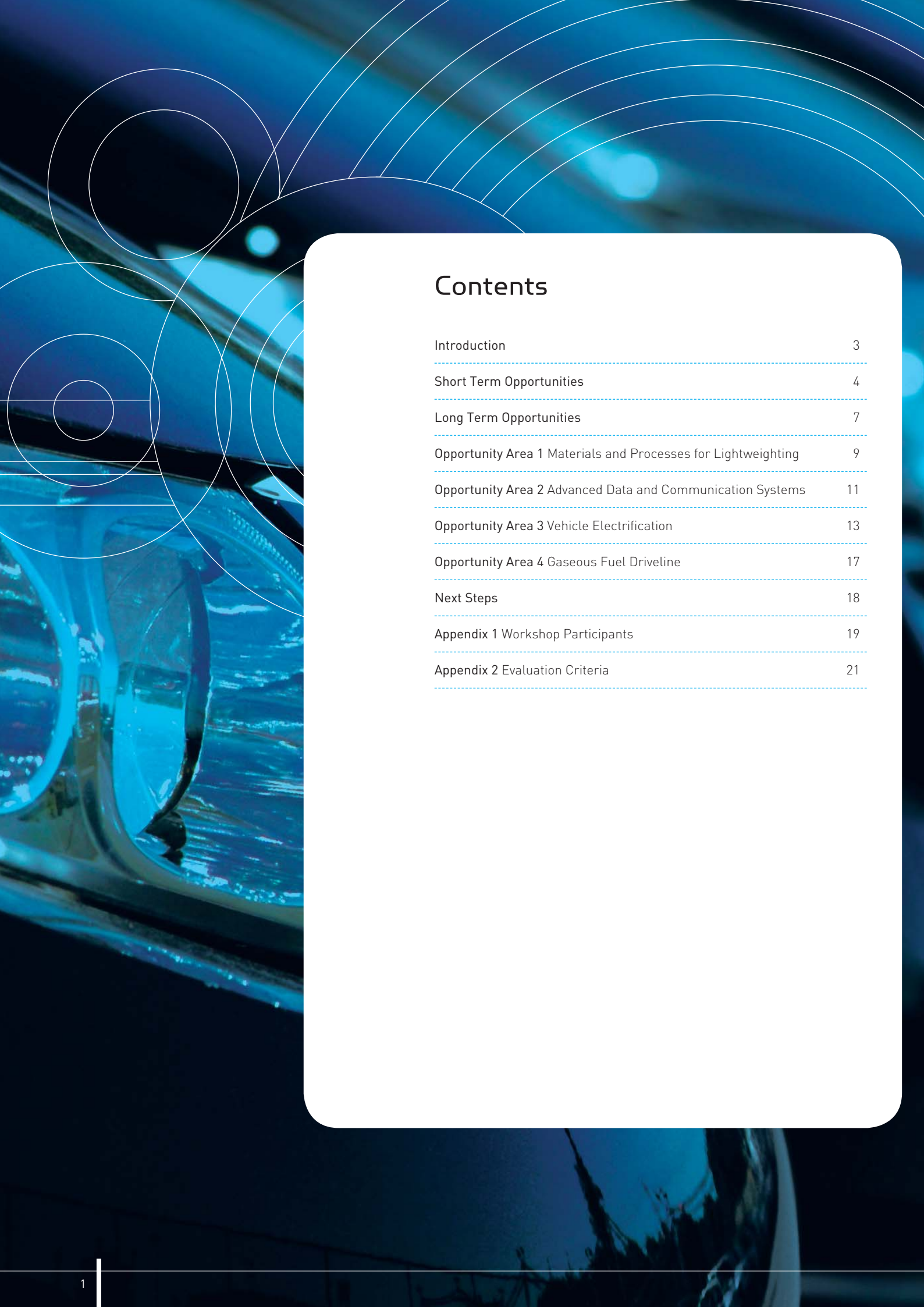
Automotive Australia 2020

OPPORTUNITY PORTFOLIO

AutoCRC
Smarter Safer Cleaner

AUTOMOTIVE AUSTRALIA 2020



Contents

Foreword

The automotive industry is strategically important to the Australian economy in terms of the investment, jobs, skills, innovation and exports it generates. The future success of the Australian automotive industry will require it to expand on current strengths to exploit opportunities in the rapidly evolving global automotive market.

Automotive Australia 2020 (AA2020) is a joint initiative of the Commonwealth Government's *New Car Plan* for a Greener Future and Victorian Government's VAMAP. This programme, led by the AutoCRC, is being undertaken with the Australian automotive industry to deliver a technology roadmap to 2020 and beyond. This roadmap will be delivered to the Automotive Industry Innovation Council to communicate a vision and strategy to transform the automotive industry to be competitve, innovative and sustainable in the short, medium and long term.

The global automotive industry is at a unique point of transition as it enters the second decade of the twenty-first century. After one hundred years of relatively stable, incremental evolution, the challenges of climate change and energy scarcity are forcing an unprecedented rate of technology change.

The AA2020 Vision, developed in Phase 1 of the programme, sets out Australia's ambition to use this upheaval to actively grow the local industry and to *"...achieve recognition as a strategic element of the global automotive industry."* It also sets out a belief that *"This can be achieved through leveraging existing strengths and building new capabilities."*

Building on this vision, the Automotive Australia project has now completed Phase 4 with the presentation of this *Opportunities Portfolio* – the culmination of a three-month study into Technology Needs in local and global markets, and Australian Capability in the automotive, non-automotive and research sectors. The study has relied on extensive stakeholder engagement through surveys, interviews and workshops involving broad industry representation.

As the project progresses into its final phases, it will focus on the key areas of opportunity identified in this report. The continued active engagement of industry will ensure the success of the process in providing a strategic direction to 2020 and beyond.

Dr Matthew Doolan
Project Manager
Automotive Australia 2020

Introduction

The Automotive Australia 2020 (AA2020) project aims to develop a roadmap for the Australian automotive industry looking to 2020 and beyond. This roadmap will represent a vision and strategy for the Australian automotive industry to remain competitive in the short, medium and long term.

This report presents key strategic and tactical opportunities, the outcomes of the 4th phase of this project. This phase has been guided by the scope of opportunities and evaluation criteria set out in the first interim report (*Automotive Australia 2020* – Vision), and is the extension of the data gathered through surveys and interviews in Phases 2 and 3.

The data from Phase 2 and 3 is available in the reports: *Automotive Australia 2020 – Capabilities*, and *Automotive Australia 2020 – Technology Needs*. Together, these three reports present a snapshot of Australia's current competitive position.

Through a series of workshops, involving more than 80 representatives from government, automotive, non-automotive and research sectors, needs and capabilities were assessed. This allowed identification of key short and long term opportunities. In the short term, three broad opportunity categories were identified:

- Immediate actions to grow or sustain local suppliers,
- Capabilities to be leveraged as export opportunities, and
- Activities designed to develop strategic capability in the long term.

PHASE 1
Establishing a vision

PHASE 2
Defining immediate domestic and long term future global technology need

PHASE 3
Understanding national capability

PHASE 4
Identifying key short and long term opportunities

PHASE 5
Strategic opportunity roadmap development

PHASE 6
Prioritisation

Workshop assessment of long term opportunities identified four key areas of interest in the long term:

- Materials and Processes for Lightweighting,
- Gaseous Fuel Driveline Technology,
- Advanced Data and Communication Systems, and
- Vehicle Electrification.

A detailed assessment has been made for each of the identified opportunities. This leads to Phase 5, where strategic opportunity roadmaps will be developed to further investigate the strongest of the long term opportunities. The aim of Phase 5 is to provide a detailed understanding of the specific opportunity, including the enabling actions that might be required to realise the opportunity. These strategic opportunity roadmaps will be prioritised during Phase 6 and become the final representation of the *Automotive Australia 2020* roadmap, providing strategic direction for the Australian automotive industry to 2020 and beyond.

Short Term Opportunities

The identification of technology needs and capabilities has highlighted a number of potential opportunities in the short term. These were defined as opportunities for next model vehicles, or a 2012 timeframe and they have been validated and prioritised through the workshop process.

Phases 2 and 3 of the project, described in the Technology Needs and Capabilities reports, identified more than 100 short term opportunities for Australian suppliers to capture and maintain contracts with local MVPs, or to export into overseas markets. Initial research, through surveys and interviews, selected approximately 60 of these short term opportunities, which were assigned initial scores to rank the attractiveness of the opportunities and their fit with existing capability in the automotive industry. These were carried forward to a series of workshops. Through the workshop processes, these measures of capability and attractiveness were adjusted and validated by more than 50 industry experts.

