



**ASIA PACIFIC  
AEROSPACE CONSULTANTS  
Pty Ltd**

**Inquiry into  
Developing  
Australia's  
Space Industry**

**Submission to  
The House of Representatives Standing Committee on  
Industry, Innovation, Science and Resources**

**12 February 2021**

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## Introduction

Asia Pacific Aerospace Consultants (APAC) is a Sydney based consulting firm staffed by space industry professionals that has been providing consulting services to the space and telecommunications industries both domestically and internationally for over 20 years. APAC is best known in Australia for its three major studies of the Australian space sector for the Australian Government conducted in 2010<sup>1</sup>, 2011<sup>2</sup> and 2015-16<sup>3</sup>. These studies were the most comprehensive reviews of the Australian space sector then conducted. They identified the pervasive breadth and significant capabilities of the Australian space sector and uncovered the fact that all major industry sectors in the Australian economy rely on space derived data or space derived services in some way. These studies also generated the headline numbers of annual Australian revenues from the space sector of \$3 billion to \$4 billion per annum and between 9,500 to 11,500 Australians with jobs that involve space that are widely quoted in the media today.

The APAC principals, Kirby Ikin and William Barrett, have long been advocates for the Australian space industry. In 1992 they were co-founders of the Australian Space Industry Chamber of Commerce (ASICC) which was later renamed the Space Industry Association of Australia (SIAA) and they served as Chairman and Deputy Chairman of the organisation for 16 years. They remain active in the organisation today as members of the SIAA Advisory Board and have been involved in virtually every ASICC/SIAA submission to government since the organisation's inception. Mr Ikin also serves as Chairman of the Board for the Washington D.C. based National Space Society which plays an active role in shaping space policy in the United States and the development of human spaceflight activities worldwide.

APAC continues to play an active role in the development of the Australian space industry by providing a wide range of consulting services to start-ups, companies, space agencies, research institutions and state and Federal governments throughout the Australian and international space communities.

## General Comments

This enquiry by The House of Representatives Standing Committee on Industry, Innovation, Science and Resources into developing Australia's space industry is very timely. It has now been 31 months since the Australian Space Agency was established in July 2018. It is an appropriate time to examine the progress of the Space Agency and the development of Australian space during the early days of its operation. The information collected in this enquiry will be relevant to considerations of whether to establish the Australian Space Agency as a statutory body as recommended in the report of the Expert Reference Group into Australia's Space Capabilities<sup>4</sup> based on a review of its operations

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<sup>1</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants. 2010.

<sup>2</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants, 2011.

<sup>3</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants, 2015-16.

<sup>4</sup> 'Review of Australia's Space Industry Capabilities', Expert Reference Group for the Review, March 2018, p.5.

within the first four years of its establishment.<sup>5</sup> The theme of this enquiry is also very appropriate with the Committee's intention to focus on how the Australian Government can support and encourage the space industry while preserving and protecting the space environment.

This theme will form the basis of the APAC submission. So much has been accomplished in the 2.5 years since the establishment of the Australian Space Agency. Yet so much remains to be done to definitively position Australia to take advantage of the emerging growth of the global space industry.

## Space Agency's Strong Start

One of the key issues identified as impeding Australian participation in international space supply chains in APAC's 2015-16 study into the Australian space sector and international supply chains was that *"Australia is generally not perceived as being active in space which creates a credibility gap for Australian companies trying to participate in global supply chains."*<sup>6</sup> One of the interviewees for that report commented that when people talk of space no one thinks of Australia, in spite of the fact that Australia had significant capability in space, because Australia had withdrawn from participation in the major international space world for so long since the closure of the Australian Space Office in 1996. It was noted that Australia could reverse this view very quickly with the creation of a national Space Agency that could promote the considerable Australian capability in space and re-engage in the international space scene. And that is exactly what has come to pass. The announcement of the formation of the Australian Space Agency in front of over 4,000 international space industry professionals at the 68<sup>th</sup> International Astronautical Congress (IAC) in Adelaide in 2017 dramatically announced to the world that Australia was back in space. Australia was warmly welcomed back into the international space scene with positive anticipation of the capabilities and innovation that a nation like Australia could contribute with a renewed national emphasis on space. There was a palpable excitement in the international space community that Australia was back in space and ready to make a significant contribution and international countries and companies are increasingly expressing their interest in collaborating with Australia on space endeavours.

