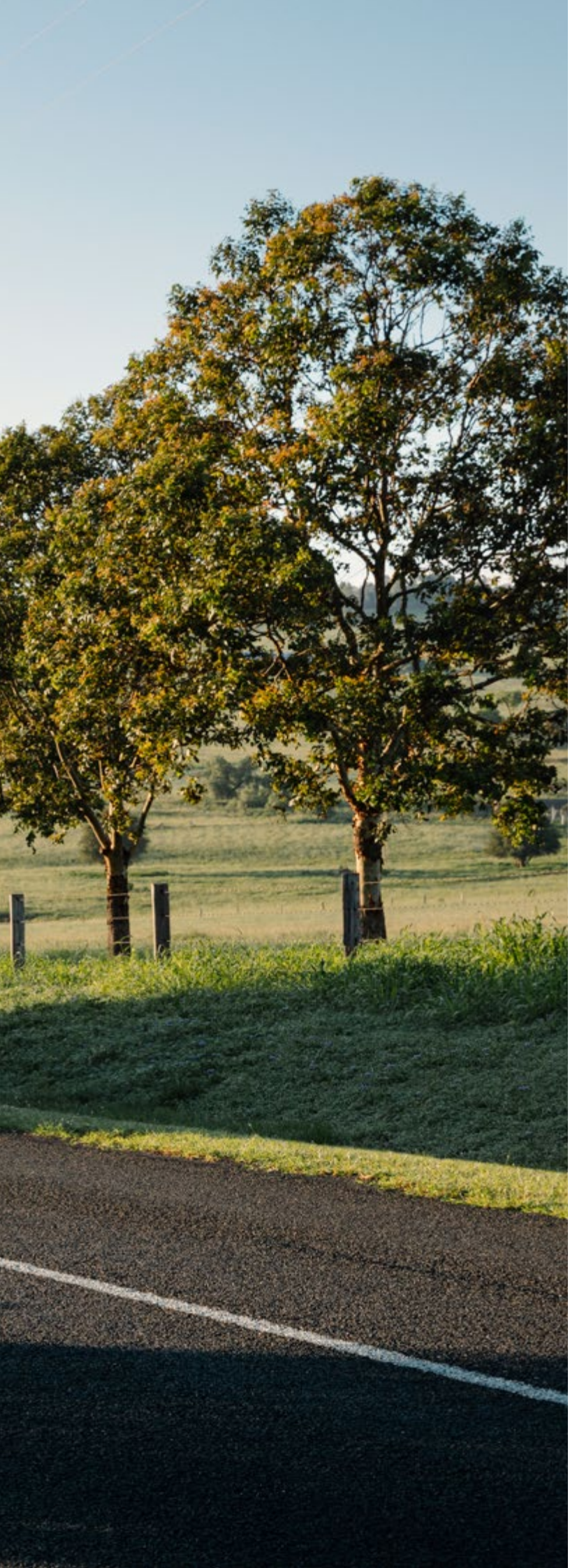
NHVR

FUTURE HEAVY VEHICLE ROADMAP

JUNE 2023



CONTENTS

INTRODUCTION

The global heavy vehicle industry has entered a period of rapid change that will fundamentally alter the vehicles that are used to deliver the road freight and passenger transport tasks. These changes, being driven by the inclusion of advanced safety systems, increasingly automated systems and a shift to reducing and eliminating vehicle emissions will mean heavy vehicles of the future will likely look and operate very differently to those the industry has used for some time.

Australia maintains notable heavy vehicle manufacturing capability, and while to a certain degree our regulation reflects the unique nature of the local heavy vehicle industry, we are heavily influenced by global developments. This will mean the changes seen in global markets will be reflected here.

While Australian transport regulators routinely update local transport regulations to reflect these global developments, the sheer scale and volume of changes under development will mean a much greater level of planning and co-ordination will be required. Our focus must be on ensuring our regulatory environment is ready for future heavy vehicles when they arrive, supporting our industry to readily adopt these cleaner and safer vehicles

The NHVR is producing the Future Heavy Vehicle Roadmap as a single reference point to capture:

- the heavy vehicle related developments that we are aware of
- a preliminary regulatory scan to identify potential barriers
- suggest a broad grouping to assist in prioritisation of reform work.

