Safety Guide for Road Users and Public Concerning Electrified Vehicle Incident Management (MyEVIM)

MIROS
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
ASEAN ROAD SAFETY CENTRE

MINISTRY OF TRANSPORT
MALAYSIA

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Sime Darby Beyond Auto Sdn Bhd
Tenaga Nasional Berhad (TNB)
UMW Toyota Motor Sdn Bhd
Volvo Malaysia Sdn Bhd

Abbreviations

EV	Electrified Vehicles
FCHV	Fuel Cell Hybrid Vehicle
FCV	Fuel Cell Vehicle
HEV	Hybrid Electric Vehicles
PEV	Pure Electric Vehicle
REESS	Rechargeable Electrical Energy Storage System
TIV	Total Industry Volume
UNECE	United Nations Economic Commission for Europe
AVAS	Acoustic Vehicle Alerting System

Terms and Definitions

Auxiliaries	Energy consuming, converting, storing or supplying devices or systems which are installed in the vehicle for purposes other than the propulsion of the vehicle and are therefore not considered to be part of the powertrain. Examples of auxiliary devices are auxiliary battery, mobile air conditioning, hydraulic crane, electric window lift or heating system.
Drivetrain	The connected elements of the powertrain for transmission of the mechanical energy between the propulsion energy converter(s) and the wheels.
Electric Generator	An electric machine transforming mechanical energy (input) into electrical energy (output).
Electric Motor	An electric machine transforming electrical energy (input) into mechanical energy (output).
Electric Motor-Generator	An electric machine transforming electric energy into mechanical energy and vice versa.
Electrified Vehicles (EV)	Vehicles equipped with a powertrain containing at least one electric motor or electric motor-generator as propulsion energy converter that do not include micromobility vehicle, also categorized as Energy Efficient Vehicles (EEV).

Fuel Cell Hybrid Vehicle - Not Off Vehicle Charging (FCHV-NOVC)	A fuel cell hybrid electric vehicle that cannot be charged from an external source.
Fuel Storage System	A propulsion energy storage system that stores chemical energy as liquid or gaseous fuel.
Hazard	The potential source of harm.
Hybrid Electric Vehicle - Not Off Vehicle Charging (HEV-NOVC)	A hybrid electric vehicle that cannot be charged from an external source.
Hybrid Electric Vehicle - Off Vehicle Charging (HEV-OVC)	A hybrid electric vehicle that can be charged from an external source.
Hydrogen Storage System	A propulsion energy storage system that stores chemical energy as liquid or gaseous hydrogen.
Incidents	Unplanned events that occur on the road network (including parking areas), often in potentially dangerous situations.
Internal Combustion Engine	A propulsion energy converter designed to transform chemical energy (input) into mechanical energy (output) with an internal combustion process.

Peripherals	Energy consuming, converting, storing or supplying devices, where the energy is not primarily used for the purpose of vehicle propulsion, or other parts, systems and control units, which are essential to the operation of the powertrain.
Rechargeable Electrical Energy Storage System (REESS)	The rechargeable energy storage system that provides electric energy for electrical propulsion.
Road Network	Any road assesses for traffic mobility which includes parking areas consisting of public and private parking areas, which encompasses residential parking as well as any off-road routes.

Abstract

The Safety Guide for Road Users and Public Concerning Electrified Vehicle Incident Management (MyEVIM) provides a comprehensive framework to ensure the safety and preparedness of road users and the general public in incidents involving Electrified Vehicle (EV). This document, developed under the directive of the Ministry of Transport Malaysia, outlines critical objectives, including the dissemination of best practices, risk management strategies, and procedural guidance for EV related incidents. Its scope covers various EV types and provides adaptable safety protocols across various scenarios such as crashes, fires, and submergence. Central to the guide are tailored procedures that emphasize high-voltage battery hazards, electrical shock risks, and other unique characteristics of EVs in emergencies, such as toxic gas emissions and thermal runaway risks. Detailed safety considerations are provided for EV users, other road users, and public, ensuring that all parties understand essential actions, from maintaining safe distances to effective emergency response measures, to mitigate potential harm. Additionally, the document aligns with Malaysia Road Safety Plan 2022-2030 and climate commitments, providing a structured and forward-looking approach that supports the rapid growth of EV adoption. Ultimately, the document serves as both a safety guide and an adaptable safety framework designed to enhance EV incident management in diverse road environments, promoting road safety and environmental responsibility.

1. Background

1.1 The directive from the Ministry of Transport Malaysia (MOT) was issued in response to growing concerns about Electrified Vehicle (EV) safety during emergency situations. In light of these concerns, MOT has mandated the Malaysian Institute of Road Safety Research (MIROS) with leading the development of a safety guide specifically addressing EV safety in emergency situations with regard to road safety concerns, focusing on EV users, other road users, and the general public.

1.2 In the process of developing this document, several established documents were referred, particularly for EV definitions, classifications, safety standards, regulations and measures. These references are comprehensively listed in the bibliography section. It is important to emphasize the differences in the scope of this document compared to other related guidelines. For instance, the Fire and Rescue Department of Malaysia developed the Fire Safety Guideline for Electric Vehicle Charging Bays (EVCB) at the premises. The purpose of this guideline is to provide a procedure for the application and approval of EVCB within and outside buildings, focusing on fire safety measures.

1.3 Additionally, the Department of Standards Malaysia has published MS ISO 17840: Road Vehicles - Information for First and Second Responders. This standard consists of four parts. Part 1 defines the contents and layout of the rescue sheet, which provides crucial information to rescue teams when extricating occupants involved in accidents, with applicability to passenger cars and light commercial vehicles. Part 2 focuses on the rescue sheet for buses, coaches, and heavy commercial vehicles, supporting rescue efforts to ensure swift and safe occupant extraction. Part 3 outlines the template for the emergency response guide, offering detailed information about accidents involving specific vehicle technologies, particularly in situations involving fire,

submersion, or fluid leakage. Part 4 defines labels and corresponding colours to indicate the type of fuel or energy source used for vehicle propulsion, especially concerning new technologies and hybrid drivetrains.

1.4 In view of the existing guidelines, this document has been developed to provide road users and the public with essential knowledge and best practices for managing and responding to EV-related operations and incidents safely. By doing so, it aims to enhance overall road safety and equip the public with the information needed to address emergency situations involving EV.

2. Introduction

2.1 EV represent a significant technological advancement in the transportation industry, providing numerous environmental benefits, such as reduced emissions and increased energy efficiency. As the adoption of EV continues to grow, it is essential to understand the unique safety challenges they present, particularly in the context of road incidents. This document aims to provide a safety guide for road users and the public with regard to EV operation and incidents, addressing the hazards associated with EV and outlining appropriate safety measures.

