Australian Government | Australian Space Agency

Committee Secretary
Standing Committee on Industry, Innovation, Science and Resources
PO Box 6021
Parliament House
Canberra ACT 2600

Dear Committee Secretary,

Parliamentary inquiry into developing Australia's space industry

The Australian Space Agency (the Agency) and the wider Department of Industry, Science, Energy and Resources (the Department) welcome the opportunity to provide this submission to the Standing Committee on Industry, Innovation, Science and Resources. I also acknowledge the contributions to this submission of the Department of Defence; the Department of Foreign Affairs and Trade; and the Department of Infrastructure, Transport, Regional Development and Communications, and their portfolio agencies.

A non-statutory entity within the Department, the Agency's purpose is to transform and grow a globally respected Australian space industry. The Agency is responsible for whole-of-government coordination of civil space matters and is the primary source of advice to the Australian Government on civil space policy. The Agency Charter at space.gov.au provides an overview of the Agency's purpose, responsibilities and governance structure.

This submission provides the committee with an overview of how the Agency and other areas of the Australian Government support the development of the space industry, in line with the terms of reference for this inquiry.

Yours sincerely,

[redacted]

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Standing Committee on Industry, Innovation, Science and Resources

Inquiry into developing Australia's space industry

Submission by the Department of Industry, Science, Energy and Resources (Australian Space Agency)

With input from the Department of Defence; the Department of Foreign Affairs and Trade; and the Department of Infrastructure, Transport, Regional Development and Communications, and their portfolio agencies

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Executive summary

The Australian Space Agency (the Agency) and the Departments of Industry, Science, Energy and Resources; Defence; Foreign Affairs and Trade; and Infrastructure, Transport, Regional Development and Communications provide this submission as an overview of how they support the development of Australia's space industry, in line with the terms of reference for the parliamentary inquiry. The submission highlights the benefits of space to all Australians, opportunities for developing Australia's space industry, current activities to support the sector, and measuring economic progress.

Space improves the lives of Australians every day. Space technology is critical to the modern economy, enabling services on Earth such as modern navigation, weather forecasting, internet access, online banking and crop management. The space sector creates high-tech jobs, supports a strong and agile manufacturing base, and inspires young Australians and career-changers to pursue skills and jobs in science, technology, engineering and maths (STEM).

There are major opportunities to transform and grow Australia's space industry. Australia can leverage the global shift from government being the main actor to industry growing the sector with government as a partner and facilitator, for example by leveraging Australia's demonstrated world-class strengths in 'adjacent' sectors, such as mining and remote operations, that can diversify into the space sector. This allows Australia to increase its share of a global space market predicted to be worth US$1 trillion by 2040. The growth of the sector should be balanced with ensuring safe and responsible activities, and the resilience of space technologies that are critical to Australia.

Increasing Australia's share brings benefits back to Earth in new applications of space-enabled technologies. For example, new remote and extreme environment medicine techniques can assist rural medical practices, advances in robotics can automate agricultural activities to help farmers manage their land, and next generation communication technologies can improve connectivity on Earth – all of which have potential to generate additional economic activity, productivity and jobs. Space technologies can also support other areas for Australia, such as management of bushfires.

The Australian Government's *Advancing Space: Australian Civil Space Strategy 2019-2028* (the Strategy) outlines a staged plan to triple the size of the Australian space sector to $12 billion and create up to another 20,000 jobs by 2030. This is to be achieved through opening doors internationally, building capability nationally, enabling responsible space activities and inspiring the nation. To support the target, the Strategy identifies seven National Civil Space Priority Areas. The Australian Government has committed over $700 million since 2018-2019 to support the Strategy.

The Agency is responsible for whole-of-government coordination of civil space matters, and is the primary source of advice to the Australian Government on civil space policy. A flagship activity among the Agency's many activities is delivering on the $150 million Moon to Mars initiative. This is for Australian businesses and researchers to join with NASA on their Moon to Mars endeavour, supporting the diversification of industries across the economy and entering supply chains.

Space is also a priority industry for the Australian Government's Modern Manufacturing Strategy, to enable a strong, modern and resilient economy. For the reasons above, Australia's space sector can be a sustainable and long-term contributor to business-led economic recovery and jobs, post the COVID-19 pandemic. The space sector has proven resilient to the pandemic, and can build a strong manufacturing base, create high tech skills, inspire a future workforce, and strengthen the economy.

Space benefits all Australians and the economy

The profound benefits of space technologies and services improve the lives of Australians and every sector of the economy. The space sector provides essential data and services for common activities, from banking and internet access to information on the weather and knowing where you are. Space inspires people across all walks of life and all ages, including young people towards future careers in the science, technology, engineering, and mathematics (STEM) domains.

Space technologies and services touch every sector of the Australian economy. This includes financial services, construction, mining, transport, manufacturing and agriculture. For example, Australian farmers use space capabilities to monitor the health of their crops, marine pilots guide cruise liners, emergency workers plan responses to bushfires, and scientists study the effects and impact of droughts.

Investment in Australia's space sector has spill-over benefits to other sectors of the economy. For example, new remote medicine techniques can assist rural medicine, new communication technologies can improve communications on Earth, and advancements in robotics can automate farming practices to help farmers manage their land.

Multiple industries 'adjacent' to the space sector can diversify into the space sector, as they have capabilities that are transferrable to space. For example aircraft manufacturing and repair, computer system design, and surveying and mapping services. These adjacent industries possess space relevant capabilities and high potential to participate in space supply chains, employ highly skilled professionals and technical expertise such as data analysis and engineering.

The space industry will also be central to building a modern manufacturing economy and supporting Australia's economic recovery. A strong manufacturing base is important to Australia's space industry, and Australia has a range of manufacturing capabilities that can contribute to the space sector. With the rapid transformation of the space sector there are a range of opportunities, from small satellite platforms, sensors, robotics, and activities to support access to space. Capabilities developed in space manufacturing can also pivot to other manufacturing needs. Manufacturing is a key part of almost every supply chain and adds value to all sectors.

Case studies

Bushfires

Satellite-based Earth observation systems provide imagery and other data from space, supporting a range of emergency management activities. These include bushfires, floods, and severe weather. Satellite imagery supports fire seasons through risk assessment in the lead-up to a fire season, weather forecasting and warnings during a fire, and monitoring the recovery in the aftermath of a fire.

The Bushfire Earth Observation Taskforce investigated opportunities for how space-based Earth observation might better support bushfire management in Australia, in response to the devastating bushfires in 2019-2020. This taskforce was led by the Agency and included CSIRO, Geoscience

Australia and the Bureau of Meteorology. The taskforce report is publicly available at https://www.industry.gov.au/publications/bushfire-earth-observation-taskforce-report and was considered by the Royal Commission into National Natural Disaster Arrangements[1].

Satellite services can also enable communications during emergencies where terrestrial communications networks have been destroyed or disabled. NBN Co[2] has mobile communications vans that can be taken into disaster areas, and provide connectivity for the community and emergency services through the Sky Muster satellites. NBN Co also have smaller satellite-reliant kits that can be carried in a plane or fire truck for the same purpose.

Agriculture

Space technology is enhancing productivity and profitability in the agricultural sector. High-precision positioning and timing data is transforming the agricultural sector through enabling autonomous spatial systems. Autonomous agricultural machinery is improving the way farmers plant, spray and harvest their crops through the use of sub-metre positioning data, which identifies individual rows in each crop, weeds, and diseased plants. It is also changing the way farmers manage their livestock. High-precision satellite positioning is being used to develop virtual fencing ('fenceless farming'). These tracking devices also allow farmers to identify changes in each animal's behaviour based on movement patterns, such as detecting if an animal is giving birth, is unwell or agitated.

Weather and environmental monitoring is possible through space technology for farmers, agricultural scientists and food manufacturers. Remote sensing satellites provide data for monitoring soil, water pollution and availability, drought and crop development. Rainfall assessments from satellites, for example, help farmers plan the timing and amount of irrigation they will need for their crops and can also help predict a region's agricultural output. The Digital Earth Australia (DEA) product of Geoscience Australia includes publicly-available mapping of waterbodies across Australia, which can be used to monitor changes in the extent of surface water area and gain insights into drought.

Space technology allows communications across remote and regional areas. For example, data connectivity through an 'Internet of Things' allows farmers to receive data remotely across their land from sensors that can, for instance, monitor water levels in dam and or moisture of the soil.

[1] *The Royal Commission into National Natural Disaster Arrangements* (2020) The Royal Commission into National Natural Disaster Arrangements Report. Available at https://naturaldisaster.royalcommission.gov.au/publications/royal-commission-national-natural-disaster-arrangements-report.

[2] NBN Co (2018) *Vigilance never sleeps: NBN Co's approach to emergency management*. Available at https://www.nbnco.com.au/blog/the-nbn-project/vigilance-never-sleeps-nbn-cos-approach-to-emergency-management.

Opportunities for developing Australia's space industry

Growth of the global space sector

The global space sector is growing rapidly and Australia can take advantage of this opportunity. The global space industry is worth around US$350 billion today and is predicted to be worth more than US$1 trillion by 2040[3]. Australia's space sector is nascent, but well-placed to leverage these activities across the globe. The Agency is tracking a $2 billion pipeline[4] of investment that is set to grow in the Australian space sector.

The space sector is undergoing a global structural shift from reliance on billion-dollar government programs to a variety of commercial enterprises. This is often referred to as Space 2.0 or NewSpace. Space 2.0 spans across start-ups, SMEs, and large businesses that offer different space products and services. Australia has a vibrant and competitive community of space start-ups and a number of internationally competitive SMEs, including those operating in close proximity to the Agency headquarters at the Lot Fourteen innovation precinct in Adelaide.

The shift also involves increasing productivity, increasing capability and lower costs in the satellite industry, which makes up 74 per cent of the global space economy[5]. The satellite industry includes manufacturing, launch, ground equipment (e.g. satellite TV antennas, network equipment) and satellite services (e.g. TV, radio, internet, mobile, remote sensing).

Space 2.0 is an enabler and part of the "Fourth Industrial Revolution", often called Industry 4.0. This involves the increasing automation of manufacturing and industrial practices through the fusion of advances in smart technologies (such as artificial intelligence, robotics and machine-to-machine communications), genetic engineering and other biotechnologies, quantum computing, communications and other technologies.

This rapid transformation of industry and the space sector is one of the many reasons why Australia can harness a greater share of the global space economy. There are a growing number of business opportunities and Australian businesses have a range of capabilities that can diversify into the space sector. This means that, unlike traditional systems and structures for involvement in space, government's role can be one of a partner and facilitator.

[3]Morgan Stanley (2020). *Space: Investing in the Final Frontier*. Available at https://www.morganstanley.com/ideas/investing-in-space. Note that this is a pre-COVID-19 forecast

[4] Australian Space Agency (2020). *State of Space Report 2019-2020*. Canberra: Commonwealth of Australia. Available at https://www.industry.gov.au/publications/state-of-space-report.

[5] Bryce (2020). *2020 State of the Satellite Industry Report*. Available at https://brycetech.com/reports. Note that this is based on pre-COVID-19 data.

Leverage and strengthen comparative advantages and adjacent capabilities

Australia possesses many strengths that create opportunities to grow Australia's nascent space industry. These include our geographical location, our strong education system, our technical expertise and our international partnerships and agreements that form an important foundation for access to the global space industry supply chains and the development of sustainable commercial activities[6].

There are many Australian-based industries with globally-recognised capabilities in adjacent fields that can be applied to new space activities and grow the broader economy. Transferrable capabilities provide opportunities to attract new customers in adjacent industries and diversification avenues for sectors in decline. Some examples where Australia has comparative or competitive advantages are:

- *Remote operations with artificial intelligence and machine learning*: We have a strong heritage in remote-controlled mining operations that is recognised globally and can be leveraged into robotics, autonomous operations, remote operations, artificial intelligence, machine learning, and in-situ resource utilisation in space. This expertise can also be found in the adjacent sectors of oil and gas, transport, agriculture and fisheries.

- *Next generation communications*: Space is crucial for communications on land, and in our marine jurisdiction and airspace. We continue to have increasing capability in advanced communications, specifically in hybrid radio frequency and optical communications, antennas and signalling, and secure communication using advanced quantum technology. Advances in secure high bandwidth optical communications will significantly improve regional and remote connectivity across the country, as well as deliver value for the national finance sector. Australia's astronomy heritage can also be leveraged into space communications, especially optical signal stabilisation and space situational awareness.

