



# Queensland Aerospace 10-Year Roadmap and Action Plan

June 2018

The Department of State Development, Manufacturing, Infrastructure and Planning

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# Foreword

The Queensland Government is committed to creating a globally focused, diverse economy and is driving innovation to generate high-value, knowledge-based jobs and secure Queensland's economic future.

As part of the \$650 million Advance Queensland initiative, the Queensland Government is creating an environment to foster emerging and priority sectors with global growth potential.

Aerospace is one of these industry sectors and will play an important role in diversifying Queensland's economy and ensuring Queensland workers have access to the jobs of the future.

The aerospace industry already contributes significantly to Queensland's economy and jobs. In 2015-16, Queensland's aircraft manufacturing and repair businesses generated approximately \$1.2 billion in revenue and contributed \$565 million to Queensland's economic growth.<sup>1</sup> The state's aircraft manufacturing and maintenance sector alone provides over 4200 jobs across more than 300 enterprises.<sup>2</sup>

Due to its close proximity, Queensland is well-positioned as a hub for aerospace in the Asia-Pacific region. The aviation sector is the foundation of a resilient aerospace industry and Queensland's connections stretch back to the pioneering days of powered flight, when the Queensland and Northern Territory Aerial Services Limited (QANTAS) was founded in Winton in 1920.

From these humble beginnings, Queensland has developed a growing presence in the aerospace industry. This includes Virgin Australia's headquarters and a significant presence by half of the world's top 10 aerospace companies

(ranked in terms of total turnover) in Queensland, such as Boeing Defence Australia, Airbus, Northrop Grumman and Raytheon.

Queensland is also home to Australia's largest defence airbase, the Royal Australian Air Force (RAAF) Base Amberley, with its 70 aircraft, six fleets and more than 5800 personnel. The redevelopment of the Amberley base will see this number grow to more than 7000 military and civilian personnel by 2020.

Recognising the defence industry is a key component of Queensland's diverse aerospace sector, the Government has committed to creating Defence Jobs Queensland, establishing advisory boards of senior defence and industry personnel, and allocating \$10 million to defence supply chain logistics hubs.

This *Queensland Aerospace 10-Year Roadmap and Action Plan* will accelerate the pace of growth, and assist the sector to grasp opportunities to create the high paid, sustainable jobs of tomorrow.

Queensland's cutting-edge technology and skilled researchers position the state perfectly to take on the challenges of a dynamic and evolving aerospace sector. The roadmap articulates how we will capitalise on our competitive advantages to realise the opportunities and support the rapidly developing and innovative aerospace industry in Queensland.

The Queensland Government's vision for the aerospace industry is that by

2028 Queensland will be a leading centre in Australasia and South East Asia for aerospace innovation in training; niche manufacturing; maintenance, repair and overhaul (MRO) capabilities; and unmanned aerial systems (UAS) applications for military and civil markets.

An aerospace industry of this scale will attract significant international investment and create many high value, knowledge-based jobs for Queenslanders.

Based on our confidence in the aerospace industry's many strengths, the Queensland Government has set an ambitious vision for the sector. Opening our eyes to new possibilities and embracing innovation ultimately means creating the jobs of tomorrow and a more secure future for Queensland.



**The Honourable Cameron Dick MP**

Minister for State Development,  
Manufacturing, Infrastructure and Planning

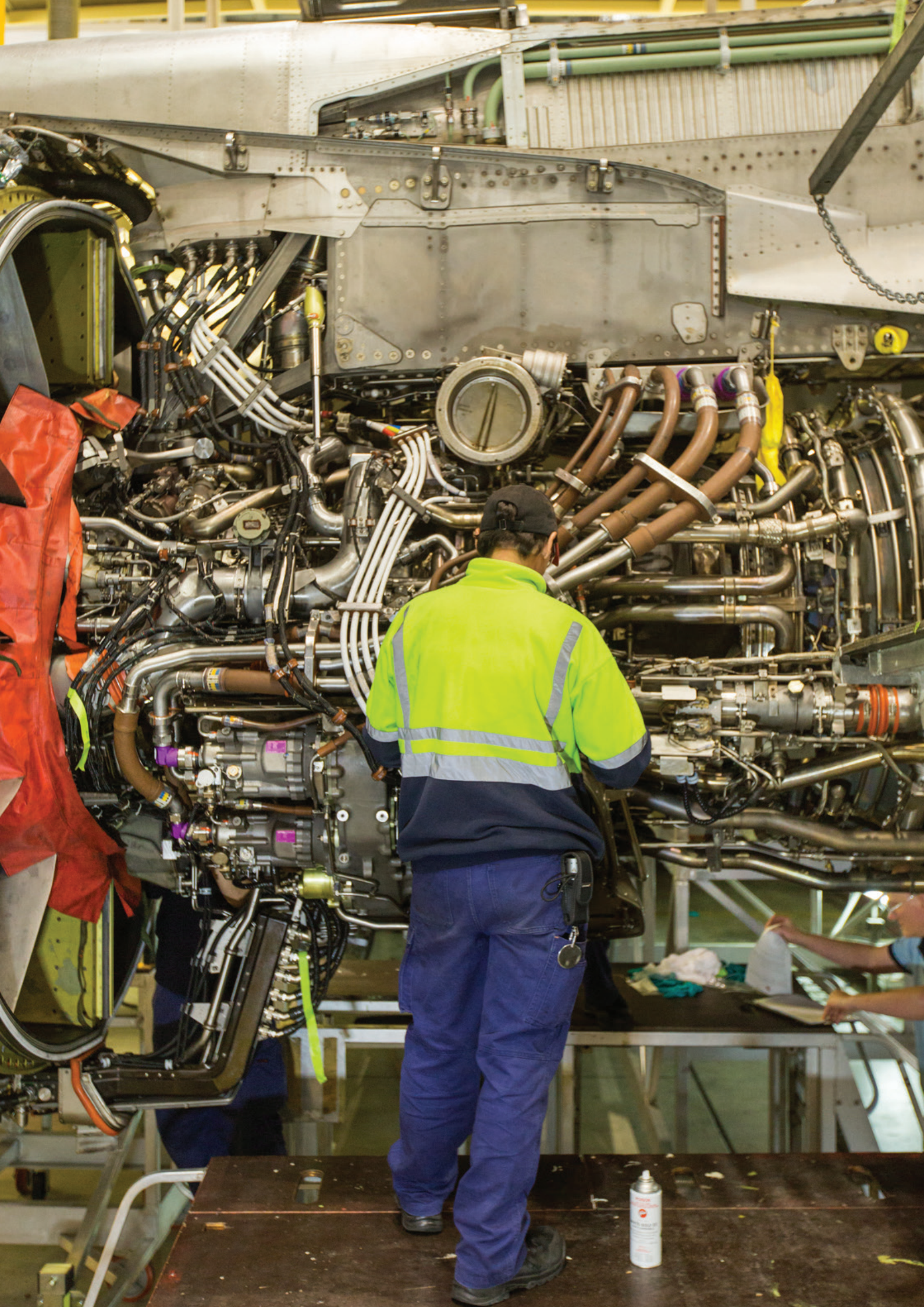




# Contents

<b>Executive summary .....</b>	<b>1</b>
<b>Unleashing Queensland's natural advantages.....</b>	<b>2</b>
Industry capability .....	2
Government and industry working together.....	3
<b>What is aerospace? .....</b>	<b>7</b>
Aerospace equipment manufacturers and suppliers.....	7
Maintenance, repair and overhaul services .....	7
Space technologies.....	7
Emerging technologies.....	7
<b>Growth drivers .....</b>	<b>8</b>
Global fleet demand .....	8
Demand for MRO.....	10
Regional demand for training .....	10
Growing defence budgets.....	10
Global sustainability trends.....	10
Emerging technologies.....	10
<b>Queensland aerospace industry snapshot.....</b>	<b>11</b>
<b>Hypersonic flight .....</b>	<b>14</b>
<b>Opportunities for growth.....</b>	<b>15</b>
Civil aerospace MRO .....	15
Research and development.....	16
Niche manufacturing.....	16
Pilot training.....	16
Defence aerospace investment.....	16
Unmanned aerial systems .....	16
Space technologies.....	17
What is graphene? .....	18
TAE Aerospace supports Joint Strike Fighter .....	19
<b>Key industry challenges .....</b>	<b>20</b>
<b>Actions to date.....</b>	<b>22</b>
Advance Queensland .....	22
Defence Cooperative Research Centre for Trusted Autonomous Systems .....	22
Skilled workforce .....	22
Avalon Airshow.....	22
STEM strategy in Queensland state schools .....	23
Aerospace Gateway to Industry Schools Program .....	23
<b>Action plan .....</b>	<b>24</b>
<b>Addressing the challenges and opportunities .....</b>	<b>25</b>
<b>Summary: Queensland Aerospace 10-Year Roadmap and Action Plan.....</b>	<b>26</b>
<b>Notes.....</b>	<b>28</b>
<b>Glossary .....</b>	<b>28</b>