2.2 The development of this document is in line with the Malaysia Road Safety Plan 2022-2030, which aims to reduce road crash fatalities by at least 50% by 2030. The priority areas in the plan are the use of safer vehicles to establish mechanisms for the adaptation of new-generation vehicle technology, including the safety of EV and also post-crash management.

2.3 Malaysia is a party to the United Nations Framework Convention on Climate Change (UNFCCC). Consonant to the Convention, Malaysia ratified the Paris Agreement in the year 2016, whereby communicated its Nationally Determined Contributions (NDC) to reduce its economy-wide carbon intensity (against GDP) by 45% in 2030 compared to the year 2005 level.

2.4 Malaysia has also made commitment to achieve Net Zero by 2050, as decided by Majlis Tindakan Perubahan Iklim Negara (MTPIN) on 14 June 2024.

2.5 In order to achieve that goal, a target for the sale of EV in the country has been developed whereby 20 % of Total Industry Volume (TIV) by 2030, 50 % of TIV by 2040 and 80 % of TIV by 2050.

2.6 Reflecting the surge in EV adoption in Malaysia, the data demonstrates a marked growth, showing 22,619 units sold in 2022 and 38,214 units sold in 2023, which is a 69 % increase according to the Malaysian Automotive Association. This data includes Pure Electric Vehicles (PEV) and hybrid vehicles.

2.7 With cooperation from various parties and meticulous planning, it is targeted that 10,000 EV charging points will be developed by 2025. Malaysia Electric Vehicle Charging Network (MEVnet) offers an online dashboard mapping of current and planned EV charging locations, aiding effective infrastructure planning and monitoring.

2.8 The history of EV development in Malaysia is illustrated as shown in Figure 1.

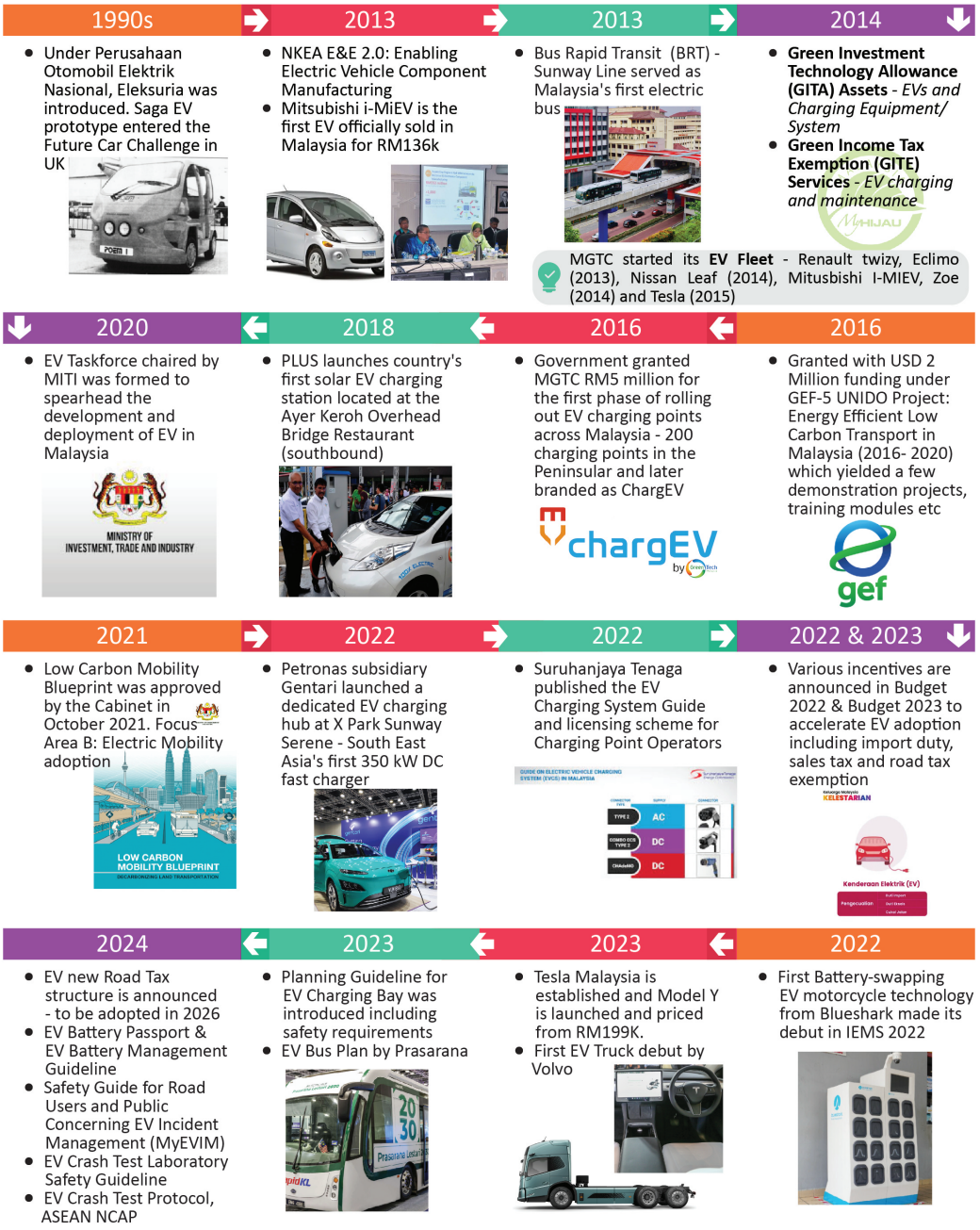

Figure 1 History of EV Development in Malaysia. Source: Malaysian Green Technology and Climate Change Corporation (MGTC)

3. Objectives

3.1 The primary objectives of this document are to provide road users and the public with the necessary knowledge and best practices to safely manage and respond with regard to EV operations and incidents, thereby enhancing overall road safety.

3.2 In addition, the document serves as a foundational reference for policymakers and regulators, offering a framework for the future development of technical and regulatory standards, including risk assessment and technical specifications. This approach ensures that the document remains applicable and flexible, addressing the evolving needs of road users and the public towards EV.

4. Conceptual Framework

4.1 The conceptual framework explains the main focus of this document, which is about the operation of EV, including before, during, and after EV are involved in incidents that focus on road users and the public.

4.2 Road users can be categorized into EV users and other road users. Meanwhile, the public refers to members of the public who are in the vicinity of the incident, including blind and vision-impaired persons.

4.3 Incidents mean unplanned events that occur on the road network, often in potentially dangerous situations. It includes crash and non-crash situations. While when associated with EV, crashes can be divided into two types, namely fire and non-fire. In addition, non-crash only involves EV on fire.