- *Scientific exploration supported by in-situ resource utilisation (ISRU)*: The expanding space industry opens up opportunities that can potentially draw on Australia's world-class skills in the mining, resources and remote industries sectors. The evolving nature of space enterprises, with longer journeys and further destinations, will make space operations more independent of Earth and more reliant on resources in space. Leveraging Australian experience in resource exploration has the potential to unlock new businesses and markets in the space sector while creating significant value for missions with international partners. Australian industry is well placed to be able to deliver key foundational services in a continuous and enduring capacity in the build-up and sustainment of operations off Earth. These activities will need to be conducted in accordance with Australia's international obligations.

- *Manufacturing*: Australia's manufacturing capabilities in adjacent industries of aviation, communications, electronics and machinery can pivot towards manufacturing for space. In addition, Australian expertise in materials and 3D printing could be used to manufacture in space, negating the incredible cost of transporting items to space.

[6] ACIL Allen Consulting (2017) *Australian Space Industry Capability: A Review*. Available at https://www.acilallen.com.au/projects/other/australian-space-industry-capability-a-review.

- *Space medicine and human life sciences*: Australia has expertise in remote medicine and precision health, with the latter involving the tailoring of healthcare to an individual. This enables Australia to contribute medical technologies, expertise and materials in support of astronauts. This could become increasingly important with the potential increase in commercial human spaceflight, including space tourists.

- *Digital mapping of celestial bodies*: Australia has significant capabilities in the application and processing of digital data sets, particularly in the area of remote sensing (e.g. Digital Earth Australia, Open Data Cube (ODC)). These skills can be leveraged and applied to other celestial bodies to assist with international exploration mission planning and aid planetary science objectives.

Creating jobs across the economy

A key Australian Government goal is to create up to another 20,000 direct and indirect jobs in the space sector by 2030. The space industry will create new, sustainable jobs across traditional trades through to advanced manufacturing and cutting-edge science and research. Metal fabricators and electricians work on equipment and systems for spacecraft, space stations and satellites, and robotics engineers and data scientists support space infrastructure. Australians do not have to be an astronaut or an astrophysicist to be part of the space industry.

Just some of the skills and qualifications required to support Australia's growing space sector are:

- *Engineering and technicians*: Engineers can design space craft, space stations and satellites. Many types of engineers can all work in space related jobs, including robotics, computer, aerospace, electronics, and mechanical. Technicians scan support a range of space activities and infrastructure.
- *Mathematicians, data scientists, and computational scientists*: Maths skills are very important to many space careers and underpins many technical roles.
- *Software developers and software engineers*: Software engineers and developers can design, build and deploy critical parts of space systems. Responsibilities can also include designing, writing and testing code. For example, most satellite systems require specialised software that is adapted to the specific purpose of a satellite.
- *Supporting services*: With the rapid growth and transformation of the space industry, there are a range of other skills and qualifications that can support the space economy, such as space lawyers to support new businesses to operate in space and science communicators.
- *Researchers*: Space science and research covers a huge number of fields, from astrophysics to meteorologists, astronomers, geologists, medical researchers and engineers.

Like many other areas, STEM skills are important to support the growth of the space industry. More opportunities will unfold as Australia accelerates its capabilities in the space sector. Australia has a strong base from which to build. For example, we have a highly skilled research base, we can leverage the skilled workforce in the manufacturing sector, and leverage skills in automation in the resources sector. The development of STEM skills and confidence is critical to ensuring young Australians will be able to participate in, and prosper from, high tech jobs and not be left behind in an increasingly competitive, STEM-dependent global economy.

Impacts of COVID-19

The space sector has been impacted but proves resilient

Initial observations of the COVID-19 pandemic's major effects indicate that the space sector has been impacted but proven resilient in Australia and internationally. Investment in space in Australia remains stable and on track. While there were delays to launch and space manufacturing activity in the first half of 2020, both have now resumed. Offshore supply chain issues caused delays to some activity, but most space applications activities (e.g. telecommunications, Earth observation) have seen minimal negative impact and the local launch industry has continued development.

IBISWorld is tracking updates on the impact of the COVID-19 pandemic to the satellite communications and astronautics industry in Australia. They estimate the industry will grow by 1.1 per cent in 2020-21 despite the COVID-19 pandemic, and then at an annualised 8.3 per cent over the five years to 2025-26[7].

The OECD report on the impacts of COVID-19 on the space industry cautioned in August 2020 that the full impact of COVID-19 on the global space sector (and its flow on to the Australian space sector) has yet to be determined[8]. Some long-term impacts may take many months, or even a few years, to become evident.

The Department supported the space industry

The Agency and other portfolio areas in the Department of Industry, Science, Energy and Resources (the Department) stepped up to support the space industry in response to the COVID-19 pandemic. The Agency worked with other areas of the Department to establish business continuity processes and inform the local space industry of the available support. Within the Department, the Agency supported relevant COVID-19 taskforces, in particular the Resilience and Recovery Taskforce. To provide support through the economic downturn, the Agency worked with the space sector to identify challenges, concerns and issues specific to the industry. This provided insights into how COVID-19 impacted their businesses and helped inform the Department's Industry Intelligence efforts.

Recognising the financial stresses imposed by the COVID-19 pandemic, the Agency prioritised the delivery of its funding programs. This included the International Space Investment initiative, the Space Infrastructure Fund and the supply chain component of the Moon to Mars initiative, which provides opportunities for businesses to enter international supply chains. In order to provide short-term financial relief to the launch sector, the Australian Government announced a 12 month deferral on the original commencement date for partial cost recovery arrangements for the assessment of applications made under the *Space (Launches and Returns) Act 2018*. Consultation on the proposed rules to implement the new fee arrangements is expected to occur in early 2021, with the fees now expected to commence in July 2021.

[7] IBISWorld (2020) *Satellite Communications and Astronautics in Australia*. November 2020 version. Available at www.ibisworld.com.

[8] OECD (2020) The impacts of COVID-19 on the space industry. 5 August 2020 version. Available at http://www.oecd.org/coronavirus/policy-responses/the-impacts-of-covid-19-on-the-space-industry-e727e36f/.

Many issues experienced by the space sector were similar to those in the manufacturing and digital sectors, with specific concerns around the financial sustainability of start-ups given the emerging nature of the sector. With industry and other international counterparts, the Agency focused on identifying areas where space could play a significant role in the post-COVID-19 recovery strategy. As Australia moves into recovery, the Agency continues working to ensure that Australia's space capabilities are considered as a part of the nation's strategic recovery, particularly in the manufacturing sector.

Advancing Space: Australian Civil Space Strategy 2019-2028

The Australian Government's *Advancing Space: Australian Civil Space Strategy 2019-2028* (the Strategy) sets out a plan for Australia to secure a larger share of the growing US$350 billion global space industry. The Strategy can be found at https://www.industry.gov.au/data-and-publications/australian-civil-space-strategy-2019-2028.

National Civil Space Priority Areas

The Strategy identified seven National Civil Space Priority Areas that further leverage our national strengths in space.

- *Position, Navigation and Timing*: Position, navigation and timing (PNT) is critical for many areas of the Australian economy, including agriculture and mining. While Australia does not have its own global navigation satellite system, Australia's PNT infrastructure should be world class to underpin the growth of the broader economy.

- *Earth observation*: Earth observation (EO) has untapped potential to grow Australia's economy, for example, by improving agricultural monitoring, water management, and monitoring shipping routes. Australia is a world leader in this field and can continue to focus on and develop this priority area to support the growth of Australia's broader economy.

- *Communications technologies and services*: Australia is geographically remote and sparsely populated, making connectivity through satellites more important for Australia than many other countries. Space technology is used for communications on land, sea and air. Australia's Southern Hemisphere location and clear skies, which are relatively free from atmospheric interference, can be leveraged to connect with satellites while they are in view in the Southern Hemisphere. This complements counterpart activities based in the Northern Hemisphere. It enables Australia to play a lead role in emerging technologies such as optical for data communication, quantum technologies for secure communication, and hybrid radio frequency and optical communications.

- *Robotics and automation*: Australia is a world leader in remote asset management, which involves monitoring, controlling and maintaining a system from a remote location, typically over large distances. It is used in industries such as mining, oil and gas, transport, agriculture, and fisheries. Australia can leverage its experience in these sectors, and its expertise in robotics technology and systems, to support remote operations in orbit and beyond, and space exploration.

- *Space situational awareness and debris monitoring*: Spacecraft collisions with orbital debris pose a risk to assets and life. Space situational awareness assists with the management of orbital resources, ensuring that orbits which are valuable for space-based services remain available for use. Australia's geographic position and clear skies makes Australia an ideal location for space traffic management activities, tracking space debris, monitoring space weather, scanning for potentially dangerous Near Earth Asteroids and satellite laser ranging.

- *Leapfrog R&D*: Australia has a strong research base in space-related R&D, contributing 7.0 per cent of the world's publications in space science between 2013-17[9]. Leapfrogging into new areas of opportunity, consistent with broader economic and security interests, Australia can encourage and support research that inspires, identify areas to develop, and commercialise R&D that would grow and transform the space sector. Potential new growth areas include hybrid rocket technology, new high-tech materials, space medicine, synthetic biology, quantum communications, in-orbit servicing, and optical wireless communication technologies.

- *Access to space*: There are emerging opportunities for Australia to leverage international space missions and commercial launch activities from Australian territory to support industry growth. Protecting national safety and meeting international and national obligations is a critical consideration for safe and responsible domestic launch.

Strategic Space Pillars

The National Civil Space Priority Areas guide activities under the four Strategic Space Pillars in the Strategy. These are:

- International (open doors)
- National (increase capability)
- Responsible (regulation, risk and culture)
- Inspire (build future workforce).

The pillars focus on transforming, inspiring and creating an environment for the space sector to grow, and advancing Australia's competitiveness and role as a responsible actor in civil space.

The Australian Government has committed over $700 million since 2018-19 to support delivery of the Strategy and grow the space sector. This includes through the Agency, Geoscience Australia, CSIRO and SmartSat Cooperative Research Centre (CRC). The Agency's activities and select other activities are detailed below under each of the Strategic Space Pillars. Activities by Geoscience Australia and CSIRO are outlined in this submission under *Other industry and science programs available to the space sector*, and described in their separate submissions to the inquiry.

Growing national capability

The National pillar focuses on transforming and growing the Australian space sector by increasing Australia's capability in areas of strength and harnessing space technology's capacity to address Australia's economic, technological and environmental challenges here on Earth. This seeks to lift the broader economy and leap into areas of future competitive advantage.

[9] Finch A (2018) *CSIRO Science Health and Excellence Report 2017-18*. Full Version. CSIRO, Australia. Available at https://doi.org/10.25919/5c59cf2e6fb7a.

Roadmaps

The Agency is developing roadmaps to align the growth of Australian space capability around the strategic vision of the Strategy. There will be a roadmap for each of the seven National Civil Space Priority Areas. The work is occurring in stages: (1) assess the opportunity, state of the art and gaps in the current sector; (2) set the strategic targets for 2030; (3) devise pathways from now until 2030; and (4) enable implementation and monitor progress.

The roadmaps will each:

- describe a pathway to uplift capability in a way that enables the meeting of the Agency's industry growth targets;
- identify and engage with opportunity and align activities;
- encourage organisations to invest resources and efforts where they want to pursue the opportunities identified in the roadmaps; and
- reinforce the role of government as a partner, facilitator and regulator for, and customer of, the sector.

These roadmaps are led by the Agency in close consultation with the sector, and informed by Technical Advisory Groups. All seven roadmaps will be individually published and publicly available by the end of 2021, as per the Strategy. The first roadmap, *Communications technologies and services*, was released in December 2020 and is available at: https://www.industry.gov.au/publications/communications-technologies-and-services-roadmap-2021-2030.

SmartSat CRC is also developing a Space and Spatial Industry Growth Roadmap 2030, which is expected later in 2021. This is a separate venture to the Agency's roadmaps. It will be consistent with the Strategy, and it will highlight how the spatial sector can further contribute to space activities. SmartSat CRC are working with representatives across the space sector to develop the roadmap, including the Agency.

Space Infrastructure Fund

The Space Infrastructure Fund (SIF) is a $19.5 million Australian Government investment in seven national infrastructure projects to support businesses and researchers to participate in the global space economy. The Australian Government announced the SIF on 2 April 2019 as part of the 2019-20 Budget.

The SIF builds a core foundation for space operations and technology by:

- supporting the creation of high-tech jobs in Australia;
- supporting industry through targeted investments;
- speeding up the delivery of new space-based services; and
- reducing barriers, making space more accessible for start-ups and small-to-medium business and benefitting Australians who rely on satellites for daily activities like GPS, communications and farming.

