

QUEENSLAND SPACE INDUSTRY STRATEGY

2020–2025

February 2020



**Queensland
Government**
Australia

The Department of State Development, Manufacturing, Infrastructure and Planning

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Foreword

The Queensland Government is working to transform the Queensland economy and create high-paid, knowledge-based jobs for our state's future, particularly in regional Queensland.

Few industries capture public and expert imagination like space. Recent private sector involvement in space has spurred the development of a US\$345 billion global space industry, three quarters of which has been driven by the private sector. The value of this industry is forecast to triple by 2040.

The opportunity for Queensland is significant. Our state's space industry already employs more than 2000 full-time equivalent positions and generates \$760 million per year through core industry services like satellite communications. The state has the capability and location to develop a space industry with the potential to contribute between \$3.5 billion to \$6 billion to Queensland's economy by 2036.

The state's universities and companies are at the forefront of space research and technology. Queensland has world-leading capability in hypersonics, robotics and automation, nation-leading Earth observation, niche manufacturing including advanced composite materials, and new launch technologies.

Queensland is Australia's space coast.

The further development of the space industry here in Queensland provides new opportunities for growth, particularly in the regions. The open spaces of our state's outback are ideal for the location of satellite ground stations, while an extensive coastline and proximity to the equator are significant assets for the establishment of a launch site.

Queensland is already home to Australia's launch vehicle and aviation manufacturing sectors, as well as supporting industries such as aerospace and defence. With our advanced manufacturing supply chain and world-leading research programs, it makes sense for the state to also be the home of Australia's space manufacturing industry.

To capitalise on these opportunities, the Queensland Space Industry Strategy builds on the Queensland Aerospace and other priority sector 10-Year Roadmaps and Action Plans to provide more targeted actions to grow our space industry.

These targeted actions will leverage the state's space industry strengths and its competitive geographical advantage. By supporting the enabling conditions for growth, Queensland's space sector will be able to offer new products and services to the state's downstream industries and to international markets.

Queensland's space industry has an important role in growing the state's economy and providing high-value knowledge-based jobs of the future. Our government is invested in supporting Queensland's space industry to grow and thrive.



The Honourable Cameron Dick MP

Minister for State Development,
Manufacturing, Infrastructure and Planning

Contents

Minister's foreword	3
Vision	5
Executive summary	6
Queensland's opportunity in space.....	8
Productivity and benefits for the rest of Queensland's economy	10
Queensland's space industry.....	11
Queensland's space industry strengths	13
Key strength 1: Launch activities.....	13
Key strength 2: Ground systems.....	17
Key strength 3: Space-enabled services	19
Key strength 4: Space systems – manufacturing and robotics	22
Our geographical strengths	24
Key growth areas and industry challenges.....	25
Strategy action overview	26
Queensland space industry strategy actions	28
Glossary	30
End notes	31



Image courtesy of the University of Southern Queensland

Vision



By 2025, Queensland's space industry will be recognised as a leading centre in Australasia for launch activities, ground systems, Earth observation, niche manufacturing, robotics and automation for space.

Image courtesy of Gilmour Space Technologies

Why a space strategy?

The Queensland Government is committed to growing the state's space industry.

The *Queensland Aerospace 10-Year Roadmap and Action Plan* (the Aerospace Roadmap) – in support of the \$755 million Advance Queensland initiative – sets out actions to leverage Queensland's well-established aerospace sector to accelerate the state's fast-growing space industry.

While Queensland's aerospace industry is well-established and world-renowned, our space industry is niche and emerging as a competitive player. Because of this, it requires its own targeted actions – beyond the Aerospace Roadmap – to support growth in Queensland's space industry.

Building off the Aerospace Roadmap, the Queensland Government commissioned Deloitte Access Economics to conduct economic modelling of Queensland's space industry. The report's findings, which showcased Queensland's enormous growth potential, were supported by the Government's decision to accept in full, or in principle, all 15 recommendations from a Queensland parliamentary inquiry into Queensland's space industry. These studies have informed the development of the Queensland Space Industry Strategy.



Executive summary

Queensland has a rich history in space. From supporting humankind’s walk on the moon with Toowoomba’s Cooby Creek Tracking Centre; to housing an emergency landing site of the space shuttle program at the Royal Australian Airforce Base Amberley.

Today, Queensland’s space industry is blossoming. It currently supports over 2000 full-time equivalent jobs and generates \$760 million in annual revenue, with a further \$500 million in value added to downstream industries through the state’s world-class space-enabled services, such as Earth observation.¹

Queensland’s space industry has enormous potential if nourished, with the possibility to support up to 6000 jobs by 2036 and add between \$3.5 billion to \$6 billion to the state economy.¹ Because of this, Queensland is primed to lead the Australian Space Agency’s goal to triple the size of Australia’s space economy to \$12 billion and create up to 20,000 jobs by 2030.²

Queensland is Australia’s space coast

Queensland is close to the equator, on the east coast of Australia, and has large areas free from radio traffic with high-speed internet thanks to the state’s remote industries. Queensland also shares a comparable latitude with Cape Canaveral, Florida; one of the world’s busiest launch sites.³

Queensland’s location makes it perfect for launch and ready to host ground stations. We also lead Australia in robotics, automation and Earth observation; with a research sector that underpins the state’s ability to transfer these skills to support space missions and services.

Key strategies and priority actions – focused on Queensland’s strengths

Two key action areas build on the government’s industry roadmaps.

1. Strengthen Queensland’s existing capabilities to support Queensland’s niche areas to be world-class and positioned for growth.