# Executive summary

## Vision

By 2028, the Queensland aerospace industry will be recognised as a leading centre in Australasia and South East Asia for aerospace innovation in training; niche manufacturing; maintenance, repair and overhaul (MRO); and unmanned aerial systems (UAS) applications for military and civil markets.

## Key strategies and priority actions

The *Queensland Aerospace 10-Year Roadmap and Action Plan* builds on the state's current strengths and addresses a number of challenges identified through consultation with aerospace industry stakeholders.

The Roadmap includes three key strategies and six priority actions, summarised below. These actions will be supported by 22 sub-actions summarised on pages 26 and 27.

1

### Grow Queensland's aerospace industry and create high-skilled jobs

#### Priority actions:

- 1.1 We will work with Queensland industry and research organisations to strengthen aerospace business capability by positioning Queensland as an international hub for UAS
- 1.2 We will work with industry to assist Queensland companies target emerging capability areas such as UAS, niche manufacturing, training, MRO and hypersonic flight
- 1.3 We will establish the Defence and Aerospace Industry Development Fund to assist Queensland SMEs to access defence contracts both directly and through supply chain opportunities.

2

### Enhance Queensland's level of aerospace industry capability to access new global supply chain opportunities and international markets

#### Priority actions:

- 2.1 We will work to secure a greater portion of national aerospace work, including in regional Queensland
- 2.2 We will work with the aerospace industry to assist Queensland companies enter global supply chains.

3

### Promote Queensland as a preferred destination for aerospace capability locally and globally

#### Priority actions:

- 3.1 We will promote Queensland industry capability to national and international civil and military aerospace markets.

During the next three to five years, particular focus will be given to securing a greater portion of the aerospace spend arising from the following strategic opportunities:

- establishing Queensland as an international hub for UAS by positioning the state as an UAS centre of excellence and pursuing opportunities for innovative application of UAS technologies through collaboration with industry and research institutions
- capitalising on major international defence and civil aerospace projects such as the F-35 Joint Strike Fighter (JSF) program
- targeting markets for export of aerospace-related education and training services and niche MRO capabilities
- investigating supply chain and training skills requirements for future development of a hypersonic flight industry in Queensland
- showcasing Queensland aerospace industries internationally to maximise opportunities for Queensland aerospace firms to access new and expanded markets.

# Unleashing Queensland's natural advantages

Queensland has competitive advantages that place it in a favourable position to capitalise on growing demand for aerospace services.

Some advantages of Queensland's aerospace sector include:

- the highest product quality levels within the Asia-Pacific region at competitive prices
- innovative, high-quality, cost-effective aerospace design with excellent communications and IT infrastructure
- world-leading research into hypersonics and UAS development with Australia's pre-eminent aerospace autonomy group at the Queensland University of Technology (QUT)
- one of only a few sites in the world with the full range of capabilities needed to assemble, test and maintain advanced military and civil helicopters
- the only aircraft heavy engineering maintenance facility in Australia, servicing Boeing 737s and Airbus 330s
- the presence of prime aerospace contractors based or headquartered in Brisbane
- extensive capabilities in systems integration and support services including operational testing and evaluation, and airworthiness planning
- proximity to key markets.

Queensland is ideally located close to the high-growth markets of South Asia and South-East Asia. Easy access to these markets is provided through the state's reliable and efficient infrastructure, including five international airports, 56 certified airports, a modern and efficient road network, and access to reliable rail and port services.

## Industry capability

The span of capabilities in Queensland includes major aircraft modification; helicopter design and assembly; life cycle support; avionics; MRO; logistics analysis and management; electronic systems integration, modelling and simulation; and UAS design and manufacture.







Complementary to the civil aerospace sector, Queensland also offers a diverse range of well-established defence industry capabilities and provides support to significant defence facilities across the state. In particular, the RAAF base at Amberley plays a significant role in bolstering Defence's mobility, strike force and heavy lift capacity as well as key elements of the RAAF Intelligence, Surveillance and Reconnaissance (ISR) capability, Airborne Early Warning and Control (AEWC) and unmanned aerial systems (UAS).

Queensland is helping Defence to maintain a technological edge and provide tactical and strategic advantages, as well as the supporting infrastructure to maintain and develop new systems and

sub-systems that will support the Australian Defence Force (ADF) and its mission.

### **Government and industry working together**

Drawing together industry, researchers and businesses, Queensland is actively developing capabilities such as hypersonic flight, robotics, unmanned aircraft and trusted autonomous systems, positioning the state as a global leader in innovative technologies.

A testament to the depth of this technological capability, Queensland has been named as the headquarters of the first Defence Cooperative Research Centre for Trusted

Autonomous Systems (DCRC TAS). With \$50 million to be invested under the Next Generation Technology Fund over seven years — and matched by the Queensland Government — the Defence Science and Technology Group, universities and industry will work together at the DCRC TAS to deliver trustworthy smart-machine technologies for the ADF across multiple domains including aerospace. This national facility, in conjunction with the development of common-user sites for testing, trials and evaluation of unmanned aircraft systems, will enhance Queensland's status as an innovation, science and technology hub.



Queensland has Australia's largest share of aircraft manufacture and repair service enterprises



Queensland has the only aircraft heavy engineering maintenance facility in Australia



Queensland is home to the \$101 million national facility to host the Defence Cooperative Research Centre for Trusted Autonomous Systems

Queensland is one of the few locations in the world with the full range of technical capabilities needed to assemble, test and maintain advanced military and civilian helicopters



Queensland has Australia's only supersonic-to-hypersonic wind tunnel



Townsville is home to Flying Colours Aviation, Australia's largest aircraft repainting provider, servicing the civil and defence aircraft and operators



Queensland has a strong network of businesses that are involved in, or supply to, the defence and aerospace industries. Major companies with offices in Queensland include:

**AIRBUS**  
GROUP

**BAE SYSTEMS**  
INSPIRED WORK

**BOEING**

**SIKORSKY**  
A LOCKHEED MARTIN COMPANY

**L3** Micro

**NORTHROP GRUMMAN**

**HAWKER PACIFIC**  
Aviation's Trusted Choice

**Nova Systems**  
Experience Knowledge Independence

**Raytheon**  
Australia



**VECTOR**  
AEROSPACE

**TAE**  
AEROSPACE

**QANTAS**

**Virgin** australia









*Blue-Point.*



# What is aerospace?

The aerospace industry comprises the wide range of entities involved with the research, design and development of flight vehicles and equipment, as well as the support of these activities. Flight vehicles include aeroplanes and rotorcraft, UAS, rockets, missiles and spacecraft such as satellites.

Aerospace businesses provide goods and services across all aspects of the design, development, manufacture, modification, testing, operation and maintenance of all flight vehicles and their on-board and ground systems.

