Queensland Space Industry Strategy 2020 – 2025

Edition 2 | Updated February 2023

Department of State Development,
Infrastructure, Local Government and Planning

Queensland Government

Acknowledgement of Country

The Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) acknowledges the First Nations peoples in Queensland: Aboriginal and Torres Strait Islander peoples and their connections to the lands, winds and waters we now all share. We pay our respect to Elders, past, present and emerging. We also acknowledge the continuous living culture of First Nations Queenslanders – their diverse languages, customs and traditions, knowledges and systems. We acknowledge the deep relationship, connection and responsibility to land, sea, sky and Country as an integral element of First Nations identity and culture.

The Country is sacred. Everything on the land has meaning and all people are one with it. We acknowledge First Nations peoples' sacred connection as central to culture and being. We acknowledge the stories, traditions and living cultures of First Nations peoples and commit to shaping our state's future together. DSDILGP recognises the contribution of First Nations peoples and communities to the State of Queensland and how this continues to enrich our society more broadly.

Photography courtesy of the Commonwealth of Australia, Department of Defence. Copies of this publication are available on our website at www.dsdmip.qld.gov.au and further copies are available upon request to: Department of State Development, Infrastructure, Local Government and Planning PO Box 15009, City East, Queensland 4002

Phone: 13QGOV (13 74 68)

Email: **djq@dsdilgp.qld.gov.au** Web: **www.dsdilgp.qld.gov.au**

Foreword

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

Nothing captures our imagination like space and the limitless possibilities that space exploration holds.

The space industry also presents incredible and real opportunities, right now. A diverse range of businesses and jobs are needed for this rapidly evolving sector from developing rockets, building satellites and space vehicles, to using space services to increase economic productivity and connect communities.

The Queensland Government is firmly focussed on securing long-term prosperity for our state. A key part of this work is recognising and supporting the jobs and industries of the future, enabling them to take full advantage of global opportunities—such as the $370 billion global space economy.

Queensland's space industry already supports more than 2200 jobs, generating around $810 million per year through services such as satellite communications. This is just the beginning.

The Queensland Government has set an ambitious target for the space industry to add between $3.5 and $6 billion to our state's economy and up to 6000 jobs by 2036. We have the plan and the trajectory to achieve this and more in partnership with the Australian Space Agency.

As part of the Queensland Jobs Fund, the *Queensland Space Industry Strategy 2023* update builds on our impressive achievements, further supported by Queensland's outstanding skills and competitive advantages.

We have an advanced manufacturing industry, leading field robotics and automation expertise, globally recognised research institutes, a highly skilled workforce and world-class aerospace and defence supply chains.

Half of the world's top 10 aerospace companies have chosen to operate in Queensland, including global space primes such as Airbus, Boeing, and Northrop Grumman. Our easterly facing position, proximity to the equator and access to multiple orbits make Queensland a suitable place for launch activities.

From agriculture and critical minerals to automated vehicles and the growing demand for big data, many industries are increasingly relying on satellite-derived data and the ability to 'look back at earth'. With new and exciting opportunities in space exploration and research the global space industry is expected to skyrocket to US$1.1 trillion by 2040.

We are nation-leading in Earth observation and have regions that are ready to host ground stations—with radio-free and clear skies, high-speed internet and an international broadband submarine cable connection.

Our goal is for Queensland to be recognised as a leading centre in Australasia for launch activities, ground systems, Earth observation, niche manufacturing, robotics and automation.

These are the industries and jobs of the present and future. Our Strategy aims to sustain, strengthen and expand our space industry capability. We want to lead the nation in the space economy.

The Honourable Steven Miles MP

Deputy Premier, Minister for State Development, Infrastructure, Local Government and Planning and Minister Assisting the Premier on Olympics Infrastructure

Queensland Space Industries Strategy Achievements

2020

- Completed a technical and environmental investigation for a potential orbital launch facility near Abbot Point and facilitating private sector development of the site.
- Conducted market sounding for a Queensland satellite ground station development and commenced commercial discussions with potential proponents.

2021

- Advocated for Queensland's space industry at the federal inquiry into developing Australia's space industry.
- In partnership with SmartSat CRC, Earth Observation Australia and the University of Queensland, the $3 million Queensland Earth observation hub was established to accelerate the growth of the Earth observation industry by supporting commercialisation of research, and EO product and service development.
- Supported Space SMEs through the Defence and Aerospace Industry Development Fund.
- Supported Queensland industry to access Australian Government programs such as the Modern Manufacturing Initiative and Moon to Mars program.
- Developed a Queensland space industry capability directory as part of the defence industries capability directory to increase connections between and within the space sector, and to support promotion in domestic and international supply chains.

2022

- Worked with industry to expand common user static test facilities for rocket engines, a key stage in the development of launch vehicles.
- Promoted and supported Queensland's space industry through participation in key space-related events and trade shows such as the Space Symposium in Colorado Springs in April 2022 and the International Astronautical Congress in Paris in September 2022.
- Partnered with Earth Observation Australia to host the inaugural Advancing Earth Observation Forum in Brisbane.

Contents

1.0 Executive summary

1.1.1 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.

1.1.2 The opportunity

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 for the space shuttle program at the Royal Australian Airforce Base Amberley. Today, Queensland's space industry is blossoming. It currently supports over 2,200 full-time equivalent jobs and generates $810 million in annual revenue, with a further $520 million in value added to industries that have realised the benefits of world-class space-enabled services such as Earth observation.[1]

Queensland's space industry has enormous potential if nourished, with up to 6000 jobs and between $3.5 billion and $6 billion added to the state economy by 2036. 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 20000 jobs by 2030.[2]

1.1.3 Industry challenges

Industry faces a range of challenges including infrastructure, awareness of the industry, human capability and connectivity across the supply chain.