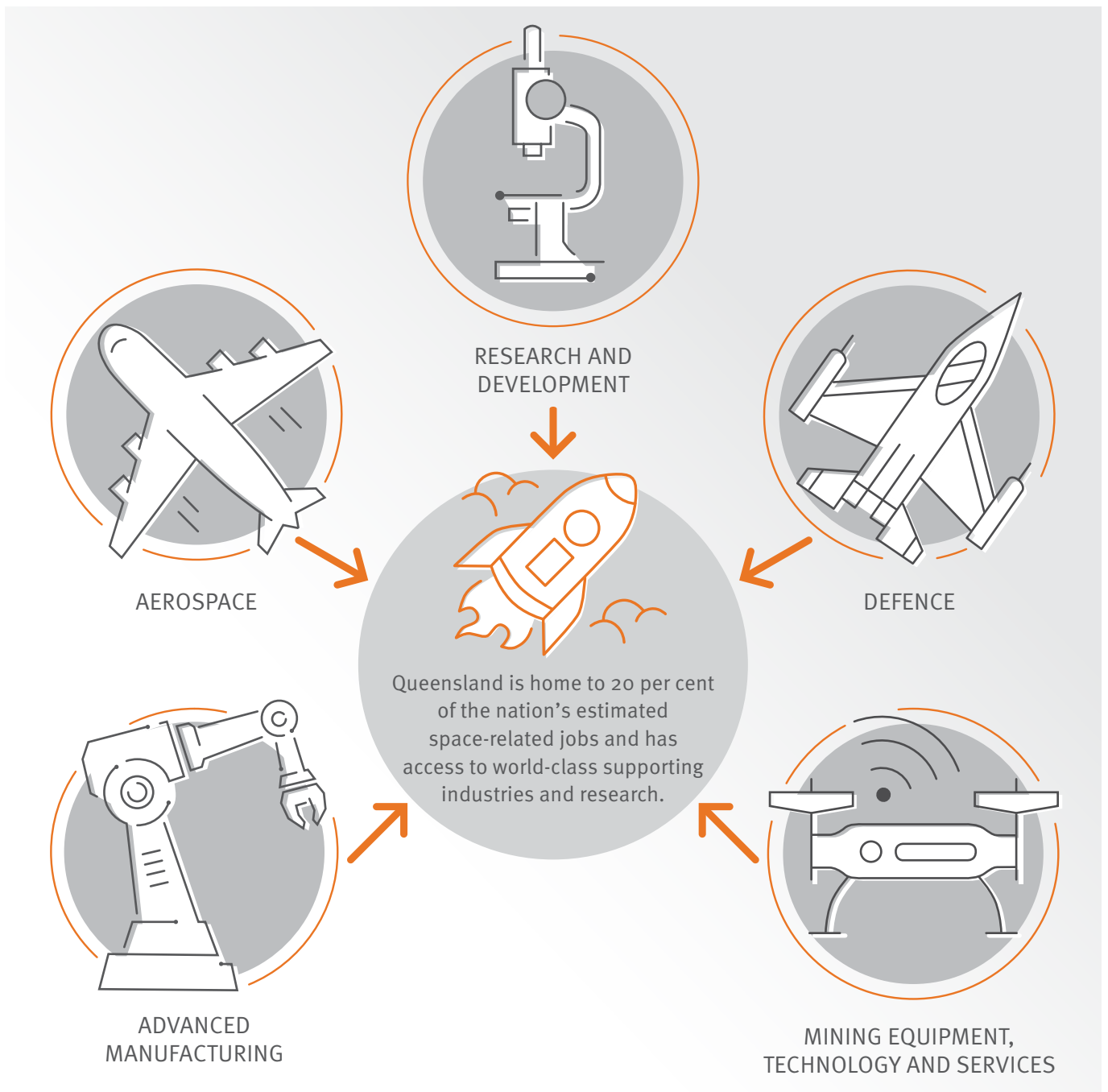
We will work to support:

- Infrastructure capability – enable growth in launch, ground systems and Earth observation
- Human capability – promote clear career pathways into the space industry
- Commercial capability – support Queensland organisations to enter the space supply chain.

2. Grow Queensland’s industry by connecting it to new markets.

We will grow Queensland’s industry by:

- Connecting industry to international markets
- Connecting industry to upstream industries to support an end-to-end supply chain
- Leveraging downstream industries – through space-enabled services.



Queensland's opportunity in space

The changing global space economy

Space has historically been the preserve of governments. The high entry costs and significant risks of space exploration necessitated governments taking the investment lead for research, development and operation. However, this is changing fast. In 2010, the United States announced the end of their Space Shuttle program, signaling the start of a new space era where industry would play a more active role in global space activity.

Since 2010, the global space economy – which includes everything from building rockets to analysing satellite data – has been increasingly decentralised. Today, the global space economy, Space 2.0, is characterised by a growing number of private organisations working alongside global space agencies, to support space missions and supply new technology and services to Earth.

Australia's space industry generates approximately \$3 billion to \$4 billion in revenue a year and employs some 10,000 full-time equivalent jobs.⁴ The Australian Space Agency, established in July 2018, has an ambitious but achievable goal to triple the size of Australia's space economy to \$12 billion per annum and create up to 20,000 additional jobs by 2030.²

Increasing domestic and global demand for space-enabled services is driving growth in Australia's space industry and, in turn, demand for new satellites and the ability to launch, build and control them.⁵

By 2036, Queensland's space economy could directly create 6000 high-value jobs; more than one quarter of Australia's overall objective.

From agriculture and mining, to automated vehicles and the growing demand for big data, the world's industries are increasingly relying on satellite-derived data and the ability to 'look back at earth'. Add to this new and exciting opportunities in space exploration and research, and the global space industry is expected to skyrocket to US\$1.1 trillion by 2040.⁶

Queensland is well-positioned to lead Australia in this emerging industry. Our expanding space economy already employs over 2000 full-time equivalent jobs and generates more than \$760 million in direct annual revenue.¹

Queensland also has geographical and industrial advantages that make it uniquely positioned to support global space activities and bolster Australia's sovereign space capability; particularly in satellite launch, control, robotics and Earth observation.

Queensland is Australia's space coast. Our state has 20 per cent of the nation's estimated space-related jobs, access to world-class supporting industries, and Australia's most advantageous location for launch.

Queensland is:

- **Perfect for launch** – east coast location with access to the equator and Australia's most advanced launch vehicle developers
- **Ready to host ground stations** – radio free regions with clear skies, remote internet, an international data cable and the ability to scan both hemispheres
- **Nation-leading in Earth observation**
- **World-class in robotics and automation**

By making the right decisions today, Queensland's space industry could directly create up to 6000 high-value Queensland jobs and contribute \$3.5 billion to \$6 billion to the state economy by 2036.¹ Many of these new jobs could be clustered in regional Queensland through the development of space infrastructure. This will create new business opportunities and an industry supply chain to service them.