Aerospace industry activity is diverse, with a multitude of commercial, industrial and military applications. Key activities within the aerospace sector include:

## Aerospace equipment manufacturers and suppliers

In addition to aircraft, propulsion systems and parts, this subsector includes manufacturers and suppliers of component and platform designs, on-board and ground-based electronic systems, communication networks and decision support systems.

## Maintenance, repair and overhaul services

A large proportion of activity in the aerospace sector is classified as MRO services. MRO is the term to describe services relating to assuring aircraft safety and airworthiness. It is estimated that the global market for MRO services is worth US\$50 billion annually.<sup>3</sup>

### Flight vehicles include:

#### Aeroplanes and rotorcraft



#### Unmanned aerial systems (UAS)



#### Rockets and missiles



#### Spacecraft (such as satellites)



## Space technologies

This subsector covers activities ranging from research and development through to manufacturing of satellites and their subsystems, ground equipment such as control stations, very small aperture terminals (VSATs), and other specialised equipment and launch services.

## Emerging technologies

The most well-known emerging aerospace technology is in the area

of UAS, which includes the flight vehicles plus the support and ground systems used to control the vehicle and its function.

New technologies are being developed across a broad range of areas including equipment for military and commercial hypersonic flight, surveillance technologies, robotics and autonomous systems, microelectronics, microwave and radio frequency communications, geospatial and simulation technologies.

# Growth drivers

Rapidly changing global supply chains, technology and market conditions have all affected recent aerospace industry directions.

In 2014, the global civilian aerospace industry was valued at US\$314.9 billion, which is expected to grow to US\$352.5 billion by 2023.<sup>4</sup>

The largest contributors to this value were commercial aircraft, engines and component original equipment manufacturers (OEM) and MRO services to commercial aircraft, which were valued at US\$233 billion and US\$62 billion respectively.<sup>5</sup>

Most aerospace companies operate across the civil and military aerospace markets. Many large aerospace companies have turned to emerging markets, investing in research and development and

seeking new market opportunities. In addition, the shift in aerospace manufacturing effort to emerging economies has been encouraged by sustained government support for this sector through policy implementation or subsidisation.

There are a number of key growth drivers which influence the Queensland context.

## Global fleet demand

The commercial aerospace sector is experiencing above-average growth rates, driven by passenger demand for air travel, rapidly increasing living standards in the Asia-Pacific region,

along with an accelerated equipment replacement cycle.<sup>6</sup>

By 2030 the global middle class is forecast to grow to 4.9 billion people, with the Asia-Pacific region's share growing to around 3.2 billion.<sup>7</sup>

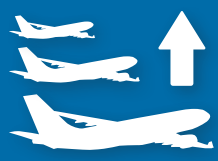
Population growth and global economic shifts from West to East are tipped to drive further demand for luxury items such as air travel.

The development of new technologies is driving long-term improvements in safety, passenger comfort, cost, fuel efficiency, noise emissions, freight and passenger capacity, and range capability of aircraft.





## Growth drivers



Global  
fleet  
demand

Emerging  
technologies

Growing  
defence  
budgets

Demand for  
maintenance,  
repair and  
overhaul

Regional  
demand for  
training

Global  
sustainability  
trends



These factors have seen airlines placing orders for new aircraft in record numbers, and demand for production of new commercial aircraft is predicted to remain at record highs over the coming decade. This growth is particularly high in Asia — by 2031, the Asia-Pacific fleet is expected to triple to about 13,500 aircraft.<sup>8</sup> There are also an estimated 4000 outstanding orders for new narrow and wide-body aircraft from carriers in the Asia-Pacific region.<sup>9</sup>

This growth in the global air fleet equates to 3.7 per cent annually over the next decade. Both Boeing and Airbus are forecasting that nearly 27,000 new large civil airliners (with a market value of \$US3.2 trillion) will be needed by 2030.

Similarly, in the helicopter market, expanding industrial applications for the use of helicopters and rapid technology advances will see substantial growth in demand. It is estimated that the global civil helicopter fleet will grow to 34,700 by 2025.<sup>10</sup>

## Demand for MRO

The rapidly increasing number of aircraft will also drive growth in the MRO subsector. The global aerospace MRO market is forecast to grow to US\$86.8 billion by 2024, according to US aviation consultancy Team SAI.

Given the predicted growth in commercial aircraft numbers and passenger demand in the Asia-Pacific region, the market for MRO services in this region is expected to grow at five per cent per year between 2014 and 2024, with China's market expanding from US\$4 billion to \$10.2 billion over this timeframe.<sup>11</sup>

## Regional demand for training

As economies in the Asia-Pacific region expand and thousands of new commercial aircraft come into service, there will be unprecedented demand for qualified pilots, technicians and engineers. Boeing has predicted that up to 248,000 new pilots and 268,000 new technical personnel will be required in the Asia-Pacific region by 2035.<sup>12</sup> This equates to 40 per cent of global demand and opens up exceptional opportunities for Queensland's training providers to meet the demand for training and education services.

## Growing defence budgets

Defence force research and development and procurement activities are significant contributors to the aerospace industry revenues. Demand in the military aerospace industry hinges mainly on global governments' security and operational needs and fiscal limitations. Globally, the aerospace industry is expected to benefit from growing defence budgets in North America, Europe and Asia, which are being refocused to meet emerging national security threats and the geopolitical environment.

## Global sustainability trends

Key global sustainability trends in the aviation sector will drive technological change and investment. Organisations such as the International Air Transport Association (IATA) and the International Civil Aviation

Organisation (ICAO) support a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector and recognise the need to mitigate emissions from air transport.

Industry-led international civil aviation targets have been set to achieve carbon neutral growth of CO<sub>2</sub> emissions from 2020<sup>13</sup> and a 50 per cent reduction of net CO<sub>2</sub> emissions by 2050 relative to 2005 levels,<sup>14</sup> through a combination of market and non-market based mechanisms. Innovation, research and development, and technical expertise will be required to meet these ambitious targets. Opportunities for Queensland include the development of new engines with improved fuel efficiency, new aircraft technology and materials, and sustainable aviation fuels.

## Emerging technologies

Emerging technologies, such as unmanned aerial systems — which encompass unmanned aerial vehicles, remotely piloted aircraft systems (RPAS) and autonomous systems — are finding a growing number of applications across a broad array of traditional industries, such as in automated crop and pest monitoring. The autonomous sector is expected to be the most dynamic growth sector of the world aerospace industry this decade. The global RPAS market was valued at US\$13.22 billion in 2016, and is forecast to grow to US\$28.27 billion by 2022.<sup>15</sup>



# Queensland aerospace industry snapshot

Queensland companies have broad capability across military and civilian aerospace, with expertise ranging from UAS design and manufacture, MRO, electronic systems integration and modelling and simulation.

In 2015-16, the aircraft manufacturing and repair services industry sector contributed around \$565 million to the Queensland economy and provided over 4200 direct jobs<sup>16</sup> and many more indirect jobs across the state.

The aircraft manufacturing and repair sector has shown national annual growth of 0.9 per cent from 2011 to 2016 with projected annual growth of two per cent in the period 2016 to 2021.<sup>17</sup>

Exports make up 54.1 per cent of industry revenue and more than 47 per cent of these go to the United States of America (USA) closely followed by the Asia-Pacific region.<sup>18</sup>

Rather than focusing on high-volume markets, Australia has developed expertise in specialised high technology, high value-add, and high-skill manufacturing that uses advanced design, processes, materials and technologies.

Queensland aerospace firms have established a reputation as a source of expertise and training across the advanced engineering and manufacturing technologies, which will ensure that they are well positioned to take advantage of emerging opportunities in the region.