The Australian Space Agency has done a remarkable job in establishing itself and commencing its initial programs in the short time since its commencement on 1 July 2018. Establishing any organisation from a virtual standing start is a challenging task and the Australian Space Agency has done that well while at the same time making a significant start on establishing capabilities and programs that will foster growth in the Australian space sector. Notable achievements of the Space Agency in its short existence include:

1. Creation of Space Agency Charter (October 2018),
2. Creation of a uniquely Australian logo for the Space Agency incorporating the strong link between space and the world's oldest astronomers – Australia's indigenous people (December 2018),
3. Completion of the Australian Civil Space Strategy 2019 - 2028 which outlines the four key pillars and seven key priority technology areas of the Space Agency (April 2019),
4. Finalising the *Space Activities Amendment (Launches and Returns) Act 2018* which was passed into law (August 2018),

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<sup>5</sup> 'Australian Government Response to the Review of Australia's Space Industry Capability', May 2018, p.5.

<sup>6</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants 2015-16, p. 103.

5. Completion of subordinate legislation for *the Space Activities (Launches and Returns) Act 2018* (the Rules, Flight Safety Code and Maximum Probable Loss Methodology) and commencing the new regulatory regime (August 2019),
6. Establishing multiple Memorandums of Understanding with international space agencies for cooperation on space projects (ongoing from September 2018),
7. Establishing multiple Memorandums of Understanding with Australian State and Territory Governments to explore cooperation and investment opportunities on space projects (ongoing from June 2019)
8. Signing multiple Statements of Strategic Intent and Cooperation (SSI) with major international and domestic aerospace companies to promote investment and capabilities for Australian space (ongoing from September 2018),
9. Commencement and award of the first grants under the \$15 million International Space Initiative (ISI) grant funding program to assist Australian companies gain access to international space supply chains (ongoing from 2018),
10. Securing an additional \$19.5 million of space funding in the form of the Space Infrastructure Fund and allocating some of the funding via grant programs for a Mission Control Centre, a Robotics, Automation and AI Command & Control Centre, and an Upgrade of Tracking Facilities (ongoing from 2018),
11. Securing an additional \$150 million for the Moon to Mars program to help Australian companies engage in the US Artemis program which will return humans to the Moon and then send humans to Mars (ongoing from September 2019).

This is a tremendous track record of significant accomplishments in just under three years.

In this short timeframe the Space Agency has created a strong platform from which the Australian space sector can be launched into future growth. But much remains to be done in order to achieve Australia's ambitious goals to triple the annual revenue from space to \$12 billion and increase the space workforce by 20,000 by 2030. The remainder of this submission addresses practical ways that the Australian Government can support and encourage the growth of the Australian space sector.

## Ways the Australian Government Can Support the Space Industry

Australia has been playing a supporting role to the major space powers in the United States and Europe since the early days of the space age, largely through the use of Australian territory for early launch activities at Woomera<sup>7</sup> and location of tracking stations to receive the signals from the early manned missions and satellites.<sup>8</sup> Involvement in these early activities enabled Australian companies and staff to obtain crucial experience in many aspects of the space industry.

Over time this experience has developed into significant Australian capabilities and corresponding business activities in many key aspects of space including satellite communications, ground stations, earth observation, positioning navigation and timing activities (GPS & GNSS activities), space situational awareness activities and emerging launch technologies. Australia has capabilities in

<sup>7</sup> Arianespace, currently one of the largest launch operators, had its roots in the European Launch Development Organisation (ELDO) which conducted its launch activities at Woomera from 1961-1970.

