Electric vehicle standards in Australia

Standards workplan

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1 About this paper

In May 2009 Standards Australia was commissioned by the Victorian Department of Innovation, Industry and Regional Development (DIIRD) to examine the need for development of Australian Standards for electric vehicles (EVs) given their likely introduction into the Australian marketplace in the near future. In assessing the need for development of specific standards in the Australian context, consideration was given to the existence of current international standards and industry practices and the degree to which these standards might negate the need for specific Australian standards.

The key findings of this work were discussed with key industry stakeholders at two workshops on 27 August 2009 and feedback from these discussions was used to refine and finalise the scoping study. The subsequent report, 'Electric vehicle standards in Australia – A scoping study (September 2009)', was delivered to DIIRD in October 2009. The report suggested that there was a need to adopt a strategic approach that advanced a suite of Australian standards in five core focus areas:

- vehicle design
- vehicle power systems
- vehicle recharging
- rescue, vehicle repair and vehicle recovery
- consumer information and GHG emissions.

The stakeholder discussions conducted for the scoping study highlighted a wide variance in the views of individual stakeholders in relation to (a) the areas where standards are likely to be required, (b) the approach that should be adopted in respect of developing specific Australian standards, and (c) the priorities of individual standards. As a consequence, it was suggested that there was a need to assemble a national working group to consider the findings of the scoping study and oversee the development of a workplan for preparation of Australian standards for EVs.

In May 2010, DIIRD commissioned Standards Australia to assemble the workplan for development of EV standards in Australia. This work essentially required the completion of two specific tasks:

- identifying priorities for the development of EV standards
- assembling the overall workplan including (a) identifying specific standards development tasks, (b) scheduling activities, (c) identifying industry composition of the project teams for development of individual standards, and (d) designing the overall structure of the approach.

This paper presents the subsequent workplan and discusses the rationale that was used to assemble the workplan.

2 Background

Growing uncertainty about the global supply outlook for conventional transport fuels, and societal concern about the growing contribution of road transport to greenhouse gas (GHG) emissions has generated significant interest in the real world application of alternative fuels and alternative drivetrain technologies. Within this context, electric powered vehicle technologies have emerged as one of the most promising near-term technologies for (a) reducing societal dependence on conventional transport fuels, and (b) reducing GHG emissions from the global passenger car fleet.

The apparent merits of EV technologies have resulted in a number of countries advancing programs and policies that have sought to accelerate the market introduction of EVs, particularly Japan, North America, Israel and some European countries. Global manufacturers have responded to these market signals by developing an increasing range of fully electric and plug-in hybrid vehicles for the global car market.

The EV market in Australia is best described as an emerging market with significant potential. An increasing number of manufacturers have introduced (or are planning to introduce) EVs into Australia in the near term, including Mitsubishi, Nissan and Holden. Progress is also being made in respect of the development of EV recharging infrastructure, with Better Place, Ecotality and ChargePoint all entering into discussions with government agencies and energy network operators to lay the foundations for a public recharging network for EVs in Australia's major cities.

In addition, governments around the country are recognising that there will likely be a need to facilitate the introduction of these vehicles into the market in the first instance given the significant barriers to wholesale market take-up. For example, the Australian Capital Territory Government is working with energy provider ActewAGL and Better Place to establish a network of recharging stations that will potentially support 1000 EVs from 2012. The New South Wales (NSW) Government has conducted trials of a plug-in hybrid EV (PHEV) and associated recharging infrastructure while the Victorian Government is working on a $5 million EV trial to commence in 2011.

All of these developments point to the fact that Australian consumers are likely to be given the chance to purchase this new vehicle technology from 2011. As with any new product or technology, the introduction of EVs into wider society will require careful consideration of the need to successfully manage related public safety and consumer protection issues.

In the case of new vehicles, these two objectives have been traditionally managed via a combination of national regulations (in the form of Australian Design Rules [ADRs]), related consumer legislation and industry standards. The very nature of EVs, however, suggests that there will be a need to look beyond traditional vehicle standards to consider issues relating to the design of EV components and vehicle recharging infrastructure.

2.1 The 2009 scoping study

At a meeting on 12 September 2008, the Council for the Australian Federation asked the Victorian Government to investigate the extent to which Australian standards need to be developed to support the market introduction of EVs. The Victorian Government subsequently commissioned Standards Australia (working in partnership with Rare Consulting Pty Ltd) to undertake a scoping study to provide advice on the need for development of national standards for EV operation in Australia.

The 2009 scoping study worked to develop an understanding of the potential role for Standards Australia in supporting the emerging EV market. The study found that the introduction of EVs into wider society will require careful consideration of the need to successfully manage related public safety and consumer protection issues. The scoping study concluded that a standards-based management of these issues was desirable as it provided an appropriate mechanism for the minimisation of the key risks without imposing an onerous burden on the vehicle industry, vehicle recharging infrastructure providers and EV consumers.

An interesting finding of the study related to the adequacy of current international standards for EV operation when considered in the context of new market commercialisation. By focussing on key market development considerations and commercialisation risks, the scoping study identified a number of 'gaps' in current international standards. These gaps included considerations such as the treatment of aftermarket conversions, the design and siting of on-street recharging infrastructure, and vehicle identification requirements.

The scoping study concluded that there was a need to develop a rolling work program for the progressive development of Australian standards in five areas: vehicle design (OEM and aftermarket vehicles); power systems; vehicle recharging; rescue, repair and vehicle recovery; and user information and GHG assessment (Figure 1).

In addition, the study highlighted the current high diversity in stakeholder views about the likely nature and timing of the development of the EV market in Australia. It was suggested that this diversity constituted a significant risk in respect of developing consensus about the priority to be assigned to individual standards and that this risk could be managed via the formation of a national EV Standards Working Group to oversee any future standards development process.

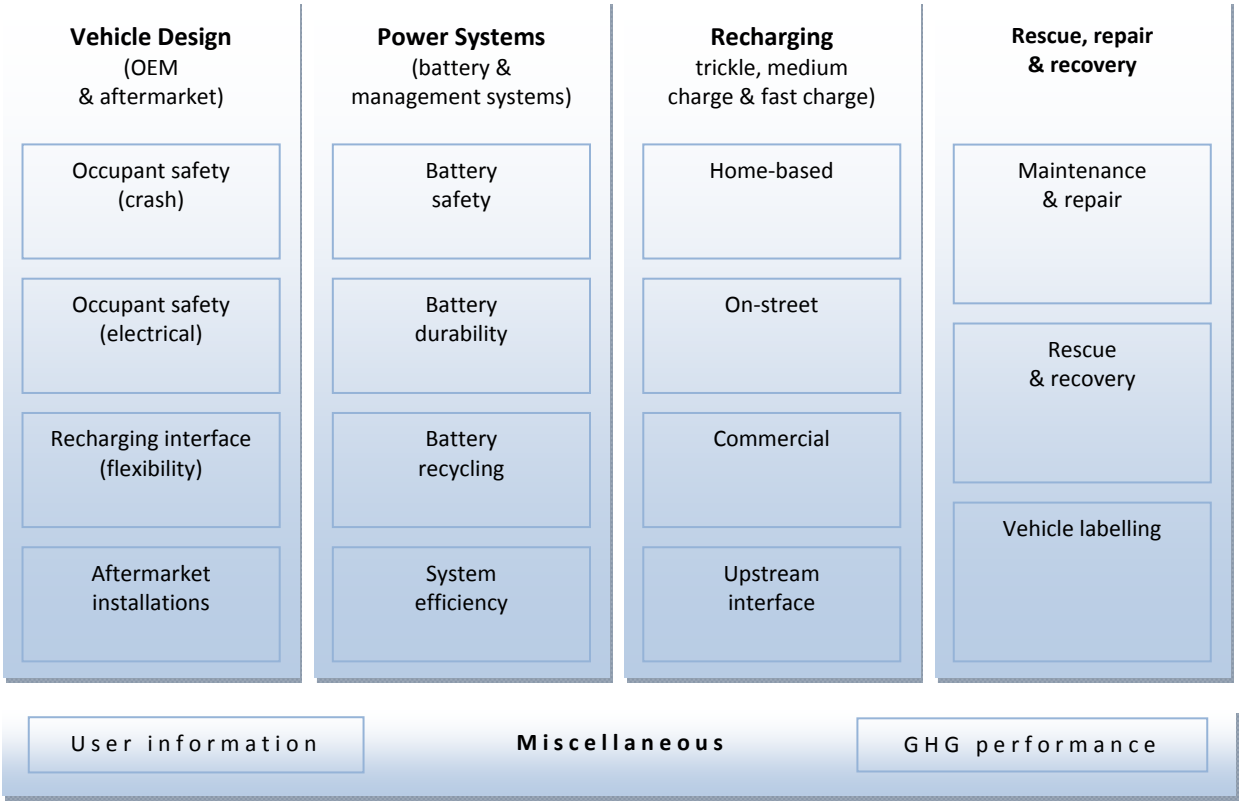

Figure 1

Five areas for consideration as identified by the 2009 scoping study

2.2 The standards development journey

Having considered the findings of the 2009 scoping study, the Victorian Government (on behalf of the Council for the Australian Federation) commissioned Standards Australia to develop a workplan for the assembly of national standards for EV operation. This request marked the commencement of the second phase of work in a three-stage journey towards the adoption of EV standards in Australia (Figure 2).