The 2017 IBIS World Aircraft Manufacturing and Repair Services in Australia report<sup>19</sup> states Queensland is home to more than 31 per cent of establishments within the segment,



Queensland is home to more than **31%** of establishments within the Australian segment – over **300** enterprises

In 2015-16, the aircraft manufacturing and repair services industry sector contributed around

**\$565m + 4200**

to the Queensland economy

direct jobs across the state



Queensland is currently home to the Army Aviation Centre at Oakey and three RAAF bases including RAAF Base Townsville and Australia's largest defence airbase — RAAF Base Amberley

Exports make up  
**54.1%**  
of industry revenue

**47%**  
of exports go to the USA, closely  
followed by the Asia-Pacific region



**25%**  
of Australia's growing UAS industry  
is located in Queensland



over an estimated 300 enterprises. This is the largest share of Australian businesses, making Queensland a major hub for the aerospace industry in the Asia-Pacific region.

Queensland is home to many subsidiaries of the global prime aerospace contractors and a significant number of Tier 2-5 companies, demonstrating capabilities across the entire span of the global aerospace industry.

Contractors such as Boeing, Airbus, Raytheon, Sikorsky (a Lockheed Martin Company), GE Aviation and Northrop Grumman have regional headquarters and substantial military and civil aerospace business in Queensland. Tier 2-5

firms including Ferra Engineering, L3 Micreo, TAE Aerospace, Flying Colours and Heat Treatment Australia (HTA) also operate in the state.

Queensland is one of only a few locations in the world with the full range of technical capabilities needed to assemble, test and maintain advanced military and civil helicopters.

**Further, around 25% of Australia's growing UAS industry is located in Queensland.<sup>20</sup>**

Queensland is home to the Army Aviation Centre at Oakey and three RAAF bases, which continue to

provide significant opportunities for the aerospace industry. The RAAF bases include RAAF Base Amberley, RAAF Base Townsville, and RAAF Base Scherger in the Cape York Peninsula. Collectively these bases employ more than 6500 uniformed and civilian personnel across the state.

The presence of numerous major defence contractors gives local firms further commercial opportunities. As a result, participating small and medium-sized Queensland businesses have an opportunity to be linked into global supply chains and to capitalise on large contracts for supply to defence projects.



Queensland companies that have participated in the JSF Program have leveraged local supply chains, capabilities and information. These include Ferra Engineering, Heat Treatment Australia, L3 Microe and TAE Aerospace.

Queensland's highly regarded research agencies with specialist expertise in aerospace related research and development include:

- the **Aerospace Autonomy Group within the Science and Engineering Faculty at QUT**, which conducts research into sub-system analysis, design and build (including detect-and-avoid and multi-sensor navigation),

optimisation and data-driven air traffic analysis

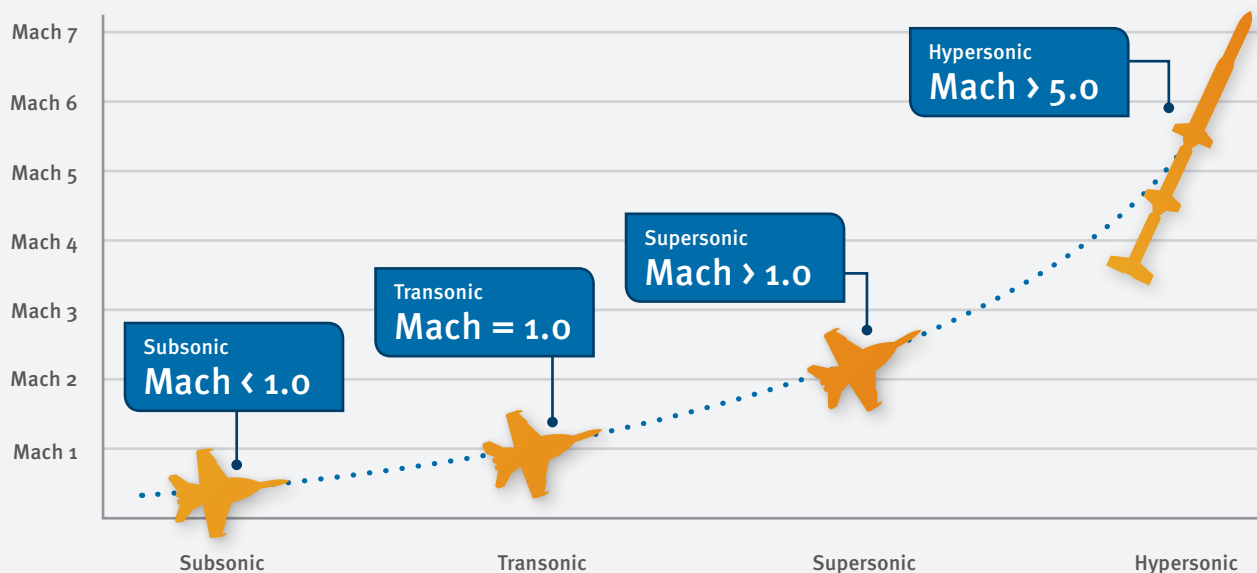
- hypersonic flight research at **UQ** and **University of Southern Queensland (USQ)** in conjunction with the **Defence Science and Technology Group – Centre for Hypersonics implementation**, which investigates unsteady hypersonic aerodynamic effects in Australia's only supersonic-to-hypersonic wind tunnel located at USQ Toowoomba
- nanotechnology and materials science research at **Griffith University** and the **Queensland Centre for Advanced Materials Processing and Manufacturing**

**(AMPAM) at UQ**, delivering leading-edge research on new-generation engineering materials, smart functional materials and advanced manufacturing technologies

- the recently formed **Aviation Innovation Network at QUT**, which was formed to bring together industry, researchers and related organisations in order to facilitate user-driven research.



# Hypersonic flight



Hypersonic flight is flight through the atmosphere at speeds above Mach 5.0, more than five times the speed of sound. This equates to flight speeds between 1700 and 3400 metres per second. The diagram above shows the Mach number regime.

Hypersonic flight has significant applications for defence programs and space travel capabilities. The Hypersonic International Flight Research Experimentation (HIFiRE) program is investigating the fundamental science of hypersonic technology and its potential for use in the next generation of aeronautical systems and is one of the largest collaborative research programs between Australia and the USA.

Queensland is playing an integral role in the HIFiRE research program, a joint collaboration between the United States Air Force Research Laboratories, the Australian Defence Science and Technology Group, Boeing and UQ.

Recently, flight trials were conducted to determine how scramjet engines start up at high altitudes, and to measure how much thrust the engines produce at lower altitudes. The HIFiRE-7 flight trial used scramjet engines that were designed by UQ and a flight test vehicle and control system designed by the Defence Science and Technology Group.

Additional funding for the flight was provided through the Queensland Government National and International Research Alliances Program.

The ultimate aim of the HIFiRE program is to find materials that can be used to build parts for practical applications, such as hypersonic aircraft for passenger flight and for transporting satellites to orbit efficiently and quickly. Hypersonic flight will, in future, mean cheaper and easier satellite launches, better telecommunications networks, more accurate weather prediction, and perhaps even commercial passenger flights at hypersonic speed.



# Opportunities for growth

The global market outlook for aerospace presents many domestic and international export opportunities for Queensland in the short, medium and long term.

The global commercial aerospace market is expected to grow to \$352.5 billion by 2023<sup>21</sup> thanks to a period of growing wealth and a global economy shift from the West to East. This provides Queensland with exceptional opportunities for growing its aerospace industry.

The Australian aerospace industry is well-placed to meet the projected increases in demand for aviation and aerospace goods and services in the Asia-Pacific region. Key opportunities for supply chain and export opportunities in the Asia-Pacific region include education and training, advanced manufacturing and design, high-value MRO, engineering services, innovation and research and development.

