Automotive Engineering

Graduate Program

Knowledge Priorities

**Introduction**

A set of Australian Automotive Technology maps has been produced, identifying nine knowledge area priorities. Alignment with priority areas serve as a selection criterion for funding applications in the Automotive Engineering Graduate Program.

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**Figure 1 – The program’s nine high-level prioritised knowledge areas**

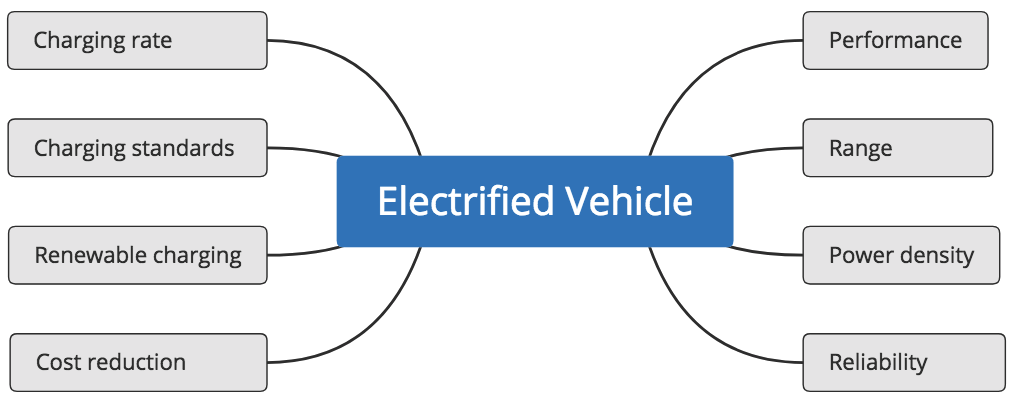
Connected Autonomous Shared - Vehicle
Electrified vehicle
electric energy storage
electronics and electrics
fuel cell and hydrogen
thermal propulsion
functional materials
automotive safety
policy and company decision-making

**Figure 2 – Knowledge area “Connected, Automated, Shared Vehicle” and next level prioritised knowledge area**

Connected:
- cooperative driving
- cooperative perception
- cloud connectivity
- interoperability
- V2V, V2I, V2X
- scaling technology
- connected lifestyle in car
- whole of life record

Shared
- scheduling and smartphone
- access and security
- congestion management
- city policy development
- vehicle specialisation

Automated
- control mechanisms
- LiDAR, radar, sonar, GPS
- hardware
- digital and image processing
- computer software
- communications systems
- artifcial intelligence
- algorithms and deep learning
- navigation
- collison detection and avoidance
- signalling and warning systems
- survelliance 

**Figure 3 – Knowledge area “Electrified Vehicle” and next level prioritised knowledge areas**

- charging rate
- charging standards
- renewable charging
- cost reduction
- performance 
- range
- power density
- reliability

**Figure 4 – Knowledge area “Electronics and Electrics” and next level prioritised knowledge areas**

Power electronics cost reduction
- wide bandgap advanced integrated power module
- multi-physics integration
- components: power module; interconnect; passives; chip set integration
- thermal strategy

Charging technology
- XFC
- wireless

Power density improvement:
- battery packaging
- motor and electronics packaging

Electric motor materials:
- non-heavy rare Earth advanced electric motor
- modelling
- thermally conductive epoxy and fillers
- base material

Electric motors cost reduction:
- asynchronous: unipolar; induction doubly-fed; induction wound rotor; induction aluminium or cooper rotor
- synchronous: permanent mangnet; reluctance

**Figure 5 – Knowledge area “Fuel Cell and Hydrogen” and next level prioritised knowledge areas**

Storage design and safety standards:
- pressure vessel design for 900+ bar

PEM fuel cell and component design

High density storage systems:
- ammonia system for transport
- compressed H2
- liquid hyrdogen

Renewable hydrogen supply strategies

Electroliser engineering

Hydrogen refueling systems

**Figure 6 – Knowledge area “Electric Energy Storage” and next level prioritised knowledge areas**

Cell and pack performance:
- charge rate
- discharge rate
- durability

Cell and pack cost:
- low cost materials
- manufacturing process improvements
- material supply security

Battery pack recycling:
- end of life recycling
- battery pack re-use

Improved cell chemistry-active materials:
- cathode
- anode
- electrolyte
- material supply security

Advanced battery-inactive materialsi:
- packaging
- electrode substrate
- separator

Improved battery management systems:
- state of health
- thermal management
- charge/discharge control

**Figure 7 – Knowledge area “Policy and Company Decision Making” and next level prioritised knowledge areas.**

- Data-cyber security
- Shared vehicle policy
- Automated vehicle ethics, liability
- Alternative fuel policy
- Renewable energy policy
- Monetising mobility - business models
- End-of-life vehicle disposition
- Consumer incentives
- Hydrogen economy

**Figure 8 - Knowledge area - “Functional Materials” and next level prioritised knowledge areas.**

**Carbon fibre composite:
- carbon material cost reduction
- manufacturing cost reduction

Polymers:
- self-healing
- structural
- polymer component manufacturing processes

Superconductor:
- high temperature superconducting alloys

Surface coatings:
- durability function coatings
- optical function coatings
- electrical function coatings
- decorative coatings

Ferrous alloys:
- HSS
- other

Non-ferrous:
- Magnesium
- Alumunium 

Smart metals:
- shape memory alloys**

**Figure 9 - Knowledge area - “Automotive Safety” and next level prioritised knowledge areas**

- EV battery safety
- Light commercial vehicle safety 
- International harmonisation
- Australian unique regulation
- Occupant protection
- Pedestrian protection
- Personal security

**Figure 10 – Knowledge area “Thermal propulsion” and next level prioritised knowledge areas**

- Modelling and simulation
- Emission control
- Fuel consumption reduction
- Combustion strategies
- Downsized engine design
- Turbo/supercharged engine design
- Hybrid drivetrain design
- Integrated drivetrain systems