<sup>8</sup> Australia has hosted ground stations for NASA since the Mercury manned program in 1961 and currently hosts one of only three global Deep Space Network sites for each of NASA and ESA.

space technical support and business support as well as in space research and education.<sup>9</sup>

It is important to recognise that Australia is not starting from scratch to build a space industry. Australia already has some strong existing capabilities around which it can build a sizeable space industry. The current size of the industry is already significant. APAC's 2016 report found that the Australian space industry generated between \$3 billion - \$4 billion annually and employed between 9,500 to 11,500 staff spread across every state and territory in Australia.<sup>10</sup> The Expert Reference Group report in 2018 confirmed these numbers estimating annual revenue from Australian space of \$3.94 billion in 2016.<sup>11</sup>

The global space economy was estimated at US\$ 329 billion in 2016.<sup>12</sup> The annual revenue from space of A\$ 4 billion in 2016 indicates that Australia generates 0.8% of the global space economy in 2016. However, this is low compared to the 1.6% of the total global economy that Australia generated that year.<sup>13</sup> This suggests that the Australian space sector is underperforming and that there is significant room for further growth in the Australian space sector.

The global space industry continues to grow at around 8% per annum with the total size of the space economy now estimated at nearly US\$ 415 billion in 2018.<sup>14</sup> Morgan Stanley predicts that the global space industry will grow to over US\$1.1 trillion by 2040.<sup>15</sup> APAC's 2016 report found that space derived products and services are now used by every sector of the Australian economy.<sup>16</sup> The space industry will be an increasingly critical sector of the global economy and a significant growth industry for the foreseeable future and it is vital that Australia recognise this as a critical emerging growth industry and take action to position Australia to take advantage of the emerging opportunities.

The Australian Government has made a good start to supporting the growth of the Australian space sector through the creation of the Australian Space Agency and providing funding for some early initiatives.<sup>17</sup> However, these measures will not be sufficient to meet the ambitious targets set for the growth of the Australian space sector by 2030<sup>18</sup> and further government effort and support is required. In the comments that follow APAC outlines some measures that the Australian Government might pursue to meet its goal of achieving underlying capability to support significant growth and an international presence for the Australian space sector.

## Recommendation 1. Establish Australian Space Agency as a Statutory Body

The Expert Reference Group Report recommended establishing the Space Agency as a statutory body to enable whole-of-government coordination on space activities. It noted that, *"Establishing the Agency as a whole-of-government statutory entity will be important to realise Australia's civil*

<sup>9</sup> Details can be found in 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants 2015-16, pp. 13-14.

<sup>10</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants 2015-16, p. 11.

<sup>11</sup> 'Review of Australia's Space Industry Capabilities', Expert Reference Group for the Review, March 2018, p. 6

<sup>12</sup> 'The Space Report 2017', The Space Foundation, 2017, p. 1.

<sup>13</sup> Based on 2016 World Bank GDP data for Australia (US\$1.2T) and Global GDP (US\$76.4T)

<sup>14</sup> 'The Space Report Q2 2019', The Space Foundation July 2019 p 1.

<sup>15</sup> 'Investing in Space', Morgan Stanley, 2019.

<sup>16</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants 2015-16, p. 11.

<sup>17</sup> These include the International Space Initiative, the Space Infrastructure Fund and the Moon to Mars Initiative as well as the funding for Geoscience Australia (GA) to develop a reliable positioning data system including a Space Based Augmentation System as well as funding to extend GA's Digital Earth Australia (DEA) platform to provide earth observation data across Australia.

<sup>18</sup> Goals: Triple annual revenue to \$12 billion and increase space jobs by 20,000 by 2030.

*ambitions in space, as well as provide important coordination across Government.”<sup>19</sup> It also noted that “The Agency will also require the appropriate expertise to advise on the nation’s investment in civil space activities, and to support Australia’s international obligations and partnerships.”<sup>20</sup>*

APAC agrees with this view and **recommends that the Government establish the Australian Space Agency as an independent statutory body** with the technical capabilities to procure and manage long-term national space programs commensurate with its peers in the space agencies of other OECD countries.

