HEAVY VEHICLE INDUSTRY AUSTRALIA

Guideline for on-road trials of powered trailers

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Heavy Vehicle Industry Australia
Represents and advances the interests of manufacturers and suppliers of heavy vehicles and their components, equipment and technology.

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Foreword

The decarbonisation of road freight transport is a global challenge. In response, industries in many countries are researching, developing, and trialling innovative low and zero emissions vehicle technologies.

These technologies include hybrid powertrains, battery electric vehicles, hydrogen fuel cell vehicles, hydrogen combustion engines, low carbon liquid fuels, and powered axles for towed equipment.

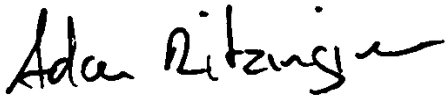
The eventual degree to which each can contribute to the overall goal of net zero is unknown. Presently, there is no 'silver bullet'. Every potential solution holds merit, and different transport sectors and operations, driven by their unique requirements, are likely to favour different decarbonisation solutions.

In that context, it is imperative that in the immediate term, every available road freight decarbonisation technology is afforded the chance to demonstrate its potential contribution.

In the case of towed equipment, the Australian regulatory pathway for trailers and dollies to feature axles capable of providing motive power is unclear.

That barrier is hindering their research and development. It is preventing industry from conducting the necessary on-road trials to refine the technology, understand the safety considerations, and determine its optimal applications.

HVIA has prepared this guideline as a starting point for discussions regarding those on-road trials. It is hoped that they will be used to guide negotiations between road managers, regulators, and the industry, so they can collaboratively design an approach that ensures the safe, efficient, and productive on-road trials of powered axle technology.



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About HVIA

Heavy Vehicle Industry Australia (HVIA) is the peak industry association for Australian manufacturers of trucks and trailers (collectively referred to as heavy vehicles), as well as the dealerships, repairers, suppliers, and service providers that support the entire industry. We represent almost every major truck manufacturer/importer, all of Australia's major trailer manufacturers, and an ever-growing list of their component, equipment and technology providers.

HVIA's 300-plus corporate members collectively employ a local workforce of over 70,000 staff. Our member's interests cover an extensive range of vehicles, starting with 3.5-tonne light commercial trucks, and extending all the way up to Australia's unique 50-metre long, 100-tonne road trains.

The industry provides some of the world's most efficient, safe, innovative, and technologically advanced vehicles. HVIA seeks to work with government and industry stakeholders to promote an innovative and prosperous industry that supports a safe and productive heavy vehicle fleet operating for the benefit of all Australians.

Disclaimer

This document provides options for a framework to assist in negotiations between industry and jurisdictional road management authorities and regulators to facilitate on-road trials of vehicles featuring powered axle technology.

The recommendations provided in this document are not exhaustive. They must not be interpreted as ensuring a minimum level of road safety or risk management if followed. The recommendations have been guided by existing regulatory requirements, preliminary findings and discussions from international regulators, and some limited research completed by international bodies.

In that context, they are also not final, as work is on-going in this area and updated versions of this guideline may be released in the future.

This document does not dictate requirements on the operators of powered axle trials, further than the following:

- compliance with existing laws and regulations
- adherence to applicable road rules
- the provision of a safety management plan
- adherence to relevant parts of ADR 109/01
- the fitment/use of Electronic Brake Systems (EBS), where available.

Of the above points, the first two naturally apply irrespective of this guideline. The third mirrors a similar recommendation in the National Transport Commission's *'Guidelines for Trials of Automated Vehicles in Australia 2023'*. The fourth and fifth, while not legal requirements, were deemed by industry and other stakeholders as necessary measures that would benefit safety.

This document also does not dictate any requirements on jurisdictional road management authorities. Road access decisions, regulatory exemptions, and the issuing of permits for vehicles featuring powered axles or similar technology remains the sole responsibility of those official bodies.

HVIA and its staff take no responsibility for the outcomes of any decisions made by any party where this guideline was used.

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1. Introduction to powered axle technology

Many international manufacturers of axles for use in heavy trailers and dollies are now offering innovative electric axle types that are collectively referred to as either 'powered axles', or 'e-axles'. Their fitment to either a heavy trailer or dolly results in what is collectively referred to as a 'powered' trailer or dolly. Similar discussions are occurring in the caravan industry.

