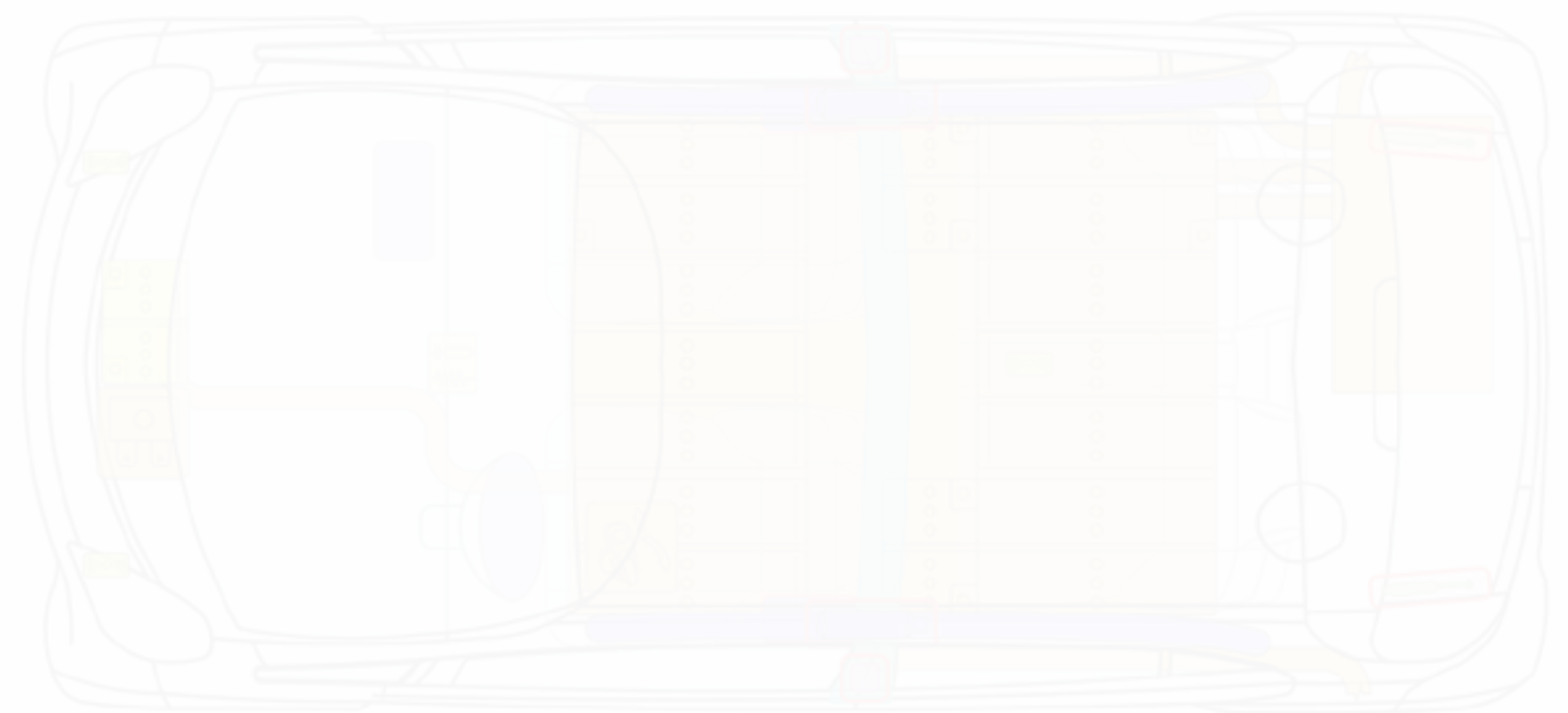
Safety: HV battery pack

HYBRID AND ELECTRIC

HV battery pack

Construction of the HV battery pack

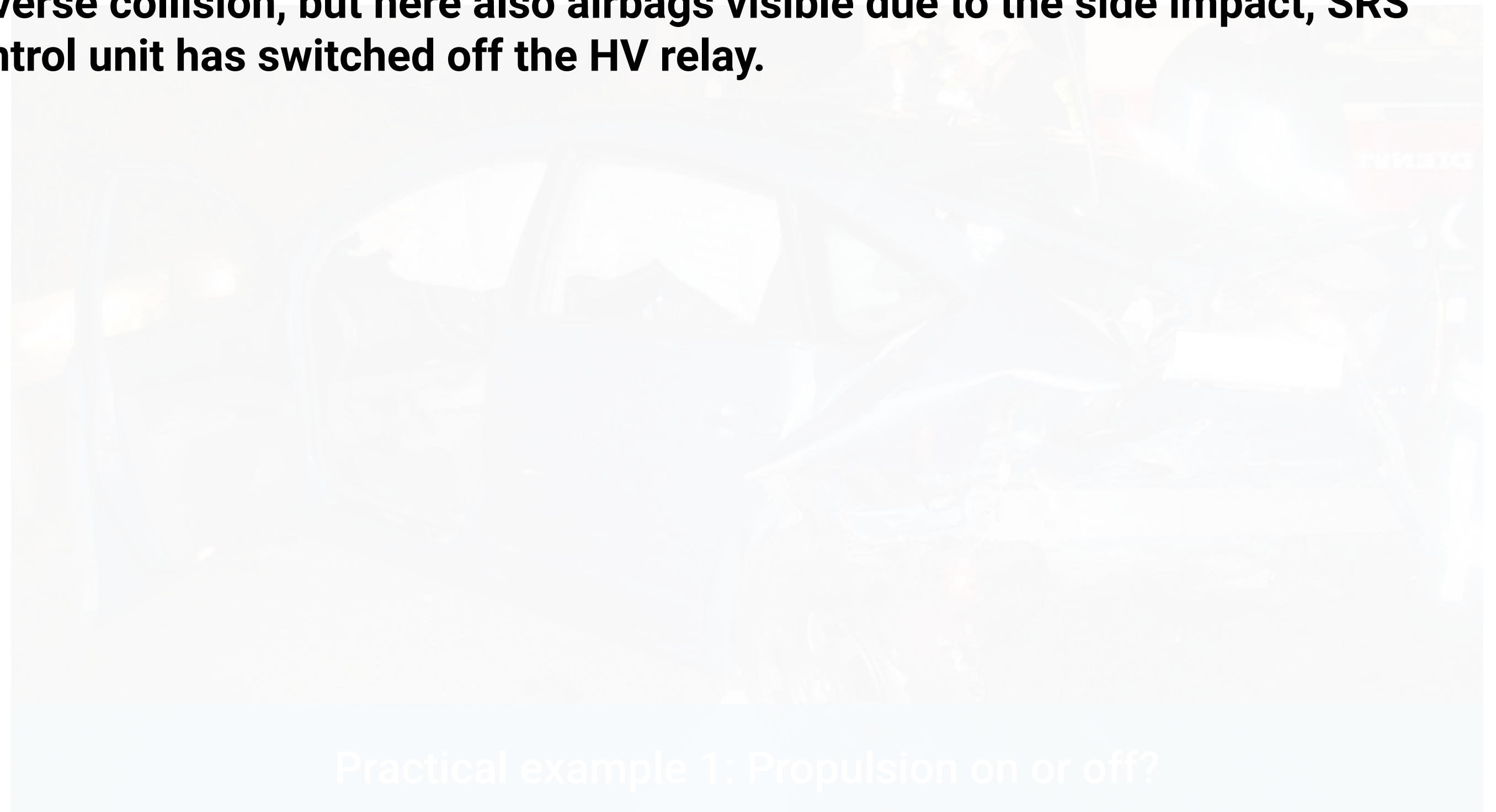
Installation location
HV battery pack



Safety: HV battery pack

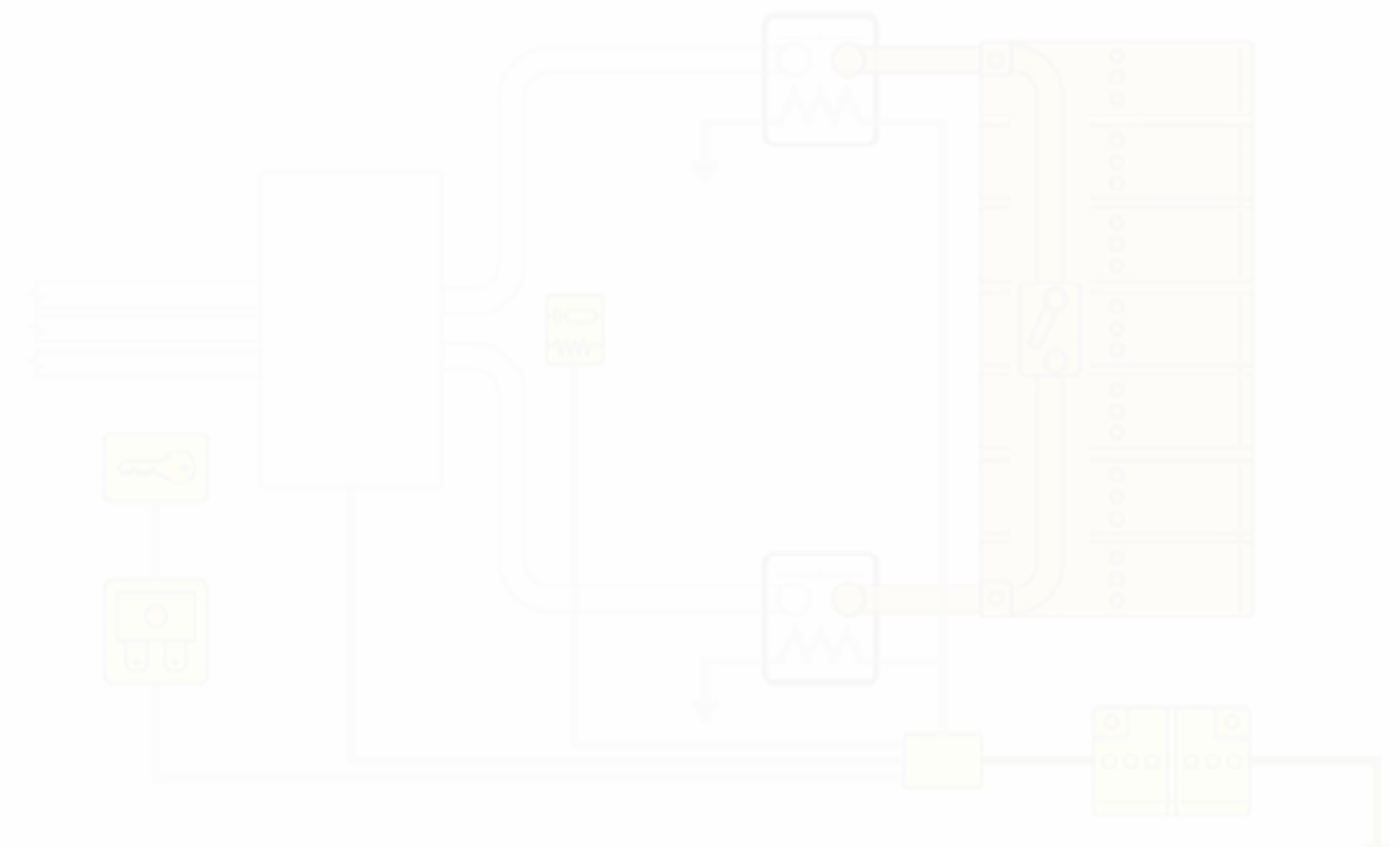
HYBRID AND ELECTRIC

Reverse collision, but here also airbags visible due to the side impact, SRS control unit has switched off the HV relay.