Image courtesy of Gilmour Space Technologies

Queensland's space industry



Growing at a rate of 7 per cent per year



Employs 2000 full-time equivalent jobs



Generates \$760 million per year in revenue



Generates \$500 million per year in value added to gross state product



Productivity and benefits for the rest of Queensland's economy

Few industries share their benefits as widely as the space economy. In 2015, it was estimated that the use of space systems and space-derived data supported 70 per cent of economic activities worldwide.⁷

In Queensland, the space economy already adds \$500 million in value to other areas of the state's economy.¹ By adopting space-enabled services, Queensland's powerhouse industries are increasing their productivity and output through better precision, automation and new insights provided by Earth observation and satellite positioning systems.

Globally, these services are expected to play a more important role in responding to the challenges associated with climate change, population growth, water scarcity and the need to produce more with less.

The full potential of space-enabled services has not yet been realised in Australia. Increasing the uptake of space-related goods and services through Queensland's industries such as agriculture and mining could contribute \$1.1 billion to \$1.7 billion in productivity by 2036. Similarly, Space 2.0 will enable opportunities for Australian companies to expand their products and services to serve the global space economy.

Water and food security from space

Around 70 per cent of the world's fresh water is used for agriculture.⁸ By 2050, feeding a planet of almost 10 billion people will require a 50 per cent increase in agriculture production and a 15 per cent increase in water withdrawals for agriculture.⁹

Satellites are expected to become a key part to solve water and food insecurity through land and water monitoring services.¹⁰ These services provide insights into land cover, crop forecasting, plant biomass and water transferal from land to the atmosphere.

While satellite services are already informing on-the-ground farming practices – such as precision agriculture and maximising soil capability – the ability to download satellite data and the costs associated with processing it or using satellite services are barriers to growth.

It is expected that these costs will decrease to make space-enabled solutions more accessible in the future, as new technologies emerge with start-ups and the growing critical mass, lowering the cost of imaging data.

Queensland's space industry

Born from industry strengths and a competitive location

Queensland's advantageous location on Australia's eastern seaboard is close to the equator and has large areas free from radio traffic with high-speed internet access. These attributes are supported by designated areas set aside for ground stations by Australia's communications authority. In addition, a new international data cable at the Sunshine Coast will provide Australia's eastern seaboard with the fastest connection to Asia and the second fastest connection to the United States.

Queensland's location, which is uniquely suited to support multiple launch orbits, has also spurred the development of Australia's commercial launch vehicle developers – Gilmour Space Technologies, Black Sky Aerospace and Hypersonix.

Our space economy is supported by Queensland's powerhouse industries

Queensland companies are used to operating remotely. Our world-leading mining equipment, technology and services (METS) industry, as well as our well-established defence, aerospace, manufacturing and research sectors, have formed a solid industry base to support space robotics, automation, launch vehicles and space-based systems.



Queensland is also home to large downstream industries, such as agriculture and mining, that are both driving and benefiting from the state's expertise in Earth observation and data analytics.

Queensland's strengths

- Launch activities
- Ground systems
- Space-enabled services
- Space systems – manufacturing and robotics



Some of our key research and development organisations supporting Queensland's space industry

<p>The University of Queensland (UQ)</p>	<p>» Centre for Advanced Materials Processing and Manufacturing</p>	<p>» Centre for Hypersonics is a world leader in hypersonic technology and reusable rockets</p>	<p>» Boeing Research and Technology Australia Centre</p>	
<p>Queensland University of Technology (QUT)</p>	<p>» QUT's Australian Research Centre for Aerospace Automation (now robotics and autonomous systems discipline) played an integral role in building Australia's unmanned aircraft system industry</p>			
	<p>» Leading the Asia Pacific with the Australian Centre for Robotic Vision</p>	<p>» The country's only low-humidity electro-manufacturing dry rooms that support production of commercial-grade lithium-ion batteries</p>		
<p>CSIRO</p>	<p>» CSIRO's Queensland capabilities and facilities include: expertise in Earth observation data analytics and applications development; satellite calibration and validation facilities; and the Queensland Centre for Advanced Technologies for research into robotics and autonomous systems, advanced navigation systems, smart mining, and advanced aeronautical engineering</p>			
<p>University of Southern Queensland (USQ)</p>	<p>» Institute for Advanced Engineering and Space Sciences is nation leading in applied research and commercial work on composites, hypersonics, solid rocket fuels, robotic vision in uncontrolled environments and astronomy</p>			
	<p>» Mount Kent Observatory and a Shared Skies Partnership with the University of Kentucky, USA, allows remote access to telescopes around the world</p>	<p>» Long duration wind tunnel for supersonic and hypersonic testing</p>		
<p>Griffith University</p>	<p>» Specialises in artificial intelligence, computer image processing and robotics through its Institute for Integrated and Intelligent Systems</p>			
	<p>» Advanced Design and Prototyping Institute (ADaPT) brings together multi-disciplinary expertise with leading industry partners to push the boundaries in advanced custom design, rapid prototyping and new materials</p>			

Queensland's space industry strengths

Key strength 1: Launch activities

The annual global launch services market is worth US\$5.5 billion and growing.¹¹ Reducing launch costs, combined with the rising demand for space-enabled services, are driving the demand for rocket launches and creating opportunities to launch, operate, manufacture, test and develop launch supply chains.

Most of the world's launch companies are developing next generation launch vehicles. New entrants, such as Space X and New Zealand's RocketLab have entered the market with aggressive price points; forcing established providers to align and develop new generation launchers targeted at delivering low-cost payloads.¹²

In Queensland, Gilmour Space Technologies, Black Sky Aerospace and Hypersonix are developing affordable access to space for small and medium-sized payloads.

Launching from Queensland

There are a number of technical considerations to holding an ideal launch location.

- Rockets are generally required to launch along a coastline to avoid population.
- Launching eastward is cost-effective as rockets accelerate with, rather than against, the Earth's rotation to leave the atmosphere.
- Proximity to the equator means that rockets can pick up an additional 460 metres per second of speed from the Earth's spin, further reducing costs.

Queensland is the only state on Australia's eastern seaboard with access to equatorial orbits. Ideal latitude, clear skies and open waters to the east means that Queensland can launch larger payloads, and into more orbits, than any other place in Australia.

- Low Earth orbit (polar and inclined) ✓
- Geosynchronous equatorial orbit ✓

Queensland also has a comparable latitude to Cape Canaveral, Florida, which hosts the Kennedy Space Centre; one of the world's busiest launch sites.