To identify opportunities of interest, the attractiveness and fit with existing capability have been mapped to obtain an overall score as depicted in Figure 1. Through this process, 15 opportunities, including at least one from each of nine automotive subsystems, were selected for further validation at a Portfolio Workshop on November 27th, 2009.

SHORT TERM OPPORTUNITIES BY ATTRACTIVENESS

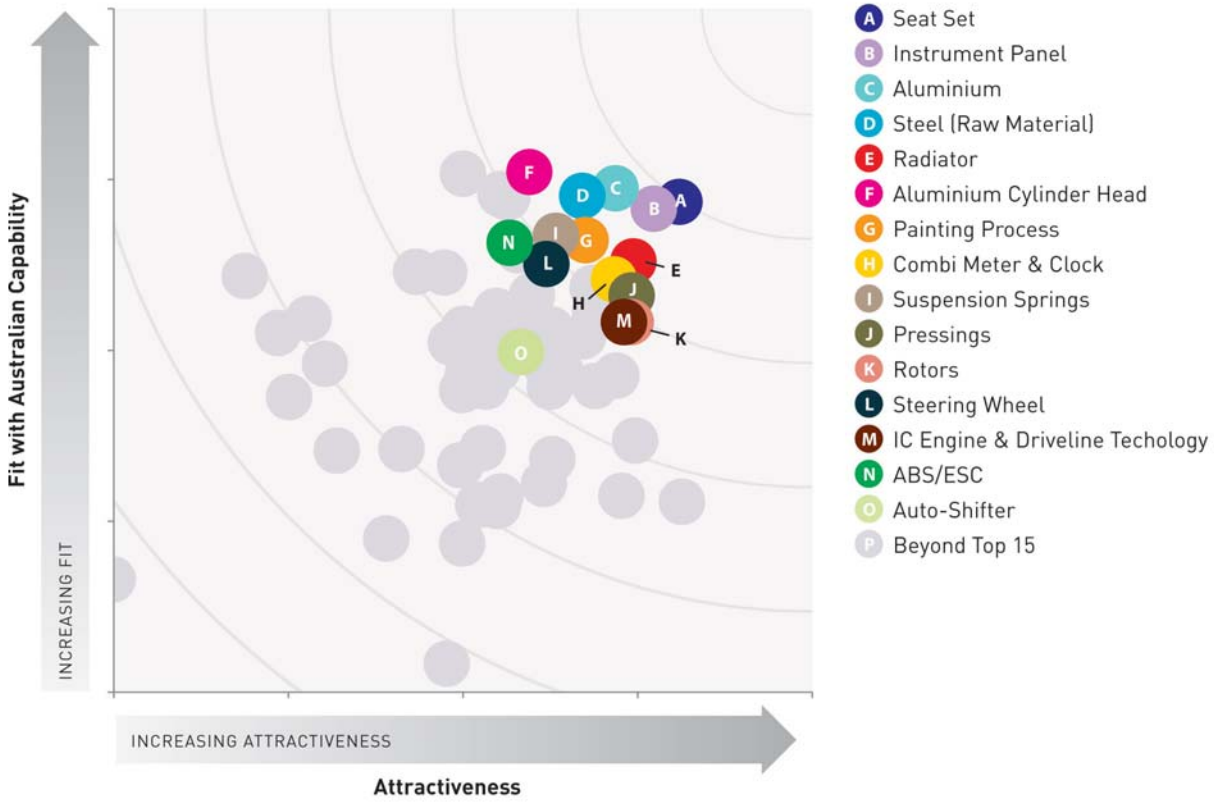


FIGURE 1 – **SHORT TERM OPPORTUNITIES**

Short Term Opportunities continued

The participants at the Portfolio Workshop were given the opportunity to adjust the overall attractiveness and capability score of the top 15 identified opportunities to establish the priority ranking shown in Table 1. In addition, the Portfolio Workshop identified three broad categories for short term opportunities:

- Immediate actions that might grow or sustain current local sourcing either by displacing imported components or protecting current local activities,
- Current capabilities that may be leveraged to generate a viable export activity (recognising that there will be significant lead time to achieve significant success), and
- Current activities that are important in building strategic capability in a technology area identified as being highly attractive in the long term.

Using existing data, an analysis of the opportunities was carried out to highlight the three areas of opportunity identified above. Figure 2 plots the strength of local capability against a measure of the likely sourcing scenario. This measure was calculated based on the identified shift in future sourcing trends of the Australian MVPs, combined with a score representing the relative ease of import and export for each opportunity. This identifies several areas of strong Australian capability with potential to replace imported products.

There are also opportunities to export commodities from Australia and, while this was a component of the overall attractiveness score calculated for each opportunity, it is informative to examine the data for export opportunities in isolation. Figure 3 represents the most attractive export opportunities for the Australian automotive industry.

Finally, there are a number of identified short term opportunities that have a direct influence on future capability required to realise the long term opportunities presented in the following section. Opportunities to exploit raw material, for example steel and aluminium, cannot be realised in the short term. Although there are abundant natural resources, establishment of indigenous industrial capability will have a significant lead-time. Investment in the short term, however, will be critical if opportunities in lightweight metals and processing are to be realised. Similarly, IC engine and driveline technology development will have little short term impact, but would be instrumental in an emerging capability for design and development of gaseous fuel driveline technology.

SHORT TERM OPPORTUNITIES BY SOURCING SCENARIO

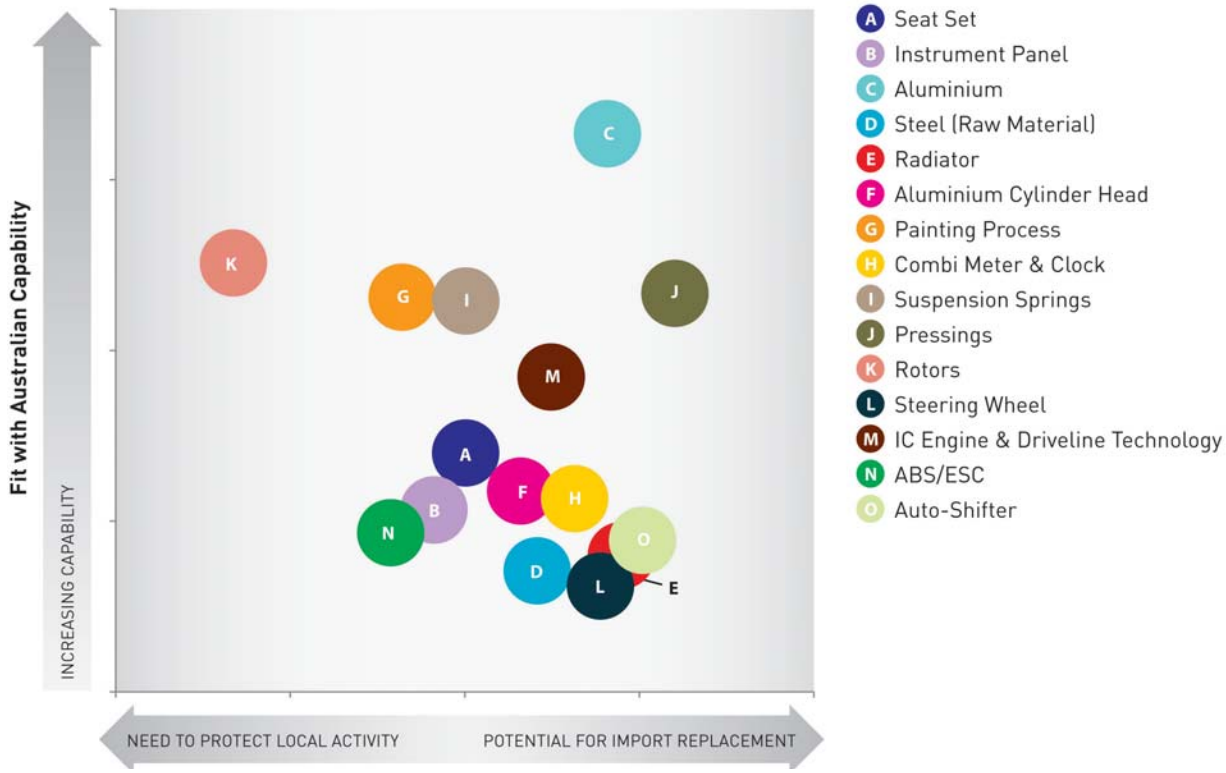


FIGURE 2 – **POTENTIAL SOURCING SCENARIO AND AUSTRALIAN CAPABILITY FOR SHORT TERM OPPORTUNITIES**

Rank	Opportunity
1	Aluminium
2	Seat Set
3	Painting Process
4	Instrument Panel
5	Aluminium Cylinder Head
6	Suspension Springs
7	Steel (Raw Material)
8	Pressings
9	IC Engine and Driveline Technology
10	Rotors
11	Radiator
12	Combi Meter and Clock
13	ABS/ESC
14	Steering Wheel
15	Auto-Shifter