ENVIRONMENTAL SCAN SUMMARY

Based on our ongoing engagement with the heavy vehicle industry the NHVR has developed an understanding of the future technologies currently under development and the potential barriers these technologies will face. These have been reviewed and grouped into three themes.

Connected and automated vehicles

As is evident in the light vehicle industry, through the work of companies like Tesla, GM, Google, etc, the development of vehicle automation is well underway. While the progress in the light vehicles space has made notable progress, specific heavy vehicle application is still in its infancy. Despite this, many of the foundation systems that will be required to automate heavy vehicles will come from the light vehicle development and through maturation of currently used advanced driver assistance systems. As such, it is essential that these developments are monitored, and contributions made to the development of regulation in this space.

For the most part, this roadmap will not consider changes required to support the development and implementation of automated heavy vehicles as this is being overseen and progressed by the National Transport Commission (NTC).

Advanced vehicle safety technologies

In recent years there has been a significant increase in heavy vehicle safety technologies such as:

- Electronic braking systems
- Roll stability control
- Forward collision alert and avoidance
- Fatigue/distraction detection technology.

These advanced safety technologies provide operators and other road users with an increased chance of detecting, avoiding or surviving a crash. Additionally, while some systems are passive and are designed to warn the vehicle operator (or in some cases surrounding road users), other are active and intervene to change the dynamic performance of the vehicle.

While progress is made to a future of automated vehicles, the short to medium term will see a continued development and implantation of advanced safety systems and technologies. Transport regulators must ensure they monitor these developments to ensure necessary changes to regulations are progressed in a timely fashion.

Low and zero emission vehicles

Traditionally diesel has been the driving force behind the heavy vehicle industry and since the first diesel engine was developed over 100 years ago, they have become a highly efficient and productive way of powering heavy vehicles.

However, as Australia and the world seek to reduce our environmental impacts, the push towards zero emission vehicles (ZEVs) has started to gain momentum. Australia has made international commitments to reduce carbon emissions, which will have impacts on the road transport task.

In addition to the reducing environmental impacts, ZEVs are also expected to provide other benefits not typically considered such as:

- reduced vehicle maintenance
- permitted operating hours (currently restricted in some areas due to noise)
- decreased driver fatigue (less vibration, noise, etc).

To accompany this shift towards ZEVs, there has also been a significant investment made towards increasing vehicle efficiency and reducing the emissions of diesel-powered vehicles. These interim developments that reduce emissions are an important first step towards a zero emissions future and cannot be overlooked.

THE ROADMAP

The purpose of the Future Heavy Vehicles Roadmap is to provide a blueprint of how the heavy vehicle industry, including regulators, can plan for the forthcoming changes. The roadmap captures key developments at their highest level, the identified regulatory barriers and describes a potentially prioritised approach.

As part of our routine engagement with heavy vehicle manufacturers and the heavy vehicle industry, the NHVR also anticipates that further supporting work will be undertaken that investigates the barriers identified in the roadmap. This more detailed work will seek to explain the cause of the barrier and to quantify it as much as is possible.

It is intended that the roadmap will lead to the development of more detailed action plans that will see specific work packages identified and action parties allocated. The NHVR also acknowledges that while the roadmap deals with transport specific issues, it is likely that there will also be roadmaps in adjacent policy areas, such as energy infrastructure and education and training.

Additionally, the roadmap presents the current state of developments and their timetables, it is highly unlikely that this will remain static over time. As each technology matures and progresses from research towards production, some technologies may be discontinued, new technologies emerge or the timeframes for certain solutions may be accelerated or de-prioritised. As such, it will be critical that the NHVRs engagement with the industry is maintained, and this roadmap updated regularly.

Based on the current understanding of developments, the roadmap is currently separated into three phases.

Phase 1 – Current and short term developments

Focusing on developments that are already fully commercially available in the market or are expected in the short term (1-2 years). This phase also considers issues that while not critical now, are impacting industry and therefore policy consideration needs to commence immediately. The specifications of developments in this timeframe are detailed and easily articulated.