Opportunities for aerospace growth and development will come from the following areas:

## Civil aerospace MRO

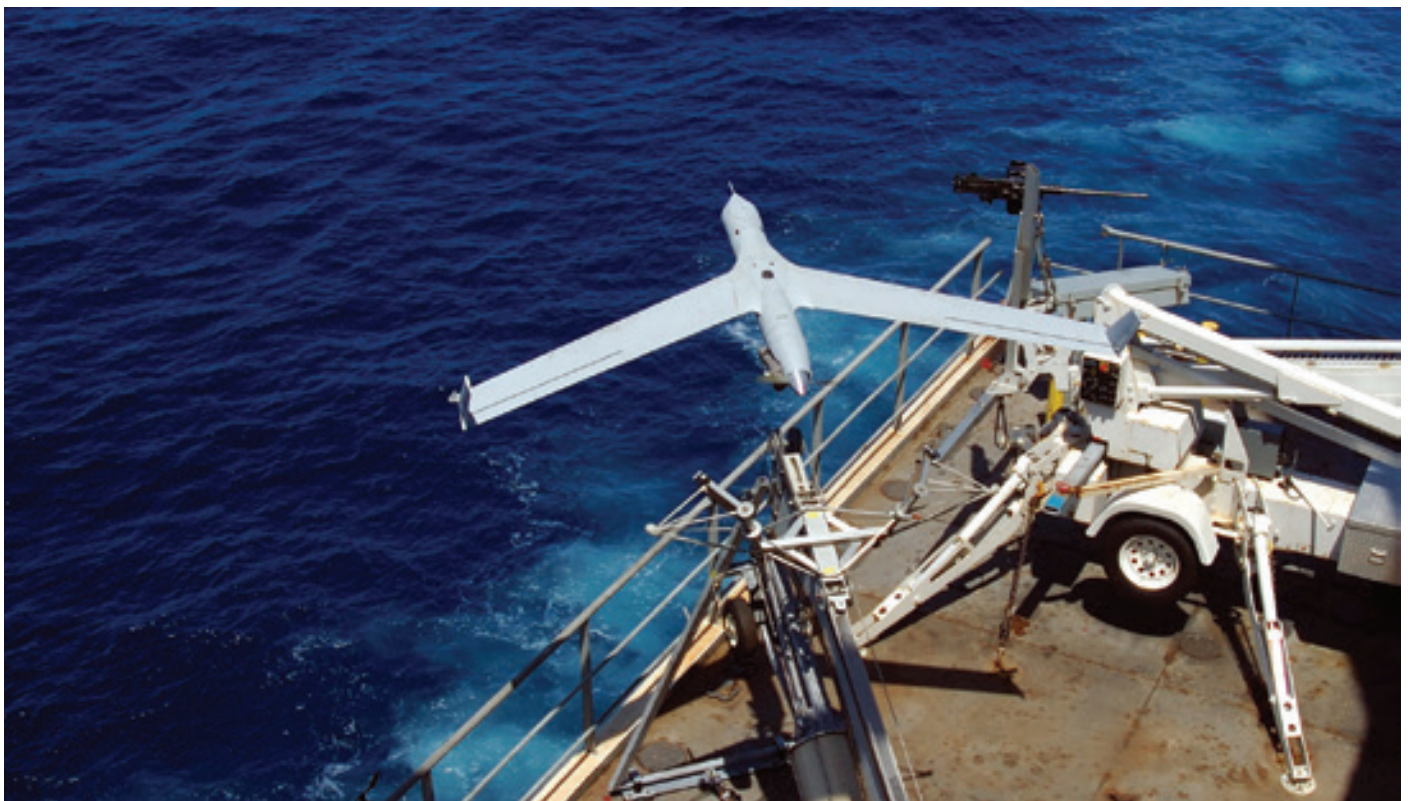
The aerospace MRO market in the Asia-Pacific region is expected to grow at a rate of five per cent between 2014 and 2024.<sup>22</sup> Aside from providing opportunities to grow the value of existing MRO services, the expansion of the air fleet in the Asia-Pacific region will present new opportunities for Queensland's aerospace industry.

Queensland's aerospace companies have a broad and technically sophisticated range of capabilities. This makes them well equipped to successfully compete in selected

high-value niche MRO opportunities, such as providing services for gas turbine engines, emerging technologies and advanced engineering services.

As aircraft design and technology advances, the number of technicians with the skills and knowledge required to sustain older aircraft models diminish. Queensland is home to the core of Australia's ageing aircraft technology and know-how. It is an area in which the state can excel, and demand for MRO services for older aircraft is likely to become a lucrative niche market to target.

The presence of the annual Aircraft Airworthiness and Sustainment





(Australia) Conference in South East Queensland, which includes a session dedicated to ageing aircraft, will underpin future activities in this area.

## Research and development

Similarly, Queensland's strong research and development capability and innovative companies will position the state to capitalise on opportunities that arise from the push toward environmentally friendly, fuel-efficient, quiet aircraft. The trend is driving innovation in aircraft structures, on-board systems, engines, materials, and low-carbon, sustainable aviation fuels.

## Niche manufacturing

There are significant opportunities for Queensland's precision manufacturing expertise, vacuum brazing and heat treatment for avionics and components and large-scale super alloy casting for jet engines.

## Pilot training

Queensland boasts a number of world-class training businesses, offering training for pilots, technicians and engineers.

The growth in demand for aerospace services and aircraft in the Asia-Pacific region, and the projected demand for thousands of newly trained and qualified pilots and technicians provides a substantial opportunity for Queensland to grow this sector.

Opportunities for providing training and education services will cover both training provided in-country and for international students who come to Australia to complete their training requirements.

## Defence aerospace investment

Over the next decade, tremendous opportunities will emerge in the defence sector.

Australia is growing its defence sector capabilities in response to changing security environments. Consequently, the increased investment in this sector is creating opportunities for aerospace businesses in Queensland, in areas where they have significant existing capability, including helicopter training, turbine engine MRO and aircraft systems integration.

Establishment of the \$101 million Defence Cooperative Research

Centre for Trusted Autonomous Systems (DCRC TAS) headquarters in Queensland will also provide the platform to create game-changing technologies and help position the state as an international UAS centre of excellence and the go-to location for the next generation of defence projects.

## Unmanned aerial systems — UAS

The autonomous sector has emerged as a dynamic growth sector in the global aerospace industry this decade. By 2020, the autonomous sector is projected to grow between 200 per cent and 500 per cent.<sup>23</sup> This growth will be a direct result of the increasing number of applications for UAS (commonly referred to as remotely piloted aircraft systems or *drones*) in areas such as infrastructure monitoring, post-disaster surveys, search and rescue, aeromedical evacuation systems, and in media for entertainment and advertising. The large range in anticipated industry growth reflects the expanding number of applications for UAS technologies.

In recognition of these emerging opportunities, the Queensland Drones Strategy is being developed



to position Queensland as a world leader in UAS technology and application, and drive investment and jobs growth statewide.

UAS offer exciting new potential applications across a range of industries and will have future benefits for Queensland's agriculture, biosecurity and environmental monitoring capability.

Queensland can capitalise on its existing technical expertise, along with its highly regarded research agencies and specialist capability in UAS to develop the systems that will operate across these industries.