HYBRID AND ELECTRIC

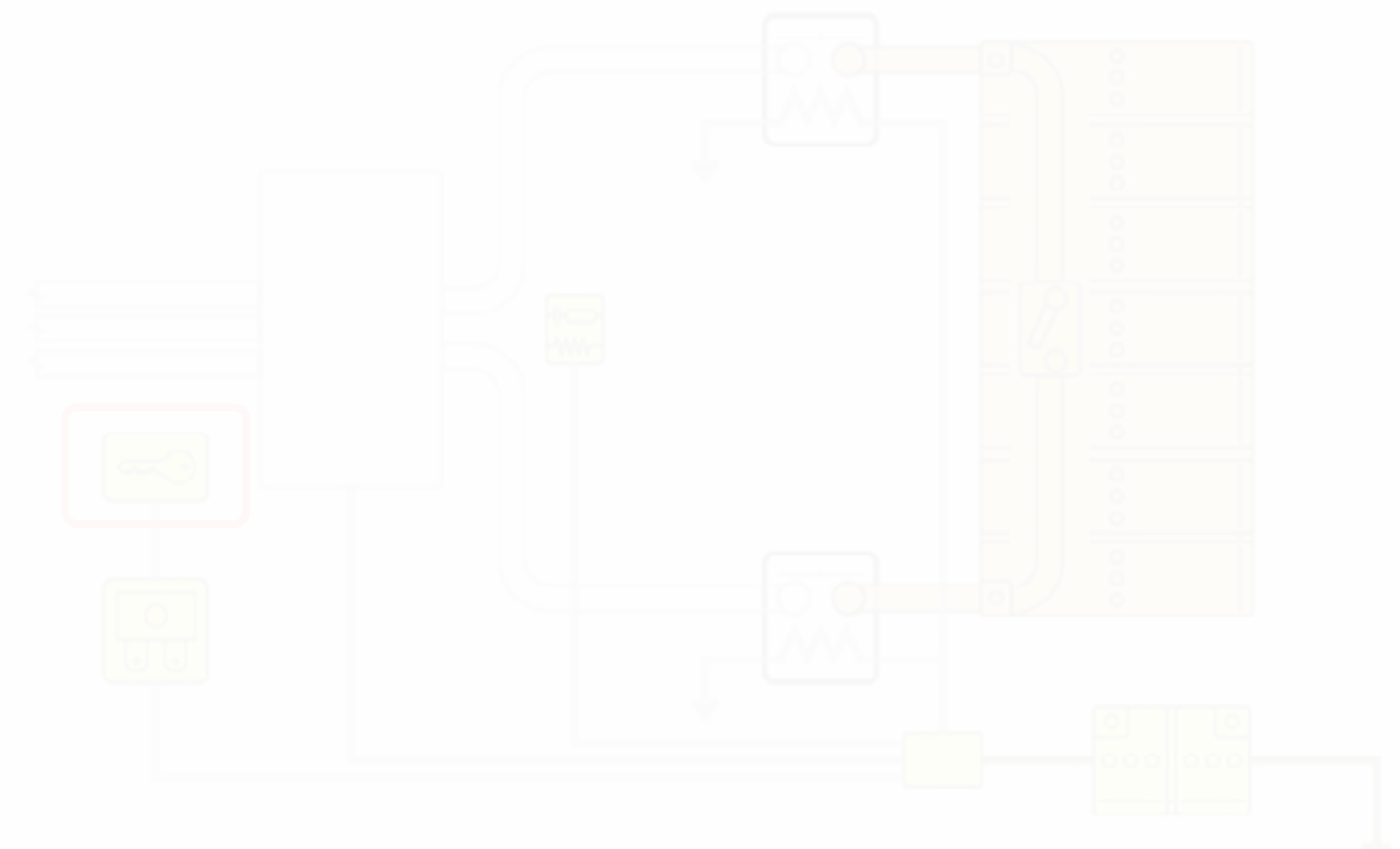
Switch on ignition with start/
stop button or ignition key



Safety: Switch on propulsion

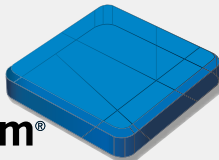
HYBRID AND ELECTRIC

Switch on ignition with start/
stop button or ignition key



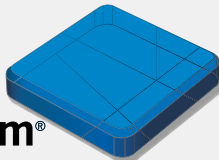
Safety: Switch on propulsion

HYBRID AND ELECTRIC

CRASH Recovery System® 

The logo for Crash Recovery System. It features the word "Crash" in a large, blue, sans-serif font, with the "C" being significantly larger and stylized. Below "Crash" is the text "Recovery System" in a smaller, black, sans-serif font. To the right of the text is a blue, 3D isometric cube with a white grid pattern on its top face.

HYBRID AND ELECTRIC

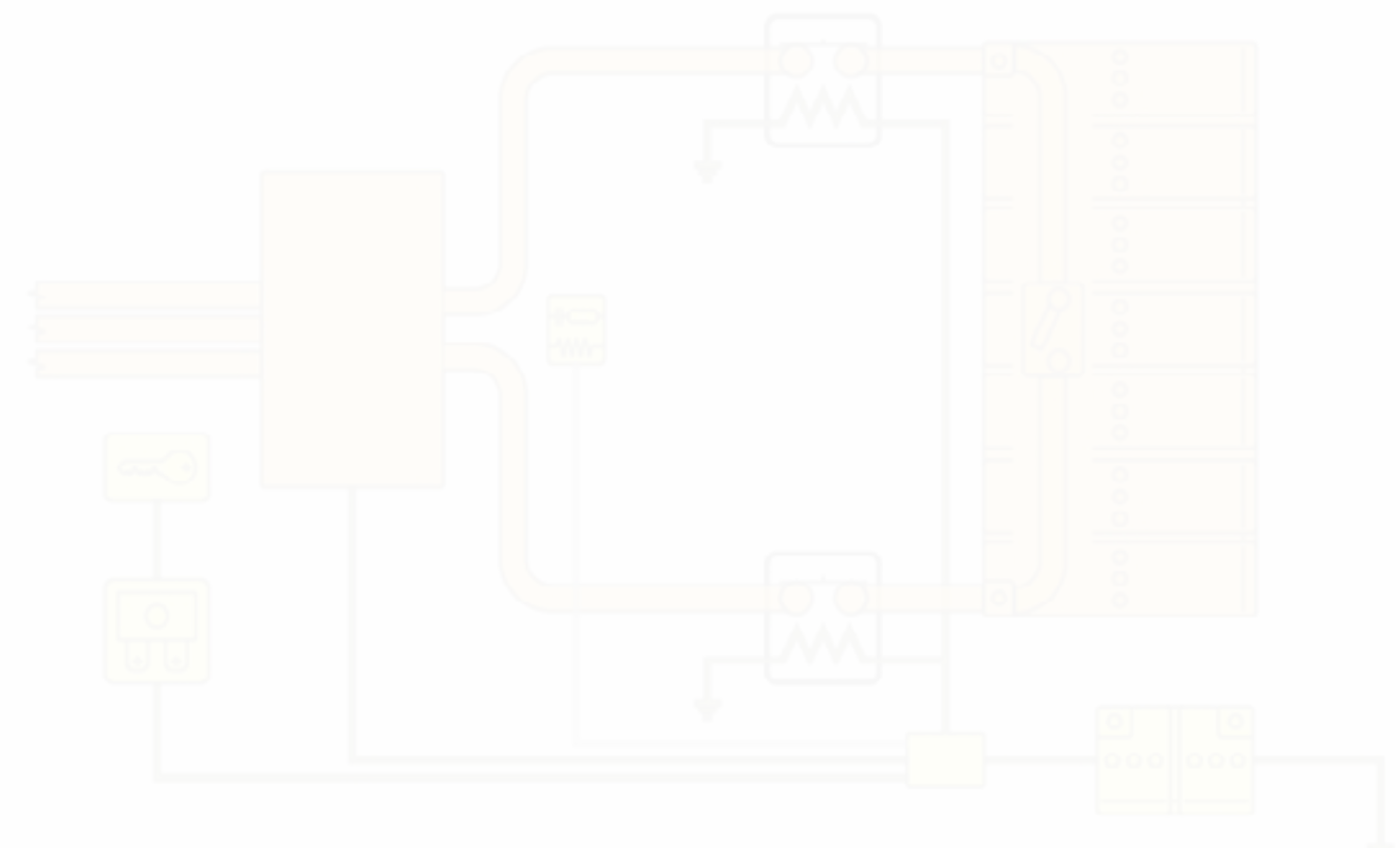
CRASH Recovery System® 

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HYBRID AND ELECTRIC

Switch on ignition with start/
stop button or ignition key

- DC voltage from battery pack
to inverter
- AC voltage
- Vehicle ready to drive



Safety: Switch on propulsion

HYBRID AND ELECTRIC



HYBRID AND ELECTRIC

By SRS activation



Safety: Automatic shutdown in the event of an accident

HYBRID AND ELECTRIC

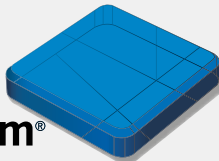
By SRS activation

Carry out a check!!
READY INDICATOR off?