The SIF also provides the tools businesses need to access international opportunities – opening doors for Australia internationally.

A summary of each project and their status is in Table 10 of the *State of Space 2020* report available at https://www.industry.gov.au/publications/state-of-space-report. Further information on the SIF is also available at https://www.industry.gov.au/funding-and-incentives/supporting-space-infrastructure-growth.

Statements of Strategic Intent and Cooperation

The Agency enters into Statements of Strategic Intent and Cooperation with domestic and international businesses, to allow businesses to highlight their commitment to growing Australia's space sector. The Agency has entered into 16 Statements of Strategic Intent and Cooperation to-date. These are with Airbus, Sitael Australia, Nova Systems Australia, Lockheed Martin Australia, Goonhilly Earth Station, Woodside Energy, Boeing Company, Myriota, XTEK, Speedcast, Maxar Technologies, Frontier SI, EM Solutions, EOS Space Systems, Thales Australia, and Gilmour Space Technologies.

Details of each Statement of Strategic Intent and Cooperation can be found at https://www.industry.gov.au/news/australian-space-agency-news?field_news_section_tid=2584.

MOUs with States and Territories

The Agency formalises its interactions with states and territories through Memorandum of Understanding (MOU). To date, the Agency has signed with all jurisdictions except SA, QLD and VIC, which will be pursued in 2021.

Details of each MOU can be found at https://www.industry.gov.au/news/australian-space-agency-news?field_news_section_tid=2584.

Modern Manufacturing Strategy

Space is a priority area for the $1.5 billion Modern Manufacturing Strategy, which forms a central plank of the Australian Government's JobMaker plan to harness Australian manufacturing capability and drive our economic recovery and future resilience. The Government announced the Modern Manufacturing Strategy on 1 October 2020 as part of the 2020-21 Budget.

The strategy sets out six National Manufacturing Priorities (NMPs) in areas of comparative advantage or strategic opportunity. Space is a NMP because it is a key growth sector and space technologies enable activities across the economy. The space sector is an opportunity to open up new markets for existing industries in manufacturing and advanced technologies, and create high skilled jobs. In addition to space, the other NMPs are defence, resources technology & critical mineral processing, food and beverage, medical products and recycling & clean energy.

The Strategy includes three key initiatives with immediate and long-term impacts. These are:

- *The Modern Manufacturing Initiative* (MMI): $1.3bn, co-invested with industry, into projects under each of the National Manufacturing Priorities that support collaboration, innovation and integration into local and global supply chains. The MMI is comprised of three key streams:

  - *Collaboration Stream*: to support a small number of large scale business-to-business and business-to-research collaboration where there are major economies of scale.
  - *Translation Stream*: to help translate good ideas into commercial outcomes and invest in non-R&D innovation.
  - *Integration Stream*: to help manufacturers integrate into local and international supply chains and markets.

- *Supply Chain Resilience Initiative* (SCRI): to better our understand supply chains and identify vulnerabilities. From July 2021, businesses will be able to access support to establish or scale a capability to address a supply chain vulnerability.
- $52.8m for a second round of the Manufacturing Modernisation Fund, helping businesses invest in new technology and take on new employees.

The Modern Manufacturing Strategy will be informed by roadmaps which are currently being developed by industry-led taskforces and will be released in early 2021. They will help set goals for the next two, five and ten years, and will identify barriers to growth and priorities for future action and investment in each NMP, including space. These roadmaps will also inform the development of the MMI guidelines which are expected to be released in early 2021.

Each taskforce includes industry representatives appointed for their expertise and experience in the priority area. This includes their ability to leverage broad professional networks to introduce a range of perspectives in developing the roadmaps from across the priority sector. The space taskforce also includes members from the Agency, the broader Department, and CSIRO.

The Modern Manufacturing Strategy is available at https://www.industry.gov.au/manufacturing.

Opening doors internationally

The International pillar focuses on opening doors for Australian industry to enter international supply chains, gain capability and experience, and develop recognition and respect as a globally competitive space industry.

Moon to Mars initiative

The Moon to Mars initiative is a $150 million Government investment in the Australian space industry, to accelerate the growth of Australian business and support Australian's ambitions to join NASA's Moon to Mars endeavours. The Prime Minister announced the Moon to Mars initiative on 21 September 2019 while visiting the United States, as a new partnership between the Agency and NASA.

The initiative includes three integrated programs, with funding starting in the 2020-21 financial year:

- *Supply Chain program* ($47.2 million): consisting of both grant and facilitation components, this program targets projects and activities to build capability in Australia's space industry, and support local industry to deliver products and services into national and international space supply chains.
- *Demonstrator program* ($45.2 million)**:** supports demonstrator and pilot projects for Australian industry and researchers to develop and launch products that will create new capability, and

enable new business ventures, revenue streams or markets. This provides a pathway to showcase Australia's strengths to the world.

- *Trailblazer program* ($50.0 million): This inspirational project will be a major mission supporting NASA's Moon to Mars activities.

The initiative will showcase to the world Australia's best ideas and technologies that can support space missions to the Moon and on to Mars. This unlocks opportunities for Australian businesses to enter national and international supply chains. It supports the transformation and diversification of industries back on Earth and across the economy into opportunities in the growing space industry.

Australia's comparative advantages that can be strengthened and diversified through Moon to Mars activities include, but not limited to, remote medicine and precision health, mining and remote operations, and connectivity across vast distances. See *Leverage and strengthen comparative advantages and adjacent capabilities* in this submission for more details.

In harnessing these opportunities, Australian industry will grow skills and strengthen overall capability to create jobs at home while attracting international investment and partnerships with global industry titans. It brings about economic growth, creates inspiration and enables spin-out technologies. The benefits will continue well after the initiative has ended.

Further information on the Moon to Mars initiative is available at https://www.industry.gov.au/funding-and-incentives/moon-to-mars-opportunities-for-australian-businesses.

International Space Investment initiative

The International Space Investment (ISI) initiative is a $15 million Australian Government investment in strategic space projects that build relationships with international space agencies for the benefit of the Australian space industry. The Government announced the ISI in the 2018-19 Budget under the measure *Australian Technology and Science Growth Plan – growing the Australian space industry*. A minimum of 80 per cent of the investment is to be made in Australia for the benefit of Australian space industry firms.

The ISI comprises two grant opportunity streams. The majority of funding is for an open, competitive 'Expand Capability' stream. The ten successful applicants were announced in June 2020, totalling approximately $11 million in funds. A summary of each project and their status is in Table 11 of the *State of Space 2020* report available at https://www.industry.gov.au/publications/state-of-space-report. Further information is also available at https://www.business.gov.au/grants-and-programs/international-space-investment-expand-capability-grants.

A smaller 'Open Doors' stream will target an opportunity or opportunities for the Australian space industry developed through agency-to-agency discussions with the Agency's international counterparts.

Arrangements with international partners

Entering international partnerships allows the Agency to establish and maintain relationships that will open doors for Australian industry. The Agency has entered into 12 arrangements with international space agencies, such as Memoranda of Understanding (MOUs) or Statements of Intent. The arrangements are with the French space agency, Canadian Space Agency, United Kingdom Space

Agency (both a MOU and a Statement of Intent), United Arab Emirates Space Agency, European Space Agency, NASA, Japan Aerospace Exploration Agency (JAXA), Italian Space Agency (both a MOU and a Statement of Intent), German Aerospace Center, and the New Zealand Ministry of Business, Innovation and Employment. Details of arrangements can be found at https://www.industry.gov.au/news/australian-space-agency-news?field_news_section_tid=2583.

Australian involvement in international missions

Becoming involved in international missions as they arise builds Australia's global reputation in space, grows the Australian space sector's capability, benefits other areas of the economy and Australians through new space-enabled technologies, and paves the way for international involvement of Australian industry and researchers in future missions. For example:

- *United States-led mission*: Australia is joining with NASA and other international partners on NASA's Moon to Mars endeavour. This is associated with Australia's Moon to Mars initiative and a joint Statement of Intent with NASA. In addition, Australia is one of the seven founding international partners who have signed the Artemis Accords. This is a practical set of principles to guide space exploration cooperation among nations participating in NASA's 21st century lunar exploration plans.

- *Japan-led mission*: Australia worked with JAXA to support the Hayabusa2 Sample Return Mission from the asteroid Ryugu, which landed in Woomera in South Australia on 6 December 2020. The Agency assessed JAXA's application for an Authorisation of Return of Overseas-Launched Space Object (AROLSO) under the *Space Activities Act 1998*, with approval granted by the Minister for Industry, Science and Technology in August 2020. The Agency was 'on the ground' with other authorities from different departments and agencies, such as the Department of Defence, the South Australian Government, and also Australia's border and health agencies to support the recovery mission and manage pandemic restrictions. JAXA and NASA recognised the Agency and 'Team Australia' for their exemplary support of this mission, opening up opportunities for Australia to be involved in future missions.

- *India-led mission*: The Agency is working with the Indian Space Research Organisation (ISRO) on their request for Australia to host temporary tracking facilities for ISRO's three 'Gaganyaan' missions. The missions are designed to send three humans into Earth's orbit to conduct scientific experiments, and plan to be finalised by August 2022. This is an opportunity for Australia to support what will become the fourth country to launch humans into space. It could strengthen ties with a country that is investing extensively in space and open up opportunities for future collaborations with the Australian space industry. The Agency is coordinating advice to ISRO from the Commonwealth agencies that will need to grant approvals for the project to go ahead.

International space standards

Growing our space sector will also depend on Australia enhancing its strategic influence on the international development of relevant standards – key tools to facilitate trade and access to markets and supply chains. Australia's national standards body, Standards Australia, represents Australian interests in the International Organisation for Standardisation and the International Electrotechnical Commission. Standards Australia can bolster Australia's influence on space related standards to support the Australian space industry.

Being responsible and safe

The Responsible pillar focuses on promoting a space sector culture that is globally respected, ensures national safety and security under an appropriate regulatory framework, and meets international obligations and norms.

National

The Agency is responsible for regulating civil space and high power rocket activities under the *Space (Launches and Returns) Act 2018* (the Act) and associated rules. The Agency assesses applications for launch facility licences, Australian launch permits, high power rocket permits, overseas payload permits, and return authorisations giving due consideration to the specific nature of the activity, including whether it is as safe as reasonably practicable. The Agency is supported in its evaluation of complex applications by a multidisciplinary team of external technical experts. Partial cost recovery fee arrangements are due to be implemented in July 2021 to support the assessment of applications under the Act.

The regulatory framework was updated in 2018 and 2019 to ensure it supports the growth of the space industry by removing unnecessary barriers to participation and encouraging entrepreneurship, as well as ensuring the safety of the activities and making sure our international obligations are met. Activities authorised under the previous *Space Activities Act 1998* were predominantly the launch of satellites from overseas where an Australian national was a responsible party.

The updated regulatory framework streamlined the approvals process, and adjusted insurance requirements appropriate to the risk levels for launches and returns. The regulation of high power rocket activities as defined in the High Power Rocket Rules was also included in the updated framework. This is because the risk profile of the activity necessitates evaluation under the Flight Safety Code and the application of insurance requirements. High power rockets are rockets with specific thrust and/or guidance as defined in the *Space (Launches and Returns) (High Power Rocket) Rules 2019* (High Power Rocket Rules). High power rockets do not reach altitudes above 100 km. Launches of space objects and high power rockets are considered to have a higher risk profile. Under the *Convention on International Liability for Damage Caused by Space Objects*, to which Australia is a State Party, a launching State is liable in certain circumstances. A launching State includes a state from whose territory or facility a space object is launched.

Innovation has allowed new and different activities, typically using smaller satellites. During the period 2003-2015 there were approvals for 7 large geostationary communications satellites. From 2016 to July 2020, 21 authorisations were granted for overseas launches (under both the previous and current legislative framework), mostly for small satellites. The applicants have been a combination of small businesses and universities, aiming to demonstrate technology or conduct experiments.

The Agency has been working with those wanting to conduct launches from Australia, which require authorisation under the Act. The Agency has received a number of applications for launch facility licences and Australian launch permits, consistent with growth in the sector. Previously there was one launch and one return approved during the period 2001-2014. Since the establishment of the Agency in 2018 until January 2021, there have been 16 such applications. This includes one return authorised under the *Space Activities Act 1998* (Hayabusa2 – see section on Australia's involvement in international missions).