## Space technologies

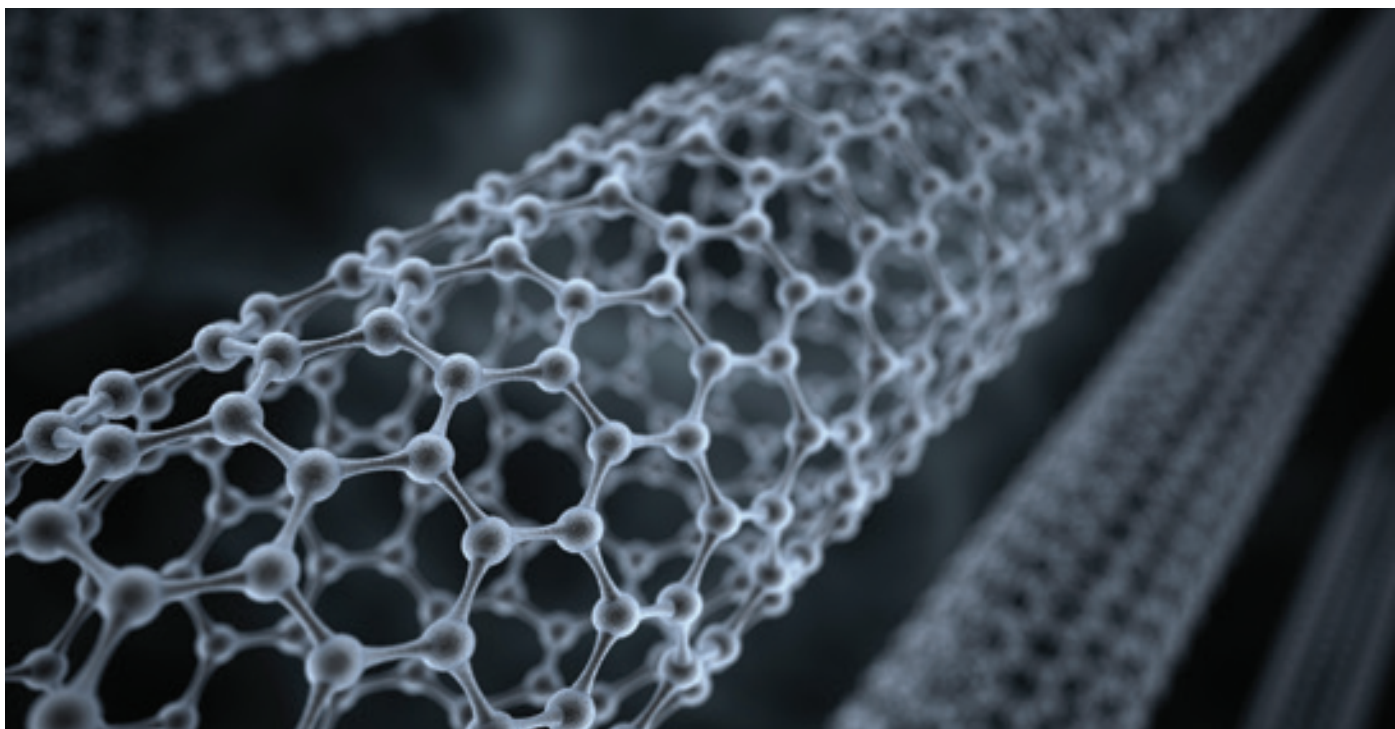
Queensland's research organisations are undertaking important projects across a broad range of areas that will have future aerospace applications. In particular, many of these technologies have application for space technology as well as broader uses in civil and military aircraft.

Queensland researchers are key partners in a cooperative research program with the USA and Boeing to understand hypersonic flight technology and explore its potential for next generation aeronautical systems.

**This will place Queensland in a prime position to capitalise on the commercial space market as it develops and matures.**

Queensland is also involved with cutting-edge research across a broad array of disciplines that have significant implications for aerospace. These include research and development of nanotechnology applications and utilisation of composite materials like graphene.





## What is graphene?

The Queensland Micro and Nanotechnology Centre at Griffith University is undertaking innovative research on graphene and its commercial applications.

Highly flexible, while being lighter and stronger than steel, and with excellent thermal and electrical conducting properties, graphene is the new wonder material with endless applications.

Graphene's unique electrical, optical and mechanical properties make it a potentially transformational technology in a wide range of fields such as electronics, medicine, aerospace, energy and solar, materials and communications.

Graphene's remarkable properties have huge potential for application in the aerospace industry as it is incredibly strong, yet lightweight and flexible at the same time.

At a single atom layer thick, graphene may be the future key to developing the strongest aeroplane to date.

Aviation specialists believe that, used as an ultra conductive covering on aircraft, graphene could prevent a plane's wings from overheating. It could also protect it from potentially devastating damage caused by lightning storms and improving fuel consumption through weight reductions.

Aerospace researchers in the United Kingdom (UK) have already trialled graphene coatings for aircraft wings and are pleased with the initial flight test results. The next stage of their research will look at successfully incorporating graphene into aerospace composite materials.



## TAE Aerospace supports Joint Strike Fighter

TAE Aerospace is the leading provider of MRO services for complex gas turbine engines in Australasia, and provides services to military, commercial and industrial engine operators throughout Australasia, South East Asia and the Pacific.

The company relocated to Australia from New Zealand in 2000, and has since expanded rapidly, growing from 6 to 205 employees, with 122 based in Queensland.

TAE Aerospace is Australia's first military gas-turbine engine through-life-support provider and is contracted to deliver engineering, maintenance and logistics services for the RAAF's F/A-18 aircraft engines – both the Hornet and Super Hornet. TAE Aerospace is now gearing up for the arrival of the JSF. With the first aircraft due in Australia in 2018, and all 72 expected to be fully operational by 2023, TAE Aerospace is looking to consolidate long-term expansion plans for its operations and highly skilled workforce.

In 2015, the company won the contract for regional MRO and upgrade responsibilities for the F-35 JSF engine.

TAE Aerospace was the first Australian company to develop aluminium vacuum brazing technology and is one of only a few companies worldwide able to provide the process. Aluminium vacuum brazing is a leading-edge manufacturing process for fusing aluminium components together, resulting in lightweight, high-strength, reliable end products. In 2013, this capability enabled TAE Aerospace to deliver advanced liquid cooled electronics enclosure parts for the F35 Lightning II JSF aircraft to be acquired by the RAAF.



# Key industry challenges

While the opportunities for the aerospace industry are significant, and the Queensland Government is determined to achieve the ambitious vision developed for the sector, there are also some challenges that need to be addressed.

This roadmap was prepared after consultation across a broad range of individuals and businesses involved with the aerospace sector. Feedback from industry indicates their key challenges include:

## Compliance with regulation and certification requirements

The aerospace industry is subject to a complex and extensive regulatory framework. Aviation and aerospace regulations are managed by the Australian Government and administered by the Civil Aviation and Safety Authority (CASA). Internationally, the main regulatory agencies are the Federal Aviation Administration and the European Air Safety Authority.

The aerospace industry is experiencing rapid changes in technology but the regulatory system can appear to be cumbersome and unresponsive to industry advancements. Concerns raised by industry included slow responses from regulatory agencies as new technologies emerge, and the need for a more internationally harmonised approach to regulation. Aerospace businesses are subject to high costs associated with compliance and certification, so time delays in responding to new technologies and advances can significantly impact the industry.

The harmonisation of aerospace regulations with overseas jurisdictions will maximise export, training and trade opportunities.

## Attracting and retaining relevant skills and meeting training needs

By 2025, a 30 per cent shortfall in the global aircraft and maintenance workforce is expected, with Australia and the Asia-Pacific region particularly affected.<sup>24</sup> Australia has both a strong need and an excellent opportunity to help meet a shortfall in the region.

Industry has raised concerns about potential shortages of skilled engineers within five to six years — particularly at senior technician, graduate and post-graduate levels — in the aerospace manufacturing base. It was felt that the decline in the number of high school students enrolling in science, technology, engineering and math (STEM) subjects, and ongoing decline of students seeking qualifications in these disciplines would worsen skills shortages in the future.

Industry also identified the opportunity to broaden the skills base of engineers and technicians looking to work within the aerospace sector, so they can obtain management and business-related skills specific to the aerospace sector. This is important to ensure that appropriate career opportunities are available and businesses can respond to future needs.

## Marketing Queensland's aerospace industry capabilities

A frequent challenge raised in consultation workshops was the difficulty in making the capabilities of the Queensland aerospace industry understood globally.

Given the high level of global competition in this sector, this means getting out and being seen. Promotion of the industry's capabilities and the benefits of Queensland as a preferred destination for aerospace is critical to growing the industry's access to global supply chains.

There is a need for the industry to ensure it can identify emerging opportunities to broaden access to global supply chains, selling to a wider range of aircraft and equipment manufacturers across a broader front of defence and civil platforms.