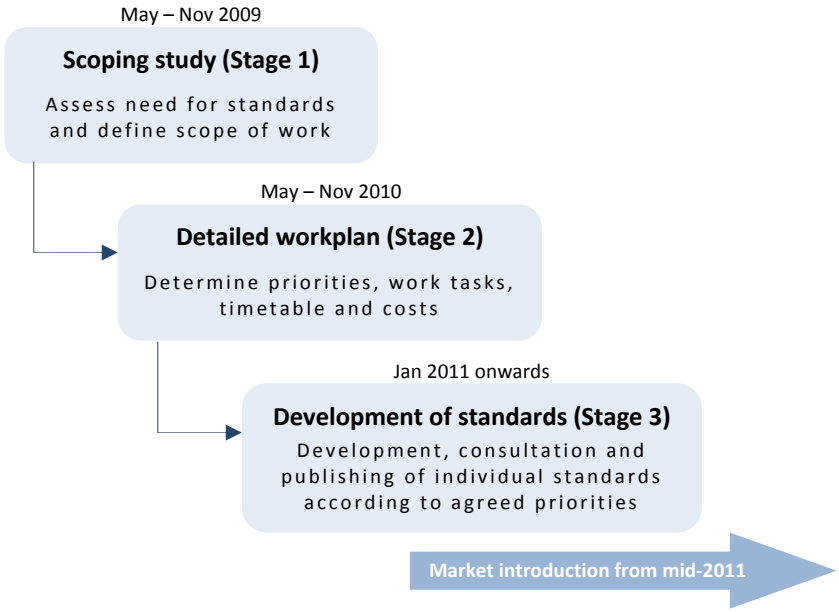

Figure 2

The three-phase standards development journey

Having assessed the nature of the need for national EV standards in Australia under Stage 1, the second stage of work involved the development of a comprehensive workplan for development of EV standards. Essentially this work required prioritising individual areas for standards development and programming of individual work tasks based on these priorities. Accordingly, Standards Australia commenced work on the development of the workplan in May 2010.

2.3 The EV Standards Working Group

The 2009 scoping study suggested that one of the central challenges to the determination of priorities for individual standards related to the apparently contrasting perspectives of key stakeholders about the likely near-term development of the EV market in Australia. On the one hand, there are a group of EV stakeholders who hold the view that there is significant latent market demand for EVs in Australia and that this potential will be released with the introduction of EVs, resulting in rapid market take-up of EV technologies in the Australian vehicle fleet.

Conversely, the scoping study suggested that there was a contra view among other key stakeholders that the development of this market was likely to proceed on a ‘slow burn’ basis given significant challenges in respect of (a) limited availability of vehicles in the near term, (b) high costs of infrastructure establishment, and (c) the high capital cost of EV offerings.

The existence of this polarisation in stakeholder views constituted a significant risk for the development of national standards, particularly given that one of the three principles of an Australian standard relates to the development of consensus on the need and nature of individual standards (the other principles being transparency of the development process and balanced representation of stakeholder views).

In an effort to manage this risk and protect the integrity of the overall standards development process, a decision was taken to assemble a national EV Standards Working Group. The formation of such a group is not typical of a traditional standards development process where the market demand for standards is well established, but rather was seen as a necessary step given that the EV market is an emerging market where there is no reliable market history that could be used to assess priority of individual areas for standards development.

A key consideration in the formation of this group was a desire to ensured balanced representation of all stakeholders in the development of the Australian EV market including industry, government, consumer organisations and research providers. A summary of the membership of the group is provided in Appendix A.

The EV Standards Working Group was recruited to oversee the development of the workplan and provide a critique of the assigned priorities for individual standards and the nature of work proposed in each area of focus. The working group met on three occasions during the workplan development process to discuss priorities, discuss the draft workplan and finalise the workplan for government consideration (Figure 3).

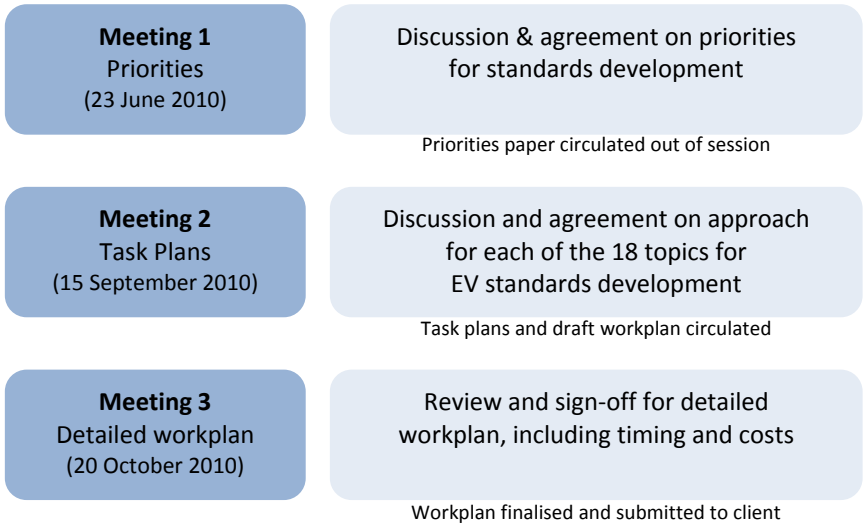

Figure 3

Involvement of the EV standards in the workplan development

2.4 Core considerations

The process used for the development of the workplan was developed around two central tasks, namely:

- development of stakeholder consensus around priority areas for standards consideration
- development of the overall workplan, including task plans for individual standards and the scheduling of activities.

The high level of diversity in stakeholder opinion about the likely EV market trajectory (as detected in the scoping study) suggested that the most challenging aspect of this study was the development of agreed consensus about the priority of individual standards. Rapid development of the market, for example, would likely result in a high priority being placed on the development of standards governing the design and functionality of high technology recharging infrastructure – as opposed to relatively simple one-way charging of the vehicle via a standard power outlet in the home.

Conversely, a slow market take-up would result in different priorities with a major focus on consumer awareness and control of the design of aftermarket conversions.

The remainder of this paper discusses the approach that was taken in relation to the assessment of priorities for individual standards and the subsequent workplan that has been developed for the progressive development of standards relating to the market adoption of EVs in Australia.

3 Priority areas for consideration of EV standards in Australia

EVs constitute a new operating paradigm for vehicle suppliers, energy networks, government agencies, local government, consumer organisations and road users. As a consequence, the requirement for development of standards is significant and will require a significant commitment of resources in the near term.

Given current capacity constraints within Standards Australia and key stakeholder groups (i.e. government and industry), there will be a need to develop EV standards on a progressive basis over a number of years. This observation gives rise to a central question: *which standards should be developed first and why?*

In traditional markets, or markets that have been operating for some time, the answer to this fundamental question is normally derived by considering the past operation of the market and the degree to which that market has created public safety and/or consumer-related issues. By understanding the level of community concern about these issues, and the degree to which this concern may threaten the longer term commercial viability of the market, priority areas for standards development are generally relatively obvious to all stakeholders.

A relevant case in point is the Australian LPG vehicle industry. LPG vehicles were first introduced during the energy crisis of the late 1970s, when concern about the oil supply outlook and the price of transport fuels resulted in the emergence of aftermarket conversion of conventional vehicles to LPG operation. The LPG vehicle market developed throughout the 1980s with investment from industry in the form of LPG refuelling points at petrol stations.

A small number of high profile vehicle fires in the early 1980s resulted in significant community push-back on LPG vehicles and threatened the viability of the industry and the associated investment that had been made. The level of concern was sufficient to prompt the LPG industry to develop voluntary codes of practice in the first instance, followed by Australian standards to increase community confidence in the safety of LPG technologies. Today, there is a suite of Australian standards governing LPG tank design, aftermarket conversions, vehicle repair and LPG refuelling.

The LPG experience demonstrates how consumer experience in the early years of operation of a new vehicle technology can set definitive priorities for standards development.

In the case of EVs, however, there is no significant market experience with EVs in the Australian context. Accordingly, the most appropriate method for determining standards for an emerging market involves consideration of industry stakeholder opinion and/or authoritative market and technical research.

Unfortunately, the work conducted for the 2009 scoping study revealed that there was a significant diversity of opinion in relation to the likely timing of market development and the inherent market risks that will need to be managed in the near term. In addition, analysis of current national and international literature (King 2008, AECOM 2009, Greenpeace 2008, McKinsey 2009, Jamison Group 2010, Automotive World 2010) reveals contrasting opinions on the development of the global (and Australian) EV market from what appear to be very credible, although different, viewpoints. Even analysis of the strategic directions and public statements of global passenger car manufacturers reveals a diversity of opinion about how the EV market will develop in the future.

Standards Australia is not in a position to make a definitive assessment about which scenario is the most likely and, consequently, the adoption of the market scenario advanced by one group of stakeholders carries a significant risk in terms of the potential failure to address a specific standard requirement in a timely way or over-commitment of resources to development of standard that largely proves unnecessary.

The above discussion gives rise to an obvious question: *how should priorities for development of individual standards be assigned in the face of the current uncertainty about the near-term development of the EV market?*

3.1 A risk-based approach to development of the EV market in Australia

Standards Australia believes that the most appropriate method for prioritising areas for standards development for EV vehicles is to consider the principal objectives that will drive the growth of the market in the future and the key risks that may threaten the viability of the market from early establishment through to market consolidation.