TABLE 1 – **RANKED SHORT TERM OPPORTUNITIES**

SHORT TERM EXPORT OPPORTUNITIES

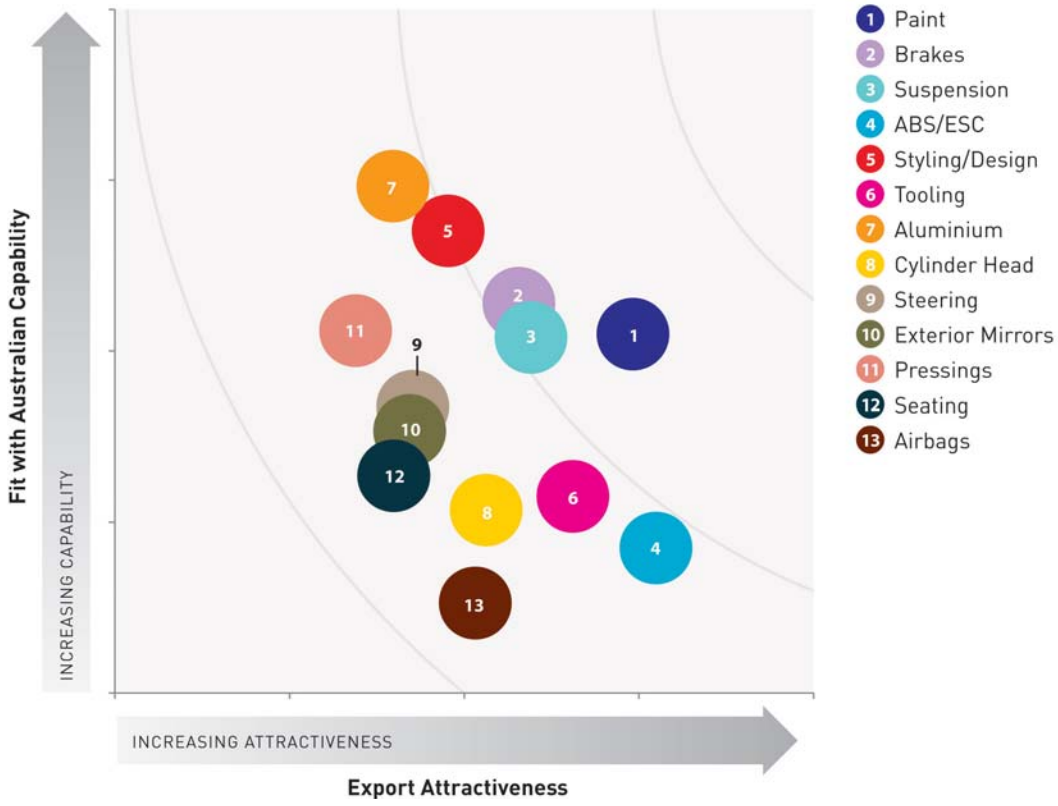


FIGURE 3 – **CAPABILITY AND EXPORT ATTRACTIVENESS OF SHORT TERM OPPORTUNITIES**

Long Term Opportunities

Phase 4 of AA2020 used the vision and evaluation criteria from Phase 1 to identify opportunities where the Australian automotive industry has the potential to establish itself as a strategic world player. The needs and capabilities of over 50 technology opportunities have been used in a portfolio analysis to prioritise sixteen of the most promising technology areas.

There are two aspects to this analysis. The first step is to identify those technologies that will play a leading role in delivering the vehicles demanded by consumers in 2020 and beyond. The second step is to understand Australian capabilities and resources that can be applied to these promising technologies. The combination of these two factors, shown in Figure 4, allows the selection of areas where attractive global market needs match well with Australia's capability to deliver them, providing a basis to establish a sustainable and differentiated competitive position on the world stage.

Underpinning this assessment are the findings in the report *Automotive Australia 2020 – Technology Needs.* The report highlights the most attractive global technology needs based on the analysis of over fifty published reports and roadmaps and the input of over 100 industry experts through interviews, surveys and workshops. Prioritisation of the identified needs was carried out according to the selection criteria established in Phase 1. The criteria address factors such as market size, accessibility and technical feasibility. These criteria are presented in detail in Appendix 2.

LONG TERM OPPORTUNITIES

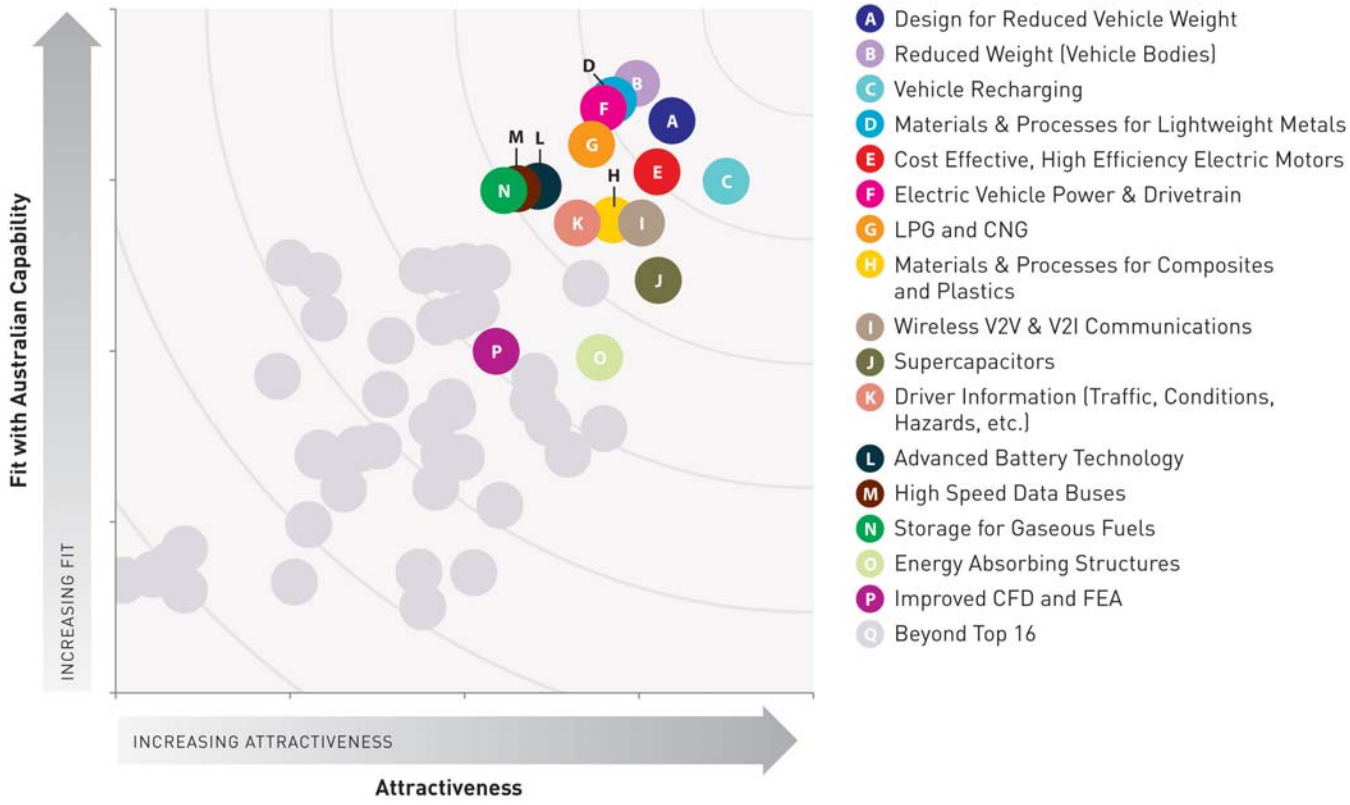


FIGURE 4 – **LONG TERM OPPORTUNITIES**

Identifying capabilities and resources that can be harnessed to address these needs requires an understanding of capability beyond the current Australian automotive supply base. While these form an essential foundation, it is important to understand the direction of technology and capacity for investment in the sector and its ability to innovate and exploit these investments within the industry. It is also vital to look beyond the confines of the automotive sector. Other industries have relevant technologies that are further advanced in their adoption, while the research sector has promising technologies in development. These external capabilities can be leveraged in meeting the future needs of the automotive industry. Each of these aspects of capability have been evaluated in the *Automotive Australia 2020 – Capabilities* report along with relevant links to Australia's natural and human resources to evaluate a measure of long term capability relevant to each of the most attractive opportunities.