Developments the NHVR has allocated in this phase are:

- Euro VI emissions implementation
- Removing barriers for European direct vision and fuel-efficient vehicles
- Low and no emissions test and evaluation framework.

Phase 2 – Medium-term developments

Considers developments that are matured in the production pipeline, where there is a clear commercially viable application and are expected to be available as mainstream vehicles within 3-5 years. It is possible that developments in this timeframe may already be coming to market by early movers. Specifications for developments in this phase are still being refined, but the possible timeframes are more certain than those in phase 3. Developments the NHVR has allocated in this phase are:

- Light and medium duty truck and bus BEVs
- Alternative axle configurations

Phase 3 – Longer-term developments

Contemplates the future vehicle technologies which manufacturers are in the early stages of developing and will likely not commence commercial production development or release for over 5 years.

This phase is highly variable as it is expected these designs will evolve significantly before being ready for distribution to the Australian Market. Specifications can only be articulated in terms of broad ranges and there is notable variation between players in the market.

Developments the NHVR has allocated in this phase are:

- Heavy duty ZEVs
- 2nd generation light and medium duty truck and bus BEVs.

Each phase will outline the focus areas, expected timeframes, stakeholders, the NHVRs current understanding of barriers and proposed solutions. It must be noted that as the maturity of certain future heavy vehicles progresses, as will our understanding of the technology, barriers and time to market release. As such these factors are dynamic and will continue to be monitored by the NHVR.

Additionally, while the phases have been listed in the order in which NHVR expect them to be implemented, the focus areas are not provided in any specific order.

1

PHASE 1
Current and short-term developments

- Euro VI emissions implementation
- Fleet exit stratergy
- Remove direct vision and fuel efficient vehicle barriers
- Low and no emissions evaluation framework

2

PHASE 2
Medium-term developments

- Light, medium duty and bus BEVs
- Alternative axle configurations
- ZEV recycling

3

PHASE 3
Longer-term developments

- Heavy duty ZEVs
- 2nd generation light, medium duty and bus BEVs

Figure 1. Graphical representation of the Future Heavy Vehicle Roadmap

THE ROADMAP

PHASE 1: CURRENT AND SHORT-TERM DEVELOPMENTS

The first phase of the roadmap focuses on the current changes that are already occurring within th evolution of the current heavy vehicle fleet in Australia

FOCUS	WHAT'S COMING	BARRIERS
Euro VI emissions implementation 	Mandating of ADR 80/04 in 2024 for low emission engines that comply with Euro VI UN-ECE regulations.	**Reduced payload capacity** Payload capacity is reduced with low-emission vehicles as the emission equipment required notably increases the tare mass of the vehicle. Consultation with manufacturers has advised that this emission equipment adds up to 500kg to the vehicle's tare mass. **Vehicle dimensions** As these vehicles are typically the higher specifications option offered by vehicle manufacturers, they are also generally fitted with the latest safety technologies. The fitment of this technology typically results in the vehicle exceeding the 2.5m width limit which in some cases results in manufacturers removing this safety equipment from vehicle's provided to the Australian market. This width impact is not directly related to emission systems. There have also been some discussions that these low-emission vehicles may result in vehicles exceeding the regulatory length limits. However, based on advice from manufacturers this is not a concern for these vehicles.
European direct vision and fuel-efficient vehicles 	EU standards have recently been updated to require improvements in direct vision by heavy vehicle drivers and to improve the fuel efficiency of heavy vehicles.	**Vehicle dimensions** In relation to improving direct vision by drivers, there will likely be significant changes made to the cabins of vehicle. OEMs have identified that the primary impact of these regulations will relate to vehicle and combination length, however as further product is developed, additional barriers may be identified. To effectively manipulate air flow and provide the intended benefits typically aerodynamic devices must be attached to the exterior of a vehicle. As a large number of heavy vehicles are already manufactured to the maximum allowable dimensions fitting these devices will result in the vehicle no longer complying with these dimensional requirements. OEMs have identified initially that aerodynamic devices will likely impact vehicle and combination length, vehicle width and ground clearance.
Low and no emissions test and evaluation framework 	As companies develop future fuelled heavy vehicles, there is a need to test and prove these vehicles in real world environments. Australia is well positioned to be a key location for this vehicle proving, due to the potential abundance of renewable fuels and some of the toughest operating environments in the world.	As future fuel vehicle designs differ significantly compared to current vehicles there are a number of barriers that will hinder conducting trials in Australia: ▪ Vehicles exceeding mass and dimension regulations ▪ Lack of a consistent framework for designing and undertaking testing ▪ Issues relating to reliable access to renewable fuels ▪ Lack of qualified tradespersons to maintain and repair vehicles.