# Actions to date

## Advance Queensland

Advance Queensland is the Queensland Government's transformational agenda designed to enable Queenslanders to adapt and thrive through global change and disruption. The \$650 million initiative includes a suite of programs to spur innovation-led growth by helping to translate Queenslanders' great ideas into commercial success, and support Queensland entrepreneurs and companies to make their products, processes and services investment-ready and competitive in global markets. This includes enhancing the competitiveness of existing industries such as aerospace, and growing new sectors where Queensland has a competitive advantage.

Advance Queensland programs have already supported the development of the aerospace industry in areas such as development and testing of UAS technologies, intelligent technology for aviation engine MRO, and aeronautical cross-data integration. Queensland aerospace companies that have participated in Advance Queensland initiatives to date include The Boeing Company and its subsidiary Insitu Pacific, Evolving Machine Intelligence Pty Ltd, CB Aerospace Pty Ltd, Skybourne Technologies, V-TOL Aerospace Pty Limited and SkyNet Satellite Communications.

## Defence Cooperative Research Centre for Trusted Autonomous Systems

In recognition of the state's depth of technological capability, in 2017 Queensland secured the headquarters of the first Defence Cooperative Research Centre for Trusted Autonomous Systems (DCRC TAS).

This \$101 million national initiative, in conjunction with the development of common-user unmanned aircraft testing sites, will bring together the Defence Science and Technology Group, research institutions and industry to deliver trustworthy smart-machine technologies for the ADF across multiple domains including aerospace.

Industry-led projects such as the DCRC TAS will assist the rapid transition of technology from universities and industry to leading-edge capability for the ADF and enhance Queensland's status as an innovation, science and technology hub.

## Skilled workforce

Queensland has a highly skilled, motivated and employment-ready workforce. World-class tertiary facilities and a network of vocational education and training providers will ensure that the training and skills needs of the aerospace industry will be met into the future.

Workplace training programs can be designed and delivered through a number of universities with aerospace-specific programs or registered training organisations who work with aerospace firms to tailor courses to particular skill requirements.

The Queensland Government has been active in supporting both current and future aerospace training needs by working with private stakeholders to establish programs that provide pathways for careers in aerospace.

Aviation Australia was established by the Queensland Government in 2001 to support the development and growth of aviation and aerospace industries in both the Australian and international markets. With campuses in Brisbane and Cairns, it provides training across a broad range of aerospace qualifications.

## Avalon Airshow

The Queensland Government hosted a stand with Queensland industry partners at the biennial Avalon Airshow to promote Queensland as one of Australia's leading aerospace and air defence destinations. Avalon is the Asia-Pacific region's most prestigious aviation, aerospace and air defence event and presents an unrivalled opportunity to showcase Queensland as an international aerospace destination and promote Queensland's capabilities, products, technologies and services to a highly targeted international audience.



## STEM strategy in Queensland state schools

A focus on STEM within Queensland state schools is a priority area of the Queensland Government's Advancing Education action plan. By building teacher capabilities and engaging more students in STEM learning, and working in partnership with industry, universities and the community, Queensland students can help meet the increasing demand for STEM graduates in knowledge-intensive industries such as aerospace. The Queensland Government has developed strategies to increase participation in STEM in schools and universities to address the industry skills shortages through initiatives such as:

- Advancing Education action plan – STEM in Queensland state schools by:
  - » upskilling teachers in science and maths through a \$3 million STEM professional development program
  - » access to a specialist STEM teacher at every state school
  - » engaging students in STEM learning through real-world coding competitions, opportunities to work with industry experts, and connecting students across the state through STEM hubs and virtual academies
- » implementing digital technologies and STEM-specific resources to develop critical and creative thinking, and problem solving in Queensland students.
- Advance Queensland – increasing participation in underrepresented groups by:
  - » STEM funding for female researchers at Queensland universities and other publically funded research organisations
  - » STEM.I.AM program for Aboriginal and Torres Strait Islander students at Queensland Universities.

## Aerospace Gateway to Industry Schools Program

The Queensland Government worked with private stakeholders to establish the Brisbane-based Aviation State High School and the Aerospace Gateway to Industry Schools Program. These provide pathways for careers in aerospace for students who can continue their tertiary training at registered training organisations and/or university.





## Action plan

This roadmap includes actions for delivery in the short-to-medium term to ensure continuing growth in Queensland aerospace industries.

It includes specific actions to capture the innovative market opportunities of the advanced aerospace industry of the future. These priorities have been identified as the three key strategies in the roadmap:

1

Grow Queensland's aerospace industry and create high-value, knowledge-based jobs by targeting emerging markets

2

Advance Queensland's aerospace industry capabilities to access new global supply chains

3

Promote Queensland as a preferred destination for aerospace capability

Particular focus will be given to the following strategic opportunities:

- establishing Queensland as an international UAS centre of excellence and pursuing opportunities for innovative application of UAS technologies through collaboration with universities and industry, the development and implementation of a Queensland Drones Strategy, and the establishment of the \$101 million DCRC TAS
- capitalising on major international defence and civil aerospace projects such as the F-35 JSF program
- targeting Australasian markets for export of aerospace-related education and training services and niche MRO capabilities
- investigating supply chain and training skills requirements for future development of a hypersonic flight industry in Queensland
- showcasing Queensland aerospace industries internationally, especially in the target markets of Singapore, the USA, New Zealand, the UK and Malaysia.

Implementation of the strategies and actions contained in the Roadmap will be monitored through annual reviews of the Roadmap and biennial surveys of Queensland's aerospace industry, which will also provide a valuable input to future policy directions and strategies.



# Addressing the challenges and opportunities

## Queensland's strengths



Capability and expertise



Proximity to growing markets



Large areas of airspace



World-class R&D

### Key strategy 1

Grow Queensland's aerospace industry and create high-value, knowledge-based jobs

### Key strategy 2

Enhance Queensland's level of industry capability to access new global supply chain opportunities and international markets

### Key strategy 3

Promote Queensland as a preferred destination for aerospace capability, servicing both local and global markets



Accessing global aerospace supply chains



Promoting capability



Compliance with regulation



Promoting capability



Attracting and retaining a skilled workforce

Challenges and opportunities

Priority actions 1.1, 1.2 and 1.3 supported by 10 sub-actions



Priority actions 2.1 and 2.2 supported by 6 sub-actions



Priority action 3.1 supported by 6 sub-actions



Priority actions

# Queensland Aerospace 10–Year Roadmap and

<b>Vision</b>	By 2028, the Queensland aerospace industry will be recognised as a leader in niche manufacturing; maintenance, repair and overhaul (MRO);	
<b>Strengths</b>	Large existing range of capability and expertise across the sector	Proximity to the large and growing markets of the Asia-Pacific and the Middle East
<b>Challenges</b>	Compliance with regulation and certification requirements of domestic and international markets	Availability of relevant talent to meet the needs of industry

## Key strategy 1 Grow Queensland's aerospace industry and create high-value, knowledge-based jobs

### Priority action 1.1

We will work with Queensland industry and research organisations to strengthen aerospace capability by establishing Queensland as an international hub for unmanned aerial systems (UAS) by:

- establishing Queensland as an UAS centre of excellence
- developing and implementing a Queensland Drones Strategy
- identifying test sites for research, development and commercialisation of UAS
- pursuing opportunities for innovative application of UAS technologies through the Defence Cooperation Research Centre for Trusted Autonomous Systems (DCRC TAS) and collaboration with universities and industry
- expanding the UAV challenge to promote Queensland's research and development expertise and commercial capacity within the UAS sector.

### Priority action 1.2

We will work with industry to assist Queensland companies to target emerging capability areas such as UAS, niche manufacturing, training, MRO, hypersonic flight and space by:

- targeting Australasian markets for export of aerospace-related education and training services and niche MRO capabilities
- targeting emerging industry opportunities, and education and training activities by undertaking analysis of:

- o country of origin of current international students studying pilot training (helicopter and fixed wing) and other aerospace-related courses
- o markets projected to have an increase in demand for education and training services for pilots and other aerospace related courses
- o investigating supply chain and training skills requirements for future development of a hypersonics industry in Queensland
- o investigating the potential and economic cost benefit of Queensland developing capacity in services for small and private satellite launch and other space industry capabilities.