Rank	Opportunity
1	Light Weight Vehicle Bodies
2	Design for Reduced Vehicle Weight
3	Materials and Processes for Lightweight Metals
4	LPG and CNG
5	Vehicle Recharging
6	Electric Vehicle Power and Drivetrain
7	Materials and Processes for Composites and Plastics
8	Electric Motors
9	Supercapacitors
10	On-Vehicle Gaseous Fuel Storage
11	Advanced Batteries
12	Wireless V2V and V2I Communications
13	Driver Information
14	High Speed Data Buses
15	Energy Absorbing Structures
16	Improved CFD and FEA

TABLE 2 – **RANKED LONG TERM OPPORTUNITIES**

The top 16 technologies, with borderline selections made through open discussion in the workshop, were then reviewed in more detail and a concise business case developed. These business cases include which Australian capabilities would enable delivery and what enabling actions might support success. As a final validation step, the priority technology opportunities were reviewed by the original members of the Vision Workshop and moderated to ensure consistency. These moderated scores resulted in the following prioritised list of long term opportunities in Table 2.

The technologies that emerged as priorities through this analysis fall into four themes. Each of these is an integral part of achieving the industry vision to *"maximise opportunities in local and international markets"*. These were:

- Materials and Processes for Lightweighting:
  - Design for reduced vehicle weight,
  - Materials and Processes for light-weight composites and plastics,
  - Materials and Processes for light-weight metals, and
  - Reduced weight vehicle bodies.
- Advanced Data and Communications Systems:
  - V2V and V2I Wireless Communications,
  - Driver Information Systems, and
  - High Speed Data Buses.
- Vehicle Electrification:
  - EV Power and Drivetrain,
  - Electric Motors,
  - Advanced Batteries,
  - Supercapacitors, and
  - Vehicle Recharging.
- Gaseous Fuel Driveline:
  - LPG & CNG Engines, and
  - On-vehicle storage of gaseous fuels.

The attractiveness of these technology opportunities is determined by external, global factors beyond the influence of Australian stakeholders. However, the current Australian capability can clearly be developed and advanced further through focused intervention in areas of the most attractive opportunity. These will be carried forward to the final phases of the project.

OPPORTUNITY AREA 1

Materials and Processes for Lightweighting

Four opportunities were identified in the area of Materials and Processes for Lightweighting. These opportunities are Design for Reduced Vehicle Weight, Reduced Weight Vehicle Bodies, Materials and Processes for Composites and Plastics and Materials and Processes for Light Weight Metals.

To improve the fuel efficiency and reduce emissions from vehicles manufacturers continue to reduce vehicle weight. Current trends include the use of high strength steels, to reduce the thickness of components, and material substitution with lighter weight alternatives. These trends will continue subject to the cost effectiveness of mass reduction.

Design for Reduced Vehicle Weight

This opportunity is an engineering service and an enabler for meeting the market need for light weight vehicles. Design for Reduced Vehicle Weight encompasses designing with new materials and new approaches with vehicle design.

Across all the measurements of attractiveness this opportunity has scored very highly. The size of both the local and global markets indicates the global application of the capability. Design for Reduced Vehicle Weight encompasses all components of the vehicle. The breadth of this application has led to its identification as an opportunity for Australia to play a leadership role.

The social, economic and environmental attractiveness of this opportunity has again been identified as high. This is due to the high value add nature of design and the reduction in emissions achieved through the reduction of vehicle weight.

Australian capabilities have been identified as strong in the area of weight reduction. The focus of MVPs to reduce the vehicle weight has meant that the automotive supply base has been developing and focusing on methods to reduce the weight of their products. This has resulted in both current and developing industry capability in the area of design for reduced vehicle weight.

There is also significant identification of alignment with the non-automotive sector, which may include industries such as aerospace. The identified alignment with natural and human resources reflects the current level of engineering design capability present in Australia.

Materials and Processes for Composites and Plastics

To reduce the weight of vehicles, the use of new materials is becoming increasingly common. Two classes of materials have started to replace heavier traditional materials – plastics and composite materials. The opportunity Materials and Processes for Composites and Plastics, involves the development of new composite and plastic materials, and the associated manufacturing processes.

The attractiveness of the opportunity is strong against all the assessment criteria. The opportunity for leadership in this area is indicated as very strong. This may be due to the strong capability identified in the non-automotive sector. Advanced plastic and composite materials are used extensively in the aerospace and defence industries. Difficulty in recycling these materials at End-of-Life remains a problem.

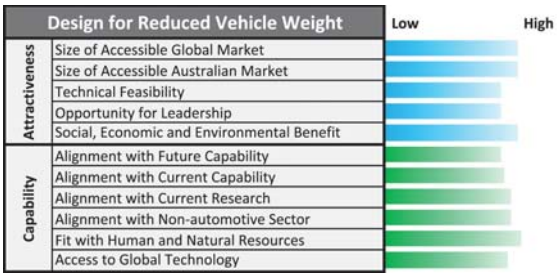


FIGURE 5 – ATTRACTIVENESS AND CAPABILITY SCORES FOR DESIGN FOR REDUCED VEHICLE WEIGHT

FIGURE 6 – ATTRACTIVENESS AND CAPABILITY SCORES FOR PLASTICS AND COMPOSITES

Materials and Processes for Lightweight Metals

Like the previous opportunity, materials and processes for lightweight metals focuses on the reduction of vehicle weight. Materials that fall into this category include aluminium and magnesium alloys.

This opportunity is seen as the most attractive in the area of lightweight material. This is due to the size of the market for lightweight metals both locally and globally. The technical feasibility of this opportunity is seen as very high as there is already some use of these materials in vehicles. The use of these materials is growing, with scope to solve problems associated with joining and interaction of different metals.

The Australian capability associated with the lightweight metals opportunities shows significant alignment with the research sector, in contrast to the plastics and composite materials opportunity. In contrast to composite materials, lightweight metals are cost effective to recycle.

Reduced Weight Vehicle Bodies

This opportunity is the resulting output of the three previous opportunities. The manufacture of Reduced Weight Vehicle Bodies can be achieved by applying advances in plastics, composites and light metals combined with design for weight reduction. Vehicle bodies are particularly suited to weight reduction because gains can be achieved without sacrificing safety or performance.

The size of the market for lightweight vehicle bodies has been identified as very large both globally and locally. The attractiveness of the opportunity is further enhanced by its technical feasibility. However, the opportunity for leadership in this area, and social, economic and environmental factors have been identified as less attractive.

The capability of the automotive industry and research community in this area is considered very strong. The lack of alignment with the non-automotive sector is not surprising as most components in the body of a car are not transferable from the non-automotive sector. Any alignment with non-automotive sectors is in the area of design and materials as identified in the three previous opportunities.

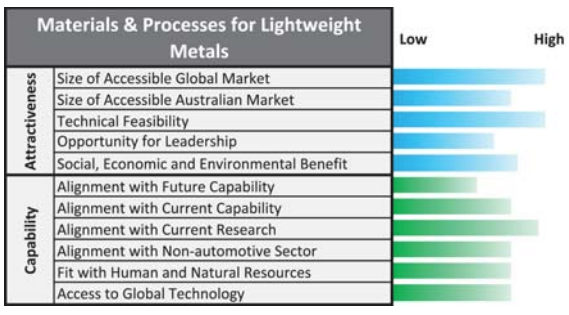


FIGURE 7 – ATTRACTIVENESS AND CAPABILITY SCORES FOR LIGHTWEIGHT METALS

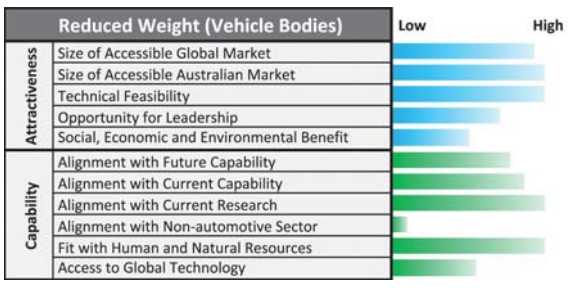


FIGURE 8 – ATTRACTIVENESS AND CAPABILITY SCORES FOR REDUCED WEIGHT VEHICLE BODIES

OPPORTUNITY AREA 2

Advanced Data and Communication Systems

In Phase 1 of the AA2020 project, participants in the Vision Workshop also identified advances in ICT technology as a key driver, with comfort, integration, convenience and flexibility as related customer requirements. Three specific opportunities of interest have been identified in this area: Wireless Communications, Driver Information and High Speed Data Buses.

Developments in software, electronics and communications represent the largest area of technology development in the automotive industry and are a key element for more than 80% of new automotive technology[1]. This trend is an important element of the current transition toward an increasingly knowledge-based economy.