Essentially, the development of the EV market in Australia is likely to be dependent on the degree to which two umbrella risks are managed. These risks can be summarised as:

- **Market development risk.** This risk comprises the supply chain considerations that will likely retard future commercial investment in EV technologies and consumer purchase of EVs. Core considerations in this area include ensuring that recharging infrastructure is compatible with the EVs sold in Australia, ensuring that recharging infrastructure is compatible with the core operating requirements of the national electricity grid, and ensuring that wiring standards support home-based recharging of vehicles.
- **Community acceptance risk.** This risk is primarily associated with the probability and consequence of adverse community reaction to EVs and the consequence rate of market adoption of EVs in the future. An example of this risk relates to the degree of safety afforded to EV users and the implications of any publicity given to an incident involving serious injury or death that is directly attributed to the attributes of EVs.

The degree to which these two umbrella risks are realised relates to three elemental risks. These risks can also be described as contributing risks as the realisation of these risks will inevitably produce an increased level of market development risk or community acceptance risk. It is suggested that there are three key contributing risks that need to be considered in relation to EVs, namely:

- **Product safety risk** – the degree to which EV products constitute an unacceptable human harm risk in terms of factors such as occupant safety, electric shock risk, and/or exposure to unacceptable levels of electromagnetic radiation.
- **Public safety risk** – the degree to which EVs could contribute increased risk to the community at large in terms of either increased road safety risk associated with vehicle operation or electrocution risk associated with vehicle recharging.
- **Consumer protection risk** – the degree to which the product could be perceived as contravening core consumer protection principles in terms of value, transparency of information and environmental credentials.

The above discussion can be used to develop a strategic framework for assessing the priorities for development of EV standards in Australia. This framework is presented in Figure 4. Application of this framework involves consideration of the degree to which each focus area identified in the scoping study (Figure 1) comprises a market development risk.

In applying this assessment framework there was a need to consider whether the probability and consequence of the associated market development risks varied according to different market development scenarios. For example, does the priority of developing standards for advanced vehicle recharging infrastructure vary with the rate of market take-up of EVs in Australia and if so, why.

Accordingly, any assessment of the priority of individual standards needed to be considered in respect of two market development scenarios – a slow rate of market adoption of EVs over the next decade and an accelerated rate of market adoption.

3.2 Stakeholder survey on priorities for standards development

The assessment methodology in Section 3.1 was used to develop a stakeholder survey that would later be used to construct a list of priorities for development of individual EV standards. By canvassing the views of a balanced representation of stakeholders about the risk associated with each potential focus area (as identified in the 2009 scoping study) it was possible to construct a list of priorities.

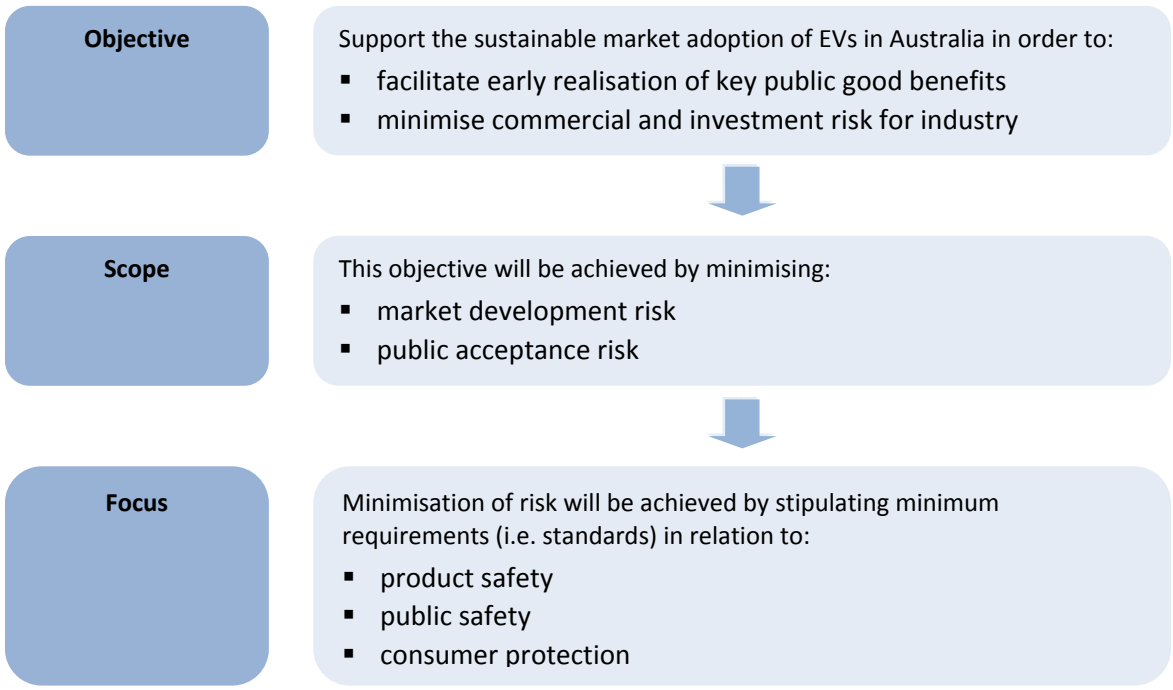

Figure 4

A risk-based framework for assessing priorities of EV standards development

Accordingly, a survey pack was developed and emailed to 26 stakeholders in the EV industry. This pack included a description of each of the 18 standards areas and their likely scope, and a description of two market development scenarios: background market adoption by 2020 and accelerated market adoption by 2020. Two market development scenarios were provided to assess the degree to which the rate of market development affected nominated priorities. These scenarios (Table 1) were constructed by considering current literature on the likely characteristics of the national and internal EV market, including recent reports from AECOM and Boston Consulting Group.

Participant surveys were conducted during July and August 2010. The majority of surveys were conducted by telephone, with a smaller number of face-to-face interviews and group interviews with umbrella organisations. A full listing of survey participants is provided in Table 2.

Interviews ranged in duration from 30–90 minutes. The format of the interviews was standardised and commenced with a recap of the materials provided in the pre-survey information pack and opportunity to seek clarification of this material. Participants were then asked to nominate the relative importance of each of the 18 focus areas to the future commercialisation of the market in terms of the umbrella risks and contributory risks summarised in Figure 4. A score was assigned as a measure of importance using a simple numeric scale of 1 to 5, with 5 being most important and 1 being least important.

In addition to nominating a score, participants were asked to support their assessment with explanatory comments. These comments were captured on a non-attributable basis to further assist with the assessment process and to account for the participants' rationale for scoring issues differently under different market development scenarios.

Table 1 **Two scenarios used to assess stakeholder opinion on priorities for EV standards development**

	Key market descriptor	Scenario A Background-level market development (2020)	Scenario B Accelerated market development (2020)
1	**Annual sales of EVs in Australia by 2020**	EVs comprise up to 1% of annual new vehicle sales.	EVs comprise approximately 5% of annual new vehicle sales.
2	**Market penetration of aftermarket EVs**	Aftermarket conversions comprise an average of 35% of all EVs sold into the Australian market by 2020.	Aftermarket conversions comprise an average of less than 10% of all EVs sold into the market by 2020.
3	**Typical profile of EV customers**	EV purchasers would largely be corporations and government agencies, with a small number sold to high-wealth households and EV enthusiasts.	Initial purchasers of EVs would exhibit similar characteristics to those of Scenario A, but ownership would rapidly extend to a broad cross-section of the community by 2020 with 50% sales to fleets and 50% to private individuals.
4	**Geographic distribution of EVs**	EV distribution is almost totally confined to the inner urban areas of Australia's major cities.	EV distribution is predominantly in metropolitan areas, with moderate vehicle ownership in outer metro and regional areas.
5	**Capital cost premium**	EVs come at considerably high capital cost with considerable and ongoing uncertainty surrounding ongoing savings and residual sale value.	The purchase price of an EV remains at a cost premium to conventional vehicles in 2020, but the magnitude of the premium has narrowed and early EV operation confirms significant savings in annual operating costs.
6	**Public policy settings**	Government initiatives are pursued on a 'technology neutral' basis and no significant incentives are provided for early market adoption of EVs.	Government initiatives are introduced to encourage increased market take-up of EVs, together with introduction of greenhouse reduction legislation.
7	**EV charging infrastructure**	National vehicle recharging infrastructure comprises: Level 1 (90%), Level 2 (10%), Level 3 (0%).	Vehicle recharging infrastructure comprises: Level 1 (50%), Level 2 (40%), Level 3 (10%).
8	**Competitive position**	Developments in battery technologies result in the market being flooded with high fuel efficiency HEVs that are substantially cheaper than EVs.	Capital costs and battery technologies have improved to such a point that EVs (and PHEVs) are a more competitive proposition than HEVs as an alternative to conventional vehicles.