Within these broad terms lie crucial differences in technology and capabilities. Powered axles and e-axles will all typically feature ***regenerative energy*** capabilities, and some may also be capable of providing ***motive power***.

An axle with ***regenerative energy*** capabilities means that it includes a physical mechanism to recover the kinetic energy from a rotating axle (either during braking or coasting), and transform it into electrical energy, either for immediate use or storage in a battery.

An axle capable of providing ***motive power*** means that it can use an on-board power source to drive one or more of the trailer's axles and assist its motion. Motive power axles may also include regenerative energy and storage capabilities.

In this document any reference to 'powered axles', or 'powered trailers' means a light or heavy trailer, or a converter dolly, using an axle with both regenerative and motive power capabilities.

In contrast, any reference to 'regenerative axles' means a trailer using an axle with only regenerative energy capabilities.

1.1 Other relevant terminology for this guideline

Powered axle trials
A trial of prototype or development systems incorporating an axle capable of providing motive power, including any related energy storage and control systems (either a prototype or development system) on public roads and road related areas, for the purpose of testing and demonstrating the operation of the system, and gathering operational data.

Trialling organisation
Any company, organisation or individual who wishes to run a powered axle trial on Australian roads.

Road transport authority
State and territory governments are road transport authorities and are responsible for roads, road transport, vehicle registration, and licensing within their jurisdiction.

Local government authority
Local government authorities are the third tier of government in Australia and are responsible for local roads and related infrastructure that link homes to schools and shops and to arterial roads and national highways.

1.2 Benefits of powered trailers

There are a wide range of benefits arising from the use of regenerative and motive power axles in trailing equipment.

The energy that regenerative axles capture is typically braking energy that is otherwise normally lost as waste heat, thereby representing a useful opportunity to decarbonise, improve efficiency, and reduce normal brake wear. Recovered energy can be used to:

- power ancillary trailer equipment (e.g. cooling/heating units, hydraulic pumps)
- charge batteries either on the trailer or the towing vehicle, for motive use or other purposes.

The driving power provided by motive power axles, using either their own stand-alone battery or one charged by a regenerative capability, can:

- reduce the load on the hauling unit, thereby improving fuel/energy efficiency and extending its range
- permit use of a lower powered hauling unit, resulting in greater overall efficiency (also referred to as a 'virtual hybrid' combination)
- improve the startability (i.e. ability of a vehicle to commence motion on a steep grade) or gradeability (i.e. ability of a vehicle to sustain a specific speed on any grade) performance of a vehicle combination.

1.3 The need to conduct trials

It is necessary to trial trailers and dollies with motive power axles to quantify these benefits, to demonstrate the capability of the technology, and answer questions regarding its regulation and safe use. These trials should include assessments in 'real-world' situations, including interactions with other road users and road environments.

On-road trials should only follow testing conducted in an off-road environment, with all aspects of vehicle directional control, dynamic stability testing, and other safety concerns as noted in this document being completed.

To date, some limited trials have been successfully undertaken in Europe, and more are proposed under European Union funded research projects in 2025. Notwithstanding, Australia has unique road conditions and unique vehicle combinations that do not exist in other countries. It also boasts a vibrant, skilled, and highly successful local trailer manufacturing sector. On that basis, it is necessary that trials are conducted using Australian vehicle combinations, operating in local conditions, as those trials have the potential to add considerable value to the existing body of knowledge.

Additionally, many trials are likely to seek increases on current trailer/dolly axle load limits, to offset the payload penalty of adding powered axles and batteries. It is essential that increases are afforded to equipment irrespective of the nature of the tyre configuration (i.e. dual tyres or super singles), as some powered axle technology may be drawn from markets where super single tyres dominate.

There are some concerns that the use of motive power axles could introduce safety risks associated with vehicle stability, principally in the areas of braking and directional control, as outlined in this document. On-road trials must not subject any road user to increased safety risk profile compared to current vehicles. To that end, trialling organisations and road transport authorities alike have existing road safety obligations and responsibilities, many of which are discussed in this document, including:

- vehicles are observed to have been properly designed and prepared (i.e. modifications signed off by a qualified Authorised Vehicle Examiner)
- trialling organisations are managing safety risks appropriately and only conducting trials in appropriate conditions
- trialling organisations can manage liability, and that any injury or damage caused by a trial can be appropriately compensated
- any incidents are properly recorded and can be appropriately investigated.