Wireless V2V and V2I Communications

There is increasing consumer demand for data connectivity in all facets of life, and vehicle communications are no exception. Vehicle communications fall into two categories: communication between vehicles (V2V) and communication with infrastructure (V2I). Because these technologies are a natural extension of current consumer technologies, the Australian market, global market, and technical feasibility all rate highly. The social and economic benefit associated with continuous connectivity also scored highly in Figure 9.

The power of V2V and V2I communications extends beyond the exchange of information between drivers and passengers. By implementing more advanced telematics features, road safety could be increased and congestion reduced. Reduced congestion and travel times have a significant social and environmental benefit.

Current capability in communication systems has been identified in Australia, especially in the non-automotive sector. This opportunity does not take advantage of natural resources, and there is a medium score for alignment with research capability, which will be investigated further in Phase 5.

Driver Information

With the advanced communications described above, useful information can be extracted and presented to the driver to increase both safety and comfort. As traffic congestion increases, driver information systems will provide a real social and economic benefit – reducing travel time. Consequently, the social, economic and environmental benefit has achieved the highest score in Figure 10. This opportunity rates highly in other criteria as well. Capability has been identified in current suppliers of underlying technologies, like sensors and software. The universal applicability of many of these technologies indicates possibilities for integration with other sectors, which is reflected in the alignment with research and non-automotive capability. The size of the local and global market indicates that driver information systems will be available in a large number of vehicles, but not universally.

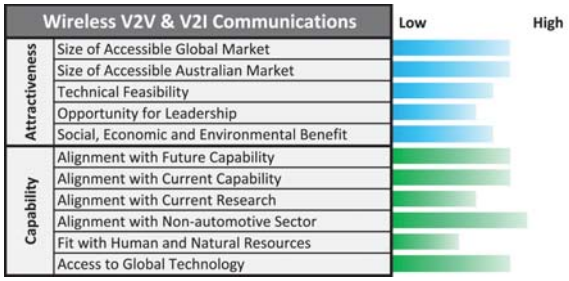


FIGURE 9 – ATTRACTIVENESS AND CAPABILITY SCORES FOR WIRELESS V2V AND V2I COMMUNICATIONS

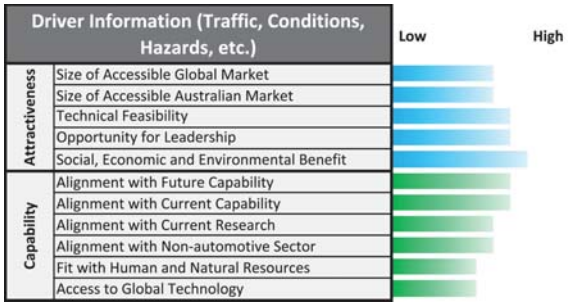


FIGURE 10 – ATTRACTIVENESS AND CAPABILITY SCORES FOR DRIVER INFORMATION

1 Supplier Business. *The Automotive Technology Roadmap.* 2009.

High Speed Data Buses

As advanced data communications systems gain importance, so do high speed data buses – the underlying systems that enable most of the advances in automotive ICT technology. The universal nature of these systems is represented by high overall scores for market size as shown in Figure 11.

Through the workshop, Australia was identified as having strong capability and engineering knowledge in microprocessor design and communications technology. While not currently applied to high speed data buses, there are resulting high scores in future capability and alignment with the non-automotive sector. Secondary social and economic drivers also present a compelling case. The technologies enabled by high speed data buses have already been shown to have an impact on improving safety and comfort. There are also potential gains in weight reduction from wiring harnesses, reducing weight and cost of manufacturing. The combination of these factors will make high speed data buses a part of every car manufactured in 2020.

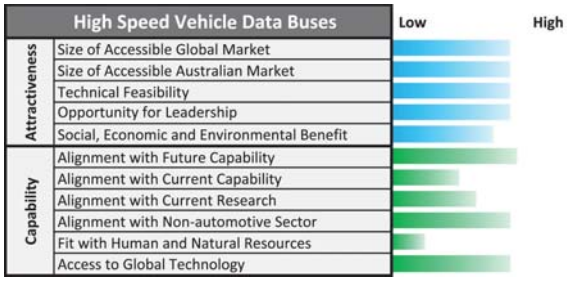


FIGURE 11 – **ATTRACTIVENESS AND CAPABILITY SCORES FOR HIGH SPEED DATA BUSES**

OPPORTUNITY AREA 3

Vehicle Electrification

The Vehicle Electrification category encompasses nearly one third of the priority opportunities that have been identified:

- **Electric Vehicle Power and Drivetrain,**
- **Cost Effective, High Efficiency Electric Motors,**
- **Advanced Battery Technology,**
- **Supercapacitors, and**
- **Vehicle Recharging.**

High attractiveness and future capability scores across these opportunities are highly compatible with the trends, drivers and vision identified in the first phase of the project. Participants in the Vision Workshop identified increasing consumer awareness of environmental issues and developments in energy storage technology as important drivers, articulating an ambition for Australia to be *"leading designers of competitive, large, powerful, zero emission passenger vehicles."*

Potential environmental and social benefits associated with the widespread adoption of electric vehicles are immense. Social benefits might include factors like reduced traffic noise, fewer maintenance requirements, and reduction of smog and pollutants in urban environments. Environmental benefits stem from increased efficiency and elimination of tailpipe emissions. A recent well-to-wheel analysis of alternative vehicle technology estimated the net CO_2 emissions of an electric vehicle at 115g/km versus 127g/km for diesel vehicles and 252g/km for modern petrol vehicles,[2] where CO_2 emissions from electric vehicles are the result of electricity generation. It is this potential for the system as a whole that has been reflected in the relevant attractiveness scores.

There are also predicted economic benefits. Though the purchase price is higher, running costs of electric vehicles are already lower than the equivalent IC engine vehicle and it is predicted that total cost of ownership for mass produced electric vehicles will also be lower.[3]

Electric Vehicle Power and Drivetrain

The changes required in the vehicle drive system of an electric vehicle extend beyond the core power plant and these auxiliary systems have been termed Electric Vehicle Drivetrain. This opportunity includes all of the power handling and drive system components beyond the electric motor. The drivetrain will include such subsystems as:

- Power control,
- Electrical distribution,
- Gearing, and
- Regenerative braking.

In the same manner as electric motors, the other drivetrain subsystems are components of existing hybrid vehicles and, as such, represent an existing, growing market in Australia and internationally.

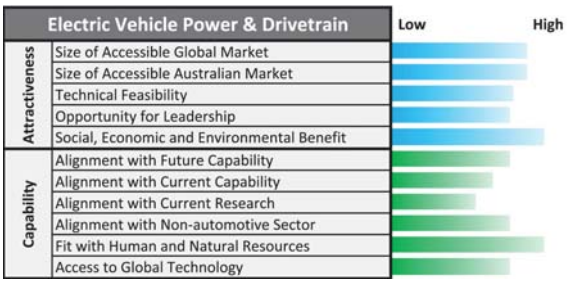


FIGURE 13 – **ATTRACTIVENESS AND CAPABILITY SCORES FOR EV POWER AND DRIVETRAIN**

2 MA Komer, JB Heywood. *Electric Powertrains: Opportunities and Challenges in the US Light-Duty Vehicle Fleet*. Sloan Automotive Laboratory, MIT. May 2007.
3 US Department of Energy. *Electric and Hybrid Vehicle Research, Development, and Demonstration Program; Petroleum-Equivalent Fuel Economy Calculation.* June, 2000.

Cost Effective, High Efficiency Electric Motors

Changing from conventional internal combustion engines to electric motors is the most fundamental shift required in realising this opportunity. Sales of hybrid vehicles, each with at least one electric motor, are increasing steadily and increased adoption of electric only vehicles would only increase the size of this market in Australia and overseas. Electric motor technology, which is already widespread outside of the automotive industry, is well advanced and this is demonstrated by the relatively high scores for technical feasibility and alignment with current capability shown in Figure 12.

Australia currently boasts capability for design, development and manufacturing of large electric motors, similar to those that would be used in OEM vehicle production, and this is reflected in the capability scoring. There are also strong linkages with current research activities and manufacturing capability in the automotive sector.

The efficiency of electric motors is already very high, so improvements in overall electric vehicle efficiency will be driven by other parts of the drive system. Future developments in motor technology will most likely relate to reducing the cost of production, coupled with reduced size and weight. Australia can leverage existing design expertise and complimentary manufacturing capability with natural reserves of rare earth metals to build a significant local industry.