Applications for launch facility licences, Australian launch permits and high power rocket permits are assessed giving due consideration to the specific nature of the activity, including whether it is as safe as reasonably practicable. The Agency is working with applicants to support them to complete their applications, however the onus remains on the applicant to provide the information required under the Act. The Agency has recently undertaken to hold a roundtable with companies considering launch activities to identify areas where guidance would benefit the stakeholder group.

International

The United Nations (UN) Committee on the Peaceful Uses of Outer Space (COPUOS) is the key forum for the development of international space law, including the five international space treaties. Australia is a founding member of COPUOS. This Committee allows for the monitoring and discussion of developments related to the exploration and use of outer space. Its mandate aims to strengthen the international legal regime governing outer space, resulting in improved conditions for expanding international cooperation.

COPUOS meets to discuss issues relating to current and future activities in space such as maintaining outer space for peaceful purposes, safe operations in orbit, space debris, space weather, the threat from asteroids, the safe use of nuclear power in outer space, climate change, water management, global navigation systems, and questions concerning space law and national space legislation. COPUOS reports to the Fourth Committee of the General Assembly, which adopts an annual resolution on international cooperation in the peaceful uses of outer space.

Australia is represented at COPUOS and its subcommittees by officials from the Agency and the Department of Foreign Affairs and Trade (DFAT). The Bureau of Meteorology attends the COPUOS Scientific and Technical Subcommittee.

Australia has signed and ratified the five UN space treaties:

- *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (the "Outer Space Treaty") (entered into force for Australia in 1967);
- *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space* (the “Rescue Agreement”) (entered into force for Australia in 1986);
- *Convention on International Liability for Damage Caused by Space Objects* (the “Liability Convention”) (entered into force for Australia in 1975);
- *Convention on Registration of Objects Launched into Outer Space* (the “Registration Convention”) (entered into force for Australia in 1986); and
- *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (the “Moon Agreement”) (entered into force for Australia in 1986).

The title of the treaties illustrates their basic subject matter, and they largely elaborate upon and refine provisions in the foundational Outer Space Treaty. The treaties bind member states (that have signed and ratified them), including Australia. The *Space (Launches and Returns) Act 2018* implements elements of the five space treaties (binding stakeholders to these elements), including that applications must include a statutory declaration that the space object is not and does not

contain a nuclear weapon or weapon of mass destruction; and applicants must supply information consistent with the Registration Convention.

Space debris

Applications for the launch of an Australian satellite overseas or a launch to space from Australia include consideration of the space environment, including space debris.

The *Space (Launches and Returns) Act 2018* includes the requirement for a debris mitigation strategy for certain activities (those involving objects going to space). The debris mitigation strategy must:

- be based on an internationally recognised guideline or standard for debris mitigation;
- identify the guideline or standard being used;
- describe any mitigation measures planned for orbital debris arising from the proposed launch; and
- include an orbital debris assessment based on an internationally recognised model.

Examples of internationally recognised guidelines or standards include the Space Debris Mitigation Guidelines of the COPUOS or the inter-agency space debris coordination committee's space debris mitigation guidelines. An example of an internationally recognised orbital debris model is NASA's Debris Assessment Software, which is publicly available. These guidelines identify a number of measures including limiting the release of debris during normal operations, avoiding intentional destruction and other harmful activities, and limiting the long-term presence of spacecraft and launch vehicle orbital stages in the low Earth orbit region after the end of their mission.

Inspiring the nation and a future workforce

The Inspire pillar focuses on building an Australian space sector that inspires industry, researchers, government and the Australian community, and contributes to the growth of the next generation of the space workforce.

Australians

Australia has a long involvement in space activities. Our crucial role in the Apollo lunar landings and tracking spacecraft exploring the solar system has been a source of pride for all the Australians involved and all those who remember these historic events. The Agency's brand is quintessentially Australian, highlighting our nation's unique geographical position and the strong link between space and our Indigenous people, who are the world's oldest astronomers.

Space can continue to play an important role in inspiring our community and encouraging our students to engage in science, technology, engineering, and mathematics (STEM). With a target of growing the workforce by 20,000 additional jobs by 2030, it is important that Australia builds a strong workforce pipeline to support the future needs of the space industry.

The Agency harnesses the inspirational value of space

To harness the inspirational value of space in developing the future STEM workforce, the Agency undertakes and supports a variety of activities and outreach programs. This includes participating in major space-themed events such as World Space Week and the celebration of the 50th anniversary of

the Apollo 11 Moon landing, as well as career-focussed events such as national Careers Week. The Agency supports and sponsors educational programs for schools, such as the Australian Space Design Competition, the One Giant Leap - JAXA Kibo-ABC program and the Deadly Science 'Junior Scientist Awards', which encourage STEM interest in students in remote schools.

In order to promote a skilled workforce, tertiary level studies, professional development and the growth of the space industry, the Agency supports and sponsors student challenges and competitions, student and professional conferences and a wide range of other programs, including those that encourage women in STEM careers.

The current uptake and inspiration of space in Australia is reflected in the engagement of the public with the Agency. From 1 July 2019 to 30 June 2020, news articles related to the Agency were viewed 76,931,340 times. This number is over three times the Australian population, meaning that some Australians viewed Agency related content multiple times over the course of the reporting year. The Agency reaches out to the community through its YouTube channel, Facebook and Twitter accounts, as well as its website space.gov.au and a regular public newsletter.

More details about the Agency's inspirational and workforce activities can be found in the *State of Space 2020* at https://www.industry.gov.au/publications/state-of-space-report.

Australian Space Discovery Centre

The Australian Government has committed $6 million towards establishing a Space Discovery Centre in Adelaide as part of the Adelaide City Deal. The Australian Space Discovery Centre will provide STEM education, engagement and inspiration for Australians. It offers a place for the community to meet and explore the latest innovations in space technologies, and Australia's role in expanding national and international space activities. Its mission statement is 'Inspiring the Australian community and the next generation of the space workforce through stories of opportunity, curiosity and technology'.

The centre will include a Careers Hub to showcase job opportunities in the local space industry; a theatrette for viewing the adjacent, operational Mission Control Centre and live space events; guest speakers and opportunities to engage with space experts; a space exhibition featuring hands-on experiences and information on Australia's growing space sector; and information on STEM education options for young people to explore pathways for a future in space.

The Agency, with Questacon, is working with the South Australian Government to establish the Australian Space Discovery Centre at Lot Fourteen in Adelaide alongside the Agency's headquarters. Construction commenced in September 2020, and plans to be completed in 2021.

Information on the centre, including a short video, is available at https://www.industry.gov.au/australian-space-discovery-centre.

Australian Space Agency

The Australian Government has tasked the Agency to triple the size of the Australian space sector to $12 billion and create up to another 20,000 jobs by 2030, as set out in the Strategy, with benefits to the broader economy.

The Agency is building on Australia's comparative strengths and areas of future competitive advantage to develop a space industry that helps every sector of the economy prosper, and assists Australian business to enter global markets and creates new jobs. Internationally, the Agency provides "one voice and one door" for Australia to work with our international counterparts.

The Agency is one of the most industry-focused space agencies in the world – being a partner and facilitator to support the growth of capability and innovation in the Australian space economy. This reflects the changing nature of the space economy as one in which businesses of all sizes can consider opportunities, rather than reliance on billion-dollar government programs. It more broadly encourages the transfer of space-related and space-enabled technologies to benefit other sectors of business and the economy.

Establishment of the Agency

The Australian Government established the Agency on 1 July 2018, in response to a review of Australia's space industry.

Specifically, in July 2017 the Australian Government initiated a review of Australia's space industry capability led by an Expert Reference Group. Guided by the review's interim report, which summarised the feedback from its extensive consultation process, in September 2017 the Government announced its intention to establish a national space agency. The agency was to support critical partnerships, coordinate a national strategy, provide support for industry growth and lead international engagement.

The Review's Final Report was published in March 2018 and outlined opportunities and recommendations for developing Australia's space industry. It is available at https://www.industry.gov.au/data-and-publications/review-of-australias-space-industry-capability-report-from-the-expert-reference-group.

Three reports were also commissioned to support the review and the work of the ERG:

- *Australian Space Industry Capability: A Review* (ACIL Allen Consulting)
- *Global Space Industry Dynamics: Research Paper* (Bryce)
- *Global Space Strategies and Best Practices: Research Paper* (Bryce)

The reports are available at https://www.industry.gov.au/data-and-publications/review-of-australias-space-industry-capability.

The Australian Government established the Agency as an ongoing entity on 1 July 2018 to effect long-term transformation and growth of Australia's space industry. It is a non-statutory, separately branded function within the Department. The Agency's headquarters are located in the innovation precinct at Lot Fourteen in Adelaide, alongside space industry neighbours such as the SmartSat CRC.

Agency Charter

The Agency Charter outlines the Agency's purpose, values, roles and responsibilities, governance structure, consultation mechanisms, and reporting on its performance. The Agency Charter can be found at https://www.industry.gov.au/data-and-publications/australian-space-agency-charter.

As detailed in the Agency Charter, the Agency's purpose is to transform and grow a globally respected Australian space industry. The Agency is responsible for whole-of-government coordination of civil space matters and is the primary source of advice to the Australian Government on civil space policy. Under this broad mandate, the Agency has six primary responsibilities:

- Providing national policy and strategic advice on the civil space sector;
- Coordinating Australia's domestic civil space sector activities;
- Supporting the growth of Australia's space industry and the use of space across the broader economy;
- Leading international civil space engagement;
- Administering space activities legislation and delivering on our international obligations*; and
- Inspiring the Australian community and the next generation of space entrepreneurs.

*Since the release of the Charter, the *Space (Launches and Returns) (High Power Rocket) Rules 2019* (High Power Rocket Rule) have commenced. Therefore, in addition to the responsibility of regulating space activities, from 1 July 2020 the Agency also has responsibility for regulating high power rocket activities (with a high power rocket defined in the High Power Rocket Rules).

The Agency's governance structure is centered on the roles of the Head of the Agency, Deputy Head of the Agency and the Advisory Board. The Advisory Board is a non-statutory, independent, skills-based board that provides advice and supports the Agency to achieve its purpose. It is not a decision-making body and has no governing legislation. Members are appointed by the Minister and at the Prime Minister's discretion. Members can be found at https://www.industry.gov.au/about-us/australian-space-agency-advisory-group. Dr Megan Clark AC commenced as Chair of the Advisory Board on 1 January 2021.

The formal mechanisms through which the Agency consults and coordinates with government and industry are: the Australian Government Space Coordination Committee Meeting, comprised of Australian Government departments and agencies; the State and Territory Space Coordination Meeting, comprised of representatives from the state and territory governments; and the Space Industry Leaders Forum, comprised of representatives from the Australian space industry. Members of the Space Industry Leaders Forum can be found at https://www.industry.gov.au/about-us/space-industry-leaders-forum.

Statement of Expectations

The Minister for Industry, Science and Technology issued a Statement of Expectations to the Head of the Agency on 2 September 2019, which outlines the Minister's expectations of the Agency. The Statement is complementary to the Agency Charter and Strategy. The Head of the Australian Space

Agency responded through a Statement of Intent, dated 8 May 2020, including details of progress against expectations. It sets out how the Agency is meeting the Minister's expectations.

The Statement of Expectations and response is available at https://www.industry.gov.au/about-us/about-the-australian-space-agency.

Evaluation and statutory basis of the Agency

A post-commencement evaluation and operational review of the Agency is to commence within four years of operation, as outlined in the Agency Charter. The review will assess the governance arrangements of the Agency, identify potential improvements, and make recommendations to Government to determine if the Agency should remain with the Department or transition to become a separate statutory entity. The Department's evaluation framework will inform this review. The evaluation framework is also intended to ensure that the Agency continues to meet the expectations of Government, industry and other stakeholders.

Other industry and science programs available to the space sector

The Department of Industry, Science, Energy and Resources (the Department) and its portfolio agencies undertake a range of activities that support the economy. While some of these programs are targeted specifically at the space sector, there are also broader programs that are accessible to the space industry.

AusIndustry

AusIndustry supports businesses to grow, diversify and thrive through a range of government programs and services. AusIndustry provides advice, networks, opportunities and funding to help businesses. These services support businesses in all sectors of the economy, including space. Information is available through the business.gov.au website, which provides information, grants, services and support from across government to help business succeed in Australia.

The AusIndustry Outreach Network is the local business connection, with offices in every state and territory, in capital cities and regional areas. The network of Regional Managers and Business Development Managers provide impartial, trusted guidance tailored to local businesses. With extensive reach into both metro and regional areas, the on-the-ground presence helps to foster strong collaborative relationships with local, state and federal government agencies, and offers a personalised business liaison function that takes into account regional conditions. The highly skilled, agile and responsive workforce flexibly delivers government services to businesses and connects them to services across all levels of government. The outreach network are local people who understand local issues and work to minimise barriers and maximise opportunities for businesses in their region, including those in the space sector.