1.1.4 Queensland's strengths

Queensland is close to the equator, on the east coast of Australia and has large areas free from radio traffic with high-speed internet to support the state's remote industries. And our coastline includes a comparable latitude to Cape Canaveral, Florida, one of the world's busiest launch sites.[3]

Queensland's location makes it suitable 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.

1.1.5 Strategies and priority actions

The Queensland Government will support the vision and deliver on it through two key strategies:

1. Sustain and strengthen Queensland's space industry capability.
2. Expand Queensland's space industry by connecting with the growing domestic and international space markets.

---

[1] DSDILGP estimates calculated by applying data sources from Deloitte Access Economic and IBISworld.

[2] Australian Space Agency 2019, Advancing Space: Australian Civil Space Strategy 2019 – 2028, Canberra.

[3] Queensland State Development, Natural Resources and Agriculture Industry Development Committee 2019, Report No.23, 56 Parliament, Inquiry into job creation opportunities in Queensland arising from the establishment of an Australian space industry.

2.0 Queensland's opportunity in space

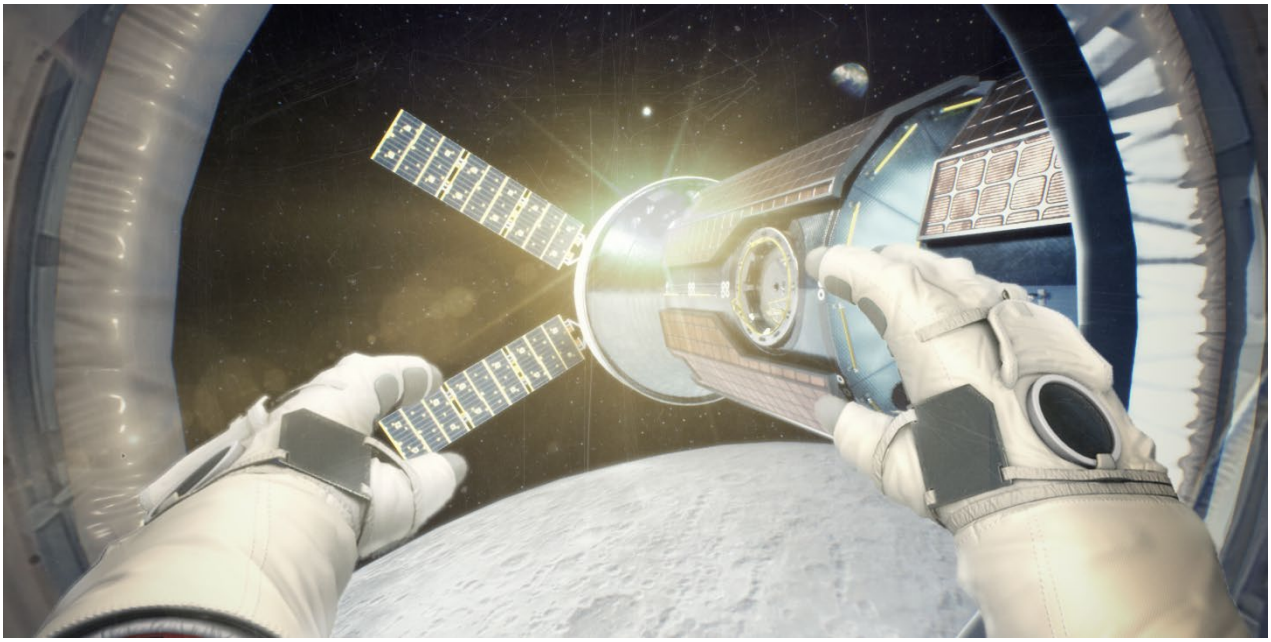


Image courtesy of Raytracer

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. 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.

Across all sectors, the world's industries and governments are increasingly relying on satellite-derived data and space enabled services to make crucial decisions and harness new opportunities. As a result the global space industry is expected to be worth US$1.1 trillion by 2040.[4]

2.1.1 Australia's space industry

Australia's space industry generates approximately $3 billion to $4 billion in revenue a year and employs some 10000 full-time equivalent jobs.[5] 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 20000 additional jobs by 2030.[2]

[4] Morgan Stanley 2018, Space: Investing in the Final Frontier, available at https://www.morganstanley.com/ideas/investing-in- space, accessed 2019.

[5] ACIL Allen 2017, Australian Space Industry Capability: A Review for the Department of Industry, Innovation and Science.

In 2021, reflecting the changing strategic environment, the Australian Government's Department of Defence identified space as one of Australia's new Sovereign Industrial Capability Priorities. This was followed in 2022 by the establishment of the Defence Space Command.

Space is also one of the six manufacturing pillars considered crucial to a modern Australian economy and which has been supported by the Australian Government. 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.[6]

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

2.1.2 Queensland's opportunity

Queensland is well positioned to lead Australia in this emerging industry. Our expanding space economy already supports over 2200 full-time equivalent jobs and generates more than $810 million in direct annual revenue[1]. Queensland also has industrial and geographical 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 already 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'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.

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 of a Queensland parliamentary inquiry into Queensland's space industry. These studies have informed the development of the *Queensland Space Industry Strategy*.

2.1.3 Benefits for Queensland's economy

Few industries share their benefits as widely as the space economy. It is estimated that the use of space systems and space-derived data supports 70 per cent of economic activities worldwide.[7]

In Queensland, the space economy already adds $520 million in value to the Gross State Product.[1] By adopting space-enabled services such as Earth observation, 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.

[6] Deloitte Access Economics 2019, Sky is Not the Limit: Building Queensland's Space Economy.

[7] IBIS World 2018, Satellite communications and astronautics: Australia market research report, available at https://www.ibisworld.com.au/industry-trends/specialised-market-research-reports/technology/satellite-communicationsastronautics.html, accessed 2019.

2.1.4 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 percent increase in agriculture production and a 15 per cent increase in water withdrawals for agriculture.[9]

Satellites are expected to become a key part of the solution to 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 space-enabled solutions will be more accessible in the future, as new technologies emerge and there is a growing critical mass, lowering the cost of imaging data.