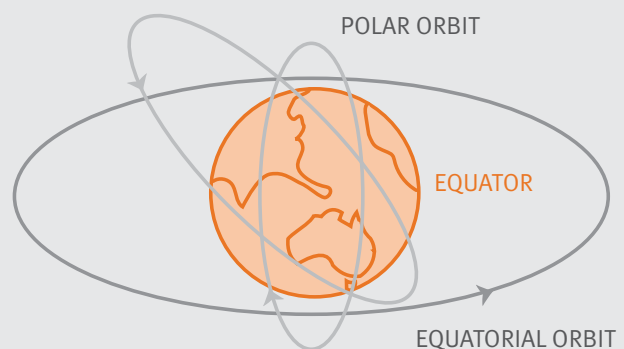
"The small satellite revolution is gaining momentum globally, with thousands of small satellites slated to launch into low-Earth orbits over the next five years. Our end goal is to provide low-cost access to space, and to enable human spaceflight and exploration."

– Adam Gilmour, CEO & Co-founder,
Gilmour Space Technologies

Queensland has a launch supply chain

Australia's most advanced launch vehicle developers – Gilmour Space Technologies, Black Sky Aerospace and Hypersonix – are based in Queensland. These companies are developing small-to-medium launch platforms to respond to the world's growing demand for smaller satellites and rapid launch capability.

INCLINED ORBIT



"When you launch a rocket, you have to launch towards an easterly direction because the Earth spins that way. The pickup that you get from the spinning of the Earth is up to about 460 metres a second, which in relative terms is almost 1½ times the speed of sound... If you launch that way, you get a slingshot effect. It is way better to launch east than west. The closer you are to the equator, the closer you are to having that slingshot effect take place."

– Adam Gilmour, CEO & Co-founder,
Gilmour Space Technologies

Queensland is also home to a high-tech aerospace industry...

Australia's highest concentration of aircraft manufacture and repair services are based in Queensland, including more than half the world's top 10 aerospace companies who are involved globally in the space supply chain.

... and a supporting research base

The University of Queensland (UQ) and the University of Southern Queensland (USQ) excel in launch systems research, testing and advanced composites.

- UQ's Centre for Advanced Materials Processing and Manufacturing is driving new combinations of metals, polymers, ceramics and composites
- UQ's Centre for Hypersonics is a world-leader in hypersonic technology and reusable rocket research with a hypersonic wind tunnel
- USQ hosts a wind tunnel for supersonic and hypersonic testing
- USQ is home to the Institute of Advanced Engineering and Space Sciences, and has nationally leading applied research and commercial work in composites and hypersonics.

Opportunity for launch: supporting launch infrastructure and a national supply chain

Queensland's geographical attributes, skilled workforce and innovative industry position the state to expand its place in the world's growing launch supply chain.

There are several opportunities to support the development of Queensland's launch industry.

1. **National support and leadership** – launch is a national capability that supports the growth in Australia's space industry and sovereign capability. A national approach to capability development is key to optimising these benefits.
2. **Support for enabling infrastructure** – development of enabling infrastructure to test launch vehicles, components and payloads will strengthen Queensland and Australia's launch supply chain. Key considerations are a static test site and an orbital launch facility in proximity to launch vehicle developers.
3. **A versatile launch site** – that can launch to multiple orbits and cater for multiple users.¹³ An Australian launch facility would bolster national capability, providing the Southern Hemisphere with a launch location accessible to Asian markets.





Image courtesy of Gilmore Space Technologies

Gilmore Space Technologies

Gold Coast-based Gilmore Space Technologies is a venture-capital-backed rocket company developing next-generation hybrid propulsion launch vehicles. The Eris rocket will launch satellites up to 240 kilograms into low Earth orbit, with the Eris Heavy rocket capable of taking 1000 kilograms.

Gilmore Space Technologies is designing launchers for production and ease of operation that will provide customers with reliable and cost-effective access to space.

CASE STUDY



Image courtesy of Black Sky Aerospace

CASE STUDY

Black Sky Aerospace

The Queensland company behind Australia's first commercial rocket launch, Black Sky Aerospace, is one of Australia's leading providers of launch services and propulsion systems.

In 2018, Black Sky Aerospace launched Australia's first commercial rocket west of Goondiwindi in outback Queensland. Three commercial payloads were tested on the sub-orbital flight, which also paved the way for more rocket flights in Queensland, including a reusable rocket which landed 1.8 kilometres away from the launch site.

Black Sky Aerospace provides payload launch vehicles, propulsion systems, ground support and infrastructure, to support launch supply chains around the world.

Key strength 2: Ground systems

Ground stations, also known as satellite parks, track and control satellites and download data. They can provide data in real time to downstream industries for time-based analytics.

Most ground stations in the global space economy are in the Northern Hemisphere. Increasing capacity in Australia will provide more access to time-based services for Australian and other Southern Hemisphere businesses, which can currently have lengthy data wait times.

Ground stations have specific requirements to operate. They require large areas free from radio traffic, clear skies, dry weather, internet connectivity and security.

Opportunity: controlling from Queensland

With clear skies and in proximity to the equator, Queensland – particularly Western Queensland – offers multiple locations for ground stations that can scan both the Northern and Southern Hemispheres.¹⁴ A ground station can be an industry enabler by connecting the upstream space economy with data analytics and downstream users.¹⁵

The ability to purchase satellite data in real time enables new services to grow. For example, real time data can improve decision making for environmental management and disaster relief. Queensland's space industry and the wider economy could benefit from ground station capability, particularly in:

- the ground system sub-sector – with the opportunity to attract large companies to Queensland
- the space-enabled services sub-sector
- downstream industry sectors, such as mining, environmental management and agriculture
- exports – by enabling the rapid export of data and analytics from Australia to the world through the Sunshine Coast International Broadband Submarine Cable.

Queensland provides a prime location for ground stations

- Radio free areas and clear skies ✓
- Remote internet and data backhaul services developed for Queensland's mining and resource industries ✓
- Location near the equator means that ground stations can scan both the Northern and Southern Hemispheres ✓
- Strong Earth observation sector with a large potential customer base across Australia's agricultural and mining industries ✓
- From 2020, a new international submarine cable on Queensland's Sunshine Coast will deliver Australia's fastest telecommunications connection to Asia, and the second fastest to the United States. ✓

Queensland companies, such as Yeronga-based EM Solutions, are also highly skilled in next-generation ground terminal development and systems integration. Most of Queensland's organisations in this sector are export-focused.