Entrepreneurs' Programme

AusIndustry's Entrepreneurs' Programme (EP) delivers expertise, connections and grants to help Australian SME businesses strengthen, grow, innovate, and commercialise products or services, both nationally and globally. This drives economic growth and jobs, improving broader community outcomes.

The program provides businesses with access to tailored advice from a national network of over 170 industry experts, which is backed up by learning events and grant funding. This helps Australian businesses to commercialise products, innovate and grow.

As at 31 December 2020, EP has helped over 19,300 businesses through tailored expert advice, grant funding and learning events, and provided $359 million in matched grant funding to help them act on the recommendations provided since it was launched in June 2014. This includes eligible businesses operating in the space sector. For example, with support through EP:

- Queensland firm Hypersonix Launch Systems is commercialising an Australian manufactured hydrogen fuelled scramjet engine to put small satellites into low-level orbit cost effectively.
- Clearbox Systems has worked with the University of New South Wales (UNSW) Canberra Space to devise new methods to extract information from spacecraft signals to enhance Space Situational

Awareness capability. Clearbox Systems is a specialist technology provider supporting satellite communications and electromagnetic spectrum surveillance, monitoring and measurement. Clearbox Systems and UNSW Canberra Space have been able to leverage the initial research collaboration and scale activity into additional commercial and grant funded collaborations, most notably a $3 million Cooperative Research Centre Project.

- Fluorosat has been able to fast track development of its platform combining agricultural modelling, remote sensing imaging (from drone, plane and satellite) and machine learning to detect early signs of plant stress and help businesses and farmers to proactively manage and respond to the needs of crops, improving yields.

EP contributes to successful outcomes for business. Based on self-reported client survey data, a business that participates in EP has on average created 4.4 new jobs and generated a $1.56 million increase in turnover per annum 12 months after completing their initial engagement.

Cooperative Research Centres Program

The Cooperative Research Centres (CRC) Program aims to lift levels of industry-research collaboration to assist in supporting science, research, and commercialisation; and enable growth and productivity for globally competitive industries. The program supports medium to long term collaborations of up to 10 years through the CRC Grants stream, and short term collaborations of up to 3 years through the CRC Projects (CRC-P) stream.

The CRC Program is open to all industry sectors and research disciplines, and has historically supported space-related investments and continues to do so, including through the SmartSat CRC and 4 active CRC-Ps contributing to the space sector.

- The SmartSat CRC will receive $55 million in funding from 2019-26, to catapult the nation in the global space industry playing a leading role in niche areas of advanced communications, earth observations from space and data analytics. In collaborating with 80 partners, including 50 Australian companies and 16 universities, the SmartSat CRC will establish a nationally coordinated ecosystem of space research-industry collaboration.
- The *Responsive Access to Space* CRC-P, led by Defendtex Pty Ltd, will receive $2,989,000 in funding from 4 July 2018 to 31 December 2021 to develop leading edge, low cost, high availability rocket propulsion technology through development of a Rotating Detonation Engine designed to integrate into a space launch system.
- The *Manufacturing Lightweight Rocket Fuel Tanks to Make Space Affordable* CRC-P, led by Gilmour Space Technologies Pty Ltd, will receive $3,000,000 in funding from 3 February 2020 to 31 January 2023 to develop composite rocket fuel tanks for low cost space transport.
- The *Next-generation Test and Measurement Devices for Photonics Sensing* CRC-P, led by Liquid Instruments Pty Ltd, will receive $2,850,000 in funding from 20 January 2020 to 19 January 2023 to commercialise advanced test and measurement technology to enable high-performance optics and photonics sensing for industrial, education and defence applications.
- The *Sensor Network for Integrated Space Traffic Management for Australia* CRC-P, led by Clearbox Systems Pty Ltd, will receive $3,000,000 in funding from 1 October 2020 to 31 March 2023 to develop new sensor technologies and commence implementation of an integrated space traffic management system that will securely store, analyse and distribute collected data for satellite location, identification, tracking and collision avoidance.

Geoscience Australia

More information can be found in Geoscience Australia's submission to this Inquiry. Some of Geoscience Australia's space-related programs are below.

Positioning and the Satellite-Based Augmentation System

Geoscience Australia received $160.9 million in the 2018-19 Federal Budget to support the development of an operational Satellite-Based Augmentation System (SBAS). The first SBAS in the Southern Hemisphere, known as SouthPAN, is being developed in collaboration by Geoscience Australia and Land Information New Zealand (LINZ). SouthPAN will augment Global Navigation Satellite System signals to deliver a satellite positioning capability across all of Australia and its maritime zones with decimetre accuracy.

Positioning data is now fundamental to a range of applications and businesses worldwide. It increases productivity, improves safety and propels innovation. It supports intelligent navigation tools and advanced transport management systems that connect cities and regions. Benefits to mining from SBAS include better use of current technology, such as more precise positioning, driverless vehicles in mine sites, navigation drones for surveying and monitoring mine sites. These technologies benefit local businesses.

Geoscience Australia is responsible for Australia's fundamental national positioning infrastructure and services, and is the Australian Government's technical lead on positioning matters.

Earth observation and Digital Earth Australia

Digital Earth Australia (DEA) provides government and businesses with unprecedented access to satellite imagery tailored for Australia. It improves understanding of environmental changes, such as water availability, soil characteristics, subsidence, vegetation health and urban expansion, which supports improved decision making and planning.

DEA supports Australia's economy by enabling small businesses and industry to more readily access satellite data to innovate and create new products. In the mining industry, for example, it provides a means to effectively and efficiently monitor the impact of operational activity including mine dewatering and rehabilitation. Through the use of time-series analysis, DEA can be used to assess changes in vegetation health around mines and other major infrastructure.

DEA also reduces the cost barriers associated with accessing and analysing satellite data, making it available to small business owners to inform decision making and develop new monitoring tools.

Geoscience Australia is the Australian Government's technical lead on Earth observation for land applications and is a member of the Australian Government Satellite Earth Observations Steering Committee governing the Australian Government Satellite Earth Observations Roadmap currently under development.

CSIRO

CSIRO, Australia's national science agency, is an independent statutory authority constituted and operating under the provisions of the *Science and Industry Research Act 1949*. More information can be found in CSIRO's submission to this Inquiry. Some of CSIRO's space-related programs are below.

National space facilities and visitors' centres

CSIRO operates several national space facilities: the Canberra Deep Space Communication Complex, the European Space Agency's New Norcia deep space tracking station, and the CSIRO share of the UK-operated NovaSAR-1 satellite. CSIRO also operates the Australia Telescope National Facility (ATNF), which includes the Parkes and Australian Square Kilometre Array Pathfinder (ASKAP) radio telescopes and the Australia Telescope Compact Array, and will be the Australian operating partner of the Square Kilometre Array (SKA).

CSIRO has two key operational agreements with NASA: the *Agreement between the Government of Australia and the Government of the United States of America concerning Space Vehicle Tracking and Communication Facilities*, under which it manages the Canberra Deep Space Communication Complex (CDSCC); and the *Agreement between the Government of Australia and the Government of the United States of America concerning the Conduct of Scientific Balloon Flights for Civil Research Purposes*, under which it manages the NASA Alice Springs Ballooning Facility. CDSCC, operated by CSIRO for NASA, provides two-way communications and control between the Earth and spacecraft, for around 30 space missions, reaching out as far as the Voyager spacecraft. In partnership with the Agency, CSIRO represents Australia on the International Space Exploration Coordination Group (ISECG) and International Mars Exploration Working Group (IMEWG).

The ATNF and CDSCC facilities are also used to undertake space science research including space domain awareness and asteroid tracking activities, and to support the Murchison Widefield Array (MWA) radio telescope, including its space science research.

CSIRO also operates visitors centres at the Parkes radio telescope and CDSCC, and together these two sites attract more than 150,000 public visitors each year, inspiring students and families to understand astronomy and space sciences.

CSIRO has acquired a 10% tasking and downlink capacity share of the UK-operated NovaSAR-1 S-band Synthetic Aperture Radar satellite, which was successfully launched in September 2018. This acquisition provides the very first opportunity for Australian scientists to directly task and acquire imagery in near-real-time from an Earth observation satellite, for applications ranging from disaster monitoring to land use and land cover mapping. CSIRO will operate the approximately $10 million investment in the NovaSAR-1 satellite as a national research facility, providing free open-access Earth observation data for the benefit of the Australian research community, with researchers from across the country able to apply for data to be acquired by this facility.

Space Technology Future Science Platform

The Space Technology Future Science Platform ("Space FSP") was established in 2018-19 specifically to generate technological innovations that will support the growth of the Australian space industry. Through the multidisciplinary Space FSP program CSIRO carries out a wide range of space technology research and development activities in areas including small satellite technologies (such as sensors, power systems and materials), Earth observation data analytics and applications, space communications, space object tracking and signal processing, robotics, remote operations and in situ resource utilisation, and space life sciences. This program is developing capability within CSIRO and generating new innovations that hold the potential to generate significant societal benefits and commercial opportunities and, in partnership with industry, will help transform the Australian space sector.

CSIRO Centre for Earth Observation

CSIRO works closely with Geoscience Australia and the Bureau Meteorology in support of operational Earth observation activities, and jointly with these agencies represents Australia on key programmatic aspects of international coordination on Earth observations from space, particularly through the international Committee on Earth Observation Satellites (CEOS) and the inter-governmental Group on Earth Observations (GEO). CSIRO provides scientific services to national and international partners including satellite calibration and validation, and development of regional petabyte-scale satellite 'Data Cube' data analytics platforms to improve the accessibility and utility of satellite data.

CSIRO directly applies its Earth observation capabilities to areas of national benefit including climate and disaster monitoring, managing our water and natural resources, monitoring the environment, and supporting public access to and use of Data Cubes, which enable governments and industry, including SMEs, to undertake scalable and low start-up cost data analysis to develop new satellite imagery-based business products.

AquaWatch Australia Mission

CSIRO is developing AquaWatch Australia as part of its emerging Missions portfolio, in partnership with the SmartSat CRC and other organisations. The aim of this Mission is to establish an integrated ground-to-space national water quality monitoring system to provide decision-ready information to water agencies, local communities, agricultural and commercial water users, in order to support better management of our valuable freshwater resources, manage the health of ecosystems and coastal resources, and prevent human or animal health impacts. The Mission aims to include three key elements that will be developed over the course of the next decade: one or more locally built Earth observation satellites, combining their data with a dense network of ground sensors, strategically placed throughout our nation's rivers and waterways, into a system that provides water quality observations and predictions and data for decision making. This Mission is working closely in collaboration with the local space industry to create more high-tech space jobs, and at the same time solve a major environmental challenge for Australia. A 'Phase 0' study is underway in 2020-21 to undertake user consultations and develop the Mission's business case.

Space 2.0 Workshops and Space Industry Development

CSIRO established the Space 2.0 Workshop series in 2017 to support the Australian space start-up sector. Over 2017 and 2018 CSIRO held three Space 2.0 workshops to support opportunities for Australian space start-ups and SMEs to develop research and business collaborations with CSIRO and the wider research and government sectors, aerospace primes, investors and space technology end-users. The fourth Space 2.0 Workshop (2019) was run jointly by CSIRO and the Australian Space Agency. It brought together the Australian space 2.0 ecosystem to discuss opportunities for large-scale national space activities that would contribute to the goals and priority areas of the Australian Space Agency. A key outcome of this workshop was the development of the AquaWatch Australia concept, which was subsequently taken forward by CSIRO and the SmartSat CRC. The most recent workshop, also run jointly by CSIRO and the Australian Space Agency, focused on national and international space supply chains and opportunities for the manufacturing sector specifically.

In 2018 CSIRO Futures released a national space industry roadmap[10] to identify major challenges over the coming decades and opportunities where Australia can potentially develop world-leading expertise and realise industry growth. The Space Roadmap also helped inform the development of the National Civil Space Priorities released April 2019.

CSIRO is also able to offer a wide range of industry support mechanisms, as well as commercial engagement strategies to enable industry and national benefit from CSIRO research. CSIRO's SME Connect facilitates and enables innovation-driven partnerships between CSIRO and industry through funding, support and resources. Main Sequence Ventures, which manages the CSIRO Innovation Fund, provides venture capital for Australian deep-tech companies, including space start-ups Gilmour Space Technologies, FluroSat and Myriota.