2. Development, intent, and purpose of the Guideline

This guideline is based on the National Transport Commission's (NTC) *Guidelines for the trials of automated vehicles in Australia 2023*. Those guidelines were developed in close consultation with all levels of government and industry and are considered a sound basis for similar guidelines on powered trailers. In drafting this guideline, a similar approach was taken and included broad consultation.

This guideline provides a framework to assist in negotiations between industry and jurisdictional road management authorities and regulators to facilitate on-road trials of vehicles featuring powered axle technology. It is intended to help trialling organisations demonstrate the required level of safety assurance when trialling powered axle technology on Australian roads. It aims to provide guidance on some matters that should be addressed by trialling organisations as part of the process.

The guideline is intended to be sufficiently flexible to deliver safety outcomes without stifling innovation, and innovative means of addressing safety concerns. It aims to accommodate a range of different powered axle technologies and applications, and the way different trials are managed will allow for those differences.

Broadly, this guideline aims to:

- support nationally consistent conditions for powered trailer trials in Australia
- provide insights to industry regarding expectations when trialling in Australia
- help road transport authorities manage trials in their own state or territory as well over borders
- highlight potential areas of safety concern
- build public acceptance by helping operators understand their obligations that vehicles are safe prior to being used on public roads
- help assure the public that roads are being used safely.

3. Regulatory pathways for powered trailer trials

The Australian regulatory pathway for trailers and dollies to feature axles capable of providing motive power is unclear but is the subject of on-going work and collaboration between the Commonwealth, the National Heavy Vehicle Regulator, and each of the states and territories. Understanding the issues requires an appreciation of three topics: the Australian Design Rule (ADR) package, the Heavy Vehicle National Law (HVNL), and the state and territory-based road rules.

3.1 The Australian Design Rule (ADR) package

The primary issue is the ADR package, administered by the Commonwealth. The Federal Department of Infrastructure, Transport, Regional Development, Communications, Sport, and the Arts (DoITRDCSA) is responsible for setting requirements for vehicles when they enter the market. This is achieved through the *Road Vehicle Standards Act 2018 (Cth),* which requires that all road vehicles (whether they are newly manufactured in Australia, or imported as new or second-hand) comply with the relevant Australian Design Rules (ADRs) at the time of supply to the Australian market. The ADRs are national standards for vehicle safety, anti-theft and emission controls and cover various safety issues such as occupant protection, lighting, noise emissions, engine exhaust emissions, and braking.

The current ADR package was not drafted with consideration of powered trailer technology, and powered trailers are not included in the current set of vehicle categories. The ADRs that could apply to powered trailers do not align well with their characteristics and functions. It is likely that a new vehicle category will be required, and revisions to existing ADRs, and/or new ADRs will be necessary. As a result, a powered trailer/dolly would be unlikely to be granted ADR approval under current arrangements.

Existing advice on importing non-approved vehicles (i.e. those that are not on the Commonwealth's Register of Approved Vehicles) may be relevant, if the vehicle is to be imported from overseas.

3.2 The Heavy Vehicle National Law (HVNL)

The Heavy Vehicle National Law (HVNL) is a set of regulations that governs the use of heavy vehicles with a gross vehicle mass (GVM) of more than 4.5 tonnes. It exists as model legislation that is modified and adopted by each of the staties and territories, with the exception Western Australia and the Northern Territory.

It does not provide a pathway for ADR approval, but via Section 87, allows the National Heavy Vehicle Regulator (NHVR) to approve a modification to a heavy vehicle, if the Regulator is satisfied that the use on a road of the modified vehicle will not pose a significant safety risk, and the modified vehicle will comply with applicable noise and emission standards, or has been otherwise exempted from them.

In that context, the HVNL may provide a regulatory pathway for powered trailers/dollies, through the NHVR's approval of an in-service vehicle which is then modified to feature powered axle technology.

3.3 State and territory-based road rules

State and territory governments are responsible for requirements relating to the road network, vehicle operation, driver licensing and vehicle registration. Some of those rules may conflict with powered trailer trials.