Table 2 **EV stakeholders who participated in the survey of priorities**

EV stakeholder organisation	Representative
Australian Industry Group	David Crossley
Australasian Road Rescue Organisation	Daryl Rush
Australian Automobile Association	Craig Newland
Australian Electric Vehicle Association	Jaron Ware
Better Place	Sali Torgoman / Alan Finkel
Blade Electric Vehicles	Ross Blade
ChargePoint	Luke Grana
CSIRO	Tony Hollenkamp
Curtin University	Andrew Simpson
Dept of Environment Climate Change and Water (NSW)	Liz Davidson
Dept of Environment and Resources (Qld)	Alina Dini
Dept of Transport and Regional Services (Commonwealth)	Jon Real
Dept of Transport (Vic.)	Kristian Handberg
Dept of Transport (WA)	Luke O'Donoghue
Department of Environment, Water, Heritage and the Arts (Commonwealth)	Chris Baker
Department of Innovation, Industry and Regional Development (Vic.)	Glenne Drover
Ecotality	Kevin Campbell
Energy Networks Association	Mark Amos
Energetique	Phil Coop
Federal Chamber of Automotive Industries (incl. manufacturer representatives)	James Hurnall et al.
Motor Trades Association of Australia	Colin Duckworth
National Association of Testing Authorities	Vinod Reddy

3.3 Findings of the stakeholder survey

The results of the survey were analysed in terms of both the scores assigned and the verbatim comments provided by participants, with a view to assembling a ranking of priorities.

3.3.1 Average scores and resultant rankings

A summary of the raw scores derived for each focus area is provided in Table 3 and the associated frequency distributed (analysis by percentage responses of survey participants) is presented in Figure 5.

3.3.2 Synthesis of participant comments

As mentioned at the outset, the survey was conducted on a non-attributable basis in order to secure as frank an assessment as possible (that is, individual participants were able to advance a perspective that reflected their technical opinion rather than being constrained by the organisation or body for which they worked.

The resultant feedback was analysed in an effort to provide a summary of the collective rationale for the priority rankings derived via the survey. This summary is provided in Table 4 and should be read in conjunction with the scores and rankings presented in Table 3.

Table 3 Average scores for each scenario (and in aggregate) together with resultant ranking

Focus area (risk consideration)	Average of participant scores			Rank
	Scenario A	Scenario B	Aggregate	
Occupant safety (crash)	4.00	4.05	4.02	**1**
Occupant safety (electrical)	3.91	4.05	3.98	**2**
Aftermarket installations	3.95	3.91	3.93	**3**
Recharging interface (flexibility)	3.70	4.11	3.91	**4**
Vehicle labelling	3.82	3.86	3.84	**5**
Rescue and recovery	3.73	3.82	3.77	**6**
Battery safety	3.77	3.77	3.77	**6**
On-street recharging	2.86	3.95	3.40	**8**
Maintenance and repair	3.14	3.55	3.34	**9**
Home-based recharging	2.86	3.38	3.12	**10**
Commercial recharging	2.57	3.57	3.07	**11**
Energy efficiency	3.00	3.14	3.07	**11**
User information	2.75	2.93	2.84	**13**
System efficiency	2.55	3.09	2.82	**14**
GHG performance	2.55	3.00	2.77	**15**
Battery recycling	2.23	3.14	2.68	**16**
Battery durability	2.48	2.59	2.53	**17**
Upstream interface	2.00	2.81	2.40	**18**

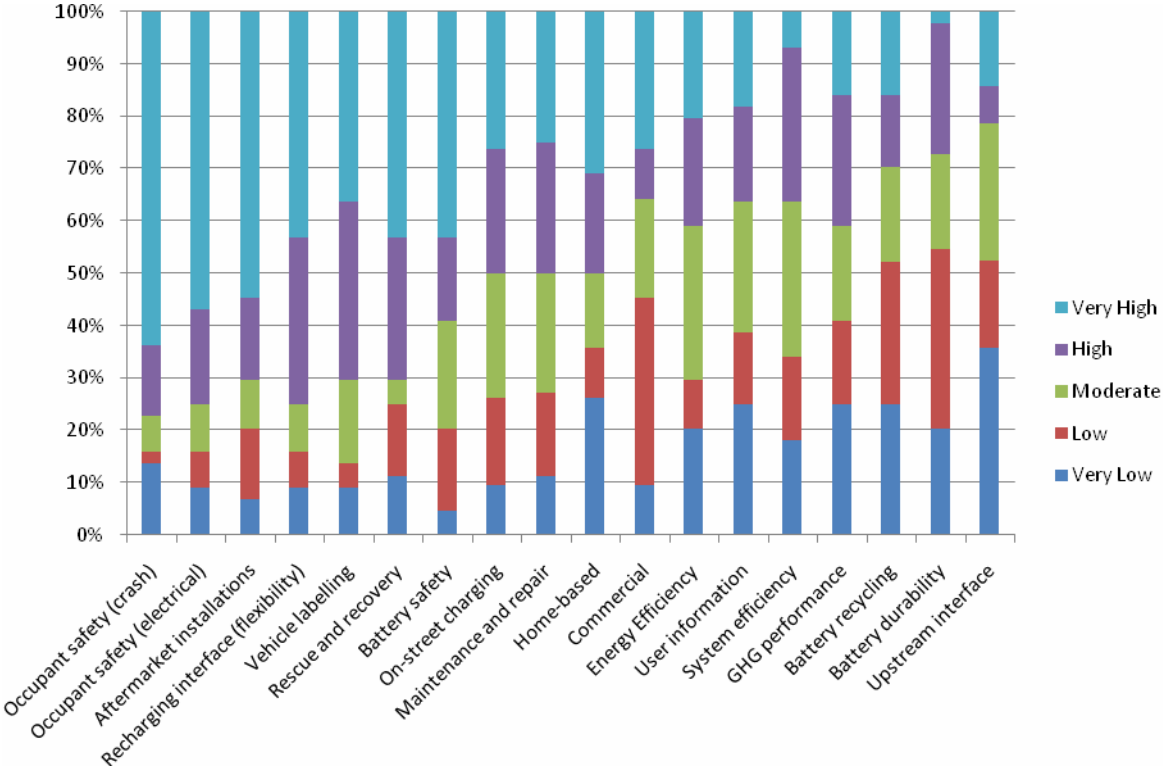

Figure 5

Frequency analysis of survey results on priority areas for standards development

Table 4 **Summary of rationale for participant ranking of priorities**

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
1 **Occupant safety (crash)**	Poorly designed EVs potentially represent risks to vehicle users in terms of crash injury. Care should therefore be taken to ensure that these vehicles are not perceived as being more unsafe in a vehicle crash than traditional vehicles.	Human harm attributed to the specific attributes of EVs during a road crash has the potential to create a discontinuity in the natural evolution of the market owing to poor community acceptance (i.e. consumer aversion to EVs).	The likelihood of this risk is essentially a factor of the growth in EV take-up within the market and the degree to which all EVs are designed to mitigate against unacceptable occupant risk (i.e. comparable with conventional vehicles). To some extent, this risk is likely to rise in proportion to the number of aftermarket conversions in operation.	**VERY HIGH (1st)** Successful management of this risk is considered to be a vital factor in managing the market development and community acceptance risk associated with the development of an EV market in Australia. This issue is considered to be of high importance, irrespective of the rate of market take-up of EVs in Australia.
2 **Occupant safety (electrical)**	Poorly designed electric systems could potentially result in human harm due to electric shock. This risk is new to motorists and therefore special consideration should be given to management of community expectations in respect of this criterion.	Electric shock incidents involving EVs have the potential to substantially degrade community acceptance of EVs, resulting in suboptimal market adoption.	As with occupant safety considerations, this risk is a factor of the growth in total EV numbers. To some extent, the likelihood of this risk is likely to increase in proportion to the number of aftermarket conversions on operation.	**VERY HIGH (2nd)** Successful management of this risk is considered to be a vital factor in managing the market development and community acceptance risk associated with the development of an EV market in Australia. This issue is considered to be of high importance, irrespective of the rate of market take-up of EVs in Australia.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
3 Recharging interface (flexibility)	Inconsistency in recharging interfaces and a lack of flexibility could potentially result in dissatisfied consumers unable to charge when needed. An additional market development risk may arise with manufacturers unable to commit to a particular recharge design with any certainty.	This risk is likely to add to current consumer acceptance issues associated with range anxiety, and the market fit of their EV, resulting in reduced market adoption.	The potential for this risk to occur is likely to reduce with the increased number of EVs on the road and consolidation of recharging interfaces.	**VERY HIGH (4th)** The management of this risk is considered key to enabling the market development of EVs in Australia. The issue is considered important, particularly in the early stages of EV adoption, and has the potential to influence the rate of market take-up.
4 Aftermarket installations	As the EV market develops, there is the potential for cottage providers of EV conversions to take advantage of relatively high prices of OEM models. Cheaper poor quality and unsafe conversions may then enter the market.	Unsafe backyard conversions that result in human harm have the potential to create significant setbacks for EV market development. Regardless of the origin of the vehicle, a generic aversion to EVs may arise with consumers due to safety concerns.	This likelihood of this risk is related to the number of aftermarket EVs on the road, considered greater under a low take-up scenario in which OEM models remain prohibitively expensive.	**VERY HIGH (3rd)** Management of this risk is considered of high importance, regardless of the market take-up of EVs. This stems from the perception that a single incident is one too many, and would result in significant impacts on consumer acceptance and market development.
5 Battery safety	Improperly designed battery systems potentially hold a fire and explosive risk under some environmental conditions. These are considered most likely to appear as a component of aftermarket conversions.	Unsafe battery systems that result in human harm have the potential to create significant setbacks on EV market development. Regardless of whether the battery originates from OEM or aftermarket vehicles, safety problems with batteries may result in consumer push back on EVs.	This likelihood of this risk is predominantly related to the number of aftermarket EVs on the road, considered greater under a low take-up scenario in which OEM models remain prohibitively expensive.	**HIGH (equal 6th)** Management of this risk is considered of high importance, regardless of the market take-up of EVs. This stems from the perception that a single incident is one too many, and would result in significant impacts on consumer acceptance and market development.

	Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
6	**Battery durability**	There is a risk that battery life within EVs will be significantly less than the life of the vehicle, resulting in a greater than expected investment being required.	The increased cost over the life of the vehicle (via a second or third battery purchase) may result in consumers avoiding EVs due to high ongoing costs.	The likelihood of this is considered to be very low, due to the commercial investments being made in battery technologies by manufacturers.	**VERY LOW (17th)** Management of this risk is considered to be of very low priority regardless of the take-up scenario. It is likely that commercial interests will dictate that battery durability is both adequate and guaranteed to a minimum period.
7	**Battery recycling**	With an increasing number of EVs on the road, there is a risk that environmental issues will arise due to the number of batteries requiring disposal at end of life.	Although not immediate, there are a range of environmental implications associated with the mass disposal of EV batteries at the end of their useful life, and these may impact on the acceptance of the market.	The recyclability of EV batteries has, to date, not been a priority from a commercial perspective, and the risk is considered moderately likely, depending on battery technology developments.	**LOW (16th)** The priority of this standard is considered low at this stage, due to the fact that any risks associated with this area will only become apparent following significant market development and subsequent end of life of batteries in the market.
8	**System efficiency**	With differing combinations of battery and engine technology, there is a risk that EVs will be of highly variable efficiency, resulting in an uncertain environment for consumers.	Varied efficiencies potentially lead to a selection of dissatisfied consumers that do not achieve the desired range from their EV. Subsequent impacts on market acceptance may arise.	The likelihood of this is considered to be low, due to the commercial investments being made in optimising system efficiency by manufacturers.	**LOW (14th)** Management of this risk is considered to be low due to the commercial lead in this area being taken by manufacturers, and the minimal impact of low efficiency aftermarket EVs brought to market.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
9 **Home-based recharging**	With home based charging likely to be the dominant form of charging in any EV market scenario, there are significant risks surrounding the uncertain impacts on home electrical circuits and potential safety implications. For instance, these may be associated with the atypical nature of the load required by an EV charging (i.e. continual draw at peak load), or of Level 2 charging home installations.	Given that home-based charging is likely to be the most common form of charging associated with EVs, any incident associated with this resulting in potential human harm will have significant impacts on the market acceptance of EVs.	The likelihood of such a catastrophic event occurring is uncertain at this stage.	**MODERATE (10th)** * The vast majority of EVs are likely to be charged in the home, hence the need to manage the potential risks in this area is considered a high priority due to the potential impacts on the market and consumer should a catastrophic event arise. * *This priority appears to be inconsistent with strategic assessment of the core market enablers and may be premised on incorrect assumptions about the adequacy of home-based wiring circuits in Australian homes.*
10 **On-street charging**	On-street charging infrastructure is likely to be provided by a number of different players, and there are safety risks associated with design and functionality of infrastructure, in particular in the case of damage. Additional risks associated with grid compatibility may be encountered.	The compromising of safety of on-street charging infrastructure, particularly in the instance of damage of vandalism, has the potential to reduce market acceptance of EVs. In addition loss of charging capacity at times of grid peak load may hold similar risks.	The likelihood of this risk occurring is considered moderate, due to the commercial interests of charging infrastructure owners, and the slow roll-out of on-street charging stations.	**MODERATE (8th)** Given the likely slow development of on-street charging infrastructure in the early stage of the market, the priority for management of this risk is considered moderate.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
11 Commercial recharging	There is a similar exposure to risks more commonly associated with conventional petrol stations such as fire, interoperability and the transparency of consumer billing. The overarching concern here is one of human harm, quality of feed-in energy and consumer protection.	Aside from the human harm resulting from fires, a lack of consumer protection could result in limiting of widespread public acceptance of EVs and hampering of market development as people do not feel comfortable using commercial charging infrastructure.	Although consumer protection is paramount, given the preference for off-peak home based charging, especially during the early phase of market development, it is unlikely that commercial recharging stations will be of significant concern.	**MODERATE (equal 11th)** The priority of this standard is considered to be a factor of the early rate of growth of the EV market in Australia. Slow market take-up of EVs will likely result in a weak business case for commercial investment in commercial recharging stations, but the commercial investment case will strengthen as the EV population increases.
12 Upstream interface	It is anticipated that high vehicle charging demands could create problems or challenges for the management of the national grid, given the lack of spare capacity. This runs the risk of peak electricity demand and the resulting brown or black outs. It is thought that inbuilt smart grid capabilities would minimise the risks associated with load capacity.	The consequence of this risk would be to reduce the perceived functionality or utility of EVs and could damage their market take-up owing to poor public perception.	It is unlikely that this will become a serious risk until there are significant numbers of vehicles drawing from the grid and therefore depends upon rapid market development.	**VERY LOW (18th)** Although it would be prudent to allow for inbuilt communications systems to allow for operator management, this risk is a factor of the rate of growth of the EV market and will not pose a significant risk until there are high volumes of EVs in Australia.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
13 Repair & maintenance	There are new and inherent risks associated with the maintenance and repair of EVs in contrast to conventional vehicles, such as the risk of high voltage electric shock. It is clear that there will be significant challenges to ensure that EVs can be absorbed into the industry without putting members in a position of significant risk.	Any information barrier regarding the maintenance and repair of EVs could put members of the industry at risk and damage public acceptance of EVs. It may also restrict the consumer options for repair and maintenance services. This will have a knock-on effect which will serve to restrict market adoption of EVs.	The likelihood of this risk is highest in market infancy and is thought to reduce over time. As long as minimum information requirements are met by the manufacturers, the past approach employed for hybrid vehicles could be adopted.	**MODERATE (9th)** This is a risk that is thought to reduce over time as the industry becomes more familiar with EVs. Its priority is also a factor of the rate of market adoption.
14 Rescue & recovery	EVs may pose a series of safety risks to the Australian road rescue authorities when making accident scenes safe and removing occupants from vehicles. This could be minimised by standardised procedures to remove occupants and disconnect or isolate the power supply to the vehicle.	Any incidents that put both EV occupants and first responders at risk are likely to receive much attention, potentially damaging public acceptance of EVs when the market is in its infancy. In turn, this will hamper market development.	The likelihood of this risk is essentially a factor of the growth in EV take-up within the market and the degree to which all EVs are designed to mitigate against electric shock risk. This is likely to rise in proportion to the number of aftermarket conversions in operation.	**HIGH (equal 6th)** This risk is considered to be a vital factor in managing the market development and community acceptance risk associated with the development of an EV market in Australia. This issue is considered to be of high importance, irrespective of the rate of market take-up of EVs in Australia.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
15 Vehicle labelling	There is a risk of electric shock associated with the operation, maintenance and accident recovery of EVs. This could be managed by clearly identifying EVs and their high voltage cables and components.	Electric shock incidents involving EVs have the potential to substantially degrade community acceptance of EVs, resulting in suboptimal market adoption.	The likelihood of this risk is essentially a factor of the growth in EV take-up within the market and the degree to which all EVs are designed to mitigate against electric shock risk. This is likely to rise in proportion to the number of aftermarket conversions in operation.	**HIGH (5th)** This risk is considered to be a vital factor in managing the market development and community acceptance risk associated with the development of an EV market in Australia. This issue is considered to be of high importance, irrespective of the rate of market take-up of EVs in Australia.
16 User information	The operation of EVs and their associated charging infrastructure will be different to that of conventional vehicles. Incorrect operating practices may result in human harm. This risk could be reduced by ensuring that manufacturers provide operators with an increased level of information.	The provision of a sufficient level of user information, especially that relating to safety, is desirable. Failure to do so would pose a risk to all new operators of EVs. Resulting safety concerns would make the public reluctant to accept EVs. This is a significant risk to market development especially during market infancy.	The likelihood of this risk is dependent on the customer profile. More informed niche customers may not require as much information as the general public. In addition, the risk decreases when there are a higher proportion of OEM vehicles in the market. Manufacturers of both EVs and the recharging equipment will seek to minimise their exposure to risk.	**LOW (13th)** Although this is considered a legitimate risk, of which potential consequences could be severe, it is assumed that the likeliness of exposure to this risk is low.