International astronomy partnerships

Australia has a rich history in exploring space through astronomy, dating back beyond the breakthrough observations of the transit of Venus by the Sydney Observatory in the 1870s. Along the way, Australian astronomy has produced broad societal benefits, including by sparking new innovations such as fast wireless LAN technology at the heart of WiFi, developed as a result of CSIRO's work on radio astronomy in the 1990s.

The Australian Government is currently invested in two globally significant astronomy collaborations: the Square Kilometre Array (SKA) and the European Southern Observatory (ESO).

The SKA is one of the world's most ambitious science projects. With 16 contributing countries, the SKA will help scientists answer fundamental questions about the Universe and open up new areas of astronomical discovery. In terms of physical scale and the volume of data it will produce, the SKA will be the world's largest scientific instrument, offering a significant technological and data challenge, and potential rewards, to its participants. Australia will host the low frequency part of the SKA, with the mid frequency element hosted in South Africa.

Australia is also a strategic partner of ESO, which operates some of the largest and most technologically advanced optical telescopes in the world. ESO's main mission is to provide state-of-the-art research facilities to astronomers and astrophysicists, allowing them to conduct front-line science in the best conditions. It is currently building the 39-metre 'Extremely Large Telescope', which will become the world's largest optical telescope.

The benefits of collaborating on mega-science astronomy projects go well beyond scientific and technological discoveries. Australian businesses are developing new skills and capabilities to respond to unique technological challenges, making them more competitive. In particular, new technologies developed to manage the SKA's unprecedented volumes of data will create commercial opportunities beyond astronomy, and support advanced manufacturing techniques. Both the SKA and ESO also have enormous potential to capture the public's imagination through exciting discoveries. Engaging with science and pursuing STEM studies will help Australians prepare for the jobs of the future.

[10] "Space: A roadmap for unlocking future growth opportunities for Australia", CSIRO Futures, 2018, https://www.csiro.au/en/Do-business/Futures/Reports/Future-Industries/Space-Roadmap

Research and development

Australia's contribution to the global space economy is also underpinned by a strong science and research and development (R&D) base. According to InCites data and Austrade, in 20 out of 22 fields of academic research, Australia's research publications achieve an impact that is at least 20 per cent above the global average – and space science in Australia's strongest category of published research.[11] Australia contributed 7.0 per cent of the world's publications in space science between 2013-17[12].

Australia has a solid base for space research in universities, public research agencies and private institutions. This includes early stage R&D and in technologies that are closer to commercialisation. Australia's space R&D capabilities range from satellite and wireless communications to Earth observation data analytics. For decades, we've operated world-class astronomical observatories and other space-related infrastructure, including tracking stations for NASA and the European Space Agency. Many research projects inspire the public and encourage young people into STEM careers.

The Agency and the broader Department highlight Australia's fields of excellence and identify areas to develop technology and applications in emerging fields, as outlined in the Strategy. In addition, the R&D Tax Incentive is a broad based, self-assessment program allowing businesses who are undertaking eligible R&D activities to claim a tax offset for those activities. The R&D Tax Incentive program is available to businesses in all sectors, including those who undertake R&D in the space sector.

National security

The space industry carries national security risks, including cyber security. The Department is working with the Department of Home Affairs through the Protecting Critical Infrastructure and Systems of National Significance package (and other measures) to address these concerns.

It is important to ensure access, as well as resilience, to space technology. This because of the benefits that Australians derive from it as detailed elsewhere in this submission, and the potentially major consequences should access to it become compromised.

[11] Austrade (2020), *Why Australia? Benchmark Report 2020.* Available at https://www.austrade.gov.au/International/Invest/Resources/Benchmark-Report

[12] Finch A (2018) *CSIRO Science Health and Excellence Report 2017-18*. Full Version. CSIRO, Australia. Available at https://doi.org/10.25919/5c59cf2e6fb7a.

Measuring progress

Defining the Australian space sector

For the purpose of measuring the progress of the space sector, the Australian space sector is defined as a set of space-related activities along the space value chain and is part of the broader space economy[13]. This definition was developed by the Agency in collaboration with the Nous Group.

All actors (private, public and academic) participating in production, operation, supply and enablement activities that form the space value chain are part of the space sector. Value chain segments in the space sector broadly include:

- Manufacturing and core inputs, such as satellite or payload manufacturing and the building and integration of ground-based facilities and equipment that perform space-related activities;
- Space operations, such as launch activities and the management of objects in space;
- Space applications such as producing the hardware and software to process earth observation imagery or direct to home television; and
- Enablers, such as essential service delivery, infrastructure and capabilities, research, development and engineering, and specialised support services.

While the space sector captures the provision of space-related goods, services and applications to broader industries, it does not include subsequent non-space (value adding) activities that are enabled by space activities (such as food grown using precision agriculture techniques). These flow-on activities are captured by the broader space economy.

This definition of the Australian space sector has drawn on the current Organisation for Economic Cooperation and Development (OECD) definition for the space economy[14]. The OECD definition has also been used by New Zealand, Canada and the United Kingdom. It allows for comparability and consistency with other international space sectors, and consistency for what is included while the Australian space sector continues to grow and change.

Targets for measuring success

The Strategy outlines the targets for measuring the Agency's success in achieving its broader objective to grow and transform Australia's space industry by tripling the size of the space sector to $12 billion and creating up to another 20,000 jobs by 2030:

- Stimulate at least $1 billion pipeline in inward capital investment in Australia's space industry between 2019 and 2025, including R&D investment and infrastructure investment.
- Achieve year-on-year growth of the Australian space industry that exceeds 8.5 per cent per annum.

[13] Australian Space Agency (2020), *Definition of the Australian space sector*, Available at https://www.industry.gov.au/data-and-publications/definition-of-the-australian-space-sector.

[14] OECD Space Forum, *OECD Handbook on Measuring the Space Economy*, Organisation for Economic Co-operation and Development, Paris, 2012, p. 20.

- Achieve year-on-year growth of direct and indirect jobs that would meet a target of 20,000 additional jobs by 2030.
- Create a regulatory framework that ensures effective, efficient and safe space activities (since 30 June 2020, this also includes high power rockets).
- Increase awareness of space activities and the impact on the Australian economy, cumulatively reaching at least 10 million Australians per year.

Progress against measures

The Australian Government publishes an annual *State of Space* report, compiled by members of the Australian Government Space Coordination Committee. The report covers progress towards meeting targets outlined the Strategy, using IBISWorld and Agency data. The following information is from the *State of Space 2020* report at https://www.industry.gov.au/publications/state-of-space-report.

Table 1 – Progress against measures of success from 2018-19

Target	Status
$1 billion pipeline of inward investment (Source: Agency data)	The Agency, through its engagement with industry and the states and territories has been tracking a strong civil space capital pipeline of activity. The observed pipeline includes $2.001 billion pipeline of capital projects including R&D in all states and territories FY2018/19 to FY2027/28. Over $729 million of this is inbound investment from industry, private foundations and international space agencies. 88 projects are being tracked across all states and territories.
Triple sector revenue to $12 billion*	In 2018-19 the Australian space sector generated approximately $5.3 billion in revenue, representing an increase of 13 per cent from 2016-17.
Growth rate exceeds 8.5 per cent*	Industry revenue is expected to grow at an annualised 5.4 per cent over the five years through to 2020-21. Industry revenue is forecast to grow at an annualised 8.3 percent over the five years through to 2025-26.
20,000 additional jobs*	In 2018-19 the Australian space sector employed approximately 13,200 people, representing employment growth of 14 per cent from 2016-17 to 2018-19. Over the two years from 2016-17 to 2018-19, the total number of businesses in the industry increased by almost 10 per cent, from 698 to 766.
Regulatory framework (Source: Agency data)	The *Space Activities Amendment (Launches and Returns) Act 2018* came into force on 31 August 2019. The Agency participated in a number of meetings to support the United Nations' Committee on the Peaceful Uses of Outer Space.
Cumulative reach of 10 million Australians (Source: Agency data)	The estimated potential cumulative media audience from 1 July 2018 to 30 June 2019 for the Agency was 71 million, meaning the majority of Australians heard or saw news about the Agency in its first year of operation. This media reach does not include the media reach of the SCC membership who also achieve good media outcomes from their space activities.

Target	Status
	The estimated reach is based on reporting available to the Australian Government through iSentia media monitoring.
GDP contribution*	Industry value added was $2 billion in 2018-19, representing an increase of 13 percent from 2016-17. $2 billion was approximately 0.1 percent of Australia's 2018-19 GDP.

* Source: IBISWorld (2020), Satellite Communications and Astronautics in Australia

Future tracking of industry growth and characteristics

Over 2019 and 2020, the Agency undertook important methodological research to support the ongoing collection, collation and analysis of data to better measure the size and characteristics of Australia's space sector and consistently track progress towards the Australian Government's goals over time.

This methodology is repeatable to inform a series of future economic snapshots to be produced by the Agency approximately every two years, providing regular visibility of the changes in Australia's space sector.

The Agency has set the 2016-17 financial year as an economic baseline and is preparing the *Economic snapshot of the Australian space sector: 2016-17 to 2018-19.* It is expected to be published in early 2021.

The snapshot will present the Agency's analysis of the Australian space sector's performance against key economic indicators such as jobs, revenue and growth (between FY16-17 and FY18-19), and investment (to September 2020)[15].

This analysis was developed using a collation and analysis of an internally managed database of Australia's space sector, including data from the survey of Australia's space sector in March 2020. It was also supported by complementary work by independent consultants, Nous Group and AlphaBeta.

The Agency used the definition of the Australian space sector described above to determine the set of organisations to be included in the analysis. This framework is expected to be different from the methodology used by IBISWorld (numbers quoted above), as it draws on the internal dataset administered by the Agency and is intended to provide richer information of activity along the value chain segments of the space sector.

[15] Note, revenue, jobs and growth are lagging indicators and investment is a leading indicator, which is why reporting timeframes differ.

Department of Defence

The Australian Space Agency works with the Department of Defence, where civil space activities interact with defence space activities. The following information has been provided by the Department of Defence.

The Australian Government confirmed in the 2020 Defence Strategic Update that assured access to space is critical to the Australian Defence Force (ADF) warfighting effectiveness, situational awareness and the delivery of real-time communications and information. The Government will significantly increase investment in Defence's space capabilities. This includes plans for a network of satellites to provide an independent and sovereign communications network and an enhanced space control program. The Government will continue investment in space situational awareness, including sensors and tracking systems. Defence will work closely with industry and other government agencies to advance its space capabilities, including through the Australian Space Agency.
The Government has agreed to invest around $7 billion in space capabilities over the next decade, as outlined in the 2020 Force Structure Plan.

Australia is increasingly reliant on satellite-based capability and services, particularly where digital data and information drives decision-making. At the same time, low-earth space orbits are becoming congested with increasing numbers of satellites being launched around the world every year.
The combination of an increasing reliance on space capabilities with the capacity limitations of Australia's legacy systems must be addressed.

Defence is working closely with the United States and other nations, including through the Combined Space Operations Initiative, the Australian Space Agency, and industry to transform the way the ADF operates in space, including in relation to satellite communications, space domain awareness, position navigation and timing, and intelligence, surveillance and reconnaissance.

Our space services and space control programs, along with the Geospatial Information and Intelligence program, contribute to Defence operations by providing assured access to space capabilities, enabling situational awareness and delivering real-time communications and position, navigation and timing information.

Continued investment in and development of space capabilities will be required to further improve Defence's resilience and enhance a large number of space-dependent capabilities across the Joint Force. Investment of around $7 billion in space capabilities over the next decade, which includes investment in sovereign-controlled satellites, will provide assured access to these services when needed.

The Government is also committed to growing the domestic space sector through the Sovereign Industrial Capability Priorities. The Sovereign Industrial Capability Priorities (the Priorities) were first identified in the 2018 Defence Industrial Capability Plan, which outlines Government's long-term vision to build a robust, resilient and internationally competitive Australian industrial base that is better able to meet Defence capability requirements.

On 8 December 2020, Defence released a full Industry Plan covering the *Surveillance and intelligence* Priority. This plan, available on the Defence website,[16] identifies space domain awareness and space-based surveillance technologies as critical industrial capabilities that Defence seeks sovereign access to in the Australian industrial base. Defence requires Australian industry to design, develop and sustain integrated sensor technologies for both space domain awareness and Earth observation purposes. This includes regular updates and upgrades to meet Defence's rapidly changing strategic priorities in the space domain.