The Australian Road Rules and Australian Light Vehicle Standards Rules form the basis for state and territory road rules and vehicle standards requirements. The Australian Road Rules promote road safety by establishing uniform rules of the road for drivers and riders of vehicles, pedestrians and passengers. The Australian Light Vehicle Standards Rules form the basis for the in-service light vehicle standards within each state and territory.

While states and territories have exemption and permit powers in relation to the road rules, traffic laws and in-service vehicle standards, those powers sometimes differ. In the past those powers have been used to enable trials of innovative vehicles. State and territory exemptions, where necessary, will likely need to be investigated on a case-by-case basis.

4. How to use this Guideline

Different parties involved in powered trailer trials will use this guideline in different ways.

For road transport and local government authorities involved in powered trailer trials, this guideline is mainly informative. It is envisaged that authority will staff read the guideline in its entirety, and consider its requirements and recommendations, in preparation for discussions with trial organisations that may occur.

For organisations considering a powered trailer trial, this guideline is again mainly informative, but also instructive in terms of the options given in the sections on seeking approval for powered trailer trials, and on preparing an application for discussion with a road transport authority.

Note that this document does not dictate requirements on the operators of powered trailer trials, further than the following:

- compliance with existing laws and regulations
- adherence to applicable road rules
- the provision of a safety management plan as part of the application for a trial
- adherence to relevant parts of ADR 109/01
- the fitment/use of Electronic Brake Systems (EBS), where available.

Of the above points, the first two naturally apply irrespective of this guideline. The third mirrors a similar recommendation from the in the National Transport Commission's 'Guidelines for Trials of Automated Vehicles in Australia 2023. The fourth and fifth, while not legal requirements, were deemed by industry and other stakeholders as necessary measures that would improve safety.

5. For trial organisations – seeking approval

It is envisaged that every powered trailer or dolly trial will be supported by two separate approvals:

- an exemption from the ADRs, or an approval as a modified vehicle under the HVNL, and exemptions from road rules that would otherwise normally apply
- an agreement between the trialling organisation and the relevant road transport authority and local government authority (if applicable) for approval to run the trial, via a permit issued by the relevant authorities to the trialling organisation.

Trialling organisations must obtain all required standards/rules exemptions and/or permits before beginning any on-road trials.

Trial organisations are encouraged to understand which regulatory pathway (i.e. ADR or HVNL) is most applicable for their trial, by discussing their application with the Federal Department of Infrastructure (DoITRDCSA), and the National Heavy Vehicle Regulator (NHVR).

Following that step, the trialling organisation should identify all relevant (i.e. impacted) sections of jurisdictional authorities and seek their 'in-principal support' for the trial. This is a crucial step, as the support of multiple jurisdictions or authorities, and possibly also third-party asset owners (e.g. railway crossing infrastructure) may be required. Lack of support of any one authority may render a trial unfeasible, and that should be known prior to the development of the application.

For heavy vehicle applications, identification of relevant sections of jurisdictional authorities for all jurisdictions other than Western Australia and the Northern Territory is readily done via the existing permit application processes available through the NHVR, in its online portal. For WA and the NT, trialling organisations should contact those authorities directly. For light vehicle applications, trialling organisations should contact all authorities directly, as there is no equivalent national light vehicle regulator.

Once all appropriate authorities are identified and in-principle support obtained, the application can be prepared and sent for review/approval by those authorities. Trial organisations should allow ample time for review and resolution of any issues that may arise.

Once the appropriate authorities have approved the application, the required permits may be issued, including documents that must be carried/held when on-road, and the trial can commence.

In summary, the proposed steps are:

Heavy vehicles – for QLD, NSW, VIC, SA, ACT and TAS:

- trialling organisation identifies roads/routes/areas of operation for the trial, and creates an NHVR Journey ID, or series of IDs for multiple roads/routes/areas
- trialling organisation submits a 'Powered Axle Trial' permit application to the NHVR using the NHVR Portal, including all relevant vehicle details and NHVR Journey IDs
- NHVR creates a case number, identifies impacted road authorities and distributes requests for in-principle support
- road authorities review request and respond to NHVR with a decision
- NHVR updates case information in the Portal
- trialling organisation completes application and provides it to the impacted road authorities via the NHVR Portal
- road authorities review the application, discuss any necessary items with the trialling organisation, and respond to NHVR with an overall decision
- NHVR issues trial permit to trialling organisation.