Focus area	Nature of risk	Consequence	Likelihood	Priority (EV stakeholder ranking)
17 GHG performance	Any decision to market EVs on the grounds that these vehicles generate lower carbon emissions than conventional vehicles will require the adoption of a consistent framework for assessing the GHG performance of EVs.	Failure to ensure consistent assessment of the GHG performance of EVs could potentially result in consumer confusion and market criticism of the EV market in general. The consequence of this risk could be a slight retardation in the rate of market adoption of EVs.	The likelihood of this risk will be a factor of the degree to which the consumer case for market adoption of EVs is premised on GHG performance.	**LOW (15th)** This risk is considered to be of limited consequence to the early development of the EV market in Australia. Ultimately, there will be a need to pursue a framework for assessing the GHG benefits of EVs, albeit that such a framework should consider all vehicle technologies.
18 Energy efficiency	It is likely that energy efficiency consideration will be a significant factor in the consumer purchase of EVs in the early stages of market development. As a consequence, there may be a need to establish standardised approaches for assessment of the energy efficiency of EV products.	Any failure to develop a standardised approach to assessing the energy efficiency of EVs could create market confusion that serves to retard the potential growth of the market during market infancy.	As with GHG considerations, the likelihood of this risk will be a factor of the degree to which the consumer case for early market adoption of EVs is premised on energy efficiency objectives.	**Moderate (equal 11th)** Energy efficiency was perceived to be one of the major considerations for early adopters of EVs. As a consequence, there appears to be a need to develop a standardised framework (and associated testing regimes) for assessing the overall energy efficiency of EVs within the EV segment.

3.4 Summary of priorities and key considerations

Consideration of the survey results by the EV Standards Working Group (at its meeting on 15 September 2010) gave rise to the classification of the focus areas into four discrete groups of priorities. These groupings are presented in Table 5 and can be classified as follows.

- **Group A – Market protection issues.** The first group of issues was considered to be the highest priority and are largely associated with the need to protect human safety in terms of both vehicle operation and vehicle recharging. The consensus was that all of these issues should be given the highest priority as the consequences of these risks were likely to be critical to the development of the market, particularly during its infancy. As a consequence, participants suggested that there was a need to ensure market control of these issues as far as practical, including the development of standards. The most notable difference in priorities for the two market development scenarios related to the ranking of vehicle recharging systems considerations, with this issue considered to be the number one consideration for the accelerated market take-up scenario and lowest for the slow market development scenario.
- **Group B – Market growth issues.** This group of issues was perceived to be issues and risks that will need to be managed to support timely growth of the market beyond market infancy. Safe procedures for the maintenance and repair of EVs figured prominently in participant responses for this group of considerations.
- **Group C – Market credibility issues.** The third group of issues was perceived to be issues relating to the ongoing market credibility of EVs in Australia. The consensus of participants seemed to be that these standards deal with issues that are more long term in nature. As such, these standards could be developed over a longer term than those listed in Groups A and B.
- **Group D – Ancillary market issues.** The final grouping, labelled as 'ancillary', can be considered as supplementary considerations. It was suggested that no commitment be made to developing standards in these areas but that the need for standards in these areas be monitored over time. The general consensus of participants was that a range of stakeholders were already working to resolve these issues and, as a consequence, these issues would be resolved without the need for development of Australian standards.

Strategic analysis of the participant feedback and subsequent working group discussion gave rise to four key observations in respect of the survey findings.

1. The nature of the participant responses highlighted a need to focus standards on performance outcomes rather than strict technical outcomes. Much of the discussion on recharging infrastructure, for example, suggests that any future standards might best be focused on the connection and performance of recharging infrastructure (i.e. wiring protocols, safety, design and siting considerations), with the technical specifications of the system largely left to determination by market and industry considerations.
2. The ranking of home-based charging (as a moderate priority) appears to be due to stakeholder perceptions that existing home-based infrastructure is sufficient to support home-based charging. Analysis by the study team, and feedback from automotive manufacturers suggest that this may not be the case given that optimum charging rates for Level 1 charging are expected to be in the order of 15 amp (versus 10 amp power outlets installed in the home). Given that home-based charging is likely to be a key enabler of early market adoption, it is suggested that the existing wiring standards group should examine the degree to which electric vehicles can be accommodated by existing wiring standards.
3. The Working Group concluded that the development of standards relating to vehicle recharging infrastructure should be dealt with as a bloc, given that the vast majority of core considerations are likely to be common to all levels of charging (in the three charging environments canvassed in the stakeholder survey)
4. The Working Group also noted that there was a need to consider a standard for ensuring consistency of terminology (i.e. an industry vocabulary) and that the development of such a standard will be a key enabler for development of all other standards.

Accommodation of the above considerations resulted in a modification of some of the focus areas presented in Table 4 and a full summary of the resultant priorities and related focus areas is provided in Table 5.

Table 5 **Classification of focus areas into four priority groupings**

Priority/Group	Description	Focus areas
1st priority **A Market protection**	This first group of issues was considered to be the highest priority and is primarily associated with protecting human safety and ensuring consistency in providing recharging infrastructure to the marketplace. This group of issues was perceived by stakeholders to be an issue of consumer protection, and any resulting 'bad press' from injury from EVs or inconsistency in access to recharging infrastructure could hinder market development. The consensus was that these issues should be given the highest priority as the consequences of these risks were likely to be critical to the development of the market, particularly during its infancy. As a consequence, participants suggested that there was a need to ensure market control of these issues as far as practical, including the development of standards. The most notable difference in priorities for the two market development scenarios related to the ranking of vehicle recharging systems considerations, with this issue considered to be the number one consideration for the accelerated market take-up scenario and lowest for the slow market development scenario	Occupant safety (crash) Occupant safety (electrical) Recharging infrastructure Aftermarket installations Vehicle labelling Rescue and recovery Battery safety and handling EV industry vocabulary
2nd priority **B Market growth**	This group of issues was perceived to be issues and risks that will need to be managed to support timely growth of the market beyond market infancy. Safe procedures for the maintenance and repair of EVs figured prominently in participant responses for this group of considerations.	Maintenance and repair Energy efficiency
3rd priority **C Market credibility**	The third group of issues was perceived to be issues relating to the ongoing market credibility of EVs in Australia. The consensus of participants seemed to be that these standards deal with issues that are more long term in nature. As such, these standards could be developed over a longer term than those listed in Groups A and B.	System efficiency GHG performance Battery recycling
4th priority **D Ancillary**	The final grouping, labelled as 'ancillary', can be considered as supplementary considerations. It was suggested that no commitment be made to developing standards in these areas but that the need for standards in these areas be monitored over time. The general consensus of participants was that a range of stakeholders were already working to resolve these issues and, as a consequence, these issues would be resolved without the need for development of Australian standards.	Battery durability

4 The role of Standards Australia in addressing priority areas of market development

The 15 September 2010 stakeholder workshop identified the priorities for Standards Australia to progress EV standards. Interestingly, the final prioritisation of focus areas for the work program differed from the survey findings on future priorities for EV standards. The discussions that informed the prioritisation of focus areas as presented in Table 5 and further detailed in Tables 5.1 – 5.4 centred on the following:

- developing an agreed vocabulary for EVs as an enabling standard
- the role of Standards Australia in setting vehicle standards and occupant protection in a crash
- electrical safety focusing on reviewing and adapting current wiring standards to accommodate EVs
- standards for aftermarket EV conversions
- developing standards for recharging infrastructure will require a 'systems' approach rather than grouping work based on where the infrastructure will be located
- energy efficiency of EVs
- batteries and their supporting supply chain.

In developing the list of priorities it was recognised that complex regulations and standards can often result in market barriers to EV adoption.

4.1 Vocabulary for EVs – an enabling standard

As a first priority, an 'enabling' standard is needed to establish an agreed vocabulary for the industry and governments to use in all EV standards and regulation.

4.2 Vehicle standards and occupant protection

Participants noted that vehicle design or vehicle 'road-worthiness' are matters overseen by the Commonwealth Government ~~Australian Motor Vehicle Certification Board (AMVCB)~~ and are ultimately governed by ADRs under the *Motor Vehicle Standards Act 1989* (and are outside the responsibility of Standards Australia). ~~As most EVs house the battery bank in the rear of the vehicle, t~~ The crash worthiness of EVs ~~(particularly in rear end collisions)~~ should be referred to the AMVCB, with a view to assessing whether current regulations are sufficient for managing occupant safety and the crash-worthiness of EVs.

4.3 Electrical safety

Issues relating to EV recharging and wiring standards would be referred to the Standards Australia wiring committee to ensure that current standards take into account the nature of load associated with EV recharging (i.e. sustained energy draw over a long period of time). The ranking of home-based charging (as a moderate priority) appears to be due to stakeholder perceptions that existing home-based infrastructure is sufficient to support home-based charging. Analysis by the study team, and feedback from automotive manufacturers, suggest that this may not be the case given that optimum charging rates ~~for Level 1 charging~~ are expected to be in the order of 15 amp (versus 10 amp power outlets installed in the home). Given that home-based charging is likely to be a key enabler of early market adoption, it is suggested that the existing wiring standards committee should examine the degree to which EV recharging can be accommodated by current wiring standards.

4.4 Aftermarket conversions

This purpose of this work is to identify the standards relevant to converting conventional vehicles to electric drivetrains within the scope of Standards Australia's area of responsibility. Any standards developed will need to be consistent with current requirements contained in the National Code of Practice 14. Standards relating to the vehicle's roadworthiness will be referred to Australian Motor Vehicle Certification Board.

4.5 Recharging infrastructure

At Workshop 2, the working group agreed to merge all issues relating to recharging infrastructure rather than separate the standards development work based on location. In other words, the working group concluded that the development of standards relating to vehicle recharging infrastructure should be dealt with as a single item, given that the vast majority of core considerations are likely to be common to all levels of charging (in the three charging environments canvassed in the stakeholder survey).