CASE STUDY

EM Solutions

Brisbane-based EM Solutions is a trusted technology developer of innovative microwave and on-the-move radio and satellite products that deliver high-speed telecommunications around the world.

EM Solutions supplies next generation high-speed communications products to deliver real-time voice, data and multimedia to a broad range of industries, including defence, government, maritime and telecommunications. The company's customers typically serve the national interest and require resilient and assured systems operable in high threat environments.

EM Solutions is building on more than two decades of experience in land and marine satellite terminals, to expand the company's space capabilities and bolster Australia's efforts to grow a national space supply chain.



Image courtesy of EM Solutions

Key strength 3: Space-enabled services

From satellite communications and satellite navigation, to Earth observation and remote sensing, the world is increasingly relying on space-enabled services. Satellite-derived goods and services have become the driving force behind the world's space economy. They are predominantly spread across satellite communications (Satcom), satellite navigation (Satnav), and Earth observation.

In Queensland, the space-enabled services sub-sector is primarily being driven by Earth observation and satellite navigation.



Satcom

– the US\$142 billion Satcom market is shifting from video to data-centric services.¹⁶



Satnav

– the US\$119 billion Satnav market has been driven by government-funded systems, which have opened up civilian and commercial activities around the world.¹⁶



Earth observation

– the US\$4.6 billion Earth observation market has historically been dominated by government services. This is changing as commercial opportunities emerge through start-ups and automated analytics.¹⁶

Observing Earth from Queensland

Australia is a world-leader in the field of Earth observation, and Queensland leads Australia in this field.

The state's Earth observation sub-sector is the largest in the country and has created a unique cluster through long-term investment in research. This has been driven by Queensland's climate, remote geography and the need to operate remotely.¹⁷

Earth and marine observation has enormous economic benefits to other industries. The value of Earth and marine observation to Asia-Pacific Economic Cooperation (APEC) forum economies is estimated at US\$372 billion.¹⁸ This is based on the value added:

- to gross domestic products through the cumulative effects of higher growth to downstream industries (US\$300 billion)¹⁸
- through improved disaster prediction and management (US\$26 billion)¹⁸
- to non-market services to consumers (US\$46 billion), such as free data for infrastructure planning.¹⁸

With Queensland's proximity to APEC nations and its role as Australia's leader in Earth observation, Queensland's Earth observation ecosystem is positioned to expand through both domestic and international uptake of Queensland's products and services. This growth will complement emerging capabilities in Queensland's ground system sub-sector through increased availability of data.

Opportunity for space-enabled services: untapped markets to drive space demand for space services

Space-enabled services are the end of the space supply chain – the point where downstream industries use the products and insights derived from satellite technology. Demand for space-enabled services drives demand throughout the rest of the space supply chain. More demand for data means more demand for satellites and the capability to build, launch and control them.

Space-enabled services have the potential to grow Queensland’s economy in two ways:

- Direct benefits and efficiency gains to downstream industries – particularly in industries that have a low awareness of space-enabled services but an untapped potential for growth

- Increased demand in the greater space supply chain – by increasing the demand to operate, launch and manufacture space systems to capture data.

A key challenge preventing the global uptake of space-enabled services in downstream industries, such as in agriculture, is the cost of accessing site-specific data and services.¹⁹ These costs are expected to lower in the coming years through new technologies, increased ground system services and new start-ups disrupting traditional price points to offer local solutions.

Space supply chain





Image courtesy of the Remote Sensing Research Centre

Remote Sensing Research Centre

The Remote Sensing Research Centre is a leading national and international research and training centre based at The University of Queensland for biophysical remote sensing to understand and solve environmental management problems.

The centre provides unique services to research and government organisations to support areas such as:

- vegetation height and canopy structure
- environmental properties to map climate-impacted change
- the composition and energy dynamics of urban environments
- the composition, structure and productivity of terrestrial and marine systems.

The centre is a core part of the Joint Remote Sensing Program with the Queensland, New South Wales and Victorian governments, as well as the University of New England, to develop scientifically and legally-defendable environmental mapping and monitoring programs using satellite image data sources linked to field measurements.



Key strength 4: Space systems – manufacturing and robotics

Industry snapshot

The demand for robotics in space exploration is increasing. Even with the advent of Space 2.0, exploration is still one of the driving forces behind space industry expenditure, with government space programs currently valued at US\$71 billion.²⁰

NASA is working to establish a permanent human presence on the Moon within the next decade. The Moon provides an opportunity to test new tools, instruments and equipment that could be used on Mars, including constructing human habitats and life support systems. Robotics and the need to operate remotely will be a key part of this.

Research, development and manufacturing robotics in Queensland

Queensland's vast geographical landscape and remote conditions share parallels with space exploration. Specifically, Queensland has a long history in robotics and remote asset management through its mining and advanced manufacturing industries.

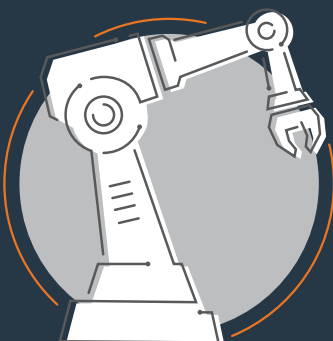
- **Manufacturing: \$20 billion contribution to the state economy, around 170,000 people employed²¹**
- **Mining: \$39 billion contribution to the state economy, 236,300 people employed²²**

Queensland's manufacturers are innovative, customer-focused and seeking ways to address emerging issues. The existing advanced manufacturing base includes:

- additive manufacturing technologies
- advanced forming technologies (medical and aerospace)
- advanced materials
- biomanufacturing
- electronics manufacturing (including aerospace and defence)
- heavy engineering
- high temperature superconducting technologies (energy and defence)
- precision tooling and niche machining (including for aerospace)
- technologically superior microwave systems (next generation broadband and defence systems).

An industry-focused government

Queensland is the place for industry to collaborate and commercialise great ideas. Through the \$755 million Advance Queensland program, the Queensland Government is growing highly skilled and high-tech jobs, and attracting industries that will feed into Australia's increasingly sophisticated space industry.