## Recommendation 2. Provide Space Agency Funding Commensurate with Goals

The initial funding of \$15 million over four years for Australian Space Agency programs is woefully inadequate to meet the Australian Space Agency goals for industry growth. Internationally it was met with incredulity and raised doubts about whether the Australian Government was serious about space. One international colleague remarked, *“I hope the Australian Government comes to realise that you cannot buy a cup of coffee in space for that kind of money”*. This initial amount has since been supplemented with the \$19.5 million Space Infrastructure Fund and the \$150 million Moon to Mars Initiative. However, these amounts are unlikely to be sufficient to achieve the industry growth Australia desires.

The decreasing cost of access to space and the increasing capability of smaller satellites and emerging new technologies certainly provide Australia with an opportunity to develop space programs at a lesser cost than the large budgets of traditional space programs. Nevertheless, Australia requires a sufficient and secure level of funding to quickly develop and demonstrate Australian space capabilities in a manner that positions Australian companies to win business in the international space arena in order to grow the Australian space industry.

The Expert Reference Group Report notes that *“the commercially focused space agencies of the UK, Canada, France, and Norway... are investing between 0.016 per cent and 0.07 per cent of GDP in space agency funding”* in 2016.<sup>21</sup> The Expert Reference Group Report notes that establishing Australian space funding at the lower end of this range would mean a Space Agency budget in the order of \$250 million per annum in 2016.<sup>22</sup> Allocating spending equivalent to 0.02% of GDP would produce a Space Agency budget in the order of \$320 million based on Australia’s GDP in 2019.<sup>23</sup>

APAC agrees that this is the right order of magnitude for a realistic space program budget to rapidly develop the Australian space sector. **APAC recommends that the Australian Government increase the Space Agency budget for space programs to the order of \$250 - \$350 million per annum for the foreseeable future** to solidly establish the Australian Space Agency on a trajectory that will meet its 2030 goals.

## Recommendation 3. Develop and Fund National Space Programs

The history of the space industry shows that the majority of major space companies have developed

<sup>19</sup> ‘Review of Australia’s Space Industry Capabilities’, Expert Reference Group for the Review, March 2018, p. 43.

<sup>20</sup> Ibid

<sup>21</sup> ‘Review of Australia’s Space Industry Capabilities’, Expert Reference Group for the Review, March 2018, p. 34.

<sup>22</sup> Ibid

<sup>23</sup> Based on 2019 World Bank GDP data for Australia (US\$1.4T)



their space capability by working on national Government programs (both civil and military). They have then used this experience to win international space contracts to grow their space business. The absence of national programs in Australia has denied Australian companies and researchers this pathway to develop capability. One of the fastest and most effective ways to develop strong Australian space capability and showcase it to the world is via conducting a series of national Australian space programs or projects that contribute to the national good and utilise and develop Australia's existing strengths in space.

At a basic level delivering the type of growth desired for the Australian space sector will require an increase in Australian exports in space products and services. At its core the pathway to export growth is an issue of establishing credibility which requires successful demonstration of capability on a platform and in a way that is widely visible to others. The traditional method of achieving this credibility in the space industry has initially been through participation in national space programs.

APAC described this process in its submission to the Expert Reference Group Review in 2017.

*"In the space industry, more than any other industry, strong reputation, credibility and track record of success are essential and non-negotiable requirements for participation in space projects. These elements are absolutely essential for any critical components for space projects where failure means loss of mission. This is the case for all upstream elements such as spacecraft or instruments, all launch activities and ground based communications and data handling. But because of the absolute insistence on these fundamental requirements throughout the history of space projects these elements are generally required for almost all other downstream aspects as well. Without a strong reputation, credibility and track record of success as well as a strong perception of overall competence in space activities companies generally have little chance to break into this industry or participate in space projects. ... It was through these national programs run by the civilian space agencies or the national military entities that national organisations and companies were able to develop the strong reputation, credibility and track record of success that are the essential requirements for participation in space projects."*<sup>24</sup>

This theme of a credibility gap in Australian space hampering and impeding Australian organisations from participating more fully in the international space marketplace was highlighted in the direct interviews with Australian space companies in APAC's study on Australian space capabilities in 2015-16, particularly among Small & Medium Enterprises (SMEs) which constitute the vast majority of Australian space businesses. The following passage from 'A Selective Review of Australian Space Capabilities' highlights the real effects of this credibility gap.