4.4 The conceptual framework of this document is shown in Figure 2.

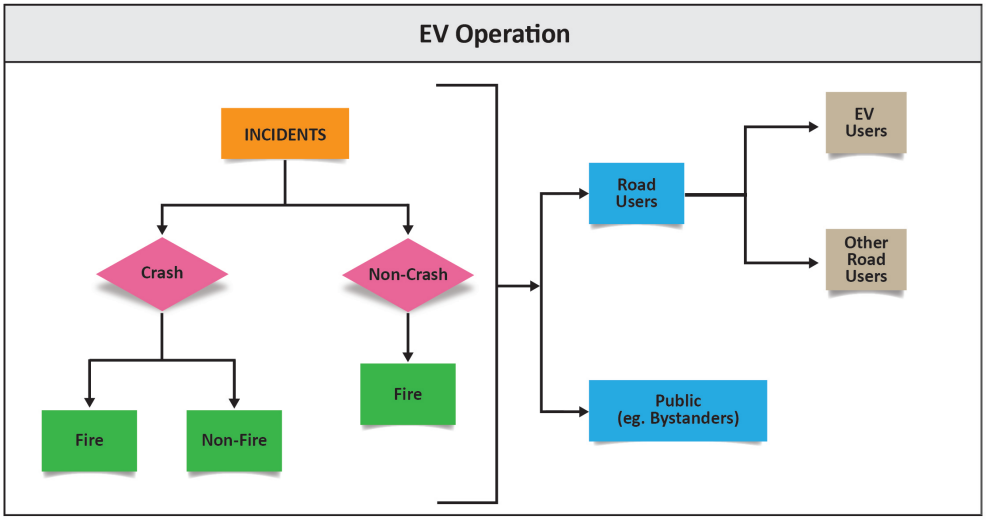

Figure 2 Conceptual Framework

5. Scope and Applicability

5.1 The document is applicable to all modes of EV, including cars, motorcycles, buses, and trucks, excluding micromobility vehicles, as stated in the Road Transport (Amendment) Act 2020. It is intended for road users and the public with regard to EV operations and incidents.

5.2 The scope of this document includes procedures for safely managing EV incidents and understanding the risks associated with EV.

5.3 It aims to provide practical guidance for various scenarios, ensuring that all road users and the public are well-prepared to handle incidents involving EV.

5.4 It does not cover other safety issues, such as cybersecurity threats or routine maintenance unrelated to incident scenarios.

5.5 This document intends to complement the MS ISO 17840: Road Vehicles – Information for First and Second Responders.

5.6 This document is generic and may be superseded by existing and future regulatory standards or manufacturers' requirements.

6. Overview of EV

6.1 Definition of EV

6.1.1 The definition of an EV is a vehicle equipped with a powertrain containing at least one electric motor or electric motor-generator as propulsion energy converter, as stated in UNECE/TRANS/WP.29/1121: Mutual Resolution No. 2 (M.R.2) of the 1958 and the 1998 Agreements.

6.1.2 This document does not include micromobility vehicles as specified in the definition of electric motor vehicles in the Road Transport (Amendment) Act 2020.

6.2 EV Classification

6.2.1 EV are categorized based on their power sources and configurations, each with distinct characteristics and safety considerations. Understanding these differences is crucial for effectively managing safety during road crashes. Various kinds of EV are currently available, each using different technologies. Typically, they are classified into four main groups, as seen in Figure 3, according to UNECE/TRANS/WP.29/1121: Mutual Resolution No. 2 (M.R.2) of the 1958 and the 1998 Agreements.

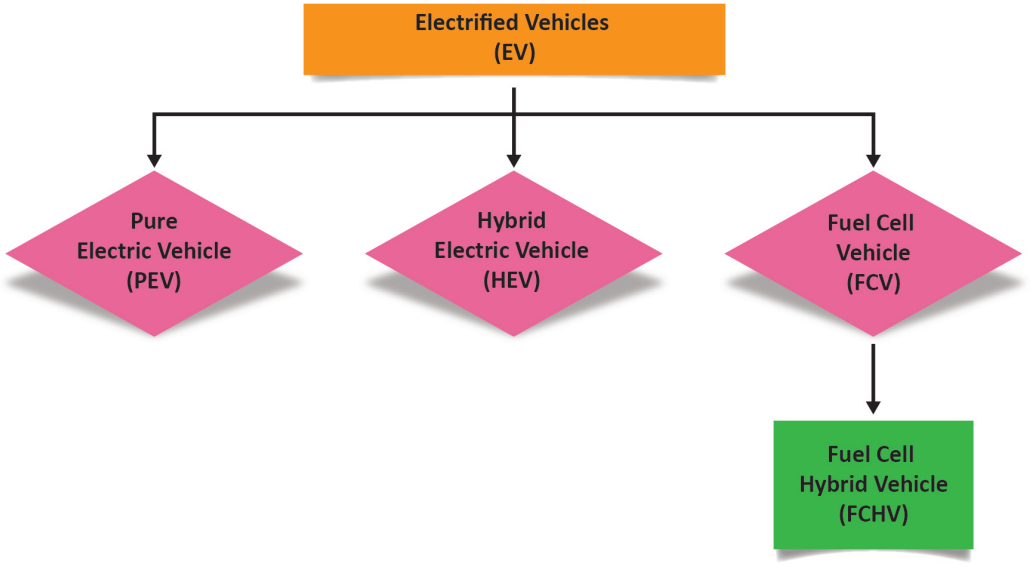

Figure 3 EV Classification

6.2.1.1 Pure Electric Vehicle (PEV) means a vehicle equipped with a powertrain containing exclusively electric machines as propulsion energy converters and exclusively rechargeable electric energy storage systems as propulsion energy storage systems.

6.2.1.2 Hybrid Electric Vehicle (HEV) means a hybrid vehicle equipped with a powertrain containing at least one electric motor or electric motor-generator and at least one internal combustion engine as propulsion energy converter.

6.2.1.3 Fuel Cell Vehicle (FCV) means a vehicle equipped with a powertrain containing exclusively fuel cell(s) and electric machine(s) as propulsion energy converter (s). This can be also non-hybrid FCV.

6.2.1.4 Fuel Cell Hybrid Vehicle (FCHV) means a fuel cell vehicle equipped with a powertrain containing at least one fuel storage system and at least one rechargeable electric energy storage system as a propulsion energy storage systems.

7. Understanding EV Road Crashes and Non-Crashes Incidents

7.1 The Road crashes, including EV, can occur due to a variety of factors, including driver error, vehicle problems and environmental conditions as follows:

7.1.1 Driver error, such as distracted driving, fatigue, or impaired driving, is a common cause of crashes. These factors are not unique to EV but are exacerbated by the unfamiliarity of some drivers with EV-specific features, such as regenerative braking and instant torque.