Safety: Automatic shutdown in the event of an accident

HYBRID AND ELECTRIC

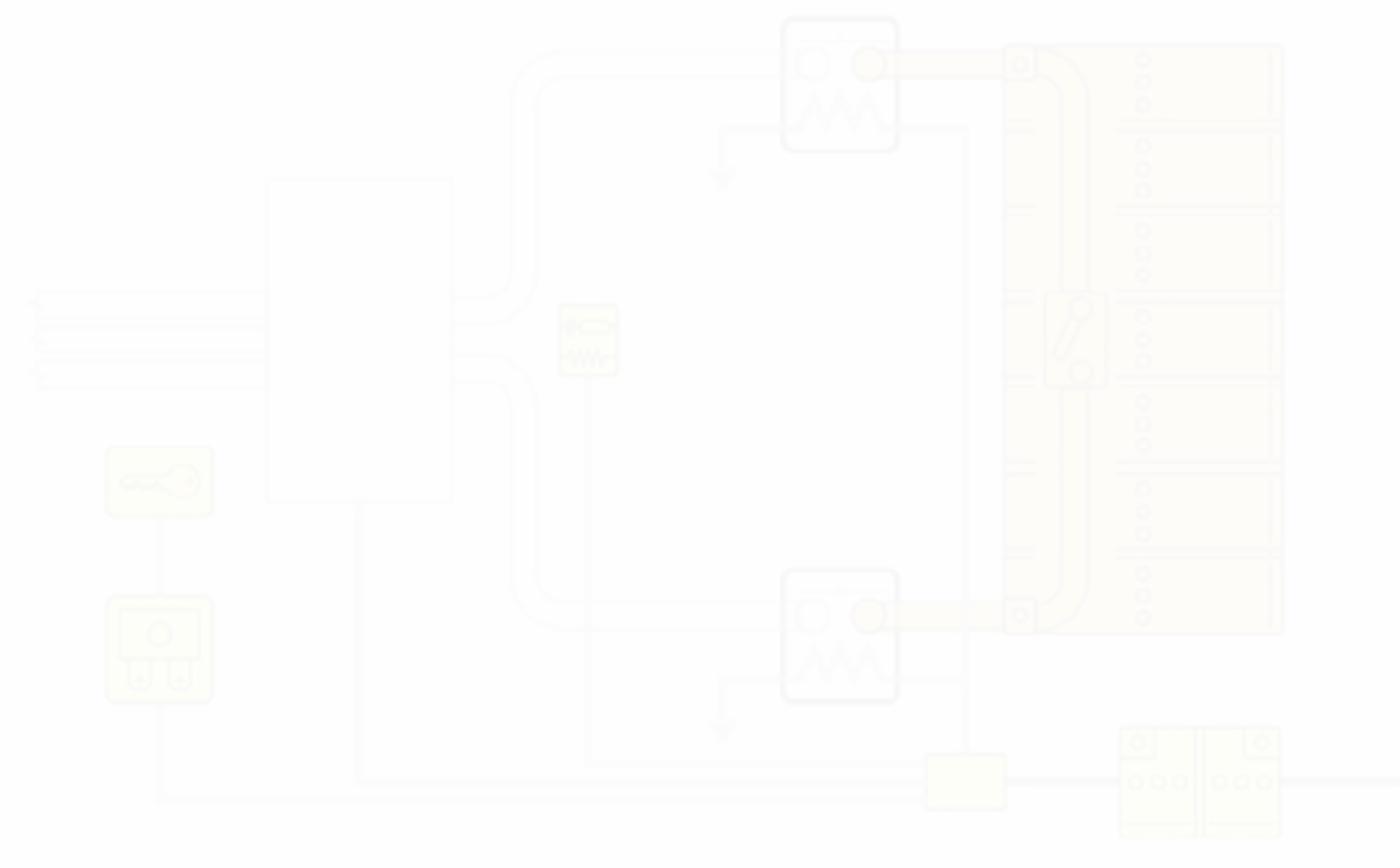
CRASH Recovery System® 

HYBRID AND ELECTRIC

By SRS activation

Carry out a check!!
READY INDICATOR

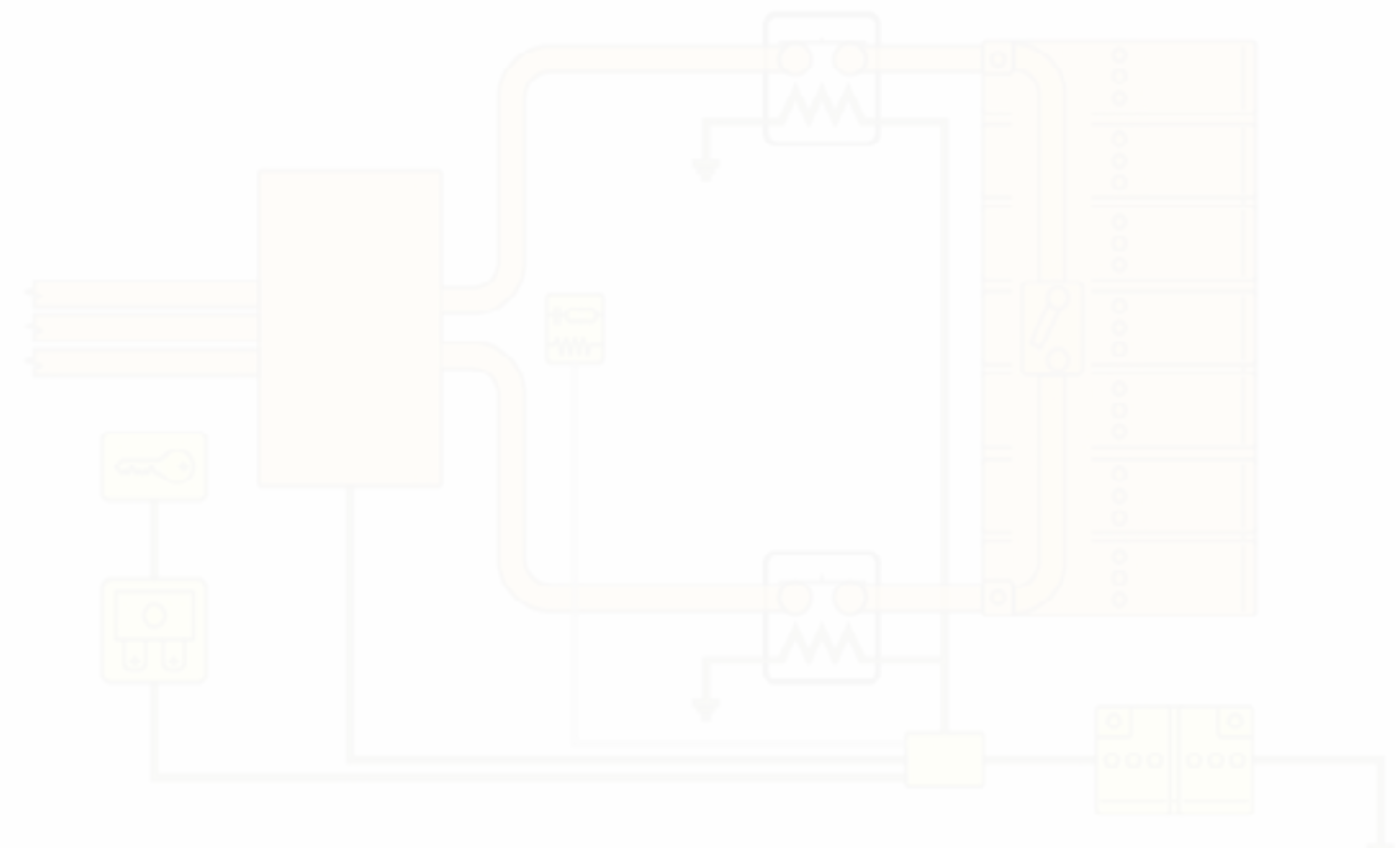
SRS control unit has switched
off the electric propulsion.



Safety: Automatic shutdown in the event of an accident

HYBRID AND ELECTRIC

Vehicle still in operating mode
after accident?:

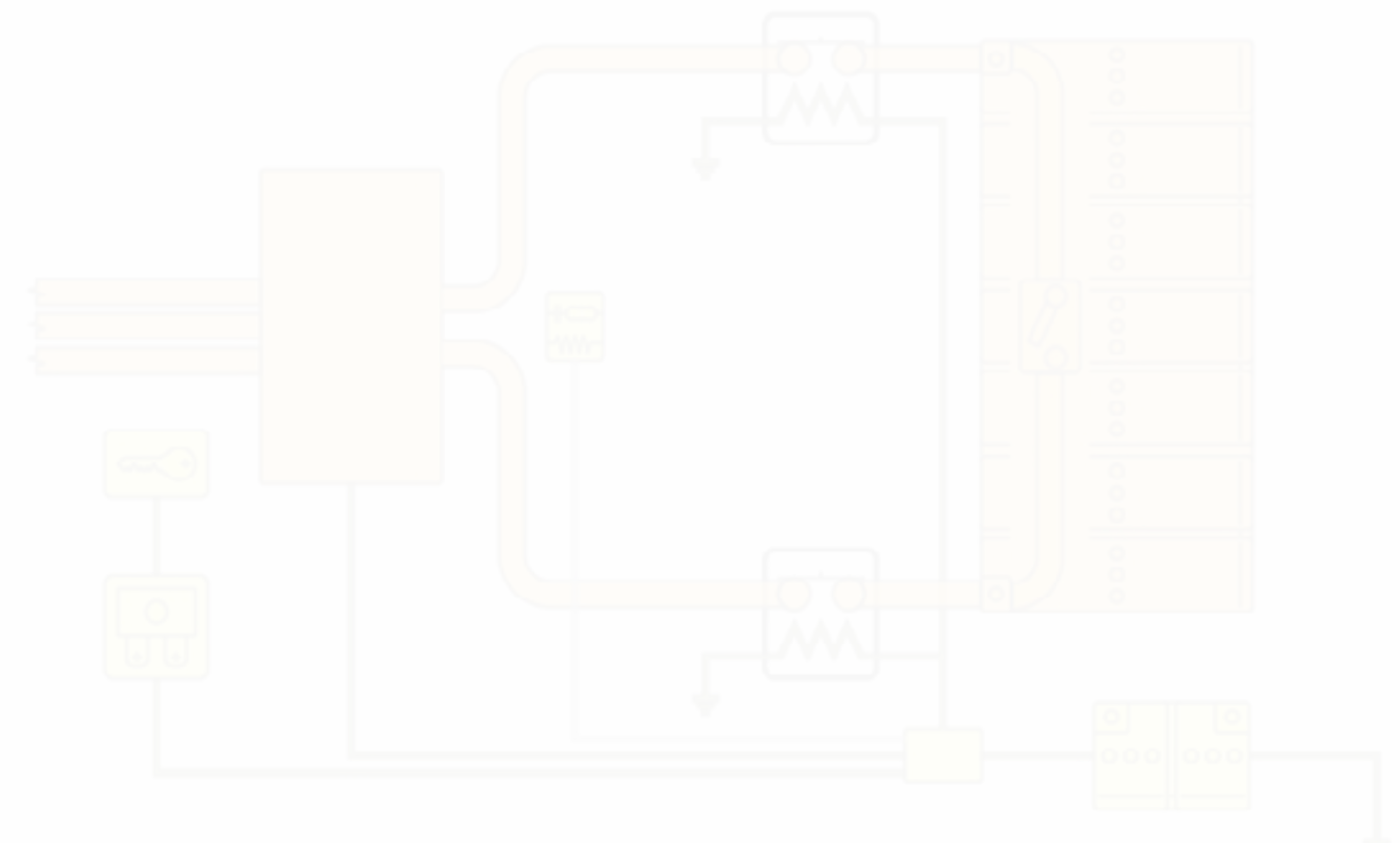


Safety: Accident without SRS activation

HYBRID AND ELECTRIC

Vehicle still in operating mode
after accident?:

- Carry out a check!
- READY INDICATOR still on?
- Follow directions in the CRS!