Image courtesy of DataFarming

[8] OECD 2019, Managing water sustainably is key to the future of food and agriculture, https://www.oecd.org/agriculture/topics/water-and-agriculture/, accessed 2019.

[9] The World Bank, 2014, Will water constrain our energy future? Available at https://www.worldbank.org/en/news/feature/2014/01/16/will-water-constrain-our-energy-future, accessed 2019.

[10] Edwards, Amy (CSIRO) 2017, Putting satellite data into the hands of famers, available at https://ecos.csiro.au/remote-sensing-for-farmers, accessed 2019.

3.0 Industry challenges

- ---

Infrastructure

A larger scale Australian orbital launch site close to the Equator and additional space-related infrastructure will be catalytic for the space industry, supporting research and development and opening up new market opportunities.[5]

Awareness of Australia's space industry

Increased awareness of Australia's space industry 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 2021, the Queensland Government released the Queensland Defence, Maritime, Aerospace and Space Industry Skills Plan with actions to help industry develop and strengthen a skilled and adaptive workforce.
- In 2019-20, the Queensland Government invested $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.[11]

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.

[11] Department of Employment, Small Business and Training 2019, Skills for Queensland: Great training for quality jobs, available at https://desbt.qld.gov.au/__data/assets/pdf_file/0012/10236/skills-for-queensland-strategy.pdf, accessed 2022

4.0 Queensland's strengths

4.1.1 Competitive location

Queensland's location on Australia's eastern seaboard and close to the equator is a great advantage. It 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 the Australian Communications and Media Authority. In addition, an international data cable at the Sunshine Coast is providing Australia's eastern seaboard with the fastest connection to Asia and the second fastest connection to the United States.

4.1.2 Powerhouse industries

Queensland companies are used to operating remotely. Our world-leading mining equipment, technology and services (METS) industry and 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 industries, such as agriculture and mining, that are both driving and benefiting from the state's expertise in Earth observation.

Australia's newly created Defence Space Command will draw on all aspects of the Australian Defence Force, establishing an organisation to achieve Australia's strategic space ambitions and assure Australia's access to space.[12] The new Defence domain will generate further opportunities for Queensland's existing industry base and growing space industry.

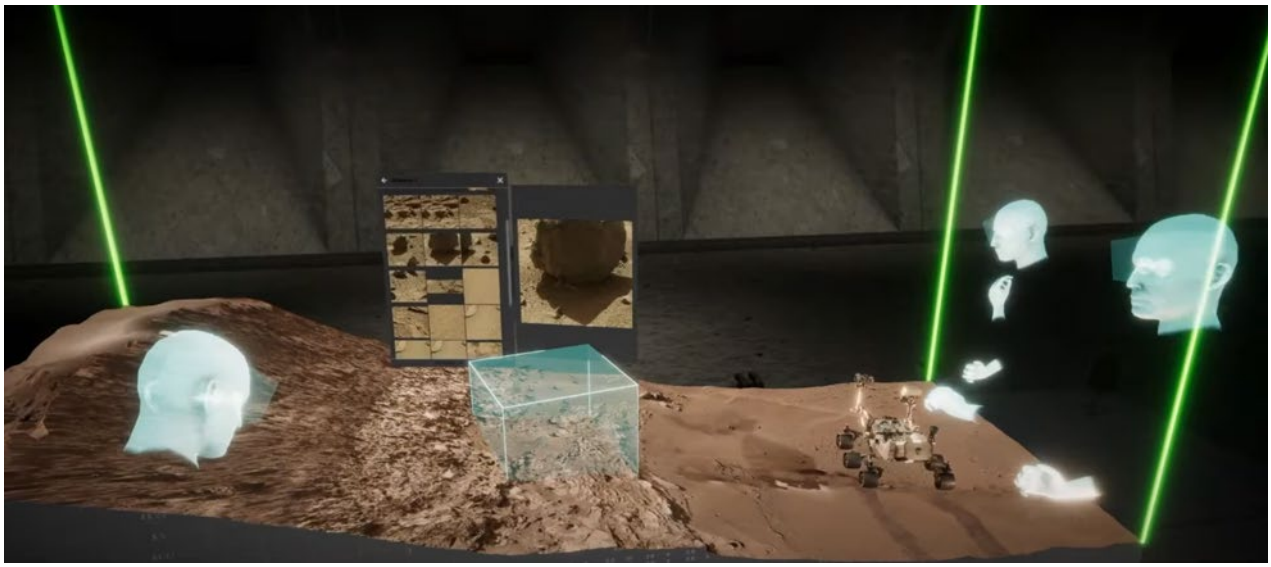


Image courtesy of Raytracer

4.1.3 Queensland's strengths

- Suitable 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, and the ability to scan both hemispheres.
- Space-enabled services – including nation-leading Earth observation.
- Space systems – including world-class manufacturing, robotics and automation.

4.1.4 Key growth areas for Queensland's space economy

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

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

Connecting Queensland organisations to the growing global space economy and to industries that can benefit from space-related services.

---

[12] What is Australia's space division, and why is it in the military?, available at https://www.abc.net.au/news/science/2021-05-13/australia-space-division-military-satellites-air-force commander/100127978#:~:text=The%20newly%20created%20military%20space,chief%20Air%20Marshal%20Mel%20Hupfeld, accessed 2022.

4.1.5 Queensland's First Nations businesses

The Queensland Government is committed to supporting First Nations businesses, communities and peoples to participate in the Queensland economy by:

- driving economic growth and enabling well-planned, inclusive and resilient local communities
- reframing the relationship with First Nations peoples and the Queensland Government by enshrining the State's commitment towards the delivery of the Moving Ahead Strategy, Reconciliation Action Plan, Cultural Capability Framework, Cultural Capability Action Plan, Path to Treaty, Closing the Gap commitments and the Queensland Indigenous Procurement Policy.