*'A number of companies remarked about the specific difficulties Australian companies face when attempting to break into space global supply chains. Companies commented that industry credibility is an important factor and Australia is generally not perceived as being active in space which creates a credibility gap for Australian companies trying to participate in global supply chains. Participation with major partners on space projects is one of the key methods to gain recognition by global supply chains in this industry. Companies felt that Australia is not perceived as a contributor in these ventures hence Australian companies find it harder to gain experience and credibility that is visible to prospective international partners.'*<sup>25</sup>

APAC's study on Australian space capabilities in 2015-16 found that Australian space export revenue was surprisingly low.

<sup>24</sup> 'APAC Submission to the Review of Australia's Space Capability Issues Paper', Asia Pacific Aerospace Consultants, August 2017, p.4.

<sup>25</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants, 2015-16, p. 103.



*“Nearly two-thirds of the companies (30 out of 46) reported generating export revenue from sales of space goods and services overseas. Collectively the interviewed companies reported over \$165 million in export revenue from space activities. However, this export revenue constitutes only 8.4% of the total space related revenue of nearly \$2 billion generated by the interviewed companies indicating that the vast majority of space revenue for these companies is earned in Australia”<sup>26</sup>*

The figure of only 8.4% of space revenue generated from exports in 2015-16 is relatively low given the size of the Australian space industry particularly for an Australian economy that has a relatively strong export focus. When compared to APAC’s 2011 study of Australian Space Activities the 2015-16 study data suggests only small export revenue growth since 2011 in the order of 4%. There are many factors that can constrain export revenue growth including commercial arrangements that define international sales territories and preclude sales from Australia outside these areas or the inability to freely export sensitive technologies particularly in the Defence domain. However, a recurring theme in the 2015-16 company interviews was the impact the space credibility gap has on Australian space exports. Another quote from APAC’s 2015-16 report on Australian Space Capabilities illustrates this point,

*“Another theme affecting export revenue growth that emerged during the interviews is that Australia is generally not perceived as being active in space hence Australian space companies suffer from a credibility gap when competing in international markets. Companies reported that this perception and negative bias is a hurdle that Australian companies must often overcome to gain traction in international space markets.”<sup>27</sup>*

Until this credibility gap is overcome the Australian space industry will continue to underperform economically and internationally. The fastest and most dramatic means of overcoming this credibility gap is to create a series of national space programs to develop and demonstrate Australian space capability. **APAC recommends that the Australian Government establish a series of national space programs or projects to contribute to the national good, develop Australian space capabilities and demonstrate Australian space capability and strengths to the world.**

#### Recommendation 4. Participate in International Space Endeavours

Historically the most common method for space companies to develop the capabilities to win international space business is to develop their capabilities on national space programs and then participate on international space endeavours to showcase their capabilities in a more direct way to the international space community. The Australian Space Agency should fund and facilitate Australian company and research participation in international space programs to demonstrate Australian space capability and facilitate Australian participation in international space supply chains.

APAC described this common approach by most nations to build their national space capacity through national programs and then through participation in international programs to the Expert Reference Group Review in 2017.

*“These new nations entering the field of space activities adopted the same model of a national space agency to develop their national capabilities and to represent their national interests in international space fora. In this environment national organisations and companies developed their space*

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<sup>26</sup> ‘A Selective Review of Australian Space Capabilities’, Asia Pacific Aerospace Consultants, 2015-16, p. 41.

<sup>27</sup> ‘A Selective Review of Australian Space Capabilities’, Asia Pacific Aerospace Consultants, 2015-16, p. 41.