Heavy vehicles – for WA and NT, and light vehicles – for all states:

- trialling organisation identifies roads/routes/areas of operation for the trial
- trialling organisation contacts main road authority directly

- main road authority identifies impacted road authorities and distributes requests for in-principle support
- road authorities review request and respond with a decision
- main road agency advises trialling organisation
- trialling organisation completes application and provides it to main road agency
- road authorities review the application, discuss any necessary items with the trialling organisation, and respond to main road authority with an overall decision
- main road authority issues trial permit to trialling organisation.

If any condition of the exemption or permit is not complied with, the exemption or permit could be suspended or revoked. Penalties may also apply, depending on the state or territory's enabling legislation or regulations.

A validity period may be placed on any exemption or permit granted to a powered axle trial, which will be set by the relevant road transport authority. State and territory laws support renewals or extensions of exemptions or permits if required and justified.

Trialling organisations must comply with all relevant Australian laws unless a specific exemption has been granted by the relevant road transport authority. This includes all existing:

- road rules and traffic laws
- vehicle standards
- vehicle registration
- vehicle roadworthiness
- driver licensing
- all relent heavy (or light) vehicle regulations and laws
- public and passenger transport laws
- work health and safety laws.

Because laws vary between states and territories, trialling organisations should consult with the relevant road transport authority to confirm the applicable laws and any specific jurisdictional requirements.

6. For trial organisations – preparing an application

The requirements for applications to trial powered trailer technology will be dictated by the relevant jurisdictional road transport authority or other authorities.

Notwithstanding, trialling organisations must provide a safety management plan at a minimum, and ideally, the following in addition to that plan:

- **a document that provides the organisation's response to the below key management criteria**
- **evidence of appropriate insurance.**

A template for the application was not developed specifically for this initiative. Trialling organisations are encouraged to use their preferred template/document layout and combine the above into a single package for submission. Trialling organisations are also encouraged to include additional information, should they deem it necessary or useful in supporting their application.

Further information on each of the above areas is provided below.

4.1 Key management criteria

Trialling organisation(s)
Provide information on the trialling organisation, including technology providers/partners, and freight transport operating partners (if applicable). Outline the relevant experience of each organisation in relation to their role in the trial.

Background information and data
Provide any previous evaluation data/reports to support the application and inform the assessment of the value added through local trials, and to illustrate how any shortcomings, risks, or safety issues previously identified will be addressed.

Trial organisations should consider any relevant local and international work, to ensure that local trials are not conducted in isolation. Considering other work and harmonising with any international vehicle standards will improve integration between trucks and trailing equipment and benefit safety.

Purpose/outcomes and scope of the trial
Detail the purpose of the trial, the desired outcomes sought, and its overall scope, including the numbers of vehicles, their operation, and the trial duration.

Trial location(s)
Set out the proposed trial location and routes. It may comprise specific roads, routes, or entire regions. Applicants are encouraged to use the NHVR portal to map the desired roads and provide NHVR Route ID numbers as part of the application, if trials operate in Heavy Vehicle National Law (HVNL) jurisdictions.

Description of the technology being trialled
Provide a high-level description of the technology being trialled in the application. The intent is not to force trialling organisations to reveal commercially sensitive intellectual property but to allow jurisdictional authorities to understand the technology and reasonably assess any safety risks. The description should cover:

- the nature of the vehicle (e.g. type of combination, axle configuration, tyre configuration, key dimensions, proposed tare and operating masses, etc.)
- the powered trailer or dolly propulsion system (e.g. powered axle type, rated power, operational power, battery capacity, etc.)
- identification of the vehicle(s) involved by VIN and compliance number, and records of any modifications made to the vehicle in accordance with Vehicle Standards Bulletin 6 (for heavy vehicles), or other standard or guide
- increases sought on regulated trailer and dolly axle load limits, and Gross Combination Mass (GCM) limits, or an assurance that in-service loads will be managed to accommodate the equipment under trial within the existing regulated mass limits for the vehicle

- the charging system (e.g. on-board via regenerative capacity, plug-in, etc.)
- the powered axle control system (e.g. electronic connection to towing vehicle throttle, electronic connection to braking system, data from instrumented kingpin, data from other sensor systems, operating speed ranges, etc.), and identification of the nature of the communications system between the hauling unit and its trailers/dollies.
- other safety systems (e.g. automatic 'shut down' systems, emergency stops, driver-accessible kill switches), and nature of the information provided to the driver.