4.1.6 Key research and development organisations supporting Queensland's space industry

- University of Queensland (UQ)
  - Centre for Advanced Materials Processing and Manufacturing is driving new combinations of metals, polymers, ceramics and composites.
  - Australian Program Office for Advanced Hypersonics, the world's leading university-based hypersonics research group.
  - Boeing Research and Technology Australia Centre enabling Boeing and UQ researchers to collaborate in areas including engineering, human movements, neuroscience, chemistry, physics and psychology.
  - Remote Sensing Research Centre is a leading national and international research and training centre for biophysical remote sensing for understanding and solving environmental monitoring management problems.
- Queensland University of Technology
  - Australian Research Centre for Aerospace Automation (now robotics and autonomous systems discipline) played an integral role in building Australia's uncrewed aircraft system industry.
  - Leading the Asia Pacific with the Australian Centre for Robotic Vision.
  - Leading the way with Australia's largest covered outdoor lunar testbed, capable of simulating different planetary environments for testing equipment, robotics and materials processing techniques.
- CSIRO
  - In-situ Resource Utilisation Facility, located in Brisbane, is a lunar testbed, simulating some of the physical characteristics of the Moon's surface, particularly lunar dust, for realistic testing and evaluation of remotely operated assets and equipment.
  - Robotics and Autonomous Systems Group is based in Queensland and is developing foundational and applied research in robotic technologies from concept to commercialisation.
- University of Southern Queensland
  - Institute for Advanced Engineering and Space Sciences is nation leading in research, commercial and defence work including rocket manufacturing and testing, hypersonics, ultra-high temperature composites, astrophysics, airborne Earth re-entry observations and robotic vision in uncontrolled environments.
  - UniSQ built and operates the world's longest-duration free piston hypersonic wind tunnel, the only one of its kind in Australia.
  - Mount Kent Observatory and a Shared Skies Partnership with the University of Louisville, Kentucky, USA, allows remote access to telescopes around the world providing ground-based support for space-based astronomy missions (NASA's and UK's exoplanet missions (TESS, Twinkle Space)), and hosting a space debris tracking telescope for Germany company DLR's aeronautics and space research centre.
  - Leading the iLAuNCH Hub (Innovative Launch, Automation, Novel Materials, Communications and Hypersonics), with 23 industry partners and two node Universities at Australian National University and the University of South Australia, to boost national space commercialisation and support sovereign space manufacturing. iLAuNCH is a $180 million Trailblazer University Program.
  - In partnership with Rocket Technologies International, UniSQ have developed a common user static test site for rocket engines.
  - Machine vision technologies for application in multiple sectors including agriculture and space

- Griffith University
  - Specialises in artificial intelligence, computer image processing and robotics through its Institute for Integrated and Intelligent Systems.
  - Advanced Design and Prototyping Institute (ADaPT) brings together multi-disciplinary expertise with leading industry partners to push the boundaries in advanced custom design, adoption of new manufacturing technologies and new material development.
- TAS DCRC
  - Queensland is home to the headquarters of Trusted Autonomous Systems, a Defence Cooperative Research Centre, which delivers world-leading robotic research through industry to enable trusted cooperation between humans and machines.
- Queensland Defence Science Alliance
  - The Queensland Government partnered with seven Queensland universities, industry partners and the Department of Defence to establish the Queensland Defence Science Alliance. This alliance fosters collaborative research and development opportunities within the Defence enterprise in support of Australia's sovereign industrial priorities, including space, robotics and autonomous systems.
- Queensland Earth Observation Hub:
  - Incorporating the SmartSat Cooperative Research Centre (SmartSat) Earth Observation Node, the Hub is a jointly funded initiative of SmartSat and the Queensland Government in partnership with Earth Observation Australia and the University of Queensland. It aims to accelerate the growth of our Earth observation industry by supporting commercialisation of research, and Earth observation product and service development.

Image courtesy of UniSQ

Image courtesy of Boeing Research and Technology Centre

4.2 Launch activities

Image courtesy of Rocket Technologies International

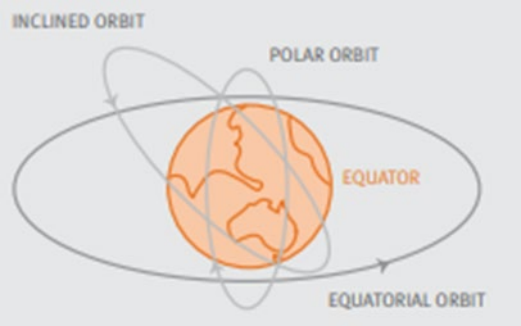
The annual global launch services market is worth US$5.7 billion and growing.[13] Reducing launch costs and the rising demand for space-enabled services are driving the demand for rocket launches and creating opportunities to launch, operate, manufacture, test and develop launch supply chains.

Most of the world's launch companies are developing next generation launch vehicles. New entrants such as SpaceX and New Zealand's Rocket Lab have entered the market with aggressive price points, forcing established providers to align and develop next generation launchers targeted at delivering low-cost payloads.[14]

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

"The small satellite revolution is gaining momentum globally, with tens of 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



[13] Bryce Tech, 2022, State of the Satellite Industry Report, https://brycetech.com/reports, accessed 2022.

[14] Neiderstrasser, Carlos 2018, Small Launch Vehicles: a 2-18 State of the Industry Survey, Northrop Grumman Corporation, Dulle.

4.2.1 Launching from Queensland

There are a number of technical considerations to identifying a suitable launch location.

- Launching rockets over the ocean from a coastline is generally advantageous 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 payload costs.

Queensland is the only state on Australia's eastern seaboard with direct 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's coastline is comparable and at better latitudes to Cape Canaveral in Florida which hosts the Kennedy Space Centre; one of the world's busiest launch sites

4.2.2 Our launch supply chain

Australia's most advanced launch vehicle developers – Black Sky Aerospace, Gilmour Space Technologies, 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. Supporting capabilities include the Rocket Technologies International nationally leading static rocket engine testing facility.