he heavy vehicle industry and also looks at options to allow for a fast and efficient

PROPOSED SOLUTIONS	MAJOR STAKEHOLDERS
Mass concessions The NTC is leading a Euro VI solution that will allow these low-emission vehicles to maintain productivity and remain fitted with the latest safety equipment. As currently proposed, this solution is considering: ▪ Additional 500kg for single steer axle vehicle which can be distributed across the steer and drive axle groups. ▪ Additional 1000kg for twin-steer vehicles permitted on the steer axle group It is also proposed that the Euro VI solution should be extended to all future low emission vehicles and zero emission vehicles to future proof the provisions and provide interim mass relief for these cleaner vehicles. The inclusion of these vehicles in the concession has led to naming the concession as the Euro VI+ concession. **Vehicle width** For the purposes of this paper, it is assumed that alignment of Australian width limits with origin markets will have been completed as part of the Safer Freight Vehicle reforms. It is estimated that these proposed solutions will be finalised November 2024.	▪ Commonwealth ▪ NTC ▪ NHVR ▪ Road managers ▪ Vehicle manufacturers ▪ Peak bodies
Review of vehicle standards Given the commitments to emissions reduction and road safety improvements, the relevant EU regulations should be reviewed with a view to determine if they should be adopted in Australia. It must be noted that as EU regulations are updated, these changes would not automatically be covered by vehicle harmonisation commitments at the UN level. **Review vehicle dimensions** Regardless of whether the EU regulations for fuel efficiency and direct vision are adopted in Australia, vehicles complying with these rules will be imported and will seek to be used on roads. Dimension limits should be reviewed to ensure they do not pose a barrier to the uptake of these cleaner and/or safer heavy vehicles. For the purposes of this paper, it is assumed that alignment of Australian width limits with origin markets will have been completed as part of the Safer Freight Vehicle reforms.	▪ Commonwealth ▪ NHVR ▪ Road managers ▪ Vehicle manufacturers
For Australia to become a leading market to test and develop future fuelled vehicles, companies must be provided commercial certainty. To do this, various levels of government should develop a comprehensive test and evaluation framework. The framework should provide a standardised approach for manufacturers and modifiers to obtain more flexible vehicle standards, mass and access provisions. To obtain this, the applicant should be required to develop safety management plans for the testing that covers all aspects of the safe operation of the vehicles. Encouraging and supporting the testing of future heavy vehicles in Australia can play an important role in kick starting the changes that will be required for these vehicles. For example: ▪ Trials will require refuelling or recharging infrastructure, so will provide initial infrastructure and also experience to local industries on designing and fitting this equipment. ▪ Trials will require the vehicles being tested to be repaired and maintained, so will provide opportunities for training for local tradespersons. ▪ Provides opportunities for familiarisation with these new vehicles by first responders, regulators etc. ▪ Exposure of the industry and public to future heavy vehicles will start developing an understanding of the vehicles and start towards accepting this new technology. Embracing this testing framework will allow Australia to remain at the forefront of heavy vehicle innovation and ensure that we are not left playing catch-up. Considering the relatively small volume of vehicle sales Australia makes up in the world market the importance of these projects cannot be understated.	▪ NHVR ▪ Road managers - Jurisdictions - Councils ▪ Commonwealth ▪ Emergency services ▪ Vehicle OEMs ▪ Energy providers - Electricity - Gas ▪ Vehicle modifiers ▪ Vehicle operators

PHASE 2 – MEDIUM-TERM DEVELOPMENTS

The second phase of the roadmap also includes 4 focus areas which are based on vehicle technolog Although the pathways for vehicles and technologies in future fuels are relatively well-known there is available to mainstream operators.