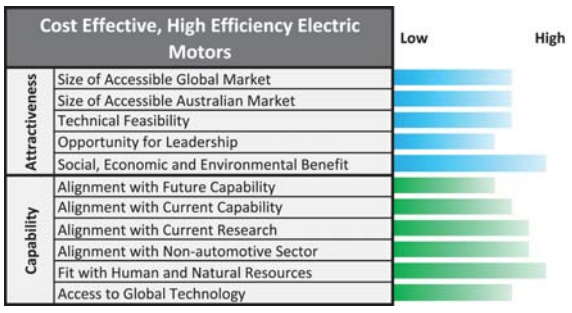


FIGURE 12 – **ATTRACTIVENESS AND CAPABILITY SCORES FOR ELECTRIC MOTORS**

OPPORTUNITY AREA 3

Vehicle Electrification continued

Advanced Battery Technology

When compared with current internal combustion drivetrain technology, electric vehicles are disadvantaged in a number of key areas: range, convenience of recharging, size and weight of energy storage systems. Consequently, a major focus of current research in the electric vehicle sector is energy storage technology, which includes developments in batteries (described here) and other methods (like supercapacitors, described in the following subsection).

Much of the new development in this sector has been forecast to take advantage of a variety of lithium battery chemistries with significant expansion in the lithium battery market expected in the medium term. It has been estimated that lithium-ion batteries in some form will be the technology of choice for vehicle producers and that the global market for electric vehicle batteries will increase from $878 million in 2010 to $8 billion by 2015.[4]

In the next 20 years, it has been estimated that battery technology will be required that achieves an energy storage density of more than 400Wh/kg, with a cost less than $200/kWh[5]. This performance leap from currently available batteries has huge global potential as indicated by strong scores for Australian and global market size in Figure 14.

Current Australian capability in this sector is limited, but research in the field and transferable capability from outside the automotive industry indicate that there is high potential to develop future capability in advanced batteries. Difficulty in accessing global technology, however, suggests that a competitive local industry will have to develop indigenously. This could be aided by a knowledge base with strong research and development skills and by leveraging Australia's rich endowment of related raw materials.

The factors that increase the attractiveness of battery technology development are equally enticing to other global markets. Billions of dollars are currently being invested by international governments and multinational corporations. This limits Australia's opportunity to establish a leadership position, and makes access to internationally developed technology more difficult, as reflected in the relevant scores.

Supercapacitors

Electric double-layer capacitors, otherwise known as supercapacitors or ultracapacitors, are a possible competitive, or complementary, solution for energy storage in electric vehicles. The underlying effect has been known since 1957, but the market for commercial applications has only been active in the last decade, reaching $208 million in 2008. It is estimated that the market will exceed $870 million by 2014.[6] Supercapacitors have a number of advantages over chemical battery technology:

- Much faster charge and discharge rates,
- Long lifecycles, and
- Low toxicity of constituent materials.

The attractiveness scores presented in Figure 15 show a particularly high score for leadership opportunity and this reflects current design and development capability in Australia. This is further demonstrated by high scores for alignment with Australian capability scores in all sectors. Local research and development has led to a global strength in this area.

Supercapacitors will most likely be applied to electric vehicles in three ways: as a storage solution for high power loads associated with regenerative braking and acceleration, to provide high current bursts to intermittent systems like solenoids, and in a hybrid configuration to increase the performance of battery energy storage. Should the adoption of electric vehicle technology proceed according to current expectations, supercapacitors will play an important role.

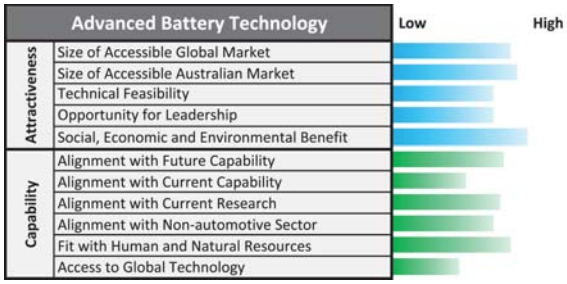


FIGURE 14 – ATTRACTIVENESS AND CAPABILITY SCORES FOR ADVANCED BATTERIES

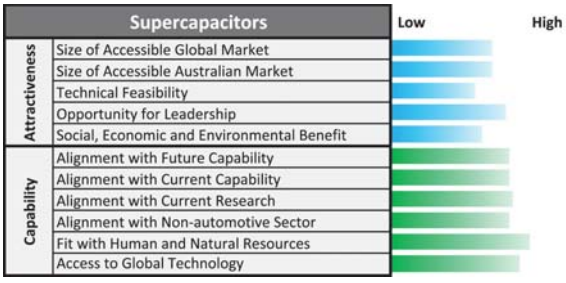


FIGURE 15 – ATTRACTIVENESS AND CAPABILITY SCORES FOR SUPERCAPACITORS

4 Pike Research. *Electric Vehicle Batteries.* December, 2009.
5 New Automotive Innovation and Growth Team. *An Independent Report on the Automotive Industry in the UK.* May 2009.
6 Lux Research. *Bridging the Gap with Supercapacitors: A Tale of Two Markets.* June 2009.

Vehicle Recharging

One major hurdle for the mass market acceptance of electric vehicles is convenience of recharging. This includes both on-vehicle solutions to simplify the recharging process, and the development of infrastructure for convenience and speed of recharging away from home.

The capability factors in Figure 16 show particularly strong links related to the deployment of infrastructure for vehicle recharging. Australia has high availability of electricity infrastructure suitable for vehicle charging as reflected by the fit with resources score. This score also relates to a natural wealth in future clean energy resources like solar and wind. The alignment with current and future capability is particularly high owing to long experience in the design and production of electrical products. The process has identified comparatively little relevant capability in the research sector and, this will be investigated further in Phase 5.

Attractiveness factors are also quite high, with the notable exception of the global market, as the unique challenges in other markets indicate comparatively little possibility of exporting infrastructure systems. The Australian market, however, is seen as a classic early adopter nation and would readily serve as a test case. As a prime requirement for the widespread adoption of electric vehicles, recharging systems and infrastructure will contribute directly to any social, economic or environmental benefits that are to be realised.

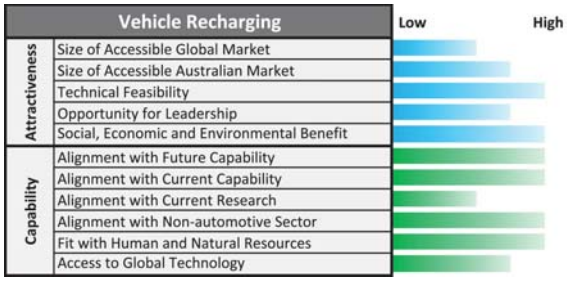


FIGURE 16 – ATTRACTIVENESS AND CAPABILITY SCORES FOR VEHICLE RECHARGING

OPPORTUNITY AREA 4

Gaseous Fuel Driveline

Two long term opportunities were identified in the area of gaseous fuels: LPG and CNG; and Storage of Gaseous Fuels. Both these opportunities were identified in the *Automotive Australia 2020 – Vision* report as being relevant in the medium to long term. These opportunities are part of a wider trend towards alternative internal combustion fuels and build on the short term opportunity of IC engine and driveline technology.

Australia is a net exporter of natural gas[7] and LPG[8], with significant reserves of both. There is significant national capability in extraction, refining, distribution, and storage of gas. This capability and resource strength is closely aligned with the identified opportunity in gaseous fuels.

LPG and CNG

The LPG and CNG opportunity describes the use of gaseous fuel as an alternative fuel for internal combustion engines. This opportunity includes the development of complete gaseous fuel systems. While LPG is currently available in the Australian market as an alternative fuel for passenger vehicles, CNG has only limited availability. LPG and CNG fitment to vehicles is available in the automotive aftermarket industry. LPG is also available as an Original Equipment Manufacturer (OEM) option on some Australian manufactured vehicles.

As shown in Figure 17, the process has identified a significant accessible market size both globally and locally. Social, economic and environmental benefits have also been identified. The social and economic benefit is linked to the ability to source the components and gas from Australian industry, while the environmental benefits of LPG and CNG are realised in a reduction in greenhouse gas emissions[2].

Currently, there is engine and fuelling system technology available for the use of LPG and CNG fuels as indicated by the high technical feasibility of the opportunity. However, there are still technical challenges to encourage greater consumer acceptance of the technology. The LPG and CNG opportunity links well with the current automotive sector capabilities, with many of the components already available through the current supply base. It rates most highly in fit with human and natural resources, taking direct advantage of Australian gas reserves.