Defence is committed to building and supporting these industrial capabilities within the Australian industrial base through Defence capability acquisition and sustainment projects that align with the Priorities. Prospective tenderers supplying Defence with these technologies will be required to address each of the relevant critical industrial capabilities. In instances where an Australian supplier is not able to provide the required product or service, tenderers are required to outline a transition plan to transfer key knowledge, skills or work packages into Australia over the life of the contract.

Defence has awarded a number of grants to companies supporting space capabilities through the Sovereign Industrial Capability Priority Grants program. This $24 million per annum program supports eligible Australian small-to-medium enterprises to invest in projects that build capabilities aligned to one or more of the Priorities. Assessments of Sovereign Industrial Capability Priority Grant applications continue on an ongoing basis, and small-to-medium enterprises delivering space domain awareness or space-based surveillance capabilities are encouraged to apply. More details on the grants program can be found on the Centre for Defence Industry Capability website.[17]

Key Defence Space Related Capability development projects are outlined below:

Satellite communications

Defence Joint Project 9102 Phase 1 aims to deliver a sovereign controlled Satellite Communications (SATCOM) system over the Indo-Pacific region with global access attained through sharing arrangements with international partners and supplementation/augmentation of the whole SATCOM system using commercial SATCOM contracts.

The Request for Tender is planned for 2021 and final operational capability in the early 2030s. Australian industry opportunities will be solution dependent and are likely to be in the development and support of the SATCOM control system, support SATCOM and satellite operations, sustain the SATCOM system, construction, maintenance, and expansion of SATCOM facilities. In addition, $50 million over 15 years has been identified to support innovation and research in Australian industry for technologies that will support future phases of the project as well as the broader needs of the Space Domain. Joint Project 9102 will work with the Australian Space Agency, the Space Domain, Defence Science and Technology Group, and the Defence Innovation Hub to identify the best opportunities for this investment.

[16] https://www1.defence.gov.au/business-industry/capability-plans/implementation-industry-plans

[17] https://business.gov.au/Grants-and-Programs/Sovereign-Industrial-Capability-Priority-Grants

Space domain awareness

Defence has moved towards Space Domain Awareness (SDA) as a broader concept than Space Situational Awareness, as SDA underpins all space missions, providing the ability to identify, characterise and understand factors that affect the space domain.

Through Joint Project 9360, Australia is investing in a diverse multi-technology sensing and command and control system that will provide a sovereign SDA capability while allowing for flexibility to adapt to emerging threats. This allows an iterative approach to capability management with a strong focus on industry partnerships. JP9360 hosted SpaceFest 2020 in early December where participants from 15 organisations (both industry and academia) demonstrated SDA sensor capabilities to Defence.

Position, Navigation and Timing

Joint Project 9380 Phase 1 – Assured Position, Navigation and Timing (PNT) in a contested environment includes a rolling upgrade program to assure PNT in a contested environment. One part of the project will seek to harden Defence's military GPS user equipment by upgrading some prioritised Defence platforms with advanced military GPS capability under a Foreign Military Sales case with the United States Department of Defense. Another aspect of the project will be to develop our own support system with testing, trials, training, and compliance capabilities to learn how to recognise and operate in PNT contested environments. The provision, operation and sustainment of simulation and emulation systems required for these purposes will present opportunities for industry. The project will also seek to identify alternative PNT data sources to those provided by GPS, some of which could be provided by Australian industry.

Intelligence, surveillance and reconnaissance

The Australian Geospatial-Intelligence Organisation (AGO), within the Department of Defence, is responsible for delivering the Defence 799 (DEF799) series of projects, which provide enhanced access to commercial satellite imagery through a network of ground stations around Australia and will deliver the future sovereign satellite imagery capability to support Defence, national security and whole-of-Government activities.

DEF 799 will provide:

- enhanced access to commercial satellite imagery capabilities out to 2030 (Phase 1);
- increased funding for Phase 2 with the intent of prioritising development of a sovereign satellite imagery capability to enhance intelligence and surveillance coverage of the Indo-Pacific region; and
- ongoing capability through additional sovereign satellites beyond 2040 (Phase 3).

Defence will continue to engage with other government agencies, such as the Australian Space Agency, and industry to understand how this capability could be supported by Australian industry.

Future research capacity, workforce development and job creation

Defence Innovation Hub

The Defence Innovation Hub (the Hub) funds the development of innovative technologies with the potential to enhance Defence capabilities and build Australia's defence industry sector. It has invested around $270 million in Australian businesses and research organisations with over $800 million in investments planned over the next decade to 2030.

The Hub is contributing to the growth of the Australian space sector by investing in the development of space-related technologies in areas such as space domain awareness, satellite communications and data fusion. Since its launch in December 2016, the Hub has invested $36 million in space related innovation projects. The Hub's investment in Australia's space industry has supported 70 jobs across the country.

The Hub has also made investments in a range of other innovations with space related applications.

The following table captures the Defence Innovation Hub's space related grants:

Company name	Contract title	Contract value (GST incl.)
Clearbox Systems Pty Ltd	SATCOM Modern TRANSEC Key Management Tool	$755,431
CyberOps Pty Ltd	Satellite Cybersecurity Capability Development	$299,200
DEWC Systems Pty Ltd	Miniaturised Orbital Electronic Warfare Sensor System (MOESS)	$3,105,251
EM Solutions	Flat-panel antenna terminal for broadband UAV or USV communications	$5,763,967
EM Solutions	Next Generation Satcom Antenna for Navy Vessels	$1,918,400
EOS Space Systems Pty Limited	A mobile space control system	$4,642,055
High Earth Orbit Robotics Pty Ltd	Orbital Flownet: A self-organising swarm for space-based SSA	$273,900
Inovor Technologies Pty Ltd	Space Based Space Situational Awareness platform to enhance Defence's space surveillance capability	$5,730,469
Inovor Technologies Pty Ltd	Sovereign small satellite technology development and flight test	$272,235
Saber Astronautics	An intelligent Data Fusion network to process a large number of space objects	$2,136,130
Saber Astronautics	Autonomous identification and modelling of electronic signals threat (Phase 1)	$274,606
Saber Astronautics	Autonomous identification and modelling of electronic signals threat (Phase 2)	$1,234,527
Silentium Defence	Ground-based Passive Radar for Covert, Wide Field-of-View Space Situational Awareness (Phase 1)	$869,826
Silentium Defence	Ground based Passive Radar for Covert wide field-of-view Space Situational Awareness (Phase 2)	$3,488,000
Spiral Blue Pty Ltd	Monitoring Australia's northern maritime approaches with satellites and AI	$643,735
Western Sydney University	Neuromorphic vision systems for next-gen space situational awareness capability	$5,456,436

Space Research and Experimentation

Defence Science and Technology Group (DSTG) contributes to the development of Australia's space capabilities in partnership with the national Science and Technology (S&T) enterprise and collaborating with international partners. DSTG has three space technologies and capabilities research and development programs:

- The space strategic research program, delivered though the Resilient Multi-mission Space STaR Shot project, to focus strategic space research and proactively develop leap-ahead Defence space capabilities. Science, Technology and Research (STaR) Shots are challenging, inspirational and aspirational S&T missions that will align strategic research with force structure priorities. DSTG is seeking an industrial (or industrial team) partner to help develop and integrate the technologies being developed for the space Star Shot.
- The Next Generation Technologies Fund (NGTF) Space Capabilities theme to support streamlined transitioning of good technological ideas into capability. The NGTF will seek submissions in the first quarter of 2021 to develop an innovative 'space qualified' Radio Frequency sensor payload as part of the Space Capabilities priority area. Defence is also a core member of the SmartSat Cooperative Research Centre.
- The Space Strategic Research Initiative program develops expertise in space with a focus on space situational awareness and the development and operation of small satellites (such as the Buccaneer CubeSat). The Buccaneer program demonstrates innovative capabilities to calibrate Defence's over-the-horizon Jindalee Operational Radar Network (JORN).
  The Buccaneer Main Mission satellite bus will be developed by the South Australian-based Inovor Technologies with other industry support.

Research and technology development

More Together Defence Science and Technology Strategy 2030

- The More Together Defence Science and Technology Strategy 2030, released on 4 May 2020, outlines Defence's broad Science and Technology (S&T) priorities. The key objectives of this Strategy are to focus on larger S&T programs supporting Defence strategic priorities, increase scale by partnering with the national S&T enterprise and international partners, and deliver a capability edge through streamlined and secure innovation pathways.
- DSTG is leading the development of the Defence Innovation Strategy, which will lay the foundation for the innovation pathways from initial concept through to transition into an operational system or capability. This will require Defence to pro-actively engage with partners in industry and academia early in the innovation process to help design and develop the solutions and transition pathways to deliver accelerated capability critical to ensuring Defence maintains a capability advantage.

International collaboration, engagement and missions

Defence has collaborated with the United States Department of Defense on a number of space capability development opportunities:

- The Australian Mission Processor processes data from US Defence Support Program and Space Based Infrared System satellites which can detect missile launches varying from short-range to intercontinental ballistic missiles. This capability supports missile warning, technical intelligence, and battlespace awareness missions.
- The C-band Radar is a joint initiative between the United States and Australia located at Harold E. Holt Naval Communication Station near Exmouth, Western Australia. It operates as a sensor in the US Space Surveillance Network which detects, tracks, identifies and catalogues objects in space.
- The Space Surveillance Telescope (SST) is a state-of-the-art, ground-based telescope developed in the United States and relocated to Harold E. Holt Naval Communication Station near Exmouth, Western Australia and is projected to be fully operational in 2022. The SST is housed in a facility purpose-built by Australian industry. The SST will provide valuable space domain awareness data on objects in deep space and will inform the global Space Surveillance Network.

Defence Science and Technology Group recently collaborated with the Japan Aerospace Exploration Agency to conduct cooperative science activities during the return of the Hayabusa2 asteroid sample space mission at the Woomera Prohibited Area in early December 2020.

Department of Foreign Affairs and Trade

The Australian Space Agency works closely with the Department of Foreign Affairs and Trade, where space activities intersect. The following information has been provided by the Department of Foreign Affairs and Trade.

Space Security

As the 2017 Foreign Policy White Paper emphasised, Australia's economic and security interests in space will grow with the rapid expansion of space-based and space-enabled capabilities. Maximising our opportunities will require enabling international and multilateral action. We need robust rules and norms to maximise the benefits of greater access to space while tackling challenges such as debris.

For the Australian Government and for industry, a stable, secure, resilient and safe space environment in which to operate is vital. For example it is a prerequisite for reliable satellite remote sensing, communications, and navigation systems that enable real-time access to information necessary to connect people, operate a global economy, respond to natural disasters, and support military operations. But in an increasingly contested, congested and competitive environment, the expansion of space-based technologies creates risks.

Geostrategic competition is intensifying in space, manifesting most significantly through ongoing development and testing of kinetic terrestrial counterspace weapons, and suspected deployment of orbital weapons. This continuing development of capabilities to disrupt satellites and degrade space-dependent military systems, threatens our defence networks and those of our alliance partner the United States. Potential state adversaries may also exploit space to obtain sensitive information about our security. Space-based capabilities are vulnerable and space is increasingly seen as an important component of strategic competition and military advantage. Commercial interests could also be impacted.

The consequences of miscalculation and even a small-scale use of kinetic weapons is dire: at best, debris would render orbits useless for many years and at worst, any actual or perceived threat to nuclear command, control and warning capabilities would provoke very serious strategic risks.

Export controls

Expanding Australia's space industry offers important economic and innovation opportunities, but will naturally engage international policy interests, especially with the United States. The dual-use nature of many space activities may trigger inherent sensitivities. Australian space industry ambitions need to be pursued in ways that maintain compliance with international obligations, such as the Missile Technology Control Regime (MTCR), the Hague Code of Conduct against Ballistic Missile Proliferation (HCOC), as well as United Nations and autonomous sanctions.

Australian space companies should undertake thorough research and be mindful of other countries' policies, such as International Traffic in Arms Regulations (ITAR) requirements when working with the United States. And Australia has its own Defence Export Controls, which may be increasingly engaged as Australian space technology exports grow.

Working towards a safer, more secure space environment

Australia is committed to strengthening international rules and laws that apply to space, including military uses of space. We are working with partners, particularly through the United Nations Committee on the Peaceful Uses of Outer Space, the Conference on Disarmament and the United Nations General Assembly, to strengthen norms of responsible behaviour.