*capabilities on national space programs. Entry into the international space market was generally only achieved after having developed sufficient capability on national programs and then having a competent national space agency that successfully negotiated national participation in international space projects in return for its contribution of funding to the international project. Only after having developed a strong track record on national programs and usually having gained international attention through international programs were organisations or companies in a position of sufficient reputation, credibility and track record of success to directly enter the global space marketplace. ... This model of a national agency funding national space programs to develop national capability and then the national agency providing funding towards international projects in exchange for national participation is relatively strongly entrenched as a business model in the space sector.”<sup>28</sup>*

APAC recommends that the Australian Space Agency follow this well established business pattern for development of national space capability. **APAC recommends that the Australian Space Agency fund and facilitate Australian company and research participation in international space programs** to demonstrate Australian space capability and facilitate Australian participation in international space supply chains.

## Recommendation 5. Buy Australian Space Products

The Australian Government is one of the largest purchasers of space data and services in Australia. Yet a large percentage of these purchases are to companies outside of Australia. One of the best and fastest ways for the Australian Government to support the Australian space sector is to use the purchasing power of the Australian government to buy Australian space products and services.

This is directly relevant to the credibility issue discussed in Item 3 above. Australian space companies will have diminished credibility on the international stage if they cannot sell their products and services to their own government. Conversely, the purchase of Australian space products by the Australian Government gives a strong endorsement to the Australian companies and enhances their credibility internationally as a supplier of space products and services.

Arguments have been made that Australia did not have the local capability for many of the large services required by the Australian Government such as the NBN satellites or the Space Based Augmentation System (SBAS) to improve the accuracy of Global Navigation Satellite System (GNSS) signals to meet aviation standards for use in landing planes at remote airfields. While these arguments might be largely accurate for these large systems simply accepting this status quo will do nothing to enhance Australian space capability. The fact remains that Australia does have capability to build elements of these larger systems. The Australian Government should be active in its tendering process to ensure the maximum amount of Australian content is included in Australian Government space products and services purchases to help build the Australian space sector.

This may involve a higher level of risk on space projects when Australian companies are building a system for the first time. However, it should be remembered that the governments of the major space industry suppliers addressed and accepted these types of risks when their companies were building their initial space systems and this approach has enabled them to successfully build their space industry on the back of government programs. If the Australian Government is serious about developing the Australian space sector it should be able to find acceptable methods to deal with these types of risks and to accept a slightly higher level of risk in order to stimulate the capability

<sup>28</sup> ‘APAC Submission to the Review of Australia’s Space Capability Issues Paper’, Asia Pacific Aerospace Consultants, August 2017, p.4.

development of the Australian space sector.

**APAC recommends that the Australian Government use its purchasing power to buy Australian space products and services as an active strategy to develop and grow the Australian space sector.**

## Recommendation 6. Pursue Sovereign Space Capability and Assets

For most of the space age Australia has been in the fortunate position where many of its close allies developed space systems for their own purposes and allowed Australia access to the data and capabilities for little or no cost to Australia. This was a highly cost-effective strategy for Australia as these arrangements meant that Australia did not need to develop sovereign space capabilities.

The world is changing however. Australia's access to allied space systems is no longer as straightforward as it once was. Allies are now starting to request a higher contribution from Australia for access to some of these systems. Also as needs and strategies change some assets and data may not be as readily available to Australia. At the same time Australia is becoming much more dependent on space derived data. At the moment all of Australia's weather and earth observation data, position navigation & timing data and most of its satellite communications (with the exception of the NBN and to a degree the Optus satellites) is obtained from foreign owned and operated satellites. APAC's 2010,<sup>29</sup> 2011<sup>30</sup> and 2015-16<sup>31</sup> reports all found that space-related products and services are used in every sector of the Australian economy. Hence the Australian economy is highly vulnerable to the loss of these space-related products and services.

It is an appropriate time for Australia to revisit its space requirements and the potential need for sovereign Australian space assets and associated ground equipment and operations staff. The investment in sovereign Australian space capability in select areas could also be used as a strategy to develop the appropriate Australian manufacturing, operations and communications/data processing capabilities to ensure that Australia has complete sovereign capability in these select space areas and at the same time stimulate the development and growth of the Australian space sector.