Thus, bundling the standards development work around functionality was considered a more effective approach than on location alone. Possible examples of work bundles include:

- power supply (e.g. physical network infrastructure and architecture, interruptability needs)
- electrical components (both on-board and external)
- communications and interoperability (plugs and connectors)
- data management (e.g. privacy and billing on a roaming network)
- location (e.g. home-based, on-street, commercial, building standards and local government planning guidelines).

While a large task, it was considered this approach would ultimately reduce the workload by limiting duplication and improving consistency.

The participant responses also highlighted a need to focus standards on performance outcomes rather than on strict technical outcomes. Much of the discussion on recharging infrastructure, for example, suggests that any future standards might best be focused on the connection and performance of recharging infrastructure (i.e. wiring protocols, safety, design and siting considerations), with the technical specifications of the system largely left to determination by market and industry considerations.

4.6 Energy efficiency

Developing a standard for measuring the on-road energy efficiency of EVs was identified to be a matter for consideration during future ADR development. Also, the group was advised that the Commonwealth Government recently amended ADR81/02 to include the fuel consumption label requirements for EVs regarding their operational emissions and energy consumption. The fuel consumption labelling standard for EVs requires the range and potential energy use on a watt per kilometre basis to be displayed. However, the CO_2 emissions on a per kilometre basis and actual energy consumed will be rated as zero given the variability in the emissions intensity of electricity generation in Australia.

4.7 Batteries

The Working Group acknowledged that there were a range of issues specific to EV batteries but that these could be dealt with as a second or third tranche of work as existing standards such as the Dangerous Goods Code of Practice would be sufficient to cover the majority of safety issues in the interim. However, the Working Group flagged that when developing standards for batteries it needs to include consideration of battery handling throughout the supply chain as well as ‘battery-swap’ facilities.

5 Proposed workplan

5.1 Workplan assembly

As discussed earlier, preparing the workplan involved two discrete but interdependent tasks.

- **Determining priority areas for standards consideration**. In the absence of market history, these priority areas were determined via direct consultation with the industry and other relevant stakeholders regarding the market risks that will need to be managed with the introduction of EVs in Australia. The results of this consultation are discussed in Section 3.
- **Identifying the specific standards (if any) that could be developed to redress the key market risks**. This work largely uses the findings of the 2009 scoping study conducted by Standards Australia which examined the degree to which the market risks identified are already accommodated by existing standards, ADRs and industry practices.

The findings from these two study tasks were used to develop elemental task plans for each of the focus areas canvassed among EV stakeholders. At the 15 September workshop, the initial 18 focus areas were rationalised to 14 after merging all matters associated with recharging infrastructure and adding an additional focus area (a glossary of terms as an enabling standard). These task plans have been assembled under the four priority groupings identified by the stakeholder consultation:

- market protection issues (highest priority)
- market growth considerations (2nd priority)
- market credibility issues (3rd priority)
- ancillary considerations (last priority).

The resulting task plans are summarised in the following subsections and will be progressed by individual technical sub-committees who will work under the oversight of the EV Standards Committee. It is likely that the EV Standards Committee will comprise the members of the existing EV Standards Working Group.

5.2 Standards required for market protection (highest priority)

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
1	Definition of terms for use by the EV industry and all other standards relating to EVs	Consideration of all of the terms, definitions and vocabulary that relate to the EV industry in Australia.	Adaption of current ISO 8713 for application in the Australian environment. Other standards for consideration include: – ISO/IEC 15118-1 – IEC 60050-161: TC/SC 1 – SAE J1715 – JEV Z805:1998, JEV Z806:1998, JEV X807:1998, JEV Z808:1998 – AS/NZ3000 and current wiring standards – Building Code of Australia	Federal Chamber of Automotive Industries (FCAI) Energy Networks Australia (ENA) Australian Electric Vehicle Association (AEVA) Recharging providers Aftermarket convertors Electricity generators, retailers and distributors Motor Trades Association of Australia (MTAA) ElectroComms and Energy Utilities Industry Skills Council (EE-OZ) Australian Industry Group (AIG) National Association of Testing Authorities (NATA) Research institutions (e.g. CSIRO, Curtin University of Technology, University of Western Australia, Swinburne University, University of South Australia, University of Technology Sydney, University of Wolloongong) Commonwealth and state governments EV Alliance Australian Building Codes Board (ABCB)	Feb 2011	Dec 2011

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
2	Procedures for assessing the electrical safety of EVs	Procedures for testing the electrical integrity of EV componentry (on-board and external interfaces). Procedures for assessing the level of electromagnetic radiation from EVs.	This work will involve the cloning of various elements of existing international standards governing the safety of EVs. These standards include: – ISO 6469, ISO10924, ISO 11541, ISO 11452, ISO 8714, ISO 60884 and ISO 8715 – IEC60784, IEC 60785, IEC60786 technical reports – SAE J2344, J2929, J2907, J2908 – JEVS E701, E702, Z101, Z102, Z103, Z104, Z105, Z106, Z107, Z108, Z109, Z110, Z111, Z112, Z901 – UNECE R100 (94, 95, 12, 10, 34) – AS/NZS3000, AS/NZ3112	FCAI EV component manufacturers AEVA ~~CSIRO~~ Research institutions Commonwealth and state governments Aftermarket converters ENA EE-OZ NATA AIG Electrical Regulatory Authorities Council (ERAC) Australian Communications and Media Authority (AMCA) EV recharging providers Consumer protection organisations EV Alliance Insurance industry peak body representative ABCB Insurance Council of Australia (ICA)	Feb 2011	Dec 2011

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
3	Aftermarket conversion of EVs	Procedures governing the conversion of conventional vehicles to electric operation. Procedures for testing the safety and performance of electric motors and controllers fitted to EVs.	Vehicle road-worthiness relating to aftermarket conversions is a matter outside the scope of Standards Australia standards development. This work will be referred to the relevant forums. Approach will involve examining: – the applicability of electrical standards identified above to aftermarket conversions – IEC technical reports (i.e. 60784, 60785 and 60786) for installing EV components – potential adoption of elements of National Code of Practice 14 (noting that currently there is a new but as yet unratified draft National Code of Practice 14)	Aftermarket converters NATA Commonwealth and state governments MTAA AEVA Research institutions ~~(e.g. Curtin University of Technology, University of Western Australia, Swinburne University, University of South Australia, University of Technology Sydney)~~ AAA Consumer protection organisations EV Alliance Insurance industry peak body representative AIG Recharging infrastructure providers EE-OZ Mechanical/electrical training providers ICA	Feb 2011	Jun 2012

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
4	Recharging infrastructure	Consideration of all elements of EV vehicle recharging including: – electrical connection architecture (e.g. plugs and connectors) – electrical AC and DC charging systems – communications protocols (e.g. between vehicle and recharging infrastructure) – wiring infrastructure and recharging infrastructure location – physical management of electricity – interoperability and vehicle-to-grid – electrical safety – battery management (e.g. electrical safety, battery swap systems) – data management and privacy Consideration of resolving the issue of home-based 15 amp recharging as a first priority e.g. establishing a minimum power requirement for EV recharging (e.g. 15 amp vs. 10 amp).	Approach will require comprehensive consideration of a range of standards and industry practices from international jurisdictions, recognising differences in infrastructure in Europe and North America. Potential standards include: – ISO6469. ISO TR11955, ISO/IEC15118, ISO14443 – IEC 62196, IEC 60783, IEC 61851, IEC 60783, IEC TR60786, IEC61968, IEC61800, IEC62196, IEC62576, IEC60364, IEC60369, IEC1980 – SAE J1772, J551/5, J2836/1-5, J2847/1-5, J2894/1-2, J2931/1-2, J2953, J1733, J2293/1-2, J2495 – AS/NZS3000, AS/NZS4755, AS/NZ3112 – JEVS C601, G101 – G109, G901-85 – ZigBee Smart Energy Profile 2.0 (application standard for HAN communications) Consider potential development of a standard to promote a uniform approach to certification of recharging equipment across all Australian states and territories. Review current international work on the two primary AC charger standards emerging: IEC 62196-2 Type 1 (the Japanese/SAE J1772 proposal) and the IEC 62196-2 Type 2 proposal (Europe).	ENA and network operators EV recharging providers EV component manufacturers FCAI Electrical regulators Commonwealth and state governments AAA AEVA Aftermarket converters EE-OZ NATA AIG ERAC AMCA Urban Development Institute of Australia (UDIA) Planning Institute of Australia (PIA) Local Government Association (LGAA) Research institutions Consumer protection organisations IT industry EV Alliance Standards Australia EL54 Committee ICA Privacy Commissioner Disability Council of Australia Telecommunications Industry Ombudsman	Feb 2011	Sep 2012

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
5	Identification and labelling of EVs	Development of requirements for the labelling of EVs to: – facilitate immediate identification of an EV, particularly in the event of a crash (i.e. vehicle identification label). – enforce parking and/or lane access Development of standardised signage for on-street recharging, lane access, parking, etc. for EVs.	Consideration of the development of a standardised symbol (and application) for EVs sold and operated in Australia. Consideration of development of standardised signage for on-street recharging infrastructure, parking, etc. for EVs. Standards for consideration: – ISO24534 – JEVS E901-85, Z804 – AS/NZ2890.1 (parking signage) – Manual of Uniform Traffic Control Devices	FCAI Australian Road Rescue Association (ARRO) Commonwealth and state governments (particularly road authorities) Aftermarket converters EV recharging providers EV Alliance AAA ABCB LGAA MTAA PIA UDIA	Feb 2011	Mar 2012
6	Rescue and recovery procedures for EVs	Development of procedures for securing an accident scene involving an EV, including consideration of a standardised procedure for disabling and discharging the vehicle's power system.	This work will involve development of a new standard relating to the design of quick discharge systems and standardised labelling of high voltage components. Potentially adapt current procedures that apply to treatment of mild hybrids involved in crashes.	ARRO FCAI Commonwealth and state governments (particularly road authorities) Aftermarket converters AAA MTAA LGAA EV Alliance	Feb 2011	Jun 2012