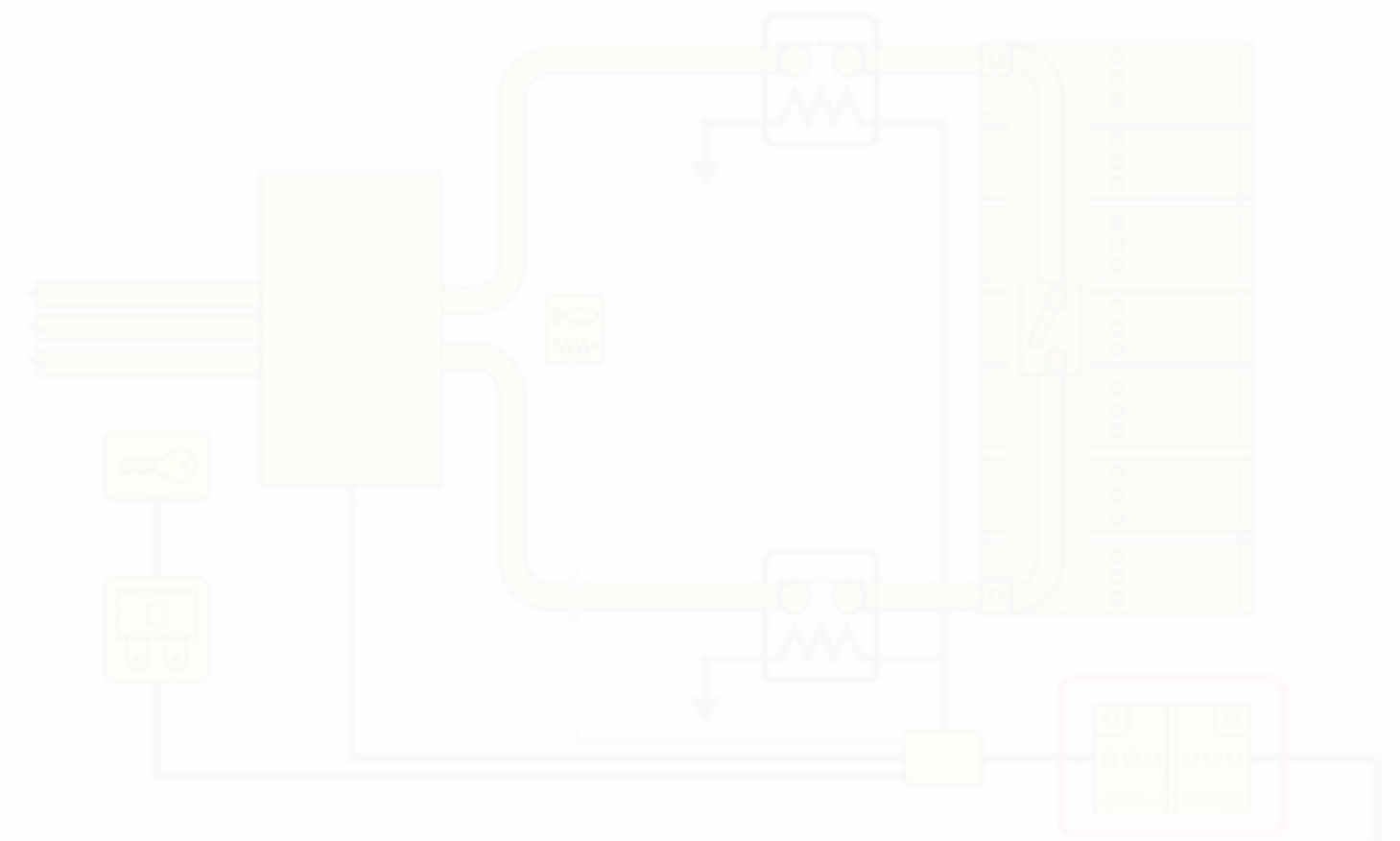


Safety: Accident without SRS activation

HYBRID AND ELECTRIC

Vehicle still in operating mode
after accident?:

- Carry out a check!
- READY INDICATOR still on?
- Follow directions in the CRS!
- Apply ignition and/or secondary
deactivation method

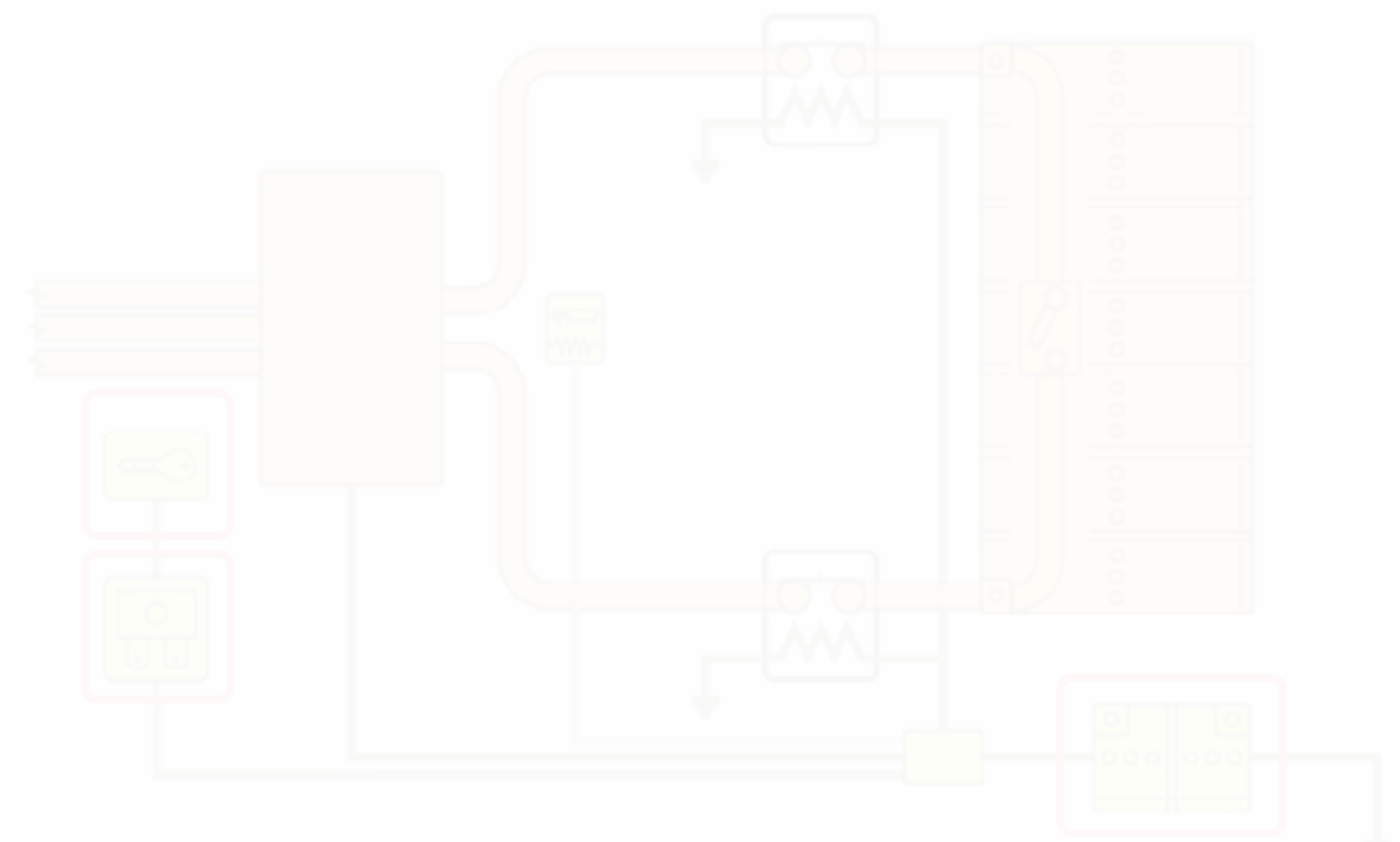


Safety: Accident without SRS activation

HYBRID AND ELECTRIC

Vehicle still in operating mode
after accident?:

- Carry out a check!
- READY INDICATOR still on?
- Follow directions in the CRS!
- Apply ignition and/or secondary
deactivation method

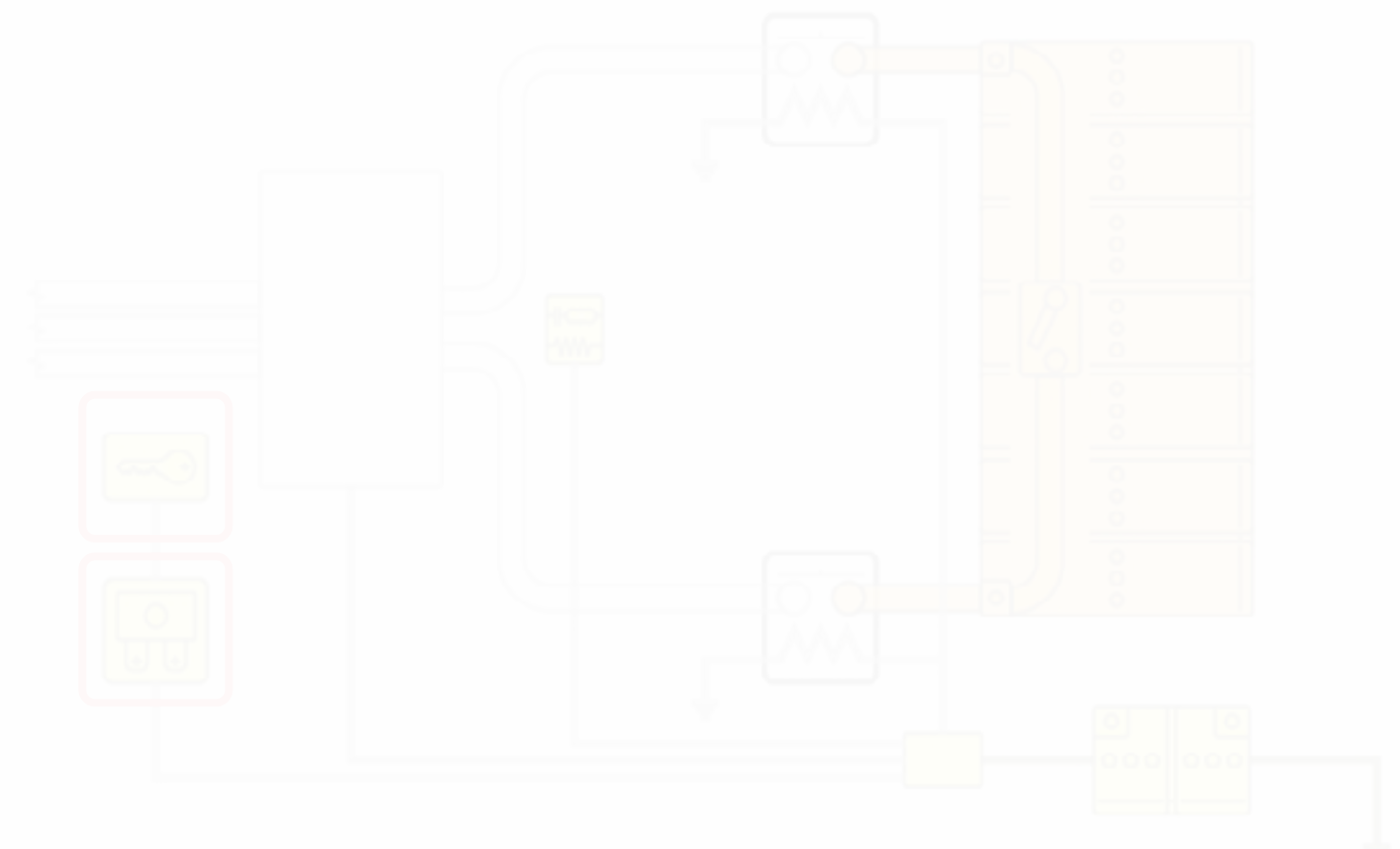


Safety: Accident without SRS activation

HYBRID AND ELECTRIC

Vehicle still in operating mode
after accident?:

- Carry out a check!
- READY INDICATOR still on?
- Follow directions in the CRS!
- Apply ignition and/or secondary
deactivation method



Safety: Accident without SRS activation

HYBRID AND ELECTRIC



Safety: Secondary deactivation

HYBRID AND ELECTRIC

SECONDARY DEACTIVATION

- Most Hybrid and electric vehicles are equipped with one or more emergency circuits