**APAC recommends that the Australian Government develop sovereign capability in select space capabilities for the national good and as a strategy to stimulate the development and growth of the Australian space sector.**

## Recommendation 7. Secure Spectrum for Space Services

Radio Frequency (RF) spectrum is the means of two-way communication between earth and spacecraft. Having access to sufficient RF spectrum is essential for all aspects of satellite communications from monitoring the health of the satellite, to sending commands to the satellite to downloading the data collected by the satellite or the communications signals from the satellite. Furthermore, some of the processes by which we understand our weather and other physical processes on earth and astronomy are able to be analysed by the RF energy they emit or absorb in certain frequencies of the RF spectrum. These RF frequencies are often referred to as 'signatures of nature' and are essential for achieving a better understanding of our world and astronomy.

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<sup>29</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants. 2010.

<sup>30</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants. 2011.

<sup>31</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants, 2015-16.

Maintaining access to sufficient RF spectrum is an essential component for the growth of the Australian space sector. Atmospheric water vapour absorbs RF spectrum at higher frequencies which attenuates the signal strength. Hence RF spectrum has been allocated in certain favourable frequency bands to accommodate the satellite link. Yet the demand for terrestrial RF spectrum is increasing dramatically with the proliferation of mobile telephony and smartphones. Some of the favourable satellite communication frequencies – particularly in C-band – are also favourable to the mobile telecommunications providers and considerable pressure has been exerted to re-allocate C-band satellite RF spectrum for terrestrial mobile communications. This re-allocation has already occurred in some jurisdictions, notably the United States where satellite operators are now required to vacate 60% of the C-band spectrum that they have been using since the early 1960s. This requires relocating and replacing both satellites and ground stations to accommodate this reduction of satellite RF spectrum over the United States at a time when the demand for satellite RF spectrum is also increasing.

Access to sufficient satellite RF spectrum is critical to the growth of the Australian space sector. The Australian Government needs to ensure that sufficient favourable RF spectrum is reserved for satellite communications and data downlink from space in order to enable the growth of the sector. The increasing demand for RF spectrum is sparking research in a wide range of alternatives including optical links and development of advanced communications waveforms that better enable spectrum sharing. Australian researchers and companies have capabilities in these areas and the Government should support this research into alternative technologies for satellite communications. But until these technologies come to fruition in a cost-effective manner APAC recommends that the Australian Government ensure that satellite communications be given priority allocation in the existing satellite RF spectrum bands and that further useful RF spectrum be allocated for satellite communications as technology opens up access to higher RF spectrum bands.

## Recommendation 8. Support All Space Activities but Concentrate on Emerging Technologies

APAC's 2010,<sup>32</sup> 2011<sup>33</sup> and 2015-16<sup>34</sup> reports all found that Australia has capability in all of the major space categories and that this capability has increased throughout the last decade. The key space categories where Australia has capability are:

1. Space Systems
2. Launch Activities & Support Services
3. Ground Systems
4. Space Enabled Services & Applications (includes Satellite Communications; Earth Observation; Position, Navigation and Timing)
5. Space Activity Support Services
6. Space Science and Research & Development
7. Space Education & Training
8. Space Related Associations and Public Information Activities
9. Other Space Related Activities

Given the existing broad range of Australian capability across the spectrum of space activities APAC believes that the Australian Space Agency should support all Australian space activities. It is hard to

<sup>32</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants. 2010.

<sup>33</sup> 'A Review of Current Australian Space Activities', Asia Pacific Aerospace Consultants. 2011.

<sup>34</sup> 'A Selective Review of Australian Space Capabilities', Asia Pacific Aerospace Consultants, 2015-16.

predict where the next technological breakthrough will come from hence the Australian Space Agency should not preclude any aspect of the Australian space sector in its grants and funding proposals.