7.1.2 Vehicle problems such as brake failures, tyre problems, autonomous driving system malfunction and modifications to the electrical system, including the battery, can also lead to crashes and fires. Although EV have fewer mechanical parts compared to conventional vehicles, they still require regular maintenance to ensure vehicle roadworthiness and the safety of critical components.

7.1.3 Adverse environmental conditions, such as heavy rain or fog, can impair visibility and road traction, increasing the likelihood of crashes. EV, like all vehicles, must be equipped to handle a variety of weather conditions. This includes ensuring that tyres are in good condition and suitable for the driving environment, that lighting systems are functioning correctly to improve visibility, and that traction control systems are operational to maintain stability on slippery surfaces.

7.2 The dynamics of EV crashes involve risks between the vehicle's electrical systems and the physical forces of impact whereby:

7.2.1 Battery damage is a significant concern in EV crashes. The battery pack consists of numerous modules, and damage to one or more modules can initiate a thermal runaway reaction. This reaction occurs when the damaged module generates excessive heat, which then spreads to adjacent modules, potentially leading to a fire.

7.2.2 Electrical hazards are another significant risk in EV crashes. Exposed wiring and damaged electrical components can pose serious risks of electric shock and electrocution. It is essential to identify these hazards and take appropriate measures to mitigate them, including avoiding direct contact with exposed wiring.

7.2.3 Hazardous material spills can occur if the EV cooling system or other components are damaged in a crash. Coolants and other fluids used in EV can be toxic and pose environmental hazards. Proper handling and disposal of these materials are crucial to preventing further harm and ensuring the safety of all individuals involved.

7.2.4 The potential for secondary incidents is another consideration in EV crashes. For example, a battery fire or electrical hazard can pose risks to bystanders and other road users, potentially leading to additional accidents or injuries. Effective scene management and clear communication with all individuals involved are essential to minimize the risk of secondary incidents. This includes establishing a safe perimeter around the crash site, providing clear instructions to bystanders, and coordinating with emergency responders to ensure a swift and effective response.

7.3 Understanding the risks associated with EV during non-crash involving fire incidents is critical for ensuring public safety. These incidents can occur in various situations, including when vehicles are parked, charging, or being towed. Such fires, though not triggered by collisions, can result in significant hazards due to the unique characteristics of EV, such as the potential for thermal runaway in the battery.

7.3.1 In parking areas, EV can be prone to fire incidents due to factors like battery malfunction or overheating. Such events can have significant consequences, especially in closed environments like underground parking lots, where fire can spread more quickly and evacuation may be challenging. Designing parking areas with proper ventilation and fire suppression systems is crucial to reducing risks in such scenarios. Public awareness regarding potential hazards in parking areas also plays a vital role in minimizing the chances of fire-related incidents.

7.3.2 Fire incidents can also occur while EV is charging, either at home or in public charging stations. Damaged battery modules or defective charging equipment can lead to dangerous thermal events. Charging stations, particularly in public spaces, must meet stringent safety standards, and users must be educated on the importance of using certified charging equipment.

7.3.3 Towing an EV presents distinct challenges, particularly if the vehicle's battery is compromised or damaged. Fires can ignite if the battery experiences physically stress during towing, which may exacerbate any existing issues. Therefore, understanding the handling of EV under such conditions and implementing proper safeguards during towing operations can prevent fires and further complications.

8. Understanding EV Road Crashes and Non-Crashes Incidents

8.1 Guidance for EV Users

8.1.1 Before Incidents

8.1.1.1 Know the make and model of your vehicle.

8.1.1.2 Obtain safety briefing and product familiarisation from the authorized dealer/distributor with regard to EV safety and functionality.

8.1.1.3 In case of any technical abnormalities, refer to the owner's manual and become familiar with your vehicle's safety information and recommended safety practices, such as the cut-off mechanism of the low and high-voltage cables.

8.1.1.4 It is recommended that emergency equipment be made available in the vehicle, such as a warning triangle, first aid kit, fire blanket, reflective vest, spare tyre, tyre replacement tools and others that are deemed necessary.

8.1.2 During Incidents

8.1.2.1 Safety Considerations

In the event of road incidents, damage to or fire involving EV:

8.1.2.1.1 Always assume the high-voltage battery and associated components are energized and fully charged.

8.1.2.1.2 Exposed high-voltage batteries present potential high-voltage shock hazards, electrical components and wires.

8.1.2.1.3 Venting/off-gassing high-voltage battery vapours are potentially toxic and flammable.

8.1.2.1.4 Physical damage to the vehicle or high-voltage battery may result in immediate or delayed release of toxic and flammable gases and fire.

8.1.2.2 Emergencies Situation

8.1.2.2.1 Road Crash Involving Non-Fire

During road crashes that involving non-fire, it is significant to require an emergency response for EV.

1) Always:

a) Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

b) Avoid contact with leaking fluids and gases.

c) Evacuate the vehicle promptly and bring along the first aid kit if possible and safe.

d) Maintain a safe distance (approximately over 15 meters) away from the vehicle.

e) Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

f) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

2) If possible and safe:

a) Move your vehicle to a safe location. Avoid slope and looks for flat area. Apply the wheel chock, if necessary, on slope area.

b) Roll down the windows before shutting the vehicle off.

c) Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

d) Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

e) Remind other road users/bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.1.2.2.2 Road Crash and Non-Crash Involving Fire

In the event of sparks, smoke, or flames coming from the vehicle due to road crash and non-crash:

1) Always:

a) Please evacuate the vehicle as soon as possible.

b) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

c) Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

d) Avoid contact with leaking fluids and gases.

e) Maintain a safe distance (approximately over 15 meters) upwind and uphill from the vehicle fire.

f) As with any vehicle fire, do not inhale smoke, vapours, or gas from the vehicle, as they may be hazardous.

g) Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

2) If possible and safe:

a) Move your vehicle to a safe location.

b) For public vehicles, the driver should guide passengers in evacuating the vehicles. Passengers should follow the instructions of drivers for evacuating.

c) Roll down the windows before shutting the vehicle off.

d) Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

e) Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

f) Remind other road users/bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.1.2.2.3 Water Submergence

Water submergence generally refers to situations where land or infrastructure is covered by water, including flooding. Floods are a common cause of submergence, which happens when rising water levels due to heavy rainfall, overflowing rivers, coastal storm surges, or other natural events that cause areas to be inundated.

Submergence from flooding can affect both natural landscapes and human-built environments, leading to damage to roads and buildings. Flooding is a type of water submergence, but submergence can also occur from other sources like dam failures, tsunamis, or waterlogging caused by poor drainage systems.