CASE STUDY

Queensland is home to the Advanced Robotics for Manufacturing hub, which provides practical production and manufacturing support in a real-life factory environment to enable Queensland manufacturers to uptake cutting-edge robotics technologies and processes.

The hub allows manufacturers throughout the state to access state-of-the-art robotics with applications across sectors as diverse as aerospace, defence, METS and space.



Image courtesy of Gough Plastics

Research and development organisations focused on robotics and automation

- QUT's Robotics and Autonomous Systems faculty was integral to building Australia's unmanned aerial system industry
- QUT is leading the Asia-Pacific with the Australian Centre for Robotic Vision and Advanced Robotics for Manufacturing hub
- QUT has Australia's only low-humidity electro-manufacturing dry rooms that support production of commercial-grade lithium-ion batteries
- UQ is home to Boeing's Research and Technology Australia Centre
- Queensland is home to Australia's Defence Cooperative Research Centre for Trusted Autonomous Systems, which delivers world-leading robotics technology to enable cooperation between humans and machines
- CSIRO's Robotics and Autonomous Systems Group is based in Queensland, developing foundational and applied research in robotic technologies from concept to commercialisation
- CSIRO's Data61 Group is based in Brisbane, with a focus on machine learning, robotics and automation
- Griffith University's ADaPT combines a variety of disciplines in designing advanced manufacturing processes.

Opportunity for space systems: diversifying into the space supply chain

In September 2019, the Australian Government announced \$150 million in new funding to support Australian businesses and researchers to join NASA's endeavour to the Moon and Mars, and deliver key capabilities for missions through participation in the United States space supply chain.

As Queensland's space industry grows, opportunities will increase for aerospace, defence and manufacturing to diversify into the space supply chain.

An opportunity exists for Queensland's leading research and industry organisations to support the Australian Space Agency and contribute to NASA's robotics and automation capabilities.



Our geographical strengths

- » Queensland's position on an eastern seaboard close to the equator, plus its low population density and low radio interference, provides benefit for potential launch activities and ground processing.
- » Queensland is ideally located as a gateway to the Asia Pacific region.
- » An international broadband submarine cable connecting to the Sunshine Coast will create world-class data export capability.

Key growth areas and industry challenges

Key growth areas for Queensland's space economy

Leveraging Queensland's industry and geographical strengths to grow the space industry.²³

Strengthening Queensland's existing space capability to be world-class and competitive.²³

Connecting Queensland organisations to the growing global space economy and to Queensland's downstream industries.²³

Industry-wide challenges



Infrastructure

An Australian launch site and additional space-related infrastructure will be catalytic for the space industry, supporting research and development and opening up new market opportunities.²⁴



Awareness of Australia's space industry

Increased awareness of Australia's space capability will improve supply chain opportunities by enabling Queensland companies to enter untapped markets.



Human capability (STEM and career pathways)

Queensland's aerospace, defence and advanced manufacturing industries – as well as the state's focus on STEM education – form a strong base to transfer current knowledge and skills for application across the space supply chain. The development of career pathways will benefit predominantly through the growth of Queensland's wider space industry.

This challenge is already being addressed through the Department of Employment, Small Business and Training and the Department of Education's Schools of the Future STEM Strategy.

- In 2019-20, the Queensland Government will invest \$978 million in skills and training to meet immediate demands and emerging needs, so that Queenslanders are skilled for the jobs of today and the future.
- In 2018-19, the Queensland Government invested over \$526,000 for 168 apprentices and trainees across aviation and aerospace.