Storage for Gaseous Fuels

The opportunity for storage of gaseous fuels describes the development and manufacture of vehicle gaseous fuel storage tanks. This is directly aligned with the opportunity for LNG and CNG fuel systems for vehicles. Currently, the storage of gaseous fuels for a vehicle, fitted either as OEM equipment or aftermarket, involves the use of a large, heavy tank. These tanks can be sourced from the local manufacturing industry. The long term opportunity identifies innovation in storage tanks to reduce weight and improve geometry to suit vehicle integration.

The attractiveness of this opportunity, as indicated by market size in Figure 18, is similar to that of the LPG and CNG opportunity. Difficulties associated with shipping fuel tanks limit market access, which results in a lower score for global accessible market.

The capabilities that have been identified with this opportunity again show a good alignment with current and future industry capability. Scores in alignment with research capability and alignment with the non-automotive sector are notable weaknesses for this opportunity. This perceived weakness will be investigated further in Phase 5 of the project.

FIGURE 17 – **ATTRACTIVENESS AND CAPABILITY SCORES FOR LPG AND CNG**

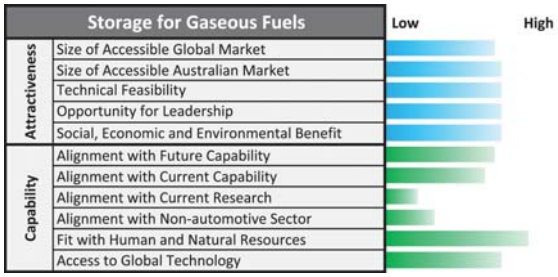


FIGURE 18 – **ATTRACTIVENESS AND CAPABILITY SCORES FOR STORAGE FOR GASEOUS FUELS**

7 Australian Goverment, Austrade. *Retrieved from http://www.austrade.gov.au/oil-gas-overview/default.aspx*, viewed 16 Dec 2009.

8 LPG Australia. *Retrieved from http://www.lpgaustralia.com.au/index.php?option=com_content&view=article&id=50&itemid=55*, viewed 16 Dec 2009.

Next Steps

Phases 1 to 4 of the AA2020 roadmap have identified a number of priority opportunities to meet the AA2020 Vision, in both the short and long term. These have been refined, from a very extensive initial data capture, through a filtering process involving over 200 interview, survey and workshop participants. The short term opportunities will be taken forward to government and industry stakeholders to determine the future course of action.

Prioritised long term opportunities will be explored further in Phase 5 of the programme, through a series of workshops covering the four broad themes of electric vehicles, light-weighting, gaseous fuels and driver information and communications. These will bring together subject-area experts in each of these themes, selected on the basis of their relevance to the shortlisted opportunities, and drawn from all stakeholder groups within the automotive sector, broader industry and academia and research. One of the primary objectives of the final phases of the project will be to identify enabling actions that support the four opportunity areas that have been taken forward. A preliminary list of enablers was identified by the workshop participants and these will be explored and expanded. These include:

- Technology transfer from other sectors,
- Product innovation,
- Leverage natural resources and energy,
- Industry collaboration through cluster development,
- International collaboration and export market exploration,
- Support for investment in capacity and infrastructure,
- Improve skills base and education,
- Standards,
- Incentives for consumer adoption of new technology, and
- Focussed R&D and commercialisation.

Each workshop will build on the outputs of the first four phases to develop detailed roadmaps tailored to each opportunity area. These recommendations will then be reviewed in Phase 6 to prioritise investment and policy decisions. Together, these roadmaps will form an implementation plan; guiding the funding, policy, skills and technology development required to achieve the industry's vision for 2020 and beyond.

FIGURE 19 – **THE AA2020 ROADMAP PROCESS**

APPENDIX 1

Workshop Participants

The data presented in this document and the accompanying reports (Automotive Australia 2020 – Technology Needs, and Automotive Australia 2020 – Capabilities) was gathered through research before validation at a series of workshops in November, 2009. The participation of the following organisations and individuals was instrumental in establishing the preceding portfolio of opportunities.

Name	Organisation
Dr Michael Brear	ACART
Ms Angela Krepcik	Advanced Manufacturing Australia
Mr Peter Taylor	ASEA
Mr Linsey Siede	ASEA
Mr Hayden Williams	Austrade
Mr Stuart Charity	Australian Automotive Aftermarket Association
Mr Russell Pettis	Australian Automotive Air Pty Ltd
Mr Richard Johns	Australian Automotive Intelligence
Mr Nixon Apple	Australian Manufacturing Workers Union
Dr Gary White	AutoCRC
Dr Matthew Cuthberston	AutoCRC
Dr Thomas Ting	AutoCRC
Mr Barry Comben	AutoCRC
Mr David Sykes	Backwell IXL
Mr Ross McDonald	Backwell IXL
Mr Evan Thornley	Better Place
Mr Talal Yassine	Better Place
Mr John Giuliani	Bostik Australia Pty Ltd
Mr Pierre Mars	Cap-XX Pty Ltd
Mr George Collins	CAST CRC
Mr Masato Furumi	Century Yuasa
Mr Steve Hermann	Century Yuasa
Mr Brian Hughes	CME
Mr Hasib Felic	CMG Technology Pty Ltd
Mr Danny Edmunds	Continental Pty Ltd
Mr Neil Silke	Continental Pty Ltd
Mr Wolfgang Obst	Continental Pty Ltd
Mr Barrie Finnin	CSIRO
Mr Stan McGlashan	DAIR
Mr Guy Amedee	Dana Automotive Systems Group Australia
Dr David Charles	Deloitte Touche Tohmatsu
Mr Damon Cantwell	Deloitte Touche Tohmatsu
Mr Todd Standal	Deloitte Touche Tohmatsu
Mr Bryan Rickard	Denso Australia Group
Mr Gavan Keenan	Denso Australia Group
Mr Christopher Wong	Department of Innovation, Industry and Regional Development, Government of Victoria
Mr John Conomos AO	Automotive Industry Envoy, Australian Goverment
Mr Steve Payne	Department of Innovation, Industry, Science and Research, Government of Australia

TABLE 3 – **WORKSHOP PARTICIPANTS**

Name	Organisation
Mr Richard Reilly	FAPM
Mr David Robb	Ford Motor Company of Australia Limited
Mr Jonathan Holbrook	Ford Motor Company of Australia Limited
Mr Peter De Leur	Ford Motor Company of Australia Limited
Mr Peter Haynes	Ford Motor Company of Australia Limited
Mr Sam Casabene	Ford Motor Company of Australia Limited
Mr Brian Thiele	Futuris Automotive Group Ltd
Mr Ross Mahon	Futuris Automotive Group Ltd
Mr David Chuter	Futuris Automotive Group Ltd
Mr Graeme Lane	GM Holden Limited
Mr James Constable	GM Holden Limited
Mr Jaydeep Solanki	GM Holden Limited
Mr Jim Mandilas	GM Holden Limited
Mr Richard Marshall	GM Holden Limited
Mr Stuart Adams	GM Holden Limited
Mr Tim Newman	GM Holden Limited
Mr Peter Keley	GM Holden Limited
Mr Mark Phillips	Grant Thornton Australia Ltd
Mr Anthony Ibrahim	KPMG
Mr Steve Mellor	Marand Precision Engineering Pty Ltd
Mr Mark Albert	MTM Pty Ltd
Prof. Stan Skafidas	NICTA
Mr David Worth	Orbital Corporation Limited
Mr Terry Stinson	Orbital Corporation Limited
Mr Tony Fitzgerald	Orbital Corporation Limited
Mr Michael Sparrow	PPG Industries Australia Pty Ltd
Mr Winston Nel	PPG Industries Australia Pty Ltd
Mr Rohan Appleton	Precision Plating (Aust.) Pty Ltd
Mr Andrew Hynson	Prodrive Automotive Technology (Australia) Pty Ltd
Prof. Aleks Subic	RMIT University
Mr Gavin Smith	Robert Bosch (Australia) Pty Ltd
Mr Graeme Wallace	Simms Metal Management
Mr Mike Shnier	Tenneco Australia and New Zealand
Mr Richard Farkashazy	Thales Australia
Mr Barry Budge	Toyota Motor Corporation Australia
Mr Cameron Cormack	Toyota Motor Corporation Australia
Mr David Jaksa	Toyota Motor Corporation Australia
Mr Lenny Tarollo	Toyota Motor Corporation Australia
Mr Mark Carbonari	Toyota Motor Corporation Australia
Mr Ronald Grasso	Toyota Motor Corporation Australia
Mr Mike Rausa	Toyota Motor Corporation Australia
Mr Mark Welte	ZF Lemforder Australia
Mr Wayne Durrant	ZF Lemforder Australia
Mr Juergen Bracht	ZF Lemforder Australia

TABLE 3 – **WORKSHOP PARTICIPANTS** CONTINUED

APPENDIX 2

Evaluation Criteria

The scores in this report are based on 21 selection criteria established during Phase 1 of the project. Presented below are the selection criteria along with some of the rationale leading to final scoring.