In September 2022 Wagner Corporation and Virgin Orbit signed a memorandum of understanding for a 2024 launch demonstration of Virgin Orbit's LauncherOne with a more permanent horizontal launch site to follow within three years.

LauncherOne is a two-stage orbital launch vehicle developed and flown by Virgin Orbit. An air-launched rocket, it carries smallsat payloads of up to 300 kg following air launch from a carrier aircraft at high altitude. LauncherOne is carried to the upper atmosphere on Virgin Orbit's modified Boeing 747-400, Cosmic Girl, and released over the ocean.

4.2.3 Our 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 in the global space supply chain.

4.2.4 Opportunity for launch

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. A Queensland launch facility would bolster national capability, providing the Southern Hemisphere with a launch location accessible to international markets.

Case study: Black Sky Aerospace

Queensland-based Black Sky Aerospace (BSA) manufactures rocket propellant for the Space and Defence industries. It also makes solid rocket motors, launch vehicles and provides launch services.

With a string of successful sub-orbital launches from 2018, BSA continues toward an all-Australian space launch. It is a fully Australian company designing, manufacturing and launching from Queensland.

BSA's sub-orbital launch program is already taking commercial and research payloads, and is leading the way for home-grown space launch. BSA's vision is to become a leading propulsion system, launch vehicle and launch services provider in the southern Hemisphere.

Image courtesy of Black Sky Aerospace

Case study: Gilmour Space Technologies

Gilmour Space Technologies (Gilmour Space) is the largest Australian space launch vehicle manufacturer, with over 170 employees in its Gold Coast facility. The venture capital backed company is developing and launching a series of next generation launch vehicles and satellites from Australia to provide global customers with reliable and cost-effective access to space. The Queensland based company is developing the Bowen Orbital Spaceport to enable sovereign launches into Low Earth Orbits (LEO) and beyond. The Eris Block 2 rocket will launch satellites up to 1000 kilograms to LEO, with the Eris Heavy rocket capable of lifting 4000 kilograms. Work has begun at the site and applications are being progressed for Commonwealth approvals for facility and launch permits.

Image courtesy of Gilmour Space Technologies

Case study: Hypersonix

Hypersonix Launch Systems is disrupting the space industry by creating low cost, reliable and reusable hydrogen fuelled scramjets using advanced carbon composites. The Wiraway is a fully reusable three stage satellite launch system for small satellites. This is the first application of scramjets for space launch and provides greater performance as around 90% per cent of the system is reusable, offering significant savings.

Image courtesy of Hypersonix

4.3 Ground systems

4.3.1 A prime location

Ground stations, often situated in satellite parks, track and control satellites and download data, including in real time to customer 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.

Queensland's Mt Kent Observatory has the infrastructure and expertise to support optical satellite tracking and laser-based satellite communication activities. The Observatory hosts a space debris tracking telescope for Germany's DLR aeronautics and space research centre and provides ground support for space astronomy missions, including NASA's TESS mission and the UK's Twinkle Space Mission in 2024.

- ✓ 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 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.
- ✓ An international submarine cable on Queensland's Sunshine Coast delivers Australia's fastest telecommunications connectionto Asia, and the second fastest to the United States.

4.3.2 Our ground systems opportunity

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.[5] A ground station can be an industry enabler by connecting the space economy with data analytics and broader industry customers.[6]

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
- space industry consumers such as the mining, environmental management and agriculture industry sectors
- exports – by enabling the rapid export of data and analytics from Australia to the world through the Sunshine Coast International Broadband Submarine Cable.

Image courtesy of UniSQ

Case study: EM Solutions

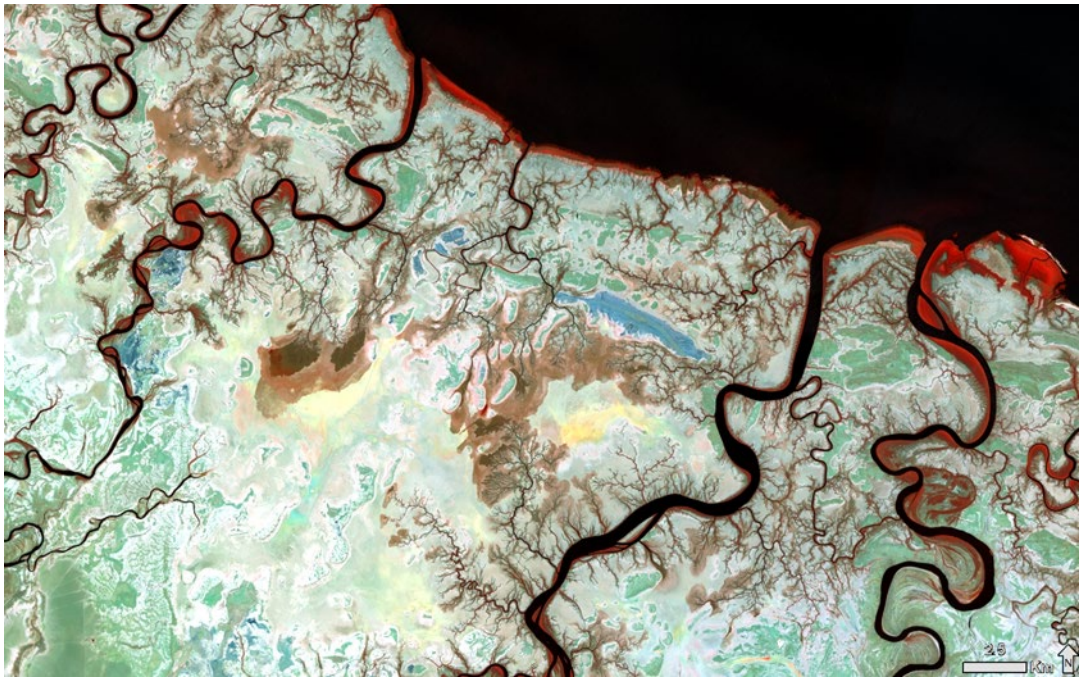
Brisbane based EM Solutions is a trusted technology developer of innovative microwave and on the move radio and satellite products that deliver high speed telecommunications around the world.