### Priority action 1.3

We will establish the Defence and Aerospace Industry Development Fund to assist Queensland small-to-medium enterprises (SMEs) to access defence contracts directly and through supply chain opportunities by:

- contributing to maintaining a competitive position for major defence projects with long-term (20+ years) sustainment horizons such as AIR 6000
- assisting companies to adopt contemporary 'lean' manufacturing processes and obtaining necessary accreditations such as ISO 9001
- supporting companies' access to global opportunities through attending international trade shows and having employees participate in selected professional development activities such as the Defence Industry Study course.

## Key strategy 2 Enhance Queensland's level of internationalisation and global supply chain opportunities

### Priority action 2.1

We will work to secure a greater portion of national aerospace work, including in regional Queensland, by:

- working with aerospace prime contractors to identify suitable Queensland businesses to feed into their respective defence and civil supply chains, strengthening Queensland's participation in national and international projects such as the F-35 JSF program
- building on existing education and training infrastructure and programs through work with Jobs Queensland, Department of Employment, Small Business and Training, the tertiary sector and relevant registered training organisations to ensure the supply of a highly qualified and experienced workforce to support the aerospace sector.

### Priority action 2.2

We will work with the aerospace industry to help Queensland companies enter global supply chains by:

- providing facilitation services for aerospace firms and regional organisations to assist with accessing new or expanding markets, including:
  - o support to identify and capitalise on supply chain opportunities



# Action Plan

as a leading centre in Australasia and South East Asia for aerospace innovation in training; and unmanned aerial systems (UAS) applications for military and civil markets.

g markets of  
East

Large areas of airspace suitable for training,  
development and testing activities

World-class research and  
development agencies

ant skills and ensuring training meets  
try as aerospace technologies evolve

Marketing the Queensland  
aerospace industry's capabilities

Accessing global  
aerospace supply chains

## Strategy 2

Industry capability to access new  
markets and international markets

- o address quality assurance and certification issues
- o support networks that encourage collaboration between industry and research organisations
- delivering the highly popular defence capability development workshops across Queensland, and working with relevant organisations to expand workshop offerings to include a series focusing on accreditations and certifications, quality management systems, and supply chain management
- identifying the economic benefits of harmonisation with international regulations and certification to help industry to continue aligning with Australian standards and regulations with our major trading jurisdictions
- increasing awareness across government on issues critical to the growth and sustainability of the Queensland aerospace industry, including aerospace policy, regulatory issues and systemic development impediments.

## Key strategy 3

Promote Queensland as a preferred destination for aerospace  
capability, servicing both local and global markets

### Priority action 3.1

We will promote Queensland industry capability to national and international civil and military aerospace markets by:

- promoting Queensland as an international destination for UAS, niche manufacturing, training, MRO and hypersonic flight development
- showcasing Queensland aerospace industries internationally, especially in the target markets of Singapore, the United States of America, New Zealand, the United Kingdom and Malaysia by working with Team Defence Australia and the Queensland Government, including Trade & Investment Queensland and their representatives in 15 locations across the globe, to maximise opportunities for Queensland aerospace firms to access new and expanded markets
- promoting growth opportunities within Queensland's aerospace industry by leveraging existing government initiatives such as the Attracting Aviation Investment Fund and the Advance Queensland Industry Attraction Fund
- attracting significant regional aerospace conferences and events to Queensland
- aggressively market Queensland's aerospace industry capability to national and international markets via targeted publications, trade shows and project-specific content
- stimulating Queensland MRO export opportunities through attendance at targeted international events such as MRO Asia-Pacific.

# Notes

- 1 Deloitte Access Economics, Economic impact analysis of DSD Priority Sectors, February 2017.
- 2 IBISWorld Aircraft Manufacturing and Repair Services in Australia, January 2017.
- 3 'Supply Chain Research Insights: Global Aerospace Industry Size and Growth', AviationWeek.com, 23 December 2015.
- 4 [www.deloitte.com/global/en/pages/manufacturing/articles/global-a-and-d-outlook.html](http://www.deloitte.com/global/en/pages/manufacturing/articles/global-a-and-d-outlook.html)
- 5 'Supply Chain Research Insights: Global Aerospace Industry Size and Growth', AviationWeek.com, 23 December 2015.
- 6 [www.prnewswire.com/news-releases/global-aerospace-market-trends-and-forecast-2014-2033-300029287.html](http://www.prnewswire.com/news-releases/global-aerospace-market-trends-and-forecast-2014-2033-300029287.html)
- 7 S King, D Hine, E Brea and H Cook, Make for Asia-The emerging Asian middle class and opportunities for Australian manufacturing, CSIRO, Australia, 2014.
- 8 A Smith, 'Why Asia's aerospace sector will boom', Willis Resilience Insurance Journal, vol. 4, April 2014.
- 9 Figures provided by Peter Harbison, Chairman of CAPA - CAPA Asia Pacific Aviation Summit, Brisbane, 4 August 2016.
- 10 <http://aviationweek.com/2016-helicopter-fleet-mro-forecast>
- 11 A Smith, 'Why Asia's aerospace sector will boom', Willis Resilience Insurance Journal, vol. 4, April 2014.
- 12 2016 Boeing Pilot and Technician Outlook. Source: [www.boeing.com/commercial/market/long-term-market/pilot-and-technician-outlook/](http://www.boeing.com/commercial/market/long-term-market/pilot-and-technician-outlook/)
- 13 [https://www.icao.int/environmental-protection/Pages/A39\\_CORSA\\_FAQ2.aspx](https://www.icao.int/environmental-protection/Pages/A39_CORSA_FAQ2.aspx)
- 14 <http://www.iata.org/policy/environment/Pages/climate-change.aspx>
- 15 <http://www.marketsandmarkets.com/Market-Reports/unmanned-aerial-vehicles-uav-market-662.html>
- 16 Deloitte Access Economics, Economic impact analysis of DSD Priority Sectors, February 2017.
- 17 IBISWorld Aircraft Manufacturing and Repair Services in Australia, July 2015.
- 18 Australian Trade Commission, Aerospace Manufacturing and Services, May 2013.
- 19 IBISWorld Aircraft Manufacturing and Repair Services in Australia, January 2017.
- 20 Invest Queensland, Queensland Government, Aviation and Aerospace, 2013, p3.
- 21 [www.deloitte.com/global/en/pages/manufacturing/articles/global-a-and-d-outlook.html](http://www.deloitte.com/global/en/pages/manufacturing/articles/global-a-and-d-outlook.html)
- 22 Team SAI, Global MRO Market Economic Assessment. January 2014.
- 23 Skidmore, M. 'Regulating RPAS for safer operations' proceedings of the Australian Association for Unmanned Systems. Canberra 7 March 2016.
- 24 University of New South Wales, The Future of Aircraft Maintenance in Australia: Workforce Capability, Aviation Safety and Industry Development, October 2015.

## Glossary

**ADF** – Australian Defence Force

**AEWC** – Airborne Early Warning and Control

**CASA** – Civil Aviation Safety Authority

**DCRC TAS** – Defence Cooperative Research Centre for Trusted Autonomous Systems

**Defence** – Australian Defence Organisation comprising of both the military and public service elements

**HIFIRE** – Hypersonic International Flight Research Experimentation

**ISR** – Intelligence, surveillance and reconnaissance capability

**MRO** – Maintenance, repair and overhaul

**MRTT** – Multi role tanker transport

**OEM** – Original equipment manufacturer

**QUT** – Queensland University of Technology

**RAAF** – Royal Australian Airforce

**RPAS** – Remotely piloted aircraft systems

**STEM** – Science, technology, engineering and mathematics

**TIQ** – Trade & Investment Queensland

**UAS** – Unmanned aerial systems

**UAV** – Unmanned aerial vehicle

**UQ** – University of Queensland

**VSAT** – Very small aperture terminals