The international legal framework for space activities was built in a very different technological and strategic environment. The current legal regime for outer space is based on the five UN space treaties – the most recent, the Moon Agreement, dates from the 1980s. The 1967 Outer Space Treaty is the cornerstone of the legal regime. It prohibits the placement of weapons of mass destruction in outer space or on celestial bodies. However, there are currently no explicit bans on the deployment of conventional weapons in outer space, or on ground-based anti-satellite weapons or high energy lasers or activities that directly or indirectly create space debris. There is general agreement among states that international law, including the provisions of the UN Charter, applies to the activities of states in outer space. But recent attempts to develop further the space framework have largely failed to reach consensus on new laws or norms, with the exception of agreement on guidelines for the long-term sustainability of outer space activities. Careful consideration is still needed as to how we build international norms, transparency and cooperation in promoting responsible behaviour in space in support of space security.

In 2020, Australia worked closely with a number of countries as part of a UK-led effort to introduce a new resolution in the United Nations First Committee on “Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours”. This is a first step in developing a new narrative around the multilateral space security conversation. It seeks to lay the groundwork for practical norms and rules that could moderate behaviour and reduce risk. These would focus initially on transparency in policies, doctrine and activity; improving communications; and building consensus on what responsible, risk-reducing behaviour entails.

As the next step, in 2021 countries have been invited by the United Nations to submit views and ideas to the Secretary-General on the further development and implementation of norms, rules and principles of responsible behaviours and on the reduction of the risks of misunderstanding and miscalculations with respect to outer space.

Department of Infrastructure, Transport, Regional Development and Communications

The Australian Space Agency works with the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC), where space activities intersect. The following information has been provided by DITRDC.

The DITRDC has a number of responsibilities and interests relating to the use of space satellites and technology. This includes providing policy and strategic advice to manage radiocommunications services and spectrum, satellite-enabled telecommunications and broadcasting, as well as the application of satellite-enabled services for the road, rail, maritime and aviation sectors. DITRDC is also involved in international collaboration and engagement related to this work, and is a member of the Space Coordination Committee.

Development of space satellites, technology and equipment

Radiofrequency spectrum and satellite filing arrangements

Space satellites, technology and equipment require access to radiofrequency spectrum to support their wireless communications. Access to spectrum is managed by the Australian Communications and Media Authority (the ACMA) in accordance with the *Radiocommunications Act 1992* (the Radiocommunications Act) and the International Telecommunication Union's (ITU) Radio Regulations (the international treaty governing the global use of spectrum). Under the Radiocommunications Act, the ACMA licenses radiocommunications, with access to spectrum for satellite services currently provided through a combination of class licences and apparatus licences.

DITRDC administers the Radiocommunications Act and provides policy advice to the Minister for Communications, Urban Infrastructure, Cities and the Arts on spectrum matters, working closely with the ACMA. Amendments to the Radiocommunications Act, passed by the Parliament in December 2020, will commence by mid-2021 and will streamline and modernise the spectrum management framework.

Communications applications

DITRDC has responsibility for telecommunications policy and programs, and provides general oversight of the telecommunications market. It also has responsibility for the development of the Universal Service Guarantee (USG), which includes the use of space-based systems to support the delivery of basic telecommunications services nationally. DITRDC also administers the funding provided to commercial broadcasters towards the satellite transmission of commercial free-to-air television over the Viewer Access Satellite Television (VAST) service.

DITRDC supports the Minister for Communications, Urban Infrastructure, Cities and the Arts in their role as joint shareholder in NBN Co. Limited (NBN Co), which is a major satellite operator in Australia and uses the Sky Muster satellites to provide broadband services, particularly to regional and remote parts of Australia.

Satellite services have long played an important role in day-to-day communications operations, both commercial and non-commercial, particularly in regional and remote Australia. For example, a range of satellite-based services play an important role in servicing multi-site business operations, particularly involving regional and remote locations. Satellite can also provide trunk transmission to and from remote locations, whether for fixed services, or terrestrial mobile base stations, including small cells. For example, under the Mobile Black Spot Program, administered by DITRDC, many of the funded mobile base stations in very remote Australia rely on satellite links. Satellite services are available in Australia, providing mobile coverage in areas where terrestrial mobile coverage is not economically viable.

In the case of isolated territories like Norfolk Island, the Cocos (Keeling) Islands, and the Australian Antarctic Territory, satellites are vital in providing them with connectivity to Australia and the wider world. Satellite can also provide international connectivity, although the vast majority of international traffic is carried by submarine cables. Satellite services are able to provide reliable quality services to ships at sea and aircraft in the air, including for passenger use.

As part of its policy and program work, DITRDC monitors and assesses the ability of new space technologies to deliver quality communications services in a more cost-effective way to meet consumer needs. There continues to be significant investment in new geostationary satellites, including, for example, Optus 11 to be deployed for Australia and New Zealand in 2023. There is interest in the emergence of new low earth orbit (LEO) satellite systems, while also noting innovations in high altitude platform stations (HAPS). Amongst other things, the lower launch and other costs of such systems could translate into lower service costs. The lower altitude of such systems can reduce latency with possible improvements in voice quality, noting they are generally focussed on the provision of data services. Service quality is also improving through developments in signal processing.

Transportation applications

Satellite services have many uses in the transportation sector, including for asset tracking, internet access, and safety and navigation systems.

For example, the Australian Maritime Safety Authority (the AMSA), via a service provider, acquires data from the international Cospas-Sarsat satellite-based distress system generated by a ground segment in Australia and New Zealand to locate beacon users in distress across our region and the globe. Incremental update and testing of the system is required to ensure the ground segment and its interaction with AMSA’s search and rescue (SAR) capabilities meet the requirements of the Cospas-Sarsat Programme.

Iridium has become, under an International Maritime Organization (IMO) framework, the second recognised mobile-satellite service provider of Global Maritime Distress and Safety System (GMDSS) services. AMSA, as Australia’s SAR provider is implementing the service for operational declaration in early 2021.

Airservices Australia provides point-to-point satellite communications and ground to air communications for the aviation sector via a service provider. DITRDC is engaged with government security agencies to manage the challenges presented by the interaction of drones and space activities to ensure the resilience of satellite-enabled emerging and future aviation technologies. The development of satellite-based communications, surveillance and navigation systems will enhance safety, efficiency and capability in the transport sector.

Airservices is collaborating with industry to share information and technical expertise to explore the development of a commercial, space-based Air Traffic Management service, including space-based surveillance and communication technologies to enhance aviation safety and efficiency.

International collaboration, engagement and missions

World Radiocommunication Conference

DITRDC leads Australia's engagement in key international and regional radiocommunication policy forums on the use of radiofrequency spectrum and satellite orbits, including the ITU's World Radiocommunication Conference (WRC) which considers changes to the Radio Regulations. To support Australia's engagement on these matters, DITRDC chairs a domestic preparatory group which includes a broad range of experts from government, industry and academia (including the Australian Space Agency, users of earth-sensing satellites such as the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and representatives of satellite companies).

The most recent WRC was held in late 2019, and a key outcome was the development of a new regulatory regime for large satellite constellations. This regime aims to foster a competitive satellite industry by providing a clear and structured framework for bringing-into-use large non-geostationary (NGSO) satellite constellations and helping to safeguard against spectrum warehousing.

The next WRC is scheduled for 2023 and agenda items of relevance to the space sector include:

- an agenda item to harmonise the use of frequency bands by earth stations on aircrafts and vessels communicating with geostationary space stations in the fixed-satellite service;
- an agenda item that studies the possibility of determining an inter-satellite service allocation to allow for inter-satellite links in specific frequency bands;
- an agenda item that considers potential new allocations to the mobile-satellite service for future development of narrowband mobile-satellite systems; and
- an agenda item considering frequency allocation for the space research service.

International Civil Aviation Organization, International Maritime Organization, International Association of Marine Aids to Navigation and Lighthouse Authorities

DITRDC also leads Australia's involvement in the International Civil Aviation Organization (ICAO), which works with the United Nations Office for Outer Space Affairs and the United Nations Committee on the Peaceful Uses of Outer Space to cooperate and coordinate the development of

aviation and aerospace activities. It is important for the growing civil space sector to be safely interoperable with existing global air traffic management systems and supporting infrastructure.

AMSA leads Australia's involvement in the IMO, which mandates the carriage by some vessels of satellite-based radiocommunication systems used to ensure safety-of-life at sea, including Inmarsat, Iridium and Cospas-Sarsat systems.

AMSA also leads Australia's involvement in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), which contributes to the development of space-based aids-to-navigation, including position, navigation and timing (PNT) with a focus on maritime.

Engagement and collaboration in international forums strengthen Australia's space capability, enabling Australia to leverage global partnerships.

Commercialisation of research and development, including flow on benefits to other industry sectors

Telecommunications

The general points about communications applications made above are also relevant here.

In addition, the USG has subsumed the Universal Service Obligation (USO) to provide access across Australia to baseline voice and broadband services. Telstra is the main provider of voice services under the USG, while NBN Co is the main provider of broadband services under the USG.

Currently, the vast majority of voice services are provided using terrestrial fixed line and wireless technologies, with only a limited number provided by satellite (around 1,000). Historically, the low use of satellite for voice services has been attributed to concerns about cost, voice quality (particularly due to latency where double hop transmission is involved) and reliability due to the need for power at the transmission sites.

The vast majority of USG broadband services are also provided by NBN Co using terrestrial fixed line and wireless technologies, but NBN Co also provides broadband services via its Sky Muster satellites (108,154 active services out of 437,370 premises ready to connect at 17 December 2020). The Government has committed to continuing to work with consumers and industry to see if there are better ways to deliver USG services over the long term.

As part of its work to develop the USG, DITRDC launched the $2 million Alternative Voice Services Trials (AVST) grant program during 2019-20 to identify new ways to deliver voice services, including by new providers, and assess their effectiveness. The program is technology neutral and is open to satellite-based voice solutions as well as terrestrial solutions.

Transport

In the transport arena, Geoscience Australia, in collaboration with Airservices, AMSA and the Civil Aviation Safety Authority (CASA), is working to establish the Southern Positioning Augmentation Network (SouthPAN), a satellite-based augmentation system, which improves the accuracy and integrity of position, navigation and timing for the maritime sector, and provides increased procedural capability, enhanced safety and efficiency of aviation.

The transition towards satellite-based technology uses accurate positioning information to enhance arrival and departure procedures at airports. Accurate positioning information is critical to future emerging aviation technologies such as drone operations where self-separation and autonomous flight will be required to enable multiple users to operate safely in the same airspace.

Greater positioning accuracy is also of particular importance for emerging road vehicle technologies, if they are to operate well in real world conditions. We expect that the rollout of SouthPAN will allow innovations in safety and accessibility for transport technologies as they become commercially available in Australia.

The space industry in Australia has good opportunities for public/private collaboration where commercial and public interests intersect. For example, development of LEO constellations could be applied to land transport technology in a variety of ways including, for example, communication in eCall services in remote, rural and regional areas. This could see transport safety benefits in remote, rural and regional Australia where a vehicle is incapacitated in areas otherwise outside of communication range.

Future research capacity, workforce development and job creation

The Australian space industry is growing rapidly and as it continues to grow, there is potential to provide significant social and economic benefit to Australian communities, and industries such as agriculture, communications, environment management, and transport.

Other related matters

DITRDC also oversees City Deals. The Adelaide City Deal includes a commitment from the Australian Space Agency to construct a Mission Control Centre (MCC) and the Australian Space Discovery Centre (ASDC) at Lot Fourteen in Adelaide. The MCC will provide a platform for small and medium-sized enterprises to observe satellite missions and provide access to space-enabled data for use in agriculture, oil and gas, mining, emergency services and maritime surveillance. The ASDC will provide Science, Technology, Engineering and Mathematics (STEM) education for students, allow the public to engage with the latest innovations in space technologies and expand community understanding of Australia's role in national and global space activities and missions.

As part of the Perth City Deal, the Australian Space Agency is providing $4.5 million from the Space Infrastructure Fund to establish an Australian Space Robotics, Automation, and AI Command Control Complex.

As Australia's civil Air Navigation Service Provider (ANSP), Airservices is responsible for providing safe, efficient and reliable use of airspace for all airspace users in Australia's administered airspace from the ground up. Given the current growth of low level and high altitude airspace users, as Australia's airspace manager, Airservices is working to ensure all airspace users, both emerging and traditional, are safely integrated into Australian airspace. As part of this responsibility, Airservices is investigating the development of a stratospheric traffic management system (Collaborative Traffic Management in the Stratosphere) in partnership with industry operators of HAPS delivering (amongst others) telecommunication services to remote and regional areas. An initial effort will focus on a proof of concept that will be used to inform international approaches for the

management of traffic above ~50 000ft, with the potential to enable increased airspace use for local and international operators delivering services to Australia.