The description should also include a section detailing the safety risks, prior testing and risk mitigation measures to ensure significant safety risks have been considered and mitigated.

Regulatory compliance
The current ADR package was not drafted with consideration of powered trailer technology, and powered trailers are not captured in the current vehicle categories. As a result, the ADRs that could apply to a powered trailer do not align with its intended function.

Nonetheless, trialling organisations must demonstrate that all equipment is compliant with the relevant parts of ADR 109/01, which specifies requirements for electric power trains used in towing equipment. Clear and unambiguous EV labelling should be present. Inclusion of that requirement in this guideline should not be interpreted as a directive from the Commonwealth; it is not a legal requirement but deemed by industry and other stakeholders as a necessary measure that would improve safety.

Trialling organisations should outline that all components used on a vehicle unit in a trial have the necessary Component Type Approval (CTA) numbers or provide adequate information to enable a reasonable assessment of such components that are not yet approved (e.g. a test report, assessment by an Authorised Vehicle Examiner, etc.). Modified equipment should have been properly designed and prepared (i.e. modifications signed off by an Authorised Vehicle Examiner).

Trialling organisations are also encouraged to list any other regulations and standards (local or international) to which the system complies.

Description of possible impacts on traffic and other road users
Whilst it is not expected that vehicles featuring powered trailers/dollies will have any noticeable impacts on traffic or other road users, and prior off-road testing should confirm that there will be no noticeable impacts, trialling organisations should outline if there are any specific features of the technology that will recognise, prevent or minimise any unintended or undesirable impacts (e.g. sudden or unexpected acceleration/deceleration).

Trialling organisations should aim to conduct all trials on routes/roads featuring road geometry that readily accommodates the size and mass of the vehicle combination being trialled. If operation in areas with any of the following characteristics is proposed, trialling organisations should explain how the safety and amenity impacts are mitigated:

- high traffic density environments
- areas with high proportions of vulnerable road users (e.g. pedestrians, cyclists)
- complex intersections, intersections with non-standard geometry, or difficult merging manoeuvres
- rail crossings
- sharp changes in topography such as inclines, declines, or short transitions between them
- any areas of non-standard negative/positive road camber, or short transitions between them.

Pre-trial phase
The vehicle should be tested in an off-road environment prior to any on-road trial being performed, with all aspects of vehicle directional control, dynamic stability testing, and other safety concerns as noted in this guideline being completed.

The trialling organisation should outline the nature and scope of the off-road tests that have been conducted, also describe any necessary and appropriate adjustments or further modifications that have been identified and achieved, leading the trial applicant to consider the vehicle safe for on-road trials.

Operational and emergency procedures
Describe the operational and emergency procedures that apply to the operation of the vehicle during the trials. Such procedures should include normal operation, including safe parking and immobilisation, and in the case of an emergency, a list of steps for the driver to follow, and steps for post-incident recovery.

Clear and visible information should be provided to enable emergency services to recognise the risks presented by the vehicle in the event of an emergency including run-off-road events, rollovers, fires, and collisions with vehicles or stationary objects. Trial organisers should consider informing emergency services of the trials planned locations and times/dates, and consider providing information such that the trailer/dolly can be included in the 'ANCAP RESCUE' app, commonly used by emergency responders.

Trained users for operation and service work
Describe the training for drivers and providers of service/maintenance work for vehicles being trialled, specific to the operation of the vehicle and its additional unique systems, and in the emergency management procedures.

Managing change
Explain how organisations intend to manage changes to the vehicle (if necessary) during the trial period. Examples of changes may include software (e.g. control systems, motor output levels, interface with OEM equipment, etc.), or hardware (axle motor size, axle location, combination type).

Software and hardware updates that substantially change (e.g. a ten percent or greater deviation from the original setting) the performance and characteristics of the vehicle (such as those outlined above) may require reassessment or further modification, triggering a new vehicle modification to be appropriately managed where necessary, and a new request for approval submitted.