FOCUS	WHAT'S COMING	BARRIERS
Light and medium duty truck and bus BEVs 	The NHVR anticipates that light and medium duty truck and bus BEVs will be the first tranche of ZEVs to enter into the Australian fleet in commercial quantities.	**Battery capability** To achieve similar range to the diesel engines these vehicles must be fitted with large battery packs with a typical capacity of around 100-300 kw/h. Battery packs of this capacity add substantial mass to the vehicle which has a direct negative impact on their payload capacity. Depending on the capacity of the battery packs and where they are located on the vehicle this mass increase and how it is spread across the steer and drive axle groups will differ. **Vehicle width** BEVs, like many traditional diesel vehicles, are designed for origin markets such as Europe. Unlike diesel vehicles however BEVs cannot be modified to reduce width because it would require reworking of major components such as the chassis or battery packs. In addition to these design variations and similar to low-emission vehicles, manufacturers also equip these BEVs with the latest safety equipment which can also result in over-width vehicles. **Standards and regulation** The current ADRs and in-service regulations do not provide minimum safety standards for future fuel vehicles. However, work has commenced to develop new ADRs which are based on international standards for these fuel systems, such as UNECE R100 and GTR20 for Electrical Safety. Until these standards are completed and implemented there is a risk that sub-standard vehicles that present a safety risk may be supplied to market.
Alternative axle configurations 	Future heavy vehicles supplied in Australia will likely feature European axle group configurations that are not common on current vehicles. These axle configurations are designed to allow for such things as increased battery pack provisions, ability to fit electric wheel-end motors, increase vehicle efficiency, reduce tyre wear and account for any increased vehicle mass.	**Vehicle design** The ADRs and in-service regulations specify the axle configurations a vehicle is permitted to have. Future vehicles fitted with axle configurations not provided for by current regulations will not be eligible for provision in Australia. This will significantly delay the variants available in Australia and subsequently the uptake of these vehicles. **Vehicle mass and dimension limits** The current axle configurations and the mass which they are afforded has been derived from their impact they have on the road network. Where a configuration is not provided for by in-service regulations, no mass limit is prescribed and prevents the use of these vehicles.

gies which are currently being developed or are in early trial/adopter stages. s still expected to be sizeable changes before they are available made widely

PROPOSED SOLUTIONS	MAJOR STAKEHOLDERS
Review of mass limits It will be necessary to undertake a review of regulation mass limits for low and no emission vehicles. It must be noted that this review will be complex as it will consider allowing a class of vehicles to the road network that the road network was not designed for. This review will need to involve a wide range of stakeholders and be informed by further market scanning to be undertaken by the NHVR. **Vehicle width** For the purposes of this paper, it is assumed that alignment of Australian width limits with origin markets will have been completed as part of the Safer Freight Vehicle reforms. **Review of international standards** To ensure Australia maintains acceptable vehicle safety standards the work which recently commenced to develop future fuel ADRs must continue. Additionally, continual review of existing and proposed future fuel international standards for possible implementation into the ADRs must occur.	▪ Commonwealth ▪ NHVR ▪ Road managers ▪ Vehicle manufacturers ▪ Vehicle modifiers ▪ Peak bodies
Review of vehicle standards Vehicle rules and regulations must be reviewed and updated to provide for the axle configurations that will be present on future heavy vehicles. **Review vehicle dimensions** In-service mass and dimension requirements must be reviewed to provide limits for the axle configurations that will be present on future heavy vehicles. It must be noted that this review will be complex as it will consider allowing a class of vehicles to the road network that the road network was not designed for. This review will need to involve a wide range of stakeholders and be informed by further market scanning to be undertaken by the NHVR.	▪ Commonwealth ▪ NHVR ▪ Road managers ▪ Vehicle manufacturers