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

4.4 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.[15]

Satcom

– the US$168 billion Satcom market is shifting from video to data-centric services.

Satnav

– the US$126 billion Satnav market has been driven by government funded systems, which have opened up civilian and commercial activities around the world.

Earth observation

– the US$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.

[15] DSDMIP ongoing industry consultation 2021, Euroconsult, June – December 2021.

4.4.1 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.[3]

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.[16] This is based on the value added:

- to gross domestic products through the cumulative effects of higher growth to industries that benefit from expanded use of space related services (US$300 billion).
- through improved disaster prediction and management (US$26 billion).
- to non-market services to consumers (US$46 billion), such as free data for infrastructure planning.

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

4.4.2 Space-enabled supply chain opportunities

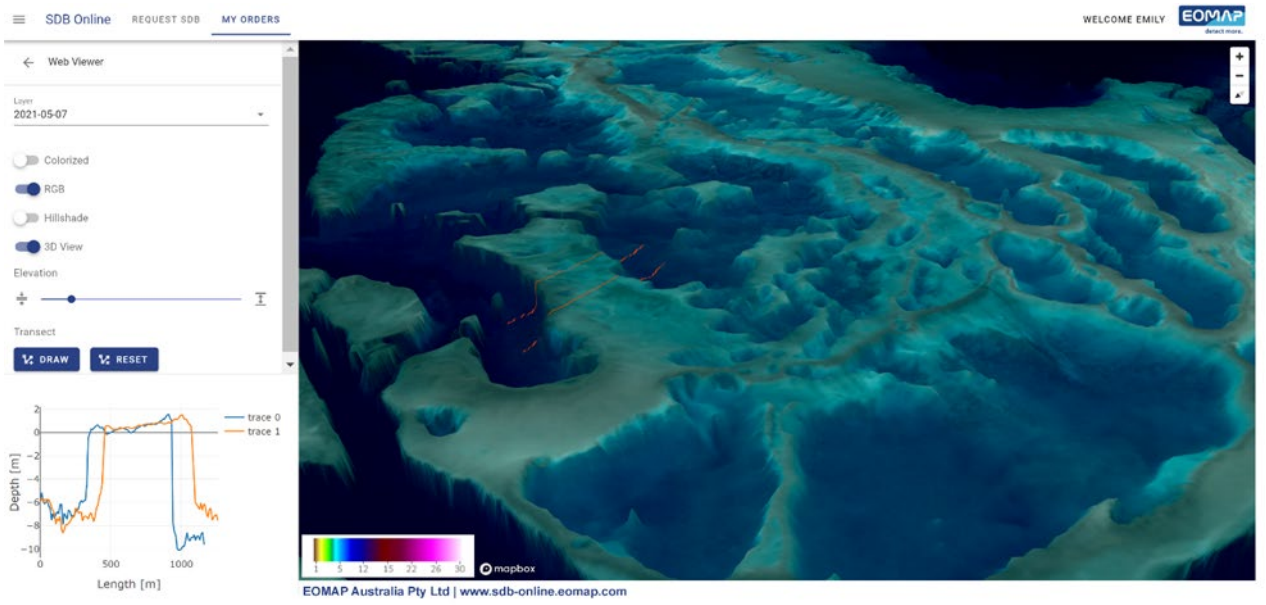


Image courtesy of EOMap

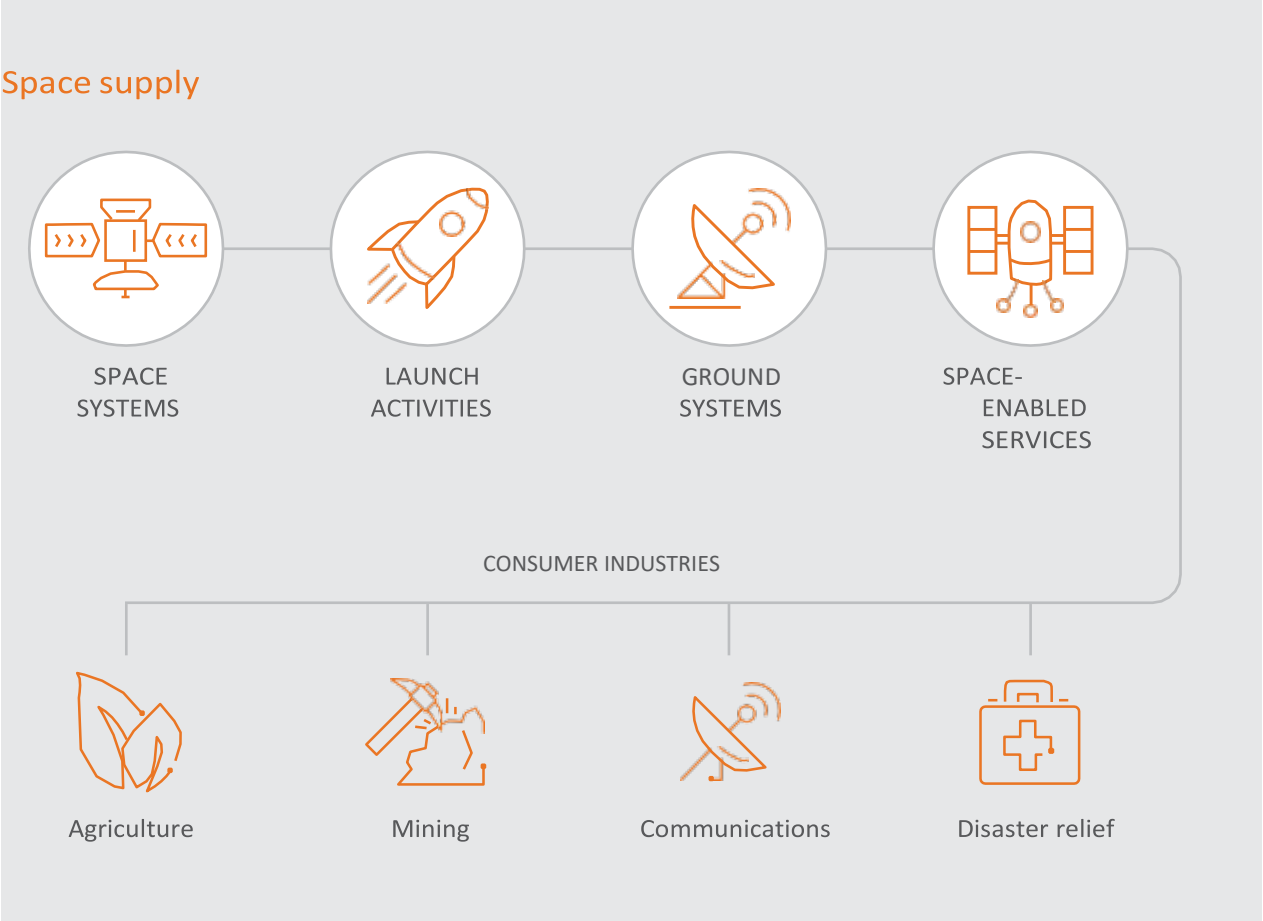
Space-enabled services are the end of the space supply chain – the point where space industry consumers use the products and insights derived from satellite technology. Demand for space-enabled services drives demand throughout the rest of the space supply chain such as launch and satellite building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