Evaluation
Explain how organisations intend to evaluate the trial in terms of safety, vehicle efficiency and energy savings. Trialling organisations should provide an end-of-trial report on the outcomes, including a high-level summary, omitting any commercially sensitive information. Examples of what could be included in an end-of-trial report are:

- a summary of the trial
- the scope and nature of the trial
- its outcomes – what worked well, unforeseen challenges, lessons learned
- changes made during the trial, and their impacts
- the specific safety concerns or benefits identified, and how concerns can be managed
- if the aims of the trial were met, and if not, or if unexpected issues arose or were identified during the trial, propose essential next steps, parameters, or clarifications necessary
- the specific emissions reductions achieved, compared to those anticipated
- identification and quantification of any other likely benefit (e.g. reduced brake wear)
- the implications on use of the technology for the industry.

Safety reporting
Explain how the organisations will manage safety reporting, within the context of the below.

Trialling organisations must abide by existing incident reporting requirements of the state or territory in which they are conducting their trial. Minimum reporting conditions are contained in the road rules.

Trialling organisations may also commit to reporting any serious incident or near miss to the relevant road transport authority. A serious incident is defined as:

- failure of a safety system or significant unexpected impacts on a safety system
- failure of communications between safety or control systems

- a crash involving a trial vehicle
- a contravention of any traffic law such as exceeding the speed limit or a red-light violation.

Trialling organisations should be prepared to provide at least the following information to the jurisdiction, and policing authority (where relevant) in the event of a serious incident:

- time, date, and location
- road surface and weather conditions
- vehicle data (e.g. speed, brake/throttle/powered axle status)
- sensor information in relation to the powered axle control system, and brake systems
- any on-board camera/video recordings
- the identity of the vehicle operator at the time of the incident.

The trialling organisation should retain data to the extent necessary to provide it to relevant parties. The length of time that data is retained may depend on the purposes the information could be used for – for example, law enforcement and insurance.

4.2 Safety management plan

Road transport technology provides the opportunity for safer roads for all road users. However, government has a responsibility to ensure new technology is introduced onto public roads safely. Trialling organisations must have a safety management plan in place outlining all relevant key safety risks for the trial and how they will be mitigated or eliminated.

Safety management plans should demonstrate that the trialling organisation has a safety culture that will enable it to manage risks identified prior to, and emerging during, the trial. The safety management plan should address the key safety risks, in the context of all potential usage scenarios for the vehicle and its systems during operation, and when operating as an 'unpowered' trailer/dolly, if it is possible to do so. If some risks are not relevant due to the scope of the trial, the trialling organisation should explain why they are excluded in their application.

Again, a template for the safety management plan was not developed specifically for this initiative. Trialling organisations are encouraged to use their preferred template/document. Trialling organisations can also use the '*Risk Assessment – Template'* in the Safety Management System (SMS) tools on the NHVR website (one assessment for each of the risks identified, including those outlined below).

Vehicle directional control and dynamic stability
Road-going vehicle combinations have historically operated with one tractive power source only. Introducing a second source may unintentionally introduce risks to vehicle directional control and dynamic stability. The following include but are not limited to examples of possible adverse situations that may arise:

- jack-knifing – where front units in the combination are 'pushed' by rear units
- low yaw damping – where the combination is unable to, or has reduced ability to, dampen yaw oscillations
- increased amplification of lateral acceleration – where lateral accelerations at the front units are greatly amplified throughout the subsequent rearward units
- increased transient off-tracking – where the lateral distance moved by rearward units is greater that the front units, following a steering input (e.g. swerving)
- diminished tracking ability – where the ability of rearward units to remain within the path set by the front units is reduced
- loss of traction, stability, or any other loss of dynamic control scenario.

Trialling organisations may opt to use the Performance Based Standards (PBS) scheme measures and its assessment methods, undertaken by approved PBS assessors to assess the above risks. While the existing PBS measures do not directly consider nor address powered trailer equipment, the assessment methods and the skills of the assessors may be beneficial in devising modified or alternate/new scenarios that can be investigated by the dynamic modelling capabilities used in PBS assessments.