In the event of an incident involving submerged or flooded areas:

1) Do not attempt to drive through areas submerged in water or flooded.

2) Promptly evacuate the vehicle and move to a safe area to ensure your personal safety.

3) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

8.1.2.2.4 Miscellaneous Emergencies

1) Other emergency scenarios are due to road incidents where it is necessary to evacuate the vehicle promptly.

2) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

8.1.3 After Incidents

1) Always:

a) Notify an authorized service centre or vehicle manufacturer representative as soon as possible, as they may have other steps to take for secure and discharge the EV battery.

b) Call 999 if you observe leaking fluids, sparks, smoke, flames, or hear gurgling or bubbling from the EV battery.

c) Do not attempt to repair a damaged EV yourself. Contact an authorized service centre or vehicle manufacturer representative for service.

2) If possible and safe:

a) Ensure that passenger and cargo compartments remain ventilated, i.e., open a window, door or trunk.

8.2 Guidance for Other Road Users

8.2.1 Before Incidents

8.2.1.1 Proactively obtain the latest information and best safety practices for handling incidents involving EV from reputable sources, including vehicle manufacturers, government agencies road safety awareness, and certified non-governmental organizations specializing in EV safety.

8.2.2 During Incidents

8.2.2.1 Safety Considerations

In the event of road incidents, damage to or fire involving EV:

8.2.2.1.1 Always assume the high-voltage battery and associated components are energized and fully charged.

8.2.2.1.2 Exposed high-voltage batteries present potential high-voltage shock hazards, electrical components and wires.

8.2.2.1.3 Venting/off-gassing high-voltage battery vapours are potentially toxic and flammable.

8.2.2.1.4 Physical damage to the vehicle or high-voltage battery may result in immediate or delayed release of toxic and/or flammable gases and fire.

8.2.2.2 Emergencies Situation

8.2.2.2.1 Road Crash Involving Non-Fire

During road crashes that involving non-fire, it is significant to require an emergency response for EV.

1) As Crash Partner

A crash partner is defined as other non-EV vehicles that is directly involved in a road crash involving EV.

a) Always:

i. Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

ii. Avoid contact with leaking fluids and gases.

iii. Evacuate the vehicle promptly and bring along the first aid kit if possible and safe.

iv. Maintain a safe distance (approximately over 15 meters) away from the vehicle.

v. Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

vi. Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform

them that the involved vehicle is an EV and inform critical information with regard to the victims.

b) If possible and safe:

i. Move your vehicle to a safe location. Avoid slope and looks for flat area. Apply the wheel chock, if necessary, on slope area.

ii. Roll down the windows before shutting the vehicle off.

iii. Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

iv. Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

v. Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

2) As Non-Crash Partner

A non-crash partner is defined as other vehicles that exist in the vicinity of a road crash involving EV however does not involve in that particular crash.

a) Always:

i. Proceed the journey in a safe manner

ii. Avoid interrupting the traffic flow

b) If possible and safe:

i. Move your vehicle to a safe location. Avoid slope and looks for flat area. Apply the wheel chock, if necessary, on slope area.

ii. Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

iii. Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

iv. Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

v. Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.2.2.2.2 Road Crash Involving Fire

In the event of sparks, smoke, or flames coming from the vehicle due to road crash:

1) As Crash Partner

A crash partner is defined as other non-EV vehicles that is directly involved in a road crash involving EV.

a) Always:

i. Please evacuate the vehicle as soon as possible.

ii. Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

iii. Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

iv. Avoid contact with leaking fluids and gases.

v. Maintain a safe distance (approximately over 15 meters) or as far as possible based on the space availability of the area, positioning upwind and uphill from the vehicle fire.

vi. As with any vehicle fire, do not inhale smoke, vapours, or gas from the vehicle, as they may be hazardous.

vii. Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

b) If possible and safe:

i. Move your vehicle to a safe location.

ii. For public vehicles, the driver should guide passengers in evacuating the vehicles. Passengers should follow the instructions of drivers for evacuating.

iii. Roll down the windows before shutting the vehicle off.

iv. Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

v. Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

vi. Remind other road users/bystanders to maintain approximately over 15 meters safe distance from the vehicles.

2) As Non-Crash Partner

A non-crash partner is defined as other vehicles that exist in the vicinity of a road crash involving EV however does not involve in that particular crash.

a) Always:

i. Proceed the journey in a safe manner.

ii. Avoid interrupting the traffic flow.

iii. As with any vehicle fire, do not inhale smoke, vapours, or gas from the vehicle, as they may be hazardous.

b) If possible and safe:

i. Move your vehicle to a safe location. Avoid slope and looks for flat area. Apply the wheel chock, if necessary, on slope area.

ii. Put the vehicle in Park (P) mode, set the parking brake, turn off the vehicle, activate the hazard lights, wear a reflective vest, and place a warning triangle.

iii. Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

iv. Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

v. Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.2.2.2.3 Non-Road Crash Involving Fire

In the event of sparks, smoke, or flames coming from the vehicle due to non-crash, such as EV is not moving or in static condition while parking or charging:

1) Always:

i. Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

ii. Avoid contact with leaking fluids and gases.

iii. Evacuate the vehicle promptly and bring along the first aid kit if possible and safe.

iv. Maintain a safe distance (approximately over 15 meters) away from the vehicle or as far as possible based on the space availability of the area.

v. Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

vi. Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

2) If possible and safe:

i. Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

ii. Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.2.2.2.4 Water Submergence

Water submergence generally refers to situations where land or infrastructure is covered by water, and it can include flooding. Floods are a common cause of submergence, which happens when rising water levels due to heavy rainfall, overflowing rivers, coastal storm surges, or other natural events that cause areas to be inundated.

Submergence from flooding can affect both natural landscapes and human-built environments, leading to damage to roads and buildings. Flooding is a type of water submergence, but submergence can also occur from other sources like dam failures, tsunamis, or waterlogging caused by poor drainage systems.

In the event of an incident involving submerged or flooded areas:

1) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

8.2.2.2.5 Miscellaneous Emergencies

Other emergency scenarios are due to road incidents.

1) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

8.3 Guidance for Public

8.3.1 Before Incidents

8.3.1.1 Proactively obtain the latest information and best safety practices for handling incidents involving EV from reputable sources, including vehicle manufacturers, government agencies, and certified non-governmental organizations specializing in EV safety.

8.3.1.2 Blind and vision-impaired persons are advised to take the following approaches to avoid involvement in EV incidents due to low noise issues:

8.3.1.2.1 Technological Solutions:

1) Most EV are equipped with Acoustic Vehicle Alerting System (AVAS), which emits artificial sounds to alert pedestrians. Vision-impaired individuals are advised to become familiar with these sounds, which are typically a distinct, continuous tone or hum, especially at lower speeds.