[16] Australian Government and Asia-Pacific Economic Cooperation 2019, Current and future value of Earth and marine observing to the Asia-Pacific.

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

- direct benefits and efficiency gains to consumer industries – particularly in industries that currently 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 manufacture, launch and operate space systems to capture data.

A key challenge preventing the global uptake of space-enabled services in consumer industries such as agriculture is the cost of accessing site specific data and services.[11] These costs are expected to reduce in coming years through new technologies, increased ground system services and new start-ups disrupting traditional price points to offer local solutions.



Case study: Remote Sensing Research Centre (UQ)

The Remote Sensing Research Centre, based at The University of Queensland, is a leading national and international research and training centre 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 and New South Wales governments, as well as the Universities of New South Wales and New England, to develop scientifically and legally defendable environmental mapping and monitoring programs using satellite image data sources linked to field measurements.

4.5 Space systems – manufacturing and robotics

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 valued at US$71 billion.[17]

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.

4.5.1 Our manufacturing base

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

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).

- Manufacturing: $21.5 billion contribution to the state economy, approximately 188000 people employed [18]
- Mining: $39 billion contribution to the state economy. [19]

4.5.2 Collaborative culture

Queensland is the place for industry to collaborate and commercialise great ideas. The $3.4 billion Queensland Jobs Fund is a one-stop-shop for investors to access a suite of flagship industry development programs specifically designed to grow highly skilled and high-tech jobs and attract industries that will feed into Australia's increasingly sophisticated space industry.

---

[17] Euroconsult 2019, Government space programs: benchmarks, profiles and forecasts to 2028, http://www. euroconsult-ec.com/shop/index.php?id_product=115&controller=product, accessed 2019.

[18] Department of State Development, Manufacturing, Infrastructure and Planning 2022, Queensland Advanced Manufacturing: 10-Year Roadmap and Action Plan, edition 3, Brisbane, p3

[19] Queensland Treasury 2019, About the Queensland Economy, https://www.treasury.qld.gov.au/queenslandseconomy/about-the-queensland-economy/, accessed 2019

4.5.3 Opportunities to grow and diversify manufacturing

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

For example, Queensland's leading research and industry organisations are already identifying ways to support the Australian Space Agency and contribute to NASA's robotics and automation capabilities.

Case Study: Advanced Robotics for Manufacturing (ARM) Hub

Headquartered in Queensland and supported by the Queensland Government, the Australian first Advanced Robotics for Manufacturing (ARM) Hub is an independent, not-for-profit innovation and commercialisation centre on a mission to accelerate the digital transformation of manufacturing industries.

Advancing the capabilities of manufacturers by connecting industry to cutting edge research, facilities and technology acceleration projects, the ARM Hub works with businesses to achieve high-value product manufacture, strengthen local supply chains, increase global competitiveness and grow employment outcomes.

Case Study: Artificial Intelligence (AI) Hub

The Artificial Intelligence (AI) Hub at The Precinct in Fortitude Valley represents a $5 million investment to build AI capabilities and global connections. The hub brings business, government and research together through AI programs and projects to accelerate AI adoption and capability development, improve productivity and support job generation and economic growth.

5.0 Priority actions

Strategy 1
Sustain and strengthen Queensland's space industry capability
Strengthen Queensland's space infrastructure capability through strategic alliances and attracting private sector investment to support the development of common user infrastructure including: 1.1. An orbital launch facility, 1.2. A common user static test site for rocket engines, 1.3. Ground stations, 1.4. Identifying opportunities for industry to access existing space infrastructure across the nation. **Sustain and strengthen our human capability and advanced skills base by:** 1.5 Implementing the Queensland Defence, Maritime, Aerospace and Space Industry Skills Plan. 1.6 Collaborating with universities, TAFE and government agencies to understand future workforce needs and promote clear career pathways into Queensland's space industry. 1.7 Supporting targeted programs to attract defence veterans and students to careers in Queensland's space and broader aerospace industry. 1.8 Supporting STEM education as it relates to Queensland's space industry. **Sustain and strengthen commercial capability to expand Queensland's space industry supply chain by:** 1.9 Establishing an Earth observation hub to connect research and industry. 1.10 Leveraging the Defence and Aerospace Industry Development Fund to support Queensland's space industry to acquire certifications needed to participate in global supply chains. 1.11 Facilitating organisations seeking to enter the space industry supply chain. 1.12 Engaging with Queensland's space industry to support their involvement in international space missions and national space projects. 1.13 Working with Queensland universities to expand the commercial applications of researching Queensland's key space related strengths. 1.14 Working with Queensland's space industry to identify and address systemic barriers to growth.