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
7	Battery safety and handling	Development of a standardised testing regime for all EV batteries, taking account of varying thermal conditions and physical crash integrity. Procedures for the transport and handling of EV batteries. Procedures for all aspects of batteries including individual cells, battery packs, management systems, labelling, etc.	This work will require adaptation of elements of ISO 6469 for Australian application and potential adoption of USA procedures for battery handling. Other standards for consideration include: – ISO12405 – SAE J1797, J2464, J1766, J240, J2950, J2289, J2288, J1798, J2380, J1495, J537, J2929, J2758, J2938, J2946, J1494 – IEC/NWIP 62619, IEC62660 IEC60050 IEC60086, IEC61427, IEC61429, IEC61960, IEC61982, IEC62281, IEC62335 – UNECE R94, R100, R101 – Australian Dangerous Goods Code 7 Also consider potential standards for electrical safety, and recharging infrastructure.	FCAI EV recharging providers (e.g. battery swap operators) Aftermarket EV converters Commonwealth and state governments (particularly road authorities and occupational health and safety regulators) LGAA MTAA NATA ENA Battery providers/ manufacturers AAA AEVA EE-OZ AIG ERAC Research Institutions EV Alliance ABCB Standards Australia Battery Committee Club Assist	Feb 2011	Mar 2012

5.3 Standards required to support market growth (2nd priority)

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
8	Procedures for the maintenance and repair of EVs	Procedures for the workshop repair of EVs.	Adaptation of elements of ISO 6469 within the context of current Australian Occupational Health and Safety legislation for the automotive industry. Consideration of standards identified under focus areas 2, 3, 4 and 7.	MTAA FCAI Aftermarket EV converters Commonwealth and state governments (particularly road authorities and occupational health and safety regulators) ENA AAA AEVA EE-OZ AIG ERAC Research institutions Industry training bodies Consumer protection organisations EV Alliance Australian Council of Trade Unions	Mar 2012	Mar 2013

5.4 Standards required to enhance market credibility (3rd priority)

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
9	Procedure for assessing the efficiency of battery systems for EVs	Development of a standardised test procedure for assessing the efficiency of battery systems for EVs including for second-life uses.	Work will require adaptation of existing international standards and guidelines, including: – relevant elements of ISO 6469 – SAE J1766, J240, J1127, J1798, J2758 – IEC61982, IEC62485, IEC/NWIP 62619 – JEVS D001, D002, D701 – D706	FCAI NATA Consumer protection organisations EV recharging providers (e.g. battery swap operators) Aftermarket EV converters Commonwealth and state governments MTAA ENA Battery providers / manufacturers AAA AEVA EE-OZ AIG ERAC Research institutions EV Alliance	Jun 2013	Dec 2014

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
10	Assessment and reporting of the GHG performance of EVs	Development of a procedure for assessing and reporting the GHG performance of EVs relative to conventional and alternative vehicle technologies.	Work will require adaptation of national and international GHG assessment protocols and emission standards for EVs. The work will include consideration of: – ISO/CD 23274 – SAE J1711, J2841 – UNECE R101 – ADR81/02	FCAI NATA Consumer protection organisations EV recharging providers (e.g. battery swap operators) Aftermarket EV converters Commonwealth and state governments MTAA AAA AEVA EE-OZ AIG ERAC Research institutions EV Alliance	Jun 2013	Jul 2014

Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
				Start date	End date
11 Recyclability of batteries for EVs	Development of procedures for assessing and reporting the degree to which EV batteries can be recycled.	Adaptation of ewaste standards currently under development by Standards Australia. Assessment procedure would need to take account of battery durability (i.e. usable life).	FCAI Consumer protection organisations Waste management industry EV recharging providers (e.g. battery swap operators) Aftermarket EV converters Commonwealth and state governments MTAA ENA Battery providers/ manufacturers AAA AEVA EE-OZ AIG ERAC Research institutions Standards Australia Battery Committee	Jun 2013	Dec 2014

5.5 Ancillary considerations (lowest priority)

	Focus area	Scope of consideration	Summary of approach	Suggested sub-committee composition	Indicative timing	
					Start date	End date
12	Procedure for assessing the durability of batteries for EVs	No action is proposed in respect of developing a standard for this focus area at the present time.	It is suggested that development in this agenda be monitored by the EV Standards Working Group.	TBA	TBA	TBA

6 Summary

This paper outlines a workplan for developing EV standards in Australia. It was developed in consultation with industry and government agencies following consideration of the findings of a scoping study commissioned by the Victorian Government in 2009.

The workplan identifies an immediate need to develop eight standards to complement existing legislation and industry practices as a means of managing the key market risks associated with introducing EVs in Australia.

These standards will focus on:

- developing a consistent vocabulary for EV standards, policy and regulation
- ensuring occupant safety in the event of a crash, particularly major rear-end collisions
- ensuring occupant safety from electrical hazards associated with EVs
- consistent requirements for aftermarket conversion of EVs to ensure user safety
- managing the risks associated with EV recharging infrastructure
- consistent approaches to identifying and labelling EVs
- consistent EV rescue and recovery procedures
- introducing procedures to ensure safe use, handling and management of EV batteries.

The workplan also identifies an additional a further six standards that will need to be progressed in tandem with the Australian EV market as it moves from early infancy through to market maturity. These standards are, in order of priority:

- procedures for maintaining and repairing EVs
- consistent assessment procedures and methodologies for measuring the energy efficiency of EVs
- consistent assessment procedures and methodologies for measuring the energy efficiency and performance of EV batteries
- consistent methodologies for measuring EV greenhouse performance
- frameworks for managing battery reuse and recycling
- assessment procedures for measuring battery durability.

It is envisaged that the activities outlined in this workplan will be managed by an EV Standards Committee (drawn from the membership of the current EV Standards Working Group) with responsibility for the development of individual standards delegated to technical sub-committees.

Appendix A

Membership of the EV Standards Working Group

EV stakeholder organisation	Representative
Australian Industry Group	David Crossley
Australasian Road Rescue Organisation	Daryl Rush
Australian Automobile Association	Craig Newland
Australian Electric Vehicle Association	Jaron Ware
Better Place	Sali Torgoman / Alan Finkel
Blade Electric Vehicles	Ross Blade
ChargePoint	Luke Grana Lance Douglass
CSIRO	Tony Hollenkamp
Curtin University	Andrew Simpson
Dept of Environment Climate Change and Water (NSW)	Liz Davidson Chris Thomas
Dept of Environment and Resources (Qld)	Alina Dini
Dept of Transport and Regional Services (Commonwealth)	Jon Real
Dept of Transport (Vic.)	Kristian Handberg
Dept of Transport (WA)	Luke O'Donoghue
Department of Environment, Water, Heritage and the Arts (Commonwealth)	Chris Baker
Department of Innovation, Industry and Regional Development (Vic.)	Glenne Drover
Ecotality	Kevin Campbell
EnergyAustralia	Terry Daly
Energy Networks Association	Mark Amos
Energetique	Phil Coop
Ergon Energy	Glenn Walden
Federal Chamber of Automotive Industries	James Hurnall
Mitsubishi Australia	Ashley Sanders
Motor Trades Association of Australia	Colin Duckworth
National Association of Testing Authorities	Vinod Reddy
National Road and Motoring Association	Jack Haley
Royal Automobile Club of Victoria	Michael Case

Appendix B

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Appendix C

Glossary

AAA	Australian Automobile Association
ABCB	Australian Building Codes Board
ADR	Australian Design Rule
AEVA	Australian Electric Vehicle Association
AIG	Australian Industry Group
AMCA	Australian Communications and Media Authority
ARRO	Australian Road Rescue Association
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DIIRD	Department of Industry, Innovation and Regional Development
DIT	Department of Infrastructure and Transport
EE-OZ	ElectroComms and Energy Utilities Industry Skills Council
ENA	Energy Networks Association
ERAC	Electrical Regulatory Authorities Council
EV	electric vehicle
FCAI	Federal Chamber of Automotive Industries
GHG	greenhouse gas
GPO	general power outlet
HEV	hybrid electric vehicle
IEC	International Electrotechnical Committee
ICA	Insurance Council of Australia
ISO	International Organization for Standardization
JEVS	Japanese Electric Vehicle Standards
LGAA	Local Government Association of Australia
LPG	liquefied petroleum gas
MTAA	Motor Trades Association of Australia
NATA	National Association of Testing Authorities
NRMA	National Roads and Motorists Association
OEM	original equipment manufacturer
PHEV	plug-in hybrid electric vehicle
PIA	Planning Institute of Australia
RACV	Royal Automobile Club of Victoria
SAE	Society of American Engineers
UDIA	Urban Development Institute of Australia
UNECE	United Nations Economic Commission for Europe