2) Wearable personal warning system devices designed for vision-impaired individuals can detect oncoming vehicles and provide alerts through vibrations or sound signals. These devices are particularly useful in areas where EV are prevalent.

8.3.1.2.2 Personal Safety Practices:

1) Although EV are quieter than conventional vehicles, they still produce some noise, particularly at higher speeds. Vision-impaired persons should enhance their ability to listen attentively for subtle vehicle sounds such as tyre friction or wind noise.

2) When crossing streets, it is essential to adjust strategies to account for the quiet nature of EV:

a) Stop and listen: Take additional time to listen carefully before stepping onto the road. Since EVs produce less noise, pausing a bit longer can assist in better detecting any nearby vehicles.

b) Ask for assistance: In situations where it is unclear whether it is safe to cross, do not hesitate to request assistance from nearby pedestrians.

c) Use designated crosswalks: Always aim to cross streets at designated crosswalks equipped with traffic lights and auditory signals, as these are generally safer and offer clearer indications of when it is safe to cross.

8.3.2 During Incidents

8.3.2.1 Safety Considerations

In the event of road incidents, damage to or fire involving EV:

8.3.2.1.1 Always assume the high-voltage battery and associated components are energized and fully charged.

8.3.2.1.2 Exposed electrical components, wires, and high-voltage batteries present potential high-voltage shock hazards.

8.3.2.1.3 Venting/off-gassing high-voltage battery vapours are potentially toxic and flammable.

8.3.2.1.4 Physical damage to the vehicle or high-voltage battery may result in immediate or delayed release of toxic and/or flammable gases and fire.

8.3.2.2 Emergencies Situation

8.3.2.2.1 Road Crash Involving Non-Fire

During road crashes that involving non-fire, it is significant to require an emergency response for EV.

1) Always:

a) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

b) Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

c) Avoid contact with leaking fluids and gases.

d) Maintain a safe distance (approximately over 15 meters) away from the vehicle.

e) Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

2) If possible and safe:

a) Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

b) Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.3.2.2.2 Road Crash and Non-Crash Involving Fire

In the event of sparks, smoke, or flames coming from the vehicle due to road crash and non-crash:

1) Always:

a) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

b) Do not touch exposed electrical components or the motor compartment, as an electrical shock hazard may exist.

c) Avoid contact with leaking fluids and gases.

d) Maintain a safe distance (approximately over 15 meters) upwind and uphill from the vehicle fire.

e) As with any vehicle fire, do not inhale smoke, vapours, or gas from the vehicle, as they may be hazardous.

f) Stay out of the roadway and stay out of the way of any incoming traffic while awaiting the arrival of emergency responders.

2) If possible and safe:

a) Use the first aid kit containing the necessary rescue items for emergencies for victims. Follow the specific instructions provided inside the kit. Always check the expiration date of the first aid items before use.

b) Remind other road users/ bystanders to maintain approximately over 15 meters safe distance from the vehicles.

8.3.2.2.3 Water Submergence

Water submergence generally refers to situations where land or infrastructure is covered by water, and it can include flooding. Floods are a common cause of submergence, which happens when rising water levels due to heavy rainfall, overflowing rivers, coastal storm surges, or other natural events that cause areas to be inundated.

Submergence from flooding can affect both natural landscapes and human-built environments, leading to damage to roads and buildings. Flooding is a type of water submergence, but submergence can also occur from other sources like dam failures, tsunamis, or waterlogging caused by poor drainage systems.

In the event of an incident involving submerged or flooded areas:

1) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

8.3.2.2.4 Miscellaneous Emergencies

Other emergency scenarios are due to road incidents.

1) Call 999 for assistance and inform that EV is involved. Inform your exact location and the nature of the emergency situation. When emergency responders arrive, inform them that the involved vehicle is an EV and inform critical information with regard to the victims.

9. Conclusion

9.1. The safety guide presented in this document aims to enhance the preparedness and response of road users and the public with regard to EV operations and incidents.

9.2. By following this document, individuals may be able to mitigate risks, protect themselves and others, and contribute to safer roads.

9.3. The unique characteristics of EV necessitate specific safety measures and guidance. By promoting a culture of safety and preparedness, it can ensure the continued success and growth of EV, contributing to more sustainable and safe transportation.