Strategy 2

Expand Queensland's space industry by connecting with the growing domestic and international space markets

Connect Queensland's space industry to growing international markets by:

2.1 Working in partnership with Trade and Investment Queensland to promote Queensland's space industry capability to overseas markets, including through participation in key space related trade shows.

2.2 Connecting Queensland's space industry to overseas primes and space agencies to compete for space industry supply chain opportunities.

Connect Queensland's space industry to the greater supply chain to promote capability and attract investment by:

2.3 Supporting Queensland's space industry to maximise access to Federal Government programs.

2.4 Promoting Queensland's space industry at relevant industry events.

2.5 Facilitating strategic partnerships between industry and universities to maximise the use of national and private space assets, increase the commercialisation of research and grow supply chain opportunities.

2.6 Facilitating engagement between the defence, aerospace and manufacturing industrial base and Queensland's space industry to expand supply chain opportunities.

2.7 Maintaining a Queensland space industry capability directory to connect industry, research, government and customers.

2.8 Delivering on a memorandum of understanding with the Australian Space Agency.

Expand the understanding of and market for space-enabled services by:

2.9 Promoting space enabled services to users and potential users, including Queensland's traditional industries and emerging industries, to grow innovative new applications and markets.

2.10 Supporting initiatives that cluster Queensland's remote sensing and Earth observation capabilities.

6.0 Glossary

ARM Hub – the Advanced Robotics for Manufacturing (ARM) Hub located at Northgate.

BOS – Bowen Orbital Spaceport.

Earth observation (EO) – 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.

QUT – Queensland University of Technology.

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 related Infrastructure - includes both ground-based and space-based physical assets, machines and facilities that are critical to the design, development, manufacture, test, launch and operations of space assets and space-based applications.

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

STEM – Science, Technology, Engineering and Mathematics careers and training.

Sub-orbital – where a rocket or spacecraft reaches outer space but not far enough to reach low Earth orbit to enable it to enter orbit around Earth, including altitudes under 160 kilometres above the Earth's surface.

UniSQ – University of Southern Queensland.

UQ – University of Queensland.

7.0 Notes

1. DSDILGP estimates calculated by applying data sources from Deloitte Access Economic and IBISworld.
2. Australian Space Agency 2019, Advancing Space: Australian Civil Space Strategy 2019 – 2028, Canberra.
3. Queensland State Development, Natural Resources and Agriculture Industry Development Committee 2019, Report No.23, 56 Parliament, Inquiry into job creation opportunities in Queensland arising from the establishment of an Australian space industry.
4. Morgan Stanley 2018, Space: Investing in the Final Frontier, available at https://www.morganstanley.com/ideas/investing-in- space, accessed 2019.
5. ACIL Allen 2017, Australian Space Industry Capability: A Review for the Department of Industry, Innovation and Science.
6. Deloitte Access Economics 2019, Sky is Not the Limit: Building Queensland's Space Economy.
7. IBIS World 2018, Satellite communications and astronautics: Australia market research report, available at https://www.ibisworld.com.au/industry-trends/specialised-market-research-reports/technology/satellite-communicationsastronautics.html, accessed 2019.
8. OECD 2019, Managing water sustainably is key to the future of food and agriculture, https://www.oecd.org/agriculture/topics/water-and-agriculture/, accessed 2019.
9. The World Bank, 2014, Will water constrain our energy future? Available at https://www.worldbank.org/en/news/feature/2014/01/16/will-water-constrain-our-energy-future, accessed 2019.
10. Edwards, Amy (CSIRO) 2017, Putting satellite data into the hands of famers, available at https://ecos.csiro.au/remote-sensing-for-farmers, accessed 2019.
11. Department of Employment, Small Business and Training 2019, Skills for Queensland: Great training for quality jobs, available at https://desbt.qld.gov.au/__data/assets/pdf_file/0012/10236/skills-for-queensland-strategy.pdf, accessed 2022.
12. What is Australia's space division, and why is it in the military?, available at https://www.abc.net.au/news/science/2021-05-13/australia-space-division-military-satellites-air-force commander/100127978#:~:text=The%20newly%20created%20military%20space,chief%20Air%20Marshal%20Mel%20Hupfeld, accessed 2022.
13. Bryce Tech, 2022, State of the Satellite Industry Report, https://brycetech.com/reports, accessed 2022.
14. Neiderstrasser, Carlos 2018, Small Launch Vehicles: a 2-18 State of the Industry Survey, Northrop Grumman Corporation, Dulle.
15. DSDMIP ongoing industry consultation 2021, Euroconsult, June – December 2021.
16. Australian Government and Asia-Pacific Economic Cooperation 2019, Current and future value of Earth and marine observing to the Asia-Pacific.
17. Euroconsult 2019, Government space programs: benchmarks, profiles and forecasts to 2028, http://www.euroconsult-ec.com/shop/index.php?id_product=115&controller=product, accessed 2019.
18. Department of State Development, Manufacturing, Infrastructure and Planning 2022, Queensland Advanced Manufacturing: 10-Year Roadmap and Action Plan, edition 3, Brisbane, p3.
19. Queensland Treasury 2019, About the Queensland Economy, https://www.treasury.qld.gov.au/queenslandseconomy/about-the-queensland-economy/, accessed 2019

.

**Department of State Development,
Infrastructure, Local Government and Planning**

PO Box 15009 City East Qld 4002 Australia
tel 13 QGOV (13 74 68)
info@dsdilgp.qld.gov.au
www.dsdilgp.qld.gov.au