PHASE 3 – LONGER TERM DEVELOPMENTS

FOCUS	WHAT'S COMING	BARRIERS
Heavy duty ZEVs 	Based on current consultation the NHVR understands that heavy-duty zero emission vehicles are still under development and will take some time to reach full commercial deployment. It is likely that these vehicles will use a mix of technologies to allow them to carry out longer range freight tasks.	Given the time horizon covered by this phase, it is not possible with any certainty to articulate the barriers. What can be assumed is that many of the barriers for heavy duty ZEVs will face will most likely be similar to those faced by light and medium duty truck BEVs, including: ▪ Increases tare mass ▪ Alternate axle configurations ▪ Excess dimensions. The scale of the barrier however will likely be proportional. As a hypothetical, where a light duty vehicle faced a 1t mass barrier, heavy duty may face a mass barrier many times this size.
2nd generation light and medium duty truck and bus BEVs 	The development of a heavy vehicles never stops, with next generation vehicles always building and improving of the lesson learnt from the previous generations. In the longer-term scenario, it is assumed that second and subsequent generation light and medium duty trucks and bus BEVs will be coming to market.	While no barriers may develop as vehicle design matures, it is important that regulators continue to monitor these developments to ensure regulation remains fit for purpose.

PROPOSED SOLUTIONS	MAJOR STAKEHOLDERS
Continue to monitor the development and trial of these vehicles to improve understanding and clearly identify barriers.	• Commonwealth • NHVR • Road managers • Vehicle manufacturers
	• Commonwealth • NHVR • Road managers • Vehicle manufacturers

DECARBONISATION

A common theme throughout this roadmap are technologies that will decarbonise the heavy transport task. While the roadmap considers these technologies that are under development and deployment, it does not consider the overall strategy to how the heavy transport task will be decarbonised.

The development of a co-ordinated approach to decarbonising the heavy transport task is currently be considered by all levels of government and will cover a range of issues, both transport and non-transport related. The NHVR expects that addressing the potential barriers outlined in this paper for low and no emissions technology will be included in any decarbonisation plan.

As progress is made towards decarbonisation the industry may change, reprioritise, or develop new technologies. The NHVR will monitor any impacts this may have on the Roadmap and make changes to ensure the roadmap remains current.

MANAGING EARLY UPTAKE

Path to regulatory change

The process for changing some areas of heavy vehicle regulation, including mass and dimension requirements, requires careful analysis and takes some time. To address this regulators apply a 'maturity model' that uses the full range of tools available to support industry while the process of making regulatory change is followed.

For future heavy vehicles, while there are currently some early adopters of these technologies these are fairly limited in their demand and are being handled by issuing individual permits. As this demand starts to increase and more certainty is available, more efficient and effective approval solutions are utilised which can handle these larger numbers. Ideally these solutions are implemented ahead of significant demand growth.

Adjacent issues

The issues outlined in this Roadmap are focused on transport regulatory issues, however there are a number of elements in other policy areas which will need to be considered to support the transition to future heavy vehicles.

Such items may include:

- Ensuring that vehicle repair and maintenance qualifications are fit for purpose
- Vehicle charging/re-fueling infrastructure is available and optimally located
- Emergency services are prepared for future heavy vehicles
- Industry can manage future vehicles at depots, delivery locations, distribution centers etc.

Moving forward

Now that these potential issues and phases have been captured and articulated, moving forward the NHVR will seek to:

- Maintain this roadmap through regular engagement with the heavy vehicle industry, including by:
  - adding new technologies that emerge or removing technologies that industry stops progressing
  - refining the barriers faced by a particular technology as its development progresses
  - refining the scale or significance of each barrier to support the regulatory consideration of each barrier
  - refining the timeframes for full scale commercial release of each technology or the realisation of each potential barrier.
- Work with relevant stakeholders to share this information and ensure action plans and work programs are developed to address the barriers faced.
- Assist other stakeholders who are progressing work to support the transition to no emissions by providing subject matter expertise.