HYBRID AND ELECTRIC

SECONDARY DEACTIVATION

- Most Hybrid and electric vehicles are equipped with one or more emergency circuits
- Wear 1000 Volt gloves when these are recommended



HYBRID AND ELECTRIC

SECONDARY DEACTIVATION

- Most Hybrid and electric vehicles are equipped with one or more emergency circuits
- Wear 1000 Volt gloves when these are recommended
- These emergency circuits are not always part of the HV system



HYBRID AND ELECTRIC

SECONDARY DEACTIVATION

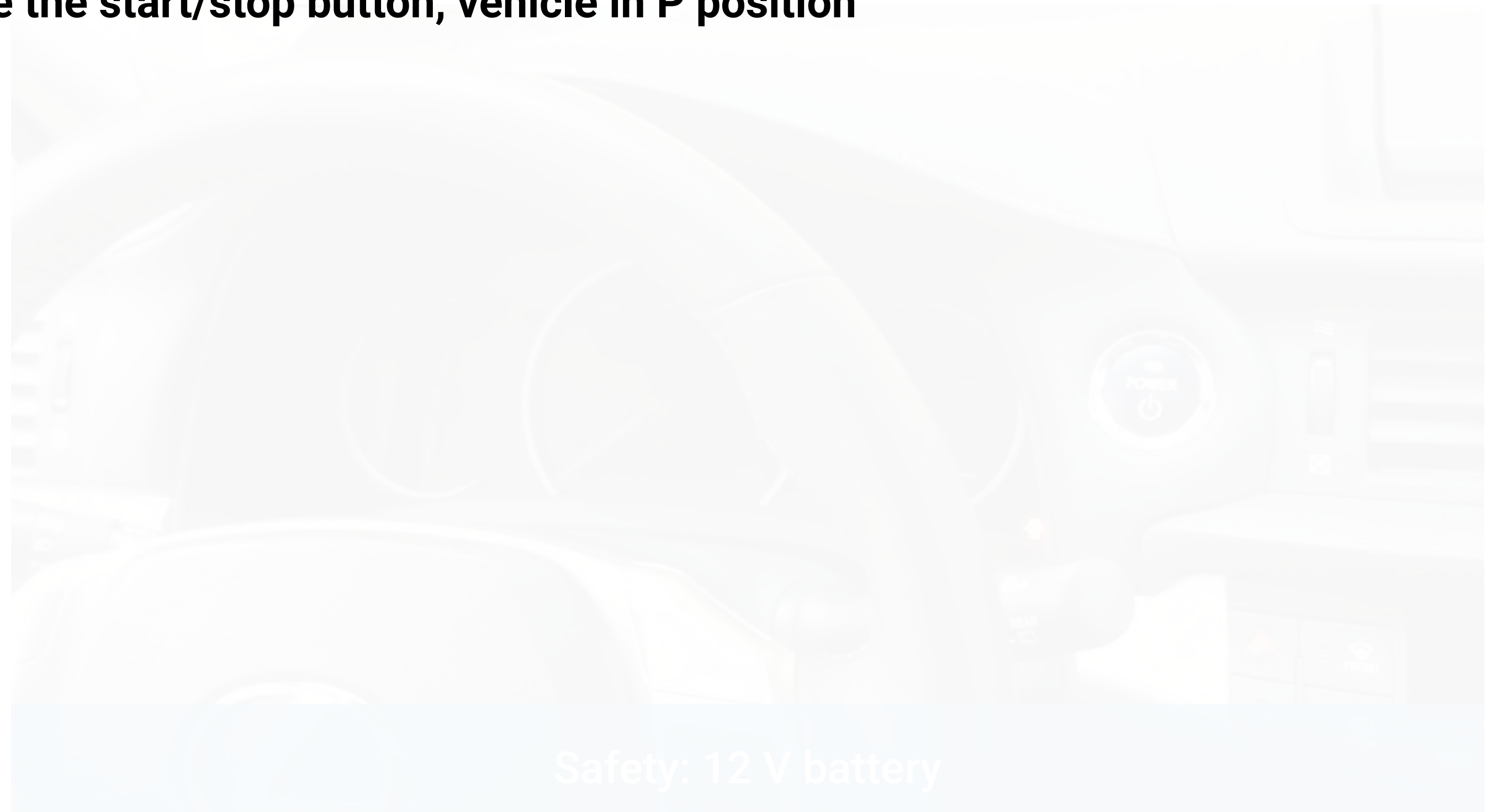
- Most Hybrid and electric vehicles are equipped with one or more emergency circuits
- Wear 1000 Volt gloves when these are recommended
- These emergency circuits are not always part of the HV system

CAUTION! These emergency circuits only switch off the propulsion.
12/24 volts remain active!



HYBRID AND ELECTRIC

Use the start/stop button, vehicle in P position



HYBRID AND ELECTRIC

Caution!
Disconnecting the 12 V battery
does not switch off the
propulsion!



Safety: 12 V battery

HYBRID AND ELECTRIC

Caution!
Disconnecting the 12 V battery
does not switch off the
propulsion!

Switched on HV system
supplies power to the safety
system



Safety: 12 V battery

HYBRID AND ELECTRIC



HYBRID AND ELECTRIC

Damaged HV battery pack?



Practical example 2: HV battery pack

HYBRID AND ELECTRIC

Damaged HV battery pack?

Wear personal protection;
1000 V gloves



Practical example 2: HV battery pack

HYBRID AND ELECTRIC

Damaged HV battery pack?

Wear personal protection;
1000 V gloves

Lithium batteries give off toxic,
flammable gases in the event of a fire



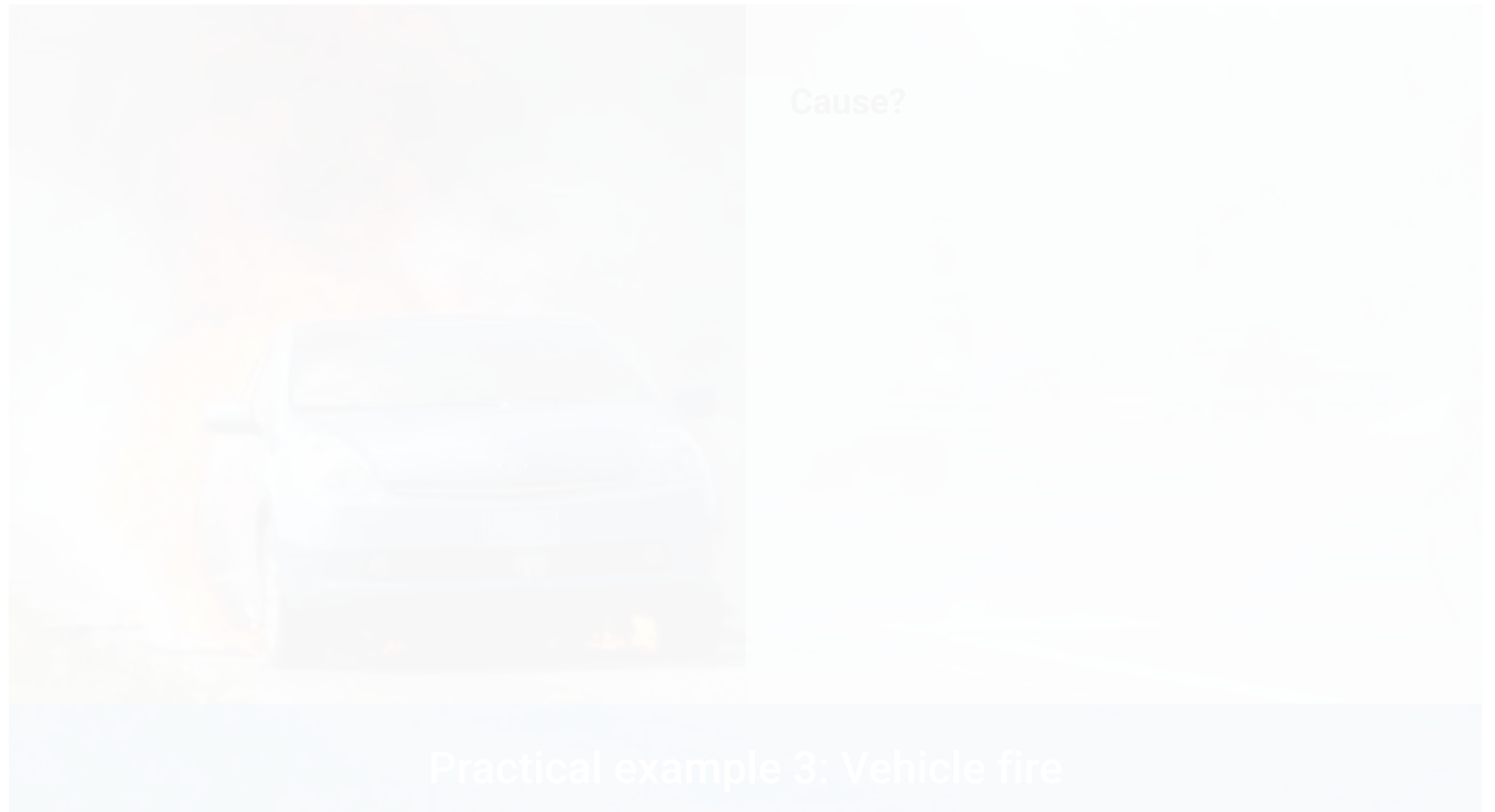
Practical example 2: HV battery pack

HYBRID AND ELECTRIC



Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



HYBRID AND ELECTRIC



Cause?

Short circuit?

Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



Cause?

Short circuit?

Can occur after an accident, even after
24 hours

Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



Cause?

Short circuit?

Can occur after an accident, even after
24 hours

Battery pack involved?

Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



Cause?

Short circuit?

Can occur after an accident, even after
24 hours

Battery pack involved?

Plan

Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



Cause?

Short circuit?