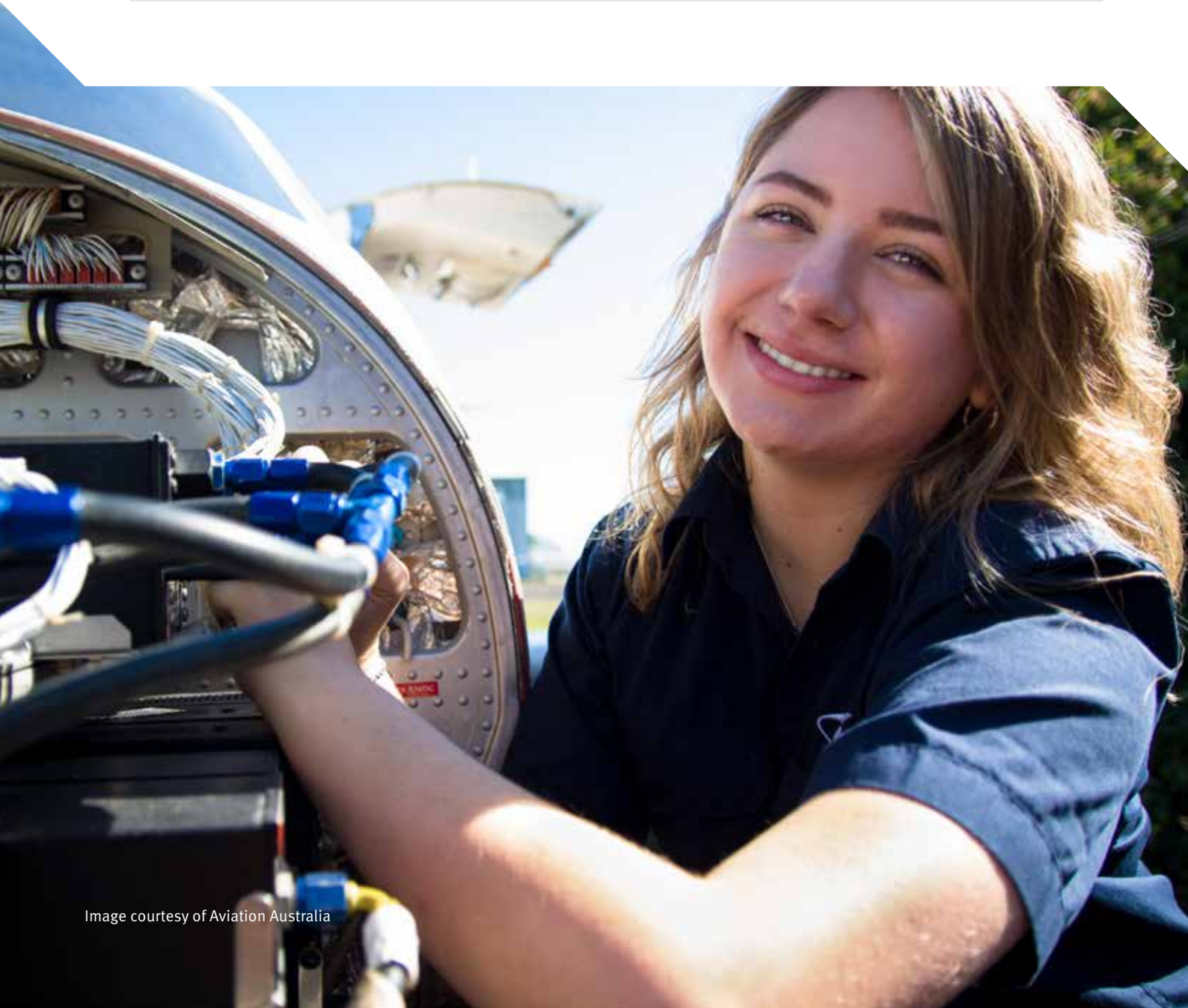
Connectivity across the supply chain

An end-to-end supply chain incorporating the research sector and associated industries within the space supply chain and potential customers will strengthen opportunities to partner and innovate.

Strategy action overview

Two key action areas build on the Aerospace Roadmap. These will support the enabling conditions for self-sustaining industry growth to generate highly skilled jobs, business opportunities and STEM career pathways of the future. These action areas address industry opportunities and challenges across Queensland's core industry strengths:

- strengthening capability
- growing the industry – connecting to wider markets.



Action area 1: Strengthening capability

Strengthening Queensland's space industry capability across its core strengths is the initial focus for implementation, with an aim to grow industry opportunities and support Queensland's niche areas to be world-class and positioned for growth. This action area supports capability across three key areas.

Opportunities and challenges addressed

Infrastructure capability

Leveraging Queensland's industry strengths with infrastructure support will unleash the state's potential and grow both upstream and downstream commercial and research opportunities.

Human capability

Raising awareness and promoting career pathways into Queensland's space industry will help boost workforce readiness to support the growing space industry.

Commercial capability

Supporting organisations in accessing the space supply chain and federal programs will boost Queensland's space industry competitiveness.

Action area 2: Growing the industry – connecting to wider markets

Once capability has been strengthened, the strategy will focus on growing Queensland's space industry.

Specifically, the strategy will support the expansion of the space industry's addressable customer base by connecting Queensland's industry to international markets and to untapped domestic downstream industries.

The focus of this will be industries that could benefit from the uptake of space-enabled services, but are currently not accessing their full potential.

Opportunities and challenges addressed

Awareness of Queensland's space industry

Raising awareness of Queensland's space industry strengths and connecting these to untapped markets will drive growth through the uptake of products and services. Primary opportunities are in:

- international markets
- the greater supply chain
- Queensland's downstream industries.



QUEENSLAND SPACE INDUSTRY STRATEGY

Vision

By 2025, Queensland's space industry will be recognised as niche manufacturing, robotics and automation for space.

Action area 1: Strengthening capability

Strengthen existing capabilities to support Queensland's niche areas to be world-class and positioned for growth, with new opportunities in the space supply chain.

We will work to strengthen capability in:

- **space-related infrastructure** to open up growth opportunities by supporting common user infrastructure to enable Queensland's strengths to grow and become competitive
- **human capability** to support the growing critical mass of space activity in Queensland
- **commercial capability** to support Queensland organisations seeking to enter the space supply chain.

Infrastructure capability (to support key strengths)

ACTIONS

1. Support the development of common user space-related infrastructure.
2. Support the development of a space-derived data analytics and commercialisation hub.
3. Support the development of a common user static test site for rocket engines.
4. Conduct a business case for an orbital launch facility in Queensland.
5. Conduct a market analysis on the demand and potential economic impact of Australian launch services.
6. Support the development of a ground station in Queensland.
7. Work with the Australian Space Agency and Queensland universities to identify opportunities for industry to access existing space infrastructure across the nation.

Human capability (skilled workforce)

ACTIONS

8. Collaborate with industry, universities, TAFE and government agencies to develop space industry-related skills and promote clear career pathways and internships into Queensland's space industry.
9. Support and facilitate industry participation at events with Queensland universities that showcase and connect students with career opportunities.
10. Explore targeted opportunities to support defence veterans to access employment in Queensland's space and wider aerospace industry.
11. Continue working with Queensland Government departments to support STEM education as it relates to Queensland's space industry.

Commercial capability

ACTIONS

12. Leverage the Defence and Aerospace Industry Development Fund to support skill accreditation and events in Queensland's space industry.
13. Provide facilitation support to organisations seeking to enter the space supply chain.
14. Engage with Queensland's industry to support their involvement in international space missions and national space projects.
15. Work with Queensland universities to increase the commercial application of research in Queensland's key space-related strengths.

ACTIONS

a leading centre in Australasia for launch activities, ground systems, Earth observation,

Action area 2: Growing Queensland's industry

Connect Queensland's industry to untapped domestic and international markets.

We will work to connect Queensland's space industry to:

- **the international market**, which is set for sustained growth
- **the greater supply chain** by supporting an end-to-end supply chain in Queensland
- **leverage downstream industries** through increased domestic awareness and demand for space-enabled services in Queensland's strong traditional industries, driving upstream growth in the space economy.

Connect industry to international markets

ACTIONS

1. Identify international and domestic market opportunities, including customer base, for Queensland's industry strengths.
2. Support participation in key space-related trade shows and facilitate industry participation.
3. Work in partnership with Trade and Investment Queensland's international offices to play an active role in targeted international market engagement, including to:
 - 3.1 promote Queensland business and capability to overseas markets, and connect with overseas primes and space agencies to understand supply chain opportunities
 - 3.2 make strategic connections between Queensland businesses and overseas companies.