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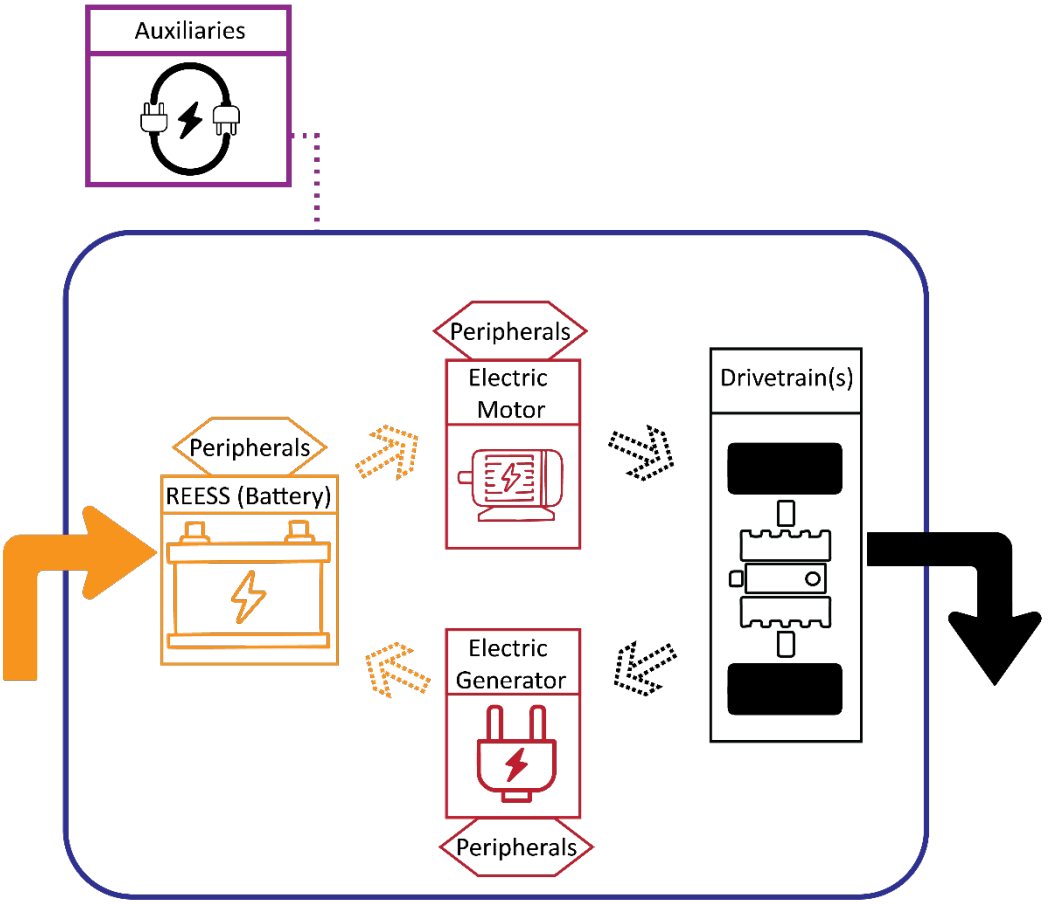
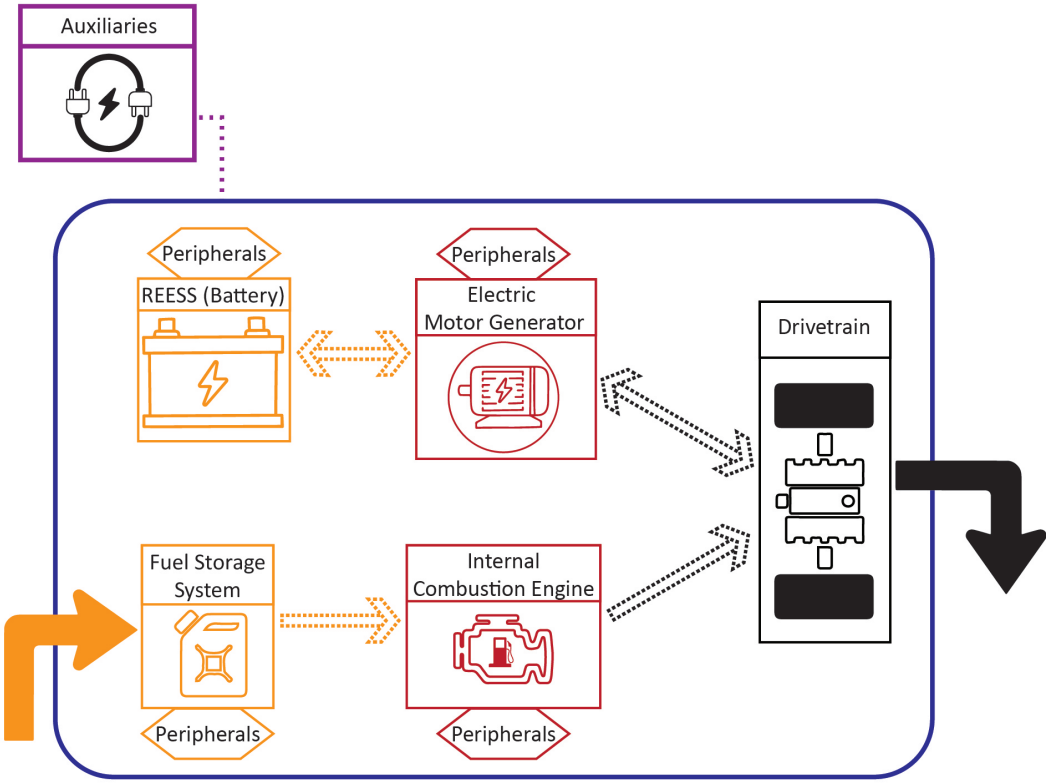
Appendix

Schemes of EV Powertrain According to UNECE/ TRANS/ WP.29/ 1121: Mutual Resolution No. 2 (M.R.2) of the 1958 and the 1998 Agreements.

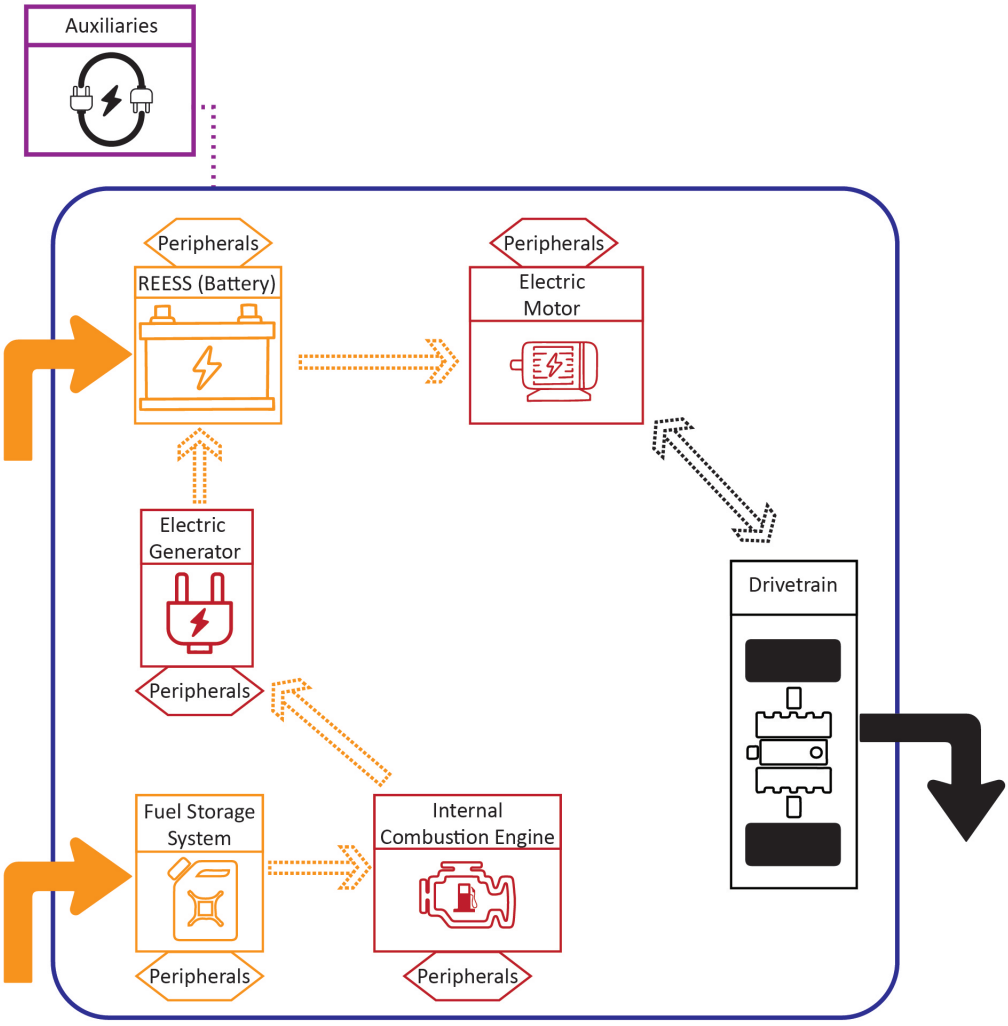
1) Scheme of Pure Electric Vehicle (PEV)