APAC notes that the Australian Space Agency has outlined seven National Civil Space Priority Areas in the 'Australian Civil Space Strategy 2019-2028'.<sup>35</sup> These Priorities focus on strengthening Australia's existing competencies and growing future capabilities and are intended to be an important guide when considering future space activities in Australia. These seven priorities are:

1. Position, Navigation and Timing
2. Earth Observation
3. Communications Technologies and Services
4. Space Situational Awareness and Debris Monitoring
5. Leapfrog Research & Development
6. Robotics and Automation on Earth and in Space
7. Access to Space

APAC agrees that these are good priority areas for the development of Australian space covering the range of existing Australian space capabilities and important national needs as well as including some of the exciting new areas driving space development in the future, two of which will be discussed in the next Items. APAC believes that the biggest growth in the Australian space sector will come from emerging technologies where Australia can be at the forefront of the key new business developments driving the space industry. Hence, while APAC believes that the Australian Space Agency should support all Australian space endeavours it also believes that the Space Agency should pay particular attention to the promise of emerging technologies.

**APAC recommends that the Australian Space Agency support all space activities while concentrating on the promise of emerging technologies that can put Australia at the forefront of the new business drivers of the space economy.**

## Recommendation 9. Lead Efforts for Global Agreement on Off-Earth Resource Exploitation

One of the emerging areas of space activities with the highest economic potential is the extraction and processing of minerals and resources from planetary bodies (Moon, Mars and asteroids). The extraction and processing of resources including carbon-rich minerals and rare earth minerals found in space will be an essential feature of long-term manned presence on the Moon, Mars and more remote space stations such as the Lunar Gateway and is the key to unlock the Off Earth economy around living, working and manufacturing in space. One of the early products will be water which is necessary for living in space and can be broken into hydrogen and oxygen to produce rocket fuel. This field shows incredible economic promise with both astrophysicist Neil deGrasse Tyson<sup>36</sup> and X-Prize founder and space entrepreneur Peter Diamandis predicting that the Earth's first trillionaire will be an asteroid-miner.<sup>37</sup>

<sup>35</sup> 'Advancing Space: Australian Civil Space Strategy 2019-2028', Australian Space Agency, April 2019.

<sup>36</sup> 'Neil deGrasse Tyson Says Space Ventures Will Spawn First Trillionaire', K. Kramer, NBC News, 3 May 2015, url: <https://www.nbcnews.com/science/space/neil-degrasse-tyson-says-space-ventures-will-spawn-first-trillionaire-n352271>, accessed 13 February 2021.

<sup>37</sup> 'How Big is the Space Economy', T Taylor, Conversable Economist Blog Post, 19 December 2019, url: <https://conversableeconomist.blogspot.com/2019/12/how-big-is-space->

Australia has world leading capabilities in mineral mining and extraction as well as world leading expertise in remote operations over large distances. Many Australian mine sites in the Pilbara including the loading and operation of the trains hauling materials to the coast are operated remotely from Perth. This expertise is being actively sought by the space industry for Off-Earth resource extraction ventures and Australia is well placed to benefit from its existing expertise in this new and promising field.

One of the challenges with attracting the necessary investment to develop Off-Earth resource exploitation is that there is currently no agreed international regime for the possession and sale of Off-Earth resources that is essential to protect the investment of mining operators and enable profits. The language and interpretation of the UN Space Treaties are part of the challenge here.

The Outer Space Treaty<sup>38</sup> says relative to Off-Earth resource exploitation:

- the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind;
- outer space shall be free for exploration and use by all States;
- outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

There is general agreement internationally that this language precludes sovereign ownership of planetary bodies which could present challenges for mineral extraction for profit however, many note the freedom of use clause as a potential enabler for resource exploitation. The United States and Luxembourg have passed domestic laws enabling companies registered in their jurisdictions to mine and sell planetary resources but other jurisdictions do not agree with this interpretation of the Outer Space Treaty.

Another UN Space Treaty, The Moon Agreement,<sup>39</sup> in its Article 11.5 states that exploitation of planetary resources is expected and allowed stating “States parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the resources of the moon<sup>40</sup> as such exploitation is about to become feasible.” However, the Moon Agreement has only been ratified by 18 countries (including Australia) compared to the 110 countries that have ratified the Outer Space Treaty. The main concern against the