Can occur after an accident, even after
24 hours

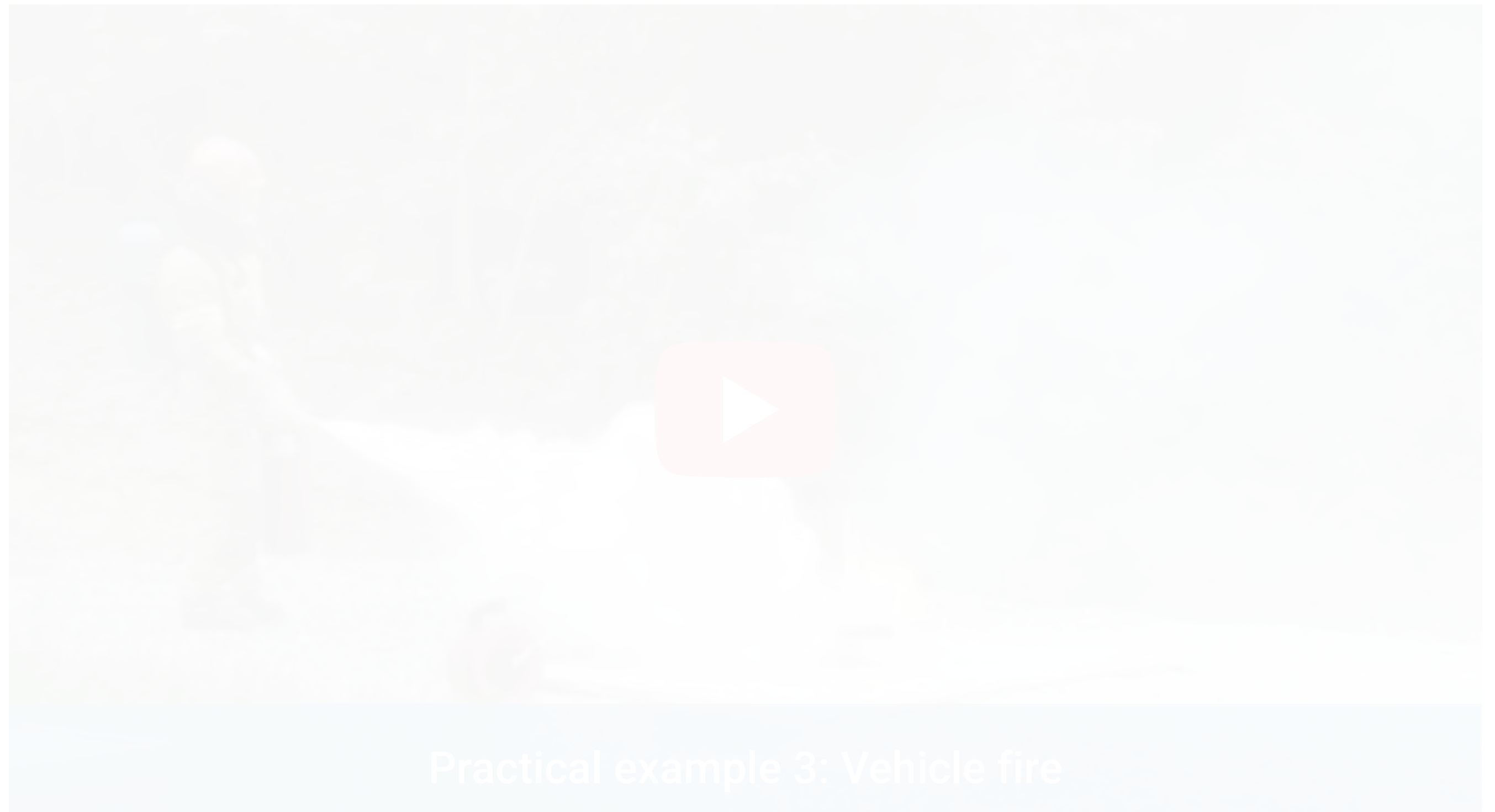
Battery pack involved?

Plan

Plan+

Practical example 3: Vehicle fire

HYBRID AND ELECTRIC



HYBRID AND ELECTRIC

Needs a lot of water



Practical example 3: Vehicle fire

HYBRID AND ELECTRIC

Needs a lot of water

Allow to burn out in a controlled way



Practical example 3: Vehicle fire

HYBRID AND ELECTRIC

Needs a lot of water

Allow to burn out in a controlled way

HV battery pack involved in the fire?



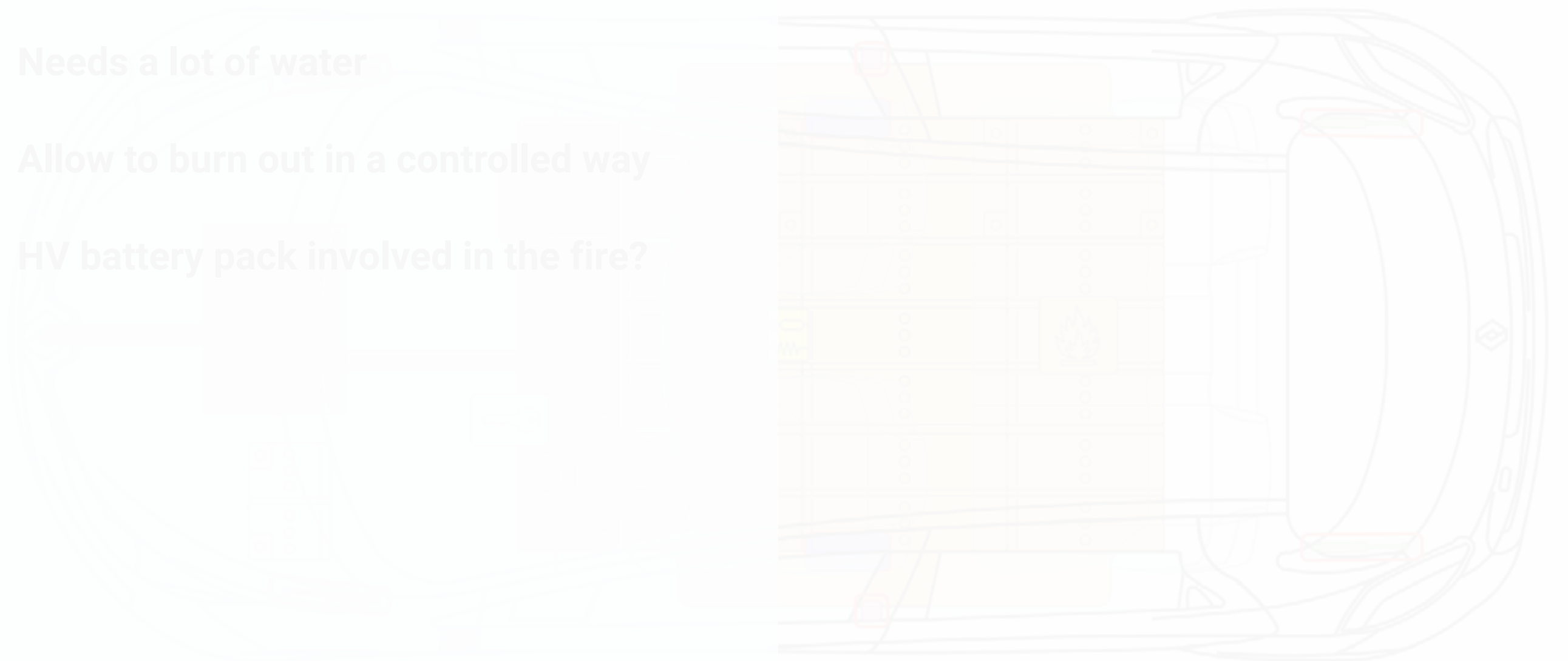
Practical example 3: Vehicle fire

HYBRID AND ELECTRIC

Needs a lot of water

Allow to burn out in a controlled way

HV battery pack involved in the fire?



Practical example 3: Vehicle fire

HYBRID AND ELECTRIC

Needs a lot of water

Allow to burn out in a controlled way

HV battery pack involved in the fire?

Extinguishing water filling opening



Practical example 3: Vehicle fire

Chapter 6

HYDROGEN



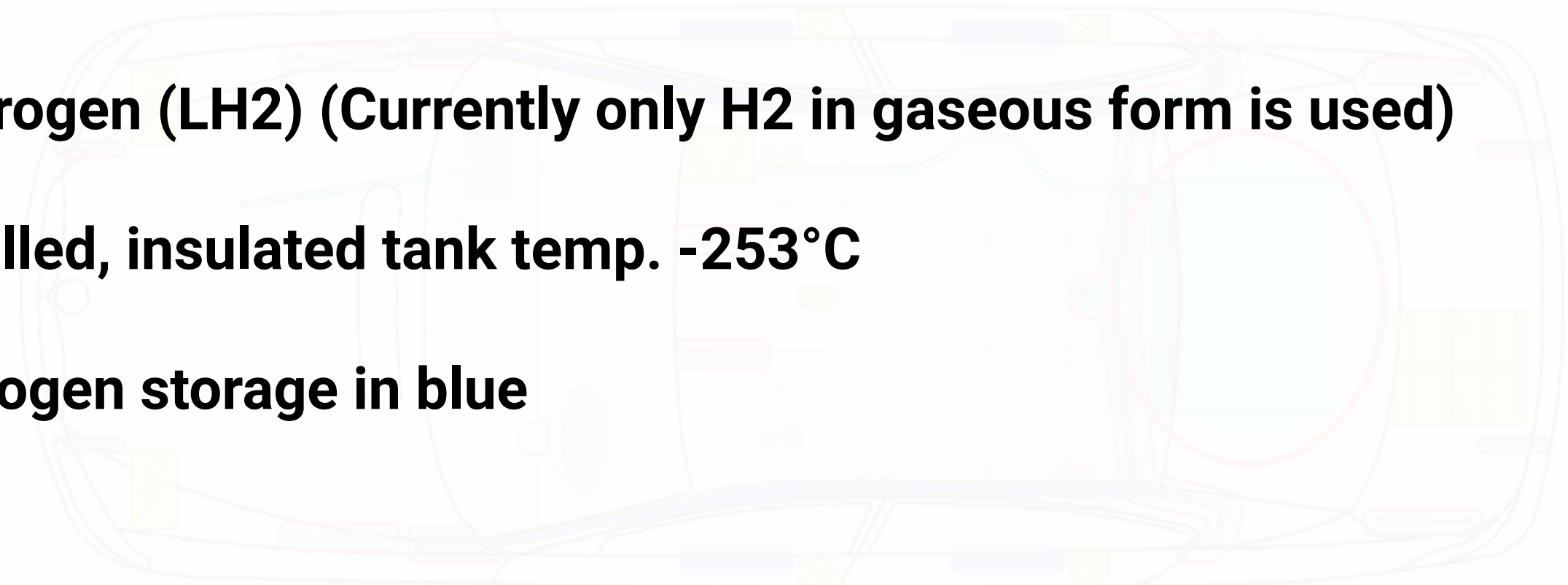
HYDROGEN

Ottomotor internal combustion engine (this type of H₂ vehicle no longer exists today)

Liquid hydrogen (LH₂) (Currently only H₂ in gaseous form is used)