In addition, trialling organisations may consider demonstrating the following:

- ensuring the distribution of tractive forces from the powered axle such that no risks to dynamic stability are introduced, and how they are managed as they arise during operation
- limiting tractive forces provided by the powered axle(s) to less than (or equal to) those needed to overcome road grade and drag forces (e.g. rolling resistance, aerodynamics, etc.), and include upper and lower speed limits for powered system operation
- setting a minimum Static Rollover Threshold (SRT) of the combination in all load states, of 0.35 g.

In some circumstances it may be necessary to temporarily increase the tractive forces provided by a powered axle above that needed to overcome grade and drag. Such situations may include low truck drive axle friction scenarios, or where improved acceleration is advantageous, such as when clearing a railway crossing or intersection from rest. If the powered axle system allows such uses, those should be clearly described by the trialling organisation. In those instances, forces applied to tow couplings should be considered.

Braking performance

Brake systems in combination vehicles have historically been designed to operate with one tractive power source only. Introducing a second source may unintentionally introduce risks to braking performance and associated systems. The following are examples of possible adverse situations that may arise:

- jack-knifing – where front units in the combination are 'pushed' by rear units
- worsened stopping distance performance
- unintentional wheel locking caused by the retardation force of regenerative braking units
- limited/reduced anti-lock performance
- limited/reduced roll stability functionality.

Trialling organisations should explain how vehicle brake performance remains unaffected by the powered axle systems and describe how that is achieved by the system's design.

Trialling organisations must use vehicles fitted with the latest version of trailer Electronic Brake Systems (EBS) available in the Australian market, and the latest version of truck EBS offered by the manufacturer for the model of vehicle used in the trial and confirm that in the application.

System failure

The trialling organisation should outline any fail-safe mechanisms that ensure there are no significant safety risks in the event of failure of any part of the system failure (e.g. control systems, software, hardware, etc.), as appropriate to the specific application.

In addition to the above, trialling organisations should consider installation of a driver-accessible emergency stop or system 'cut off' button, that when activated, cuts driving power to and/or regenerative action of the trailer/dolly axle(s).

Regenerative braking force, vehicle communications, and cyber security

Various powered trailer trials and development work has been conducted overseas and reported in United Nations working groups, principally the Working Party on Automated/Autonomous and Connected Vehicles (referred to as the 'GRVA'). The GRVA deals with safety provisions related to the dynamics of vehicles (braking, steering), Advanced Driver Assistance Systems (ADAS), automated driving systems and cyber security provisions. That group has recently proposed:

- a limit of the regenerative braking force developed by powered axles of 20 kW,
- a requirement that powered axles capable of generating a braking rate exceeding 0.04 per wheel, does not cause wheel locking at travel speeds above 15 km/h
- revisions to the ISO 11992-2 standard to enable more robust truck-trailer communications
- the need to consider cyber security risks.

While the work of that group remains on-going, trialling organisations are encouraged to consider the preliminary findings and recommendations of those groups and explain how their technical solution addresses (or negates) the risks posed by braking forces being too high, unintentional wheel-lock scenarios, existing truck-trailer communications arrangements being inadequate, and cyber security risks.

Electromagnetic interference

At present, all motor vehicles in Australia are required to comply with regulations that ensure the vehicle's systems are not adversely affected by sources of electromagnetic interference. That requirement is enacted through the Australian Communications and Media Authority (AMCA) Electromagnetic Compatibility (EMC) Standards. Those standards specify that motor vehicles and their accessories comply with UN ECE R-10, which sets specific EMC requirements for vehicles and their electronic components.

While it is unclear that powered trailers fall under the ACMA's definition of a 'motor vehicle', trial organisations should address that risk in their application, and outline how their system manages the risk of electrical interference, to ensure safe operation in all circumstances.

4.3 Evidence of insurance

Trialling organisations should demonstrate that they have appropriate insurance to protect against the risks associated with the trial. Trialling organisations should consult with the relevant road transport agency about insurance in the first instance. Appropriate insurance could include:

- compulsory third-party insurance
- comprehensive vehicle insurance
- public liability insurance
- product liability insurance
- self-insurance
- work or occupational health and safety insurance
- professional indemnity of any Authorised Vehicle Examiners used.

The trialling organisation should check with the relevant road transport agency to determine if they are covered by the state-based insurance scheme. The requirements and coverage of these schemes differ between states and territories.