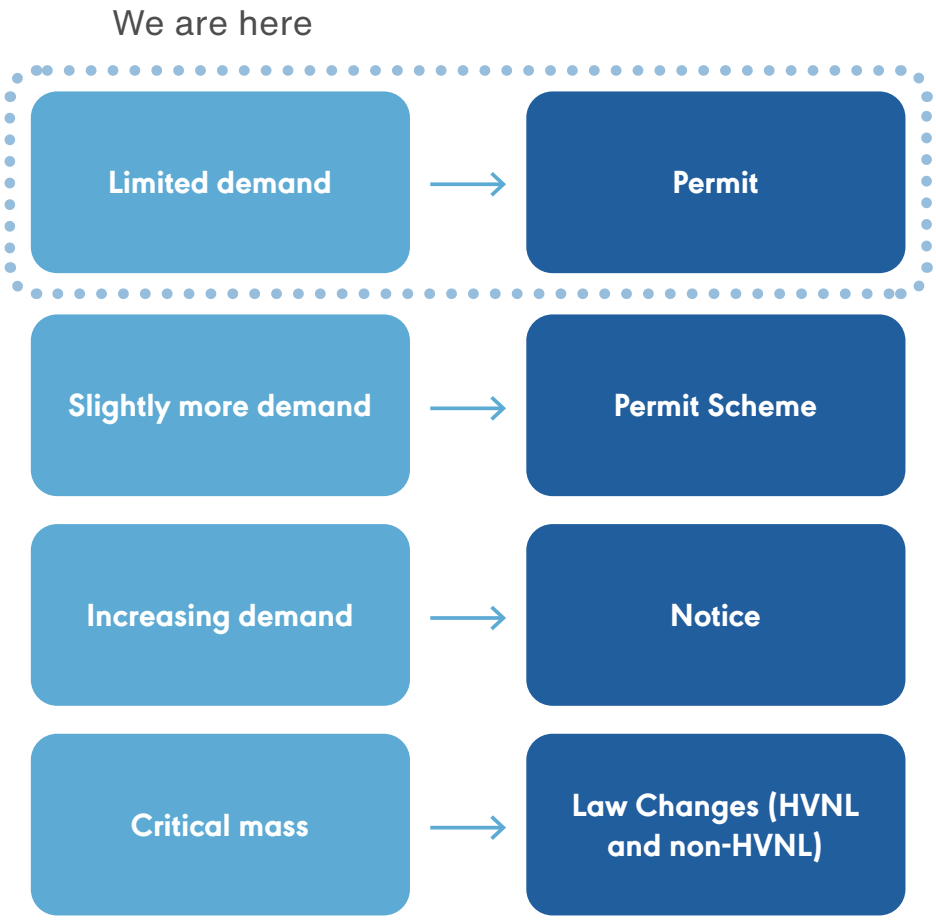


Figure 2. Graphical representation of the maturity model

APPENDIX

Appendix 1: Common terms

Term	Acronym	Basic Description
Australian Design Rules	ADR	Sets mandatory requirements for new vehicles
Battery electric vehicle	BEV	Vehicle powered by an electric motor/s and fitted with rechargeable battery packs. It must be plugged into an electricity source to recharge and have no secondary source of power.
United Nations Economic Commission for Europe	UNECE	Sets European standards
Electronic Braking Systems	EBS	Sends electronic signal to brakes
Electronic Stability Control	ESC	Warns driver of obstacles in front of vehicle
Fuel cell vehicle	FCV	An electric vehicle which derives its electricity from a fuel cell (which converts hydrogen to electricity). Typically, these vehicles are also fitted with a small battery pack and/or supercapacitor to allow the temporary storage of a small amount of electricity.
Global Positioning System	GPS	Provides location of vehicle
Heavy duty vehicle	HDV	A heavy vehicle with three or more axles OR a two axle vehicle with a GVM greater than 8000 kg and a GCM greater than 39,000 kg
Heavy Vehicle National Law	HVNL	Legislation for heavy vehicles used in transport
Lane Departure Warning	LDW	Warns driver of wandering out of lanes on the road
Lane Keep Assist	LKA	Steers truck back into middle of lane
Light duty vehicle	LDV	A heavy vehicle with a GVM between 4501 kg and 8000 kg inclusive.
Medium duty vehicle	MDV	A heavy vehicle with a GVM greater than 8000 kg and with a GCM up to 39,000 kg.
Roll Stability Control	RSC	Helps keep truck upright
Vulnerable Road Users	VRU	Pedestrians/Cyclists etc.
Zero emission vehicle	ZEV	A vehicle that produces no tailpipe emissions, and includes BEVs and FCVs.

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