Double-walled, insulated tank temp. -253°C

Show hydrogen storage in blue



H₂

Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Gas Detection System



Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Gas Detection System



Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Gas Detection System

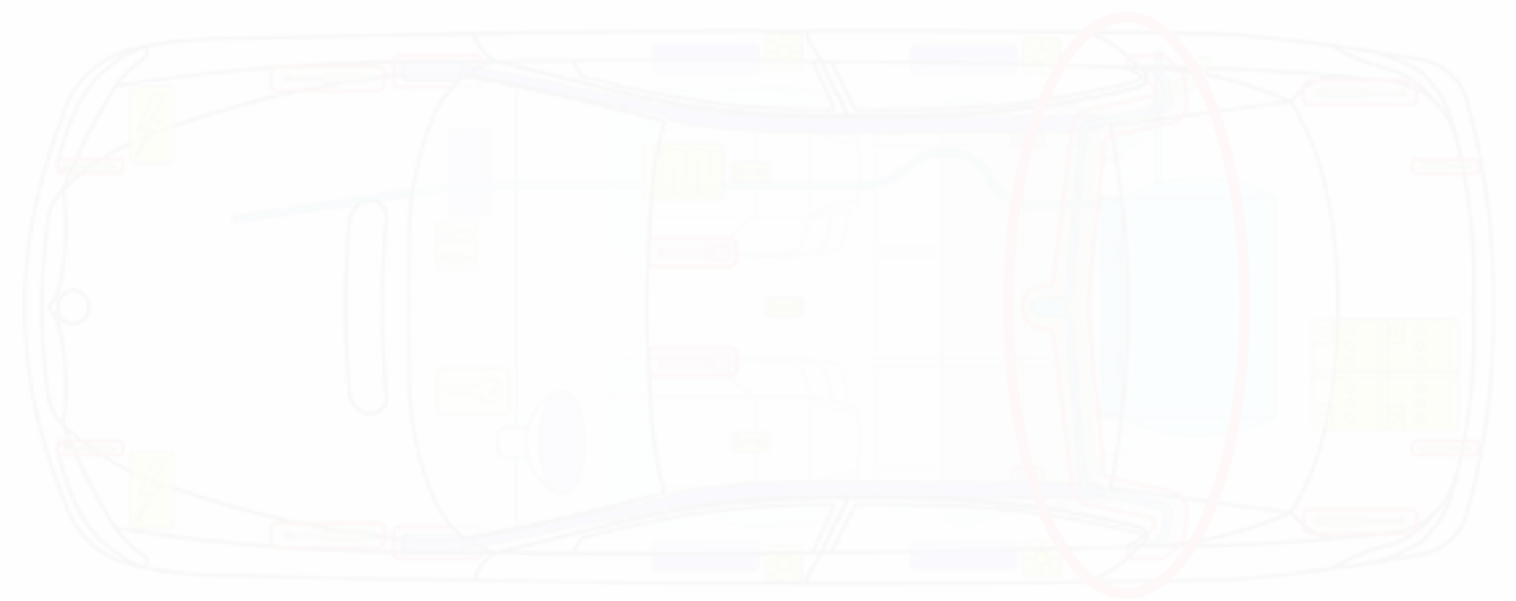


Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Gas Detection System

Extinguishing pipe and opening

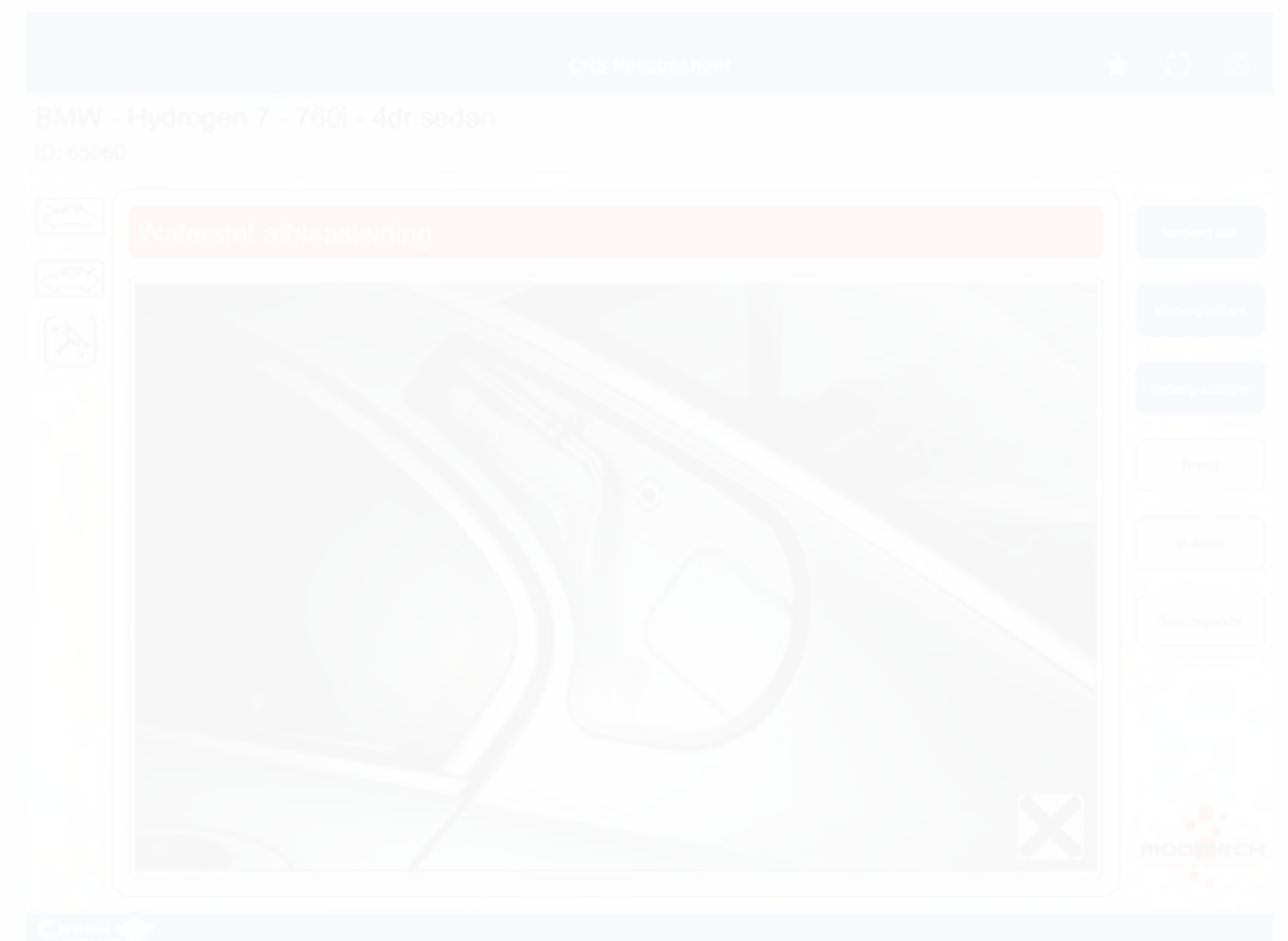


Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Gas Detection System

Extinguishing pipe and opening



Hydrogen - Combustion engine (Bivalent)

HYDROGEN

Electric car



Hydrogen - Electric

HYDROGEN

Electric car

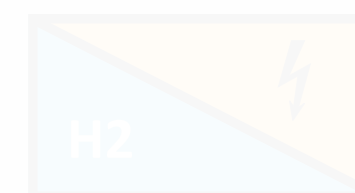


Hydrogen - Electric

HYDROGEN

Electric car

Fuel cell

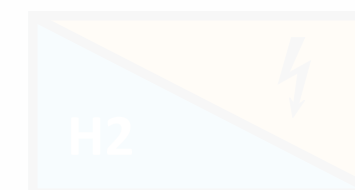


Hydrogen - Electric

HYDROGEN

Electric car

Fuel cell



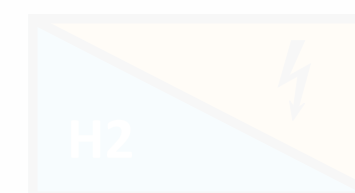
Hydrogen - Electric

HYDROGEN

Electric car

Fuel cell

Compressed hydrogen gas
(GH2)



Hydrogen - Electric

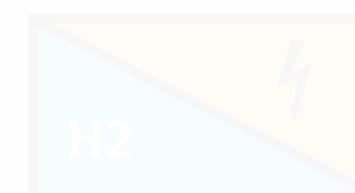
HYDROGEN

Electric car

Fuel cell

Compressed hydrogen gas
(GH2)

Pressure holders 700 Bar



Hydrogen - Electric

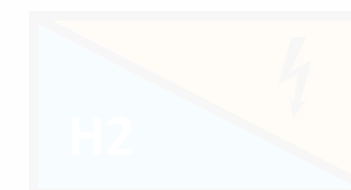
HYDROGEN

Electric car

Fuel cell

Compressed hydrogen gas
(GH2)

Pressure holders 700 Bar



Hydrogen - Electric

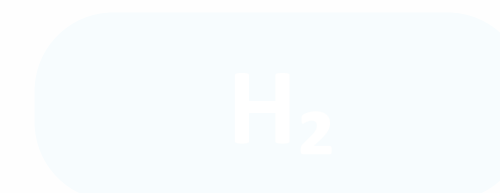
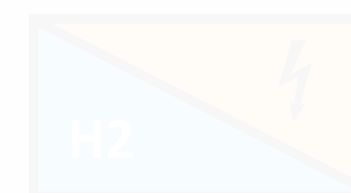
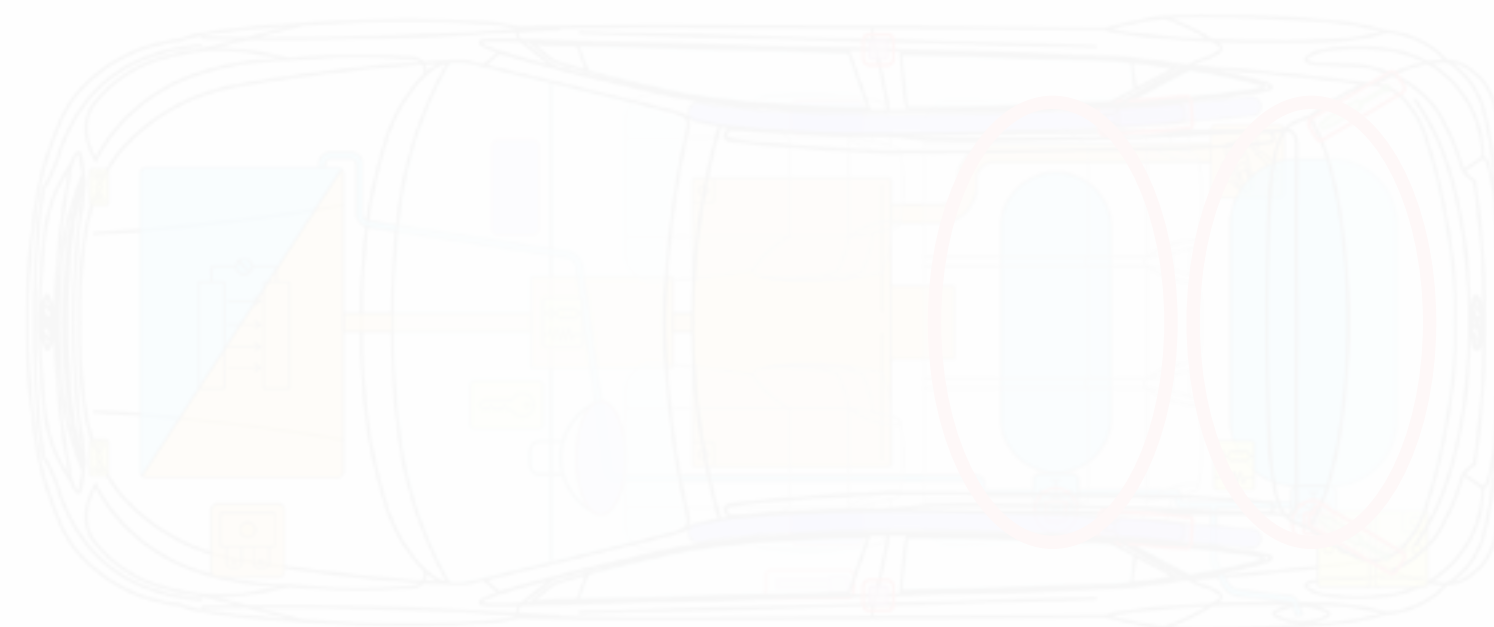
HYDROGEN

Electric car

Fuel cell

Compressed hydrogen gas
(GH2)

Pressure holders 700 Bar



Hydrogen - Electric

HYDROGEN

Electric car

Fuel cell

Compressed hydrogen gas
(GH2)

Pressure holders 700 Bar

Technology



HYDROGEN



HYDROGEN

Highly flammable

Physical properties of hydrogen

HYDROGEN

Highly flammable

14 x lighter than air (gas)

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

Odourless

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

Odourless

Explosion limit 4 and 96 vol% in air

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

Odourless

Explosion limit 4 and 96 vol% in air

Ignition energy 0.02 mJ
(= very little energy)

Ad:

Physical properties of hydrogen

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

Odourless

Explosion limit 4 and 96 vol% in air

Ignition energy 0.02 mJ
(= very little energy)

No visible flame

AD

Physical properties of hydrogen

HYDROGEN

Highly flammable

14 x lighter than air (gas)

Ignition temperature = 585°C

Odourless

Explosion limit 4 and 96 vol% in air

Ignition energy 0.02 mJ
(= very little energy)

No visible flame

Fire is very hot!