More information regarding the selection criteria, the research methodology and initial scoring can be found in two accompanying reports: *Automotive Australia 2020 – Technology Needs* and *Automotive Australia 2020 – Capabilities.*

Short Term Attractiveness

SA1 45%

Meets the needs of next model year vehicles – Australian market in 2012
- Part value and number of vehicles
- Current and desired sourcing patterns
- Market accessibility

SA2 15%

Meets the needs of next model year vehicles – Global market in 2012
- Part value and number of vehicles
- Market accessibility
- Feasibility for exporting

SA3 15%

Meets immediate financial imperative for cash-flow and profit
- Relative likelihood to deliver immediate cash-flow and profit
- Potential for future growth and margins
- Comparison of supplier profitability and cash flow in sub-sector

SA4 15%

Potential for low risk early market testing in attractive long term sectors
- Potential for future growth as basis of strategic industry need
- Position in long term opportunity ranking

SA5 10%

Market open to local suppliers
- Importance of delivery and responsiveness as success factors (local market)
- Regulatory and tariff considerations (export markets)
- Strength of established global competitors (all markets)

Long Term Attractiveness

LA1 30%

Meets future consumer automotive needs – Global accessible market in 2020
- Part value and number of vehicles
- Market accessibility
- Feasibility for exporting

LA2 30%

Meets future consumer automotive needs – Australian accessible market in 2020
- Part value and number of vehicles
- Future desired sourcing patterns
- Local market accessibility

LA3 20%

Likelihood of technical feasibility
- Likelihood of technical success
- Current technology readiness level
- Expected introduction date

LA4 10%

Opportunity to establish a leadership position
- Dominance of incumbent global suppliers (in local an export markets)
- Focus for international technology investment

LA5 10%

Potential to deliver industry triple bottom line (Profit, People, Planet)
- **Profit:** Industry profit, National GVA, Employment
- **People:** Improved safety, mobility, comfort, skills
- **Planet:** Reduced CO_2, pollutants, noise, resource usage

TABLE 4 – **SELECTION CRITERIA FOR ATTRACTIVENESS**

Short Term Fit with Capability

SC1 45%

Supply base competitiveness to meet critical success factors (CSFs)

- Importance of CSFs
- Benchmark ratings for suppliers
- Alignment between importance and performance

SC2 20%

Potential for long term, sustainable competitive position

- Innovation and investment activities in the supply base
- Capabilities that are likely to survive and thrive in the medium term

SC3 15%

Supply base capability to supply (including capacity, financial and management capabilities).

- Proportion of market met by Australian capacity
- Financial capability and resources
- Best practice processes and strategic management

SC4 10%

Critical mass and importance of Australian supply chain

- Importance of supply chain (desired CSFs for delivery, service and responsiveness)
- Depth of capability (dispersed or concentrated)
- Degree of local autonomy

SC5 10%

Partnerships with emerging Asian economies for technology and trade

- Export activities in these countries
- Effective sourcing and supply base in these countries
- Technology collaboration in these countries
- Subsidiaries or sister companies in these countries

Long Term Fit with Capability

LC1 30%

Fit with Australian capabilities – Auto supply chain

- Innovative capacity
- Relevant research focus and status
- Ability to commercialise
- Technology capture ability

LC2 20%

Fit with Australian capabilities – Alignment with future automotive supply base

- Benchmark performance against critical success factors
- Scale of relevant capability
- Market structure and future shape

LC3 20%

Fit with Australian capabilities – Science base

- Research relevance and scale
- Strength in: Technology innovation, IP protection, and commercialisation

LC4 10%

Fit with Australian capabilities – Non-auto supply chain

- Relevant and transferable capabilities
- Future R&D focus and applicability of innovations

LC5 10%

Fit with Australian capabilities – Human and Natural Resources

- **Human:** Skills, education, management, etc.
- **Natural:** Mineral, energy, climate, etc.
- **Other:** Global relationships, policy, infrastructure, etc.

LC6 10%

Global alliances and alignment with international standards

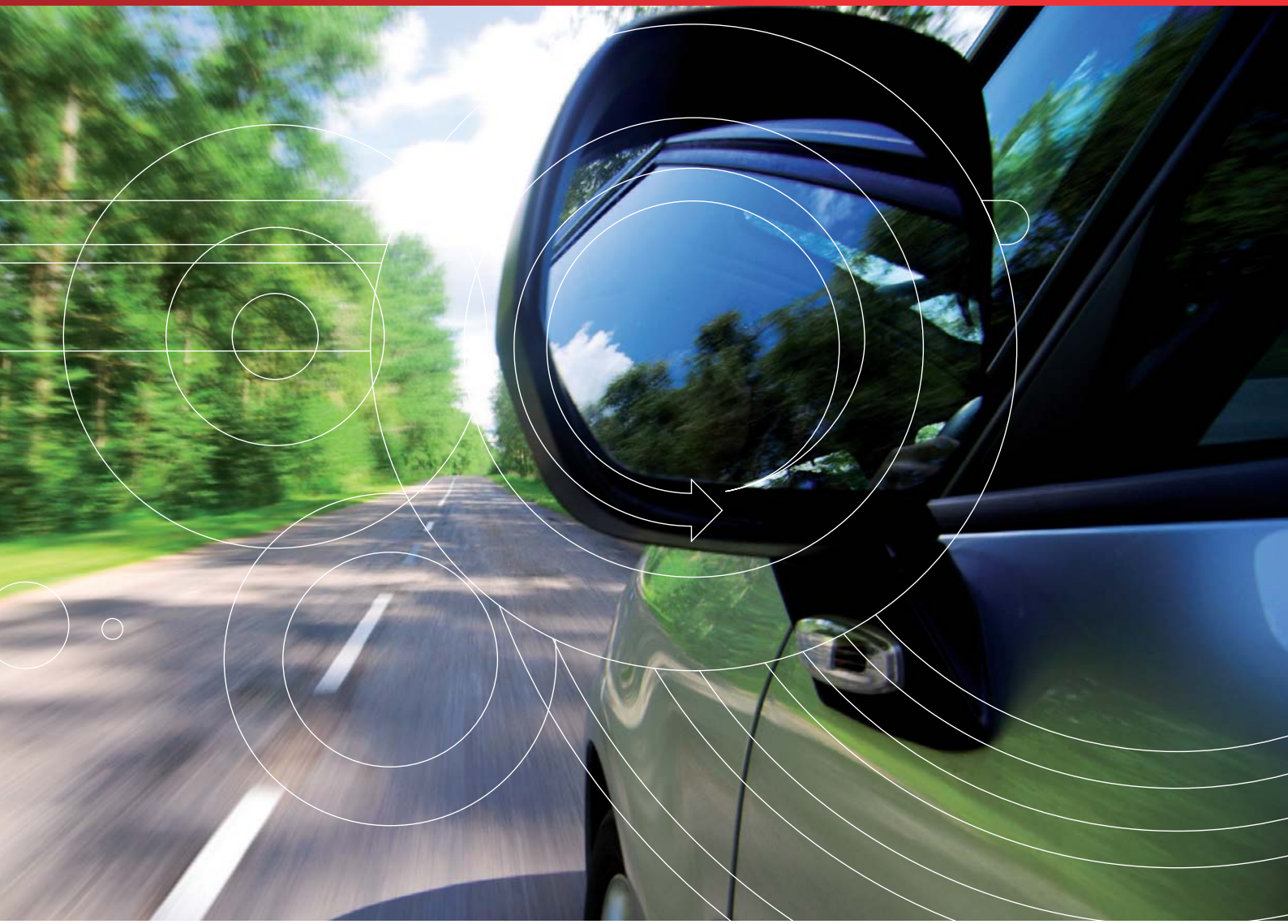
- International trade and sales
- International supply chain
- Innovation, research and technology collaborations
- Alignment with global standards

TABLE 5 – **SELECTION CRITERIA FOR FIT WITH CAPABILITY**

Further Information

Please visit **www.autocrc.com/2020.htm** or contact the Automotive Australia 2020 Project Office:

AutoCRC
Unit 1, 3 Westside Avenue
PO Box 231
Port Melbourne VIC 3207
T +61 3 9681 8626
F +61 3 9673 5999
E automotiveaustralia2020@autocrc.com



Australian Government

Victoria The Place To Be

AutoCRC Smarter Safer Cleaner

ANU THE AUSTRALIAN NATIONAL UNIVERSITY

CSIRO

UNIVERSITY OF CAMBRIDGE