Connect industry to the greater supply chain and promote capability

ACTIONS

4. Support industry cluster events with defence, aerospace, robotics and advanced manufacturing industries.
5. Support Queensland industry to maximise access to Federal Government programs.
6. Leverage current defence, aerospace and manufacturing industry platforms to promote opportunities in the space supply chain.
7. Publish a Queensland space industry capability directory to better connect industry users and service providers.
8. Facilitate partnerships between industry and universities to maximise the use of national and private space assets and grow supply chain opportunities.
9. Develop promotional material to increase awareness and access to Queensland's space supply chain.
10. Actively market Queensland's space industry at relevant industry events.
11. Increase engagement with Federal Government agencies where Queensland can support Australia's sovereign space capability.
12. Advance a memorandum of understanding with the Australian Space Agency.

Leverage downstream industries (through space-enabled services)

ACTIONS

13. Promote the application of space-enabled services to downstream industries.
14. Work with industry peak bodies to identify promotional and networking opportunities at downstream industry events.
15. Encourage increased use of space-enabled services by Queensland Government agencies.
16. Identify regulatory and non-regulatory barriers in Queensland that prevent the uptake of space-enabled services.
17. Pursue opportunities to encourage ground station data to be processed in Queensland.
18. Support initiatives that cluster Queensland's remote sensing and Earth observation capabilities.

Glossary

Earth observation – the gathering of information about the Earth’s physical, chemical and biological systems via remote-sensing technologies (e.g. satellites), supplemented by surveying techniques, which encompass the collection, analysis and presentation of data.

Geosynchronous equatorial orbit – a high Earth orbit that allows satellites to match the Earth’s rotation. Located approximately 35,780 kilometres above the Earth’s equator – a valuable position for weather monitoring, communications and surveillance.

Ground station – an on-ground terminal linked to a satellite or spacecraft by an antenna and associated electronic equipment for the purpose of transmitting or receiving data, and tracking or controlling satellites.

Low Earth orbit – an Earth orbit with an altitude of between 160 and 2000 kilometres above the Earth’s surface. Low Earth orbit can accommodate multiple trajectories, including polar and inclined. Used primarily for data communication.

Mid Earth orbit – an Earth orbit between 2000 and 35,780 kilometres above the Earth’s surface – commonly used for navigation.

Satellite park – a designated area containing a number of ground stations.

Space economy – all public and private actors involved in developing and providing space-enabled products and services. It comprises a long value-added chain; starting with researchers, developers and manufacturers of space hardware, and ending with the providers of space-enabled products and services to final users.

Space-enabled services – designing, building, manufacturing and operating equipment, services or applications that require data or other services from space-based systems or components.

Space industry – organisations involved in the space economy, and providing goods and services related to space.

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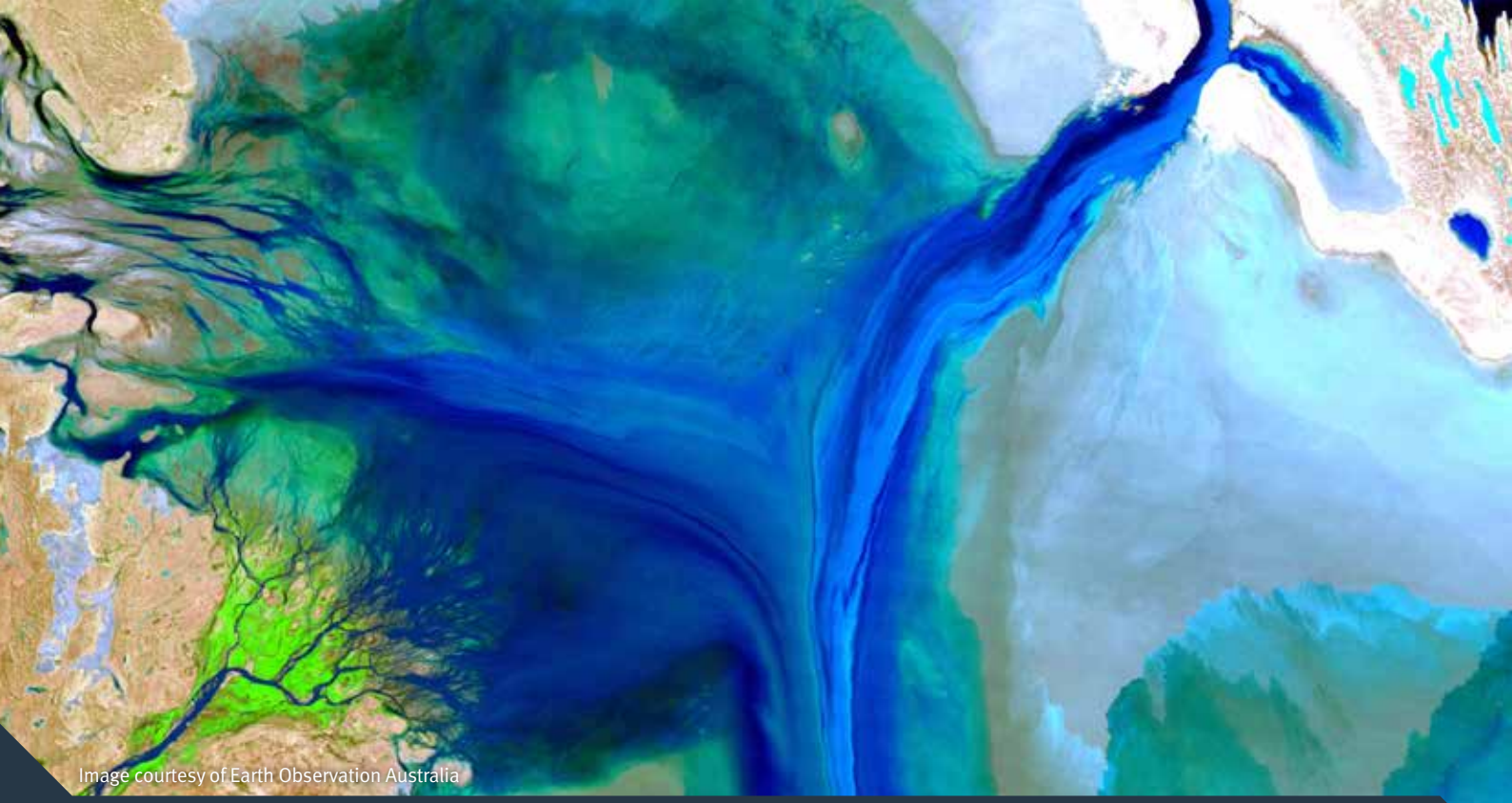


Image courtesy of Earth Observation Australia

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