ADP

Physical properties of hydrogen

HYDROGEN

Install safely



Safety

HYDROGEN

HYDROGEN

Install safely

Pressure holders

Gas detection



Safety

HYDROGEN

Install safely

Pressure holders

Gas detection

Safety valve



HYDROGEN

Detection of hydrogen gas by means of sensors in the vehicle.

At the tanks, in the interior and engine compartment.

System shuts down the fuel cell and/or vehicle (FCU)



HYDROGEN

Extinguishing opening

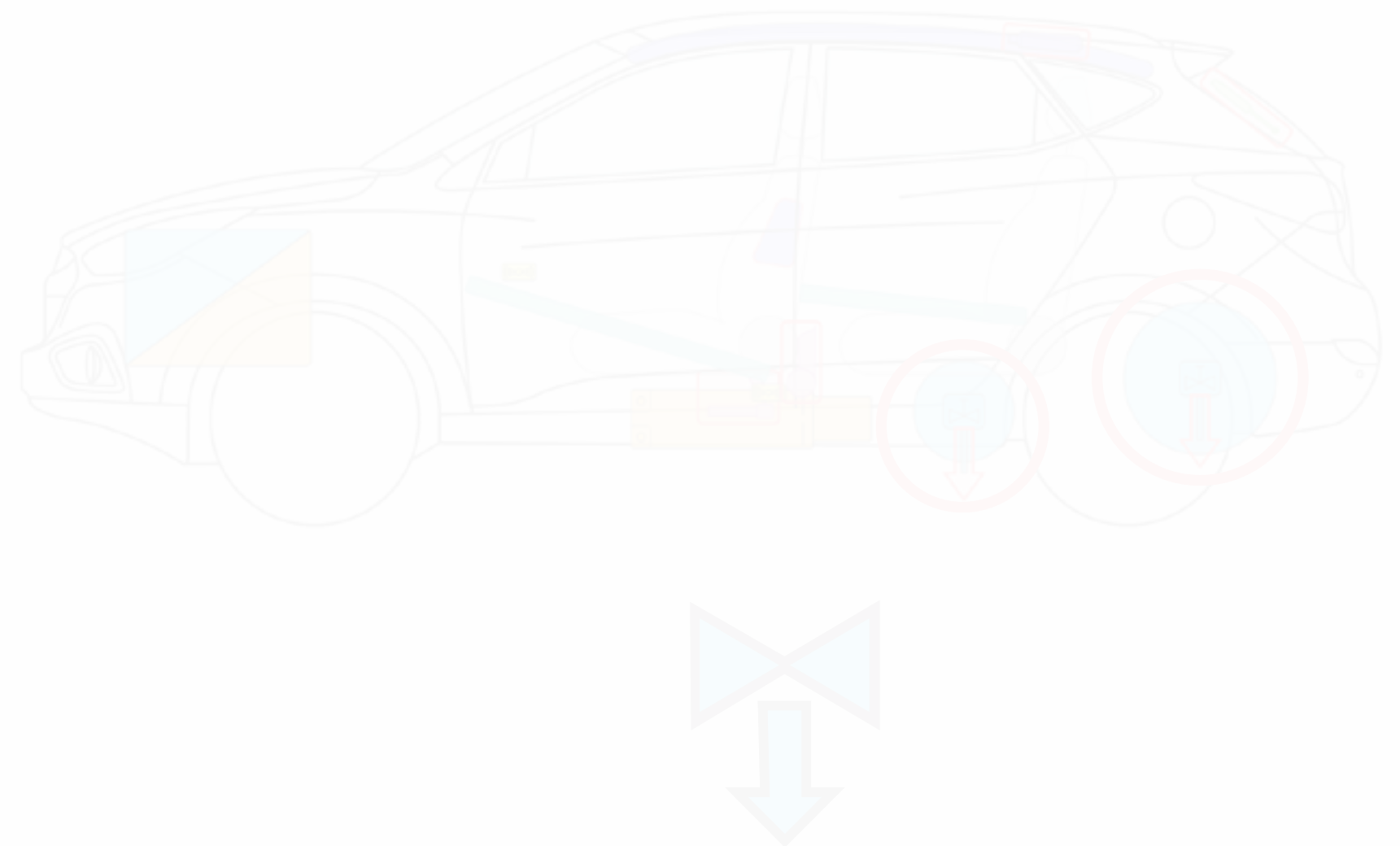
Extinguishing direction



HYDROGEN

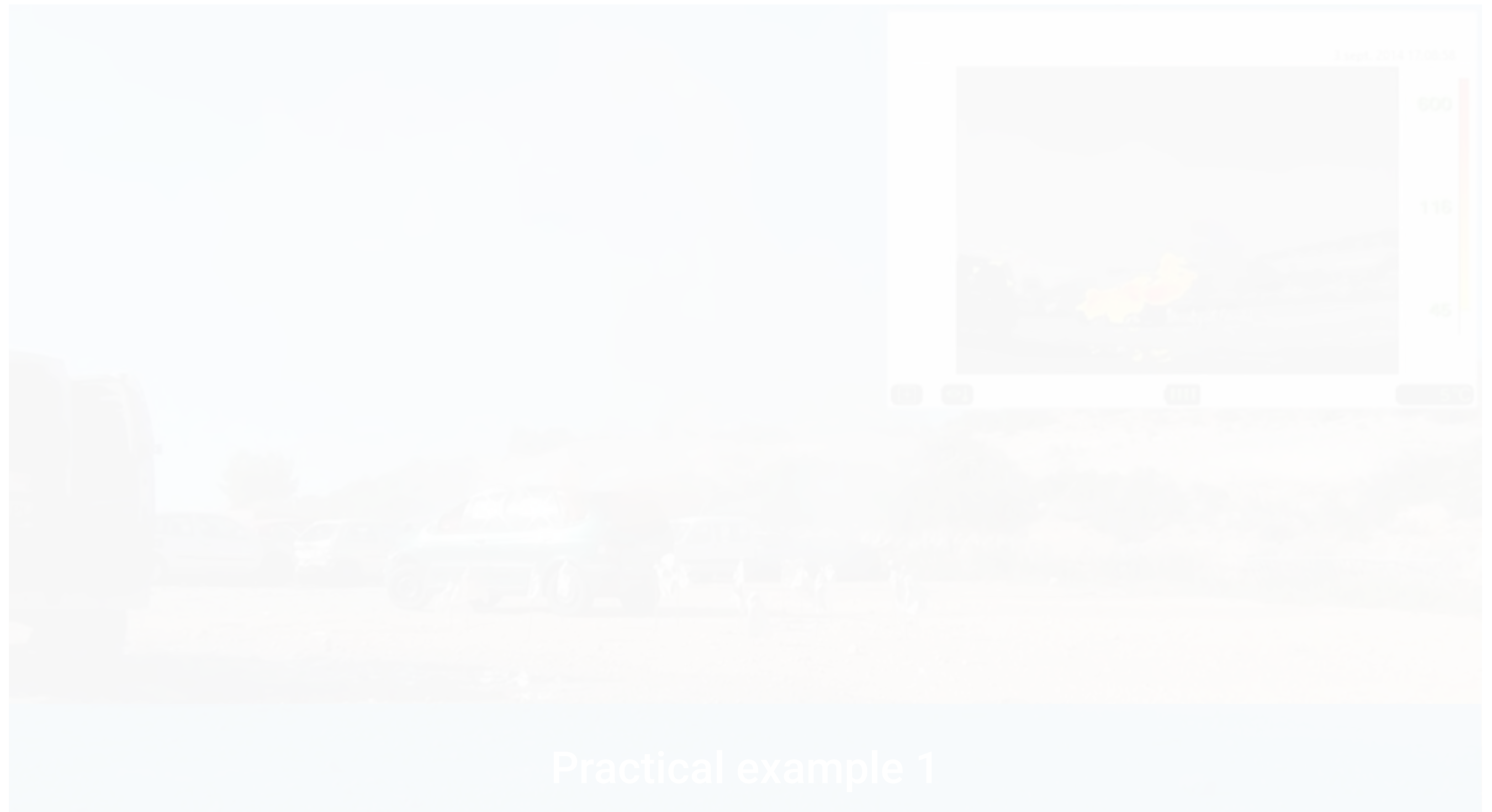
Extinguishing opening

Extinguishing direction



Safety

HYDROGEN



HYDROGEN

High pressure



Practical example 1

HYDROGEN

High pressure

No odour



Practical example 1

HYDROGEN

High pressure

No odour

No radiant heat



Practical example 1

HYDROGEN

High pressure

No odour

No radiant heat

No flames visible



Practical example 1

HYDROGEN

High pressure

No odour

No radiant heat

No flames visible

High temperature > 2000 °C



Practical example 1

HYDROGEN

High pressure

No odour

No radiant heat

No flames visible

High temperature > 2000 °C

Use thermal imaging camera



Practical example 1

HYDROGEN

High pressure

No odour

No radiant heat

No flames visible

High temperature > 2000 °C

Use thermal imaging camera

Explosive gas



Waterstof Explosie

Practical example 1

HYDROGEN



HYDROGEN

Same principle as CNG and LPG



Conversion

HYDROGEN

Same principle as CNG and LPG

Electric



Conversion

HYDROGEN

Same principle as CNG and LPG

Electric

Test vehicles



Conversion

HYDROGEN

Same principle as CNG and LPG

Electric

Test vehicles

Self-build



Conversion

HYDROGEN

Same principle as CNG and LPG

Electric

Test vehicles

Self-build



Conversion

HYDROGEN

Same principle as CNG and LPG

Electric

Test vehicles

Self-build

Hydrogen



Conversion

Chapter 7

CRASH RECOVERY SYSTEM



CRASH RECOVERY SYSTEM

Practice Exercise - CRS Symbols Quiz

- Fill in the correct meaning of the CRS symbols on the first Activity sheet. Use the CRS for this.
- Check the answers against the second Activity sheet



**THANK YOU
FOR YOUR
ATTENTION!**



For more information about Moditech and the Crash Recovery System, please visit our website and social media channels:



WWW.MODITECH.COM



WWW.FACEBOOK.COM/MODITECHRESCUE



WWW.LINKEDIN.COM/COMPANY/MODITECHRESCUE



WWW.INSTAGRAM.COM/MODITECHRESCUE

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