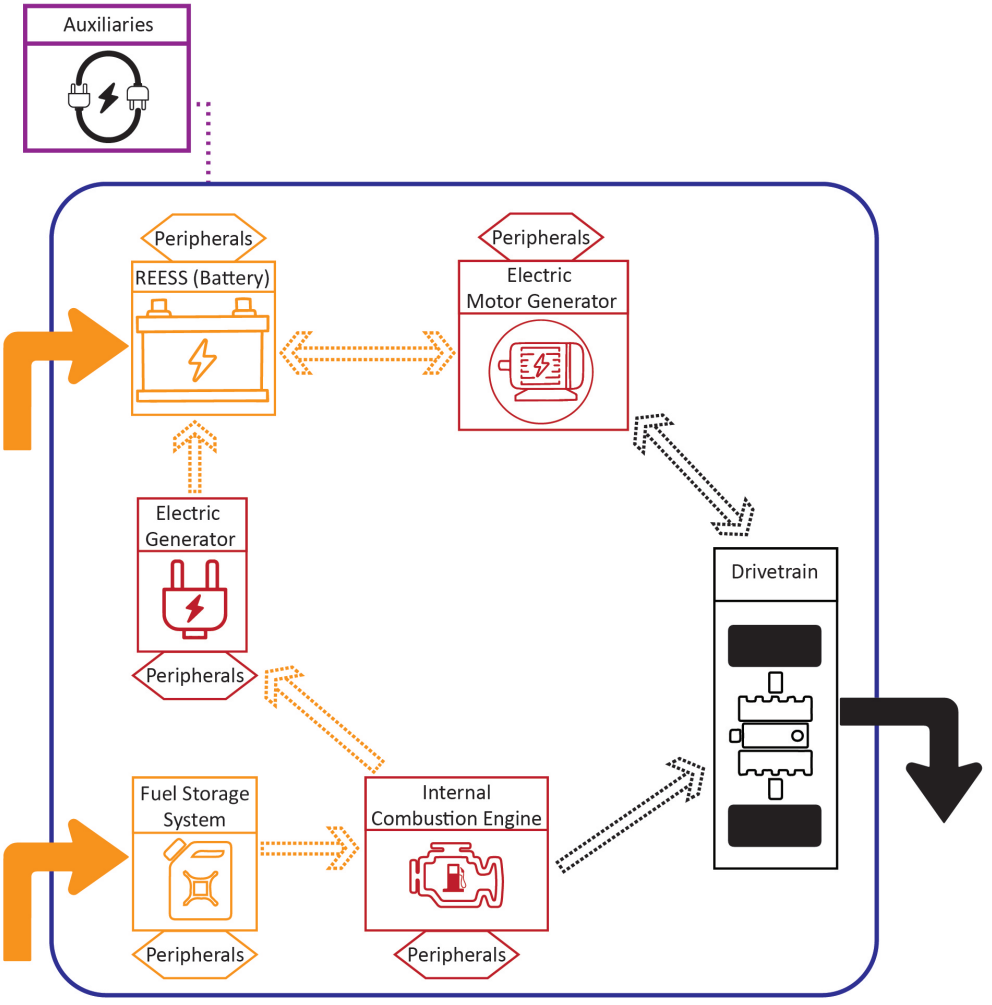
2. Scheme of Hybrid Electric Vehicle – Not Off Vehicle Charging (HEV-NOVC)



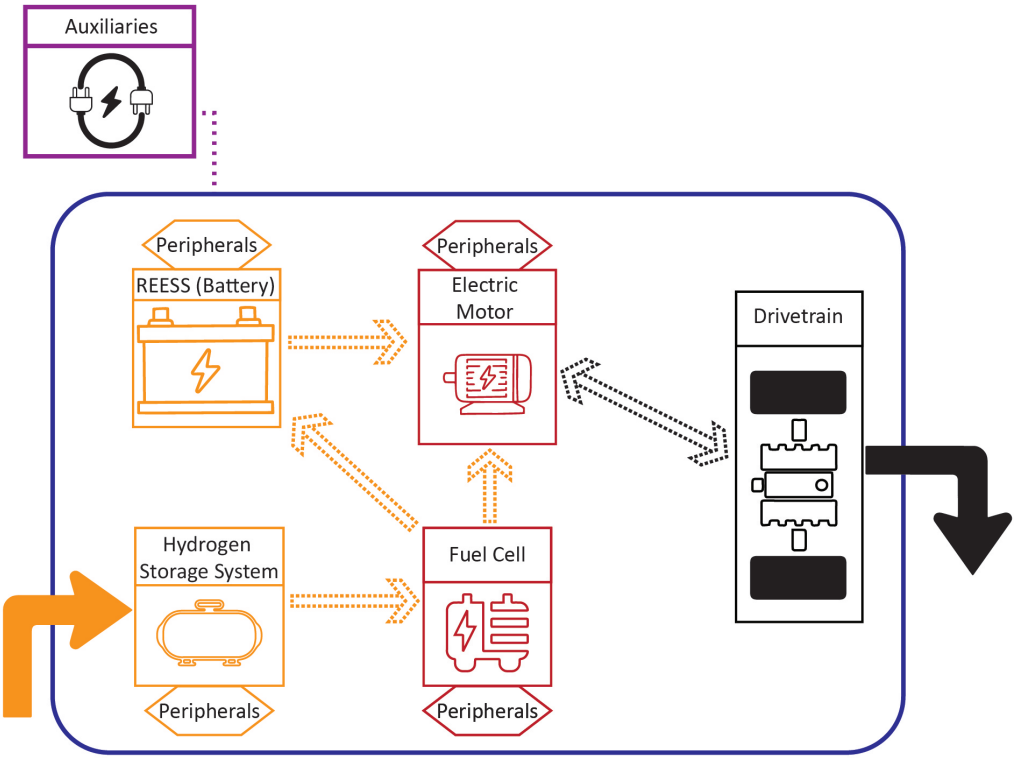
3. Schemes of Hybrid Electric Vehicle – Off Vehicle Charging (Serial, Range Extender) (HEV-OVC)



4. Schemes of Hybrid Electric Vehicle – Off Vehicle Charging (Combined) (HEV-OVC)



5. Schemes of Fuel Cell Hybrid Vehicle – Not Off Vehicle Charging (FCHV-NOVC)



Safety Guide for Road Users and Public Concerning Electrified Vehicle Incident Management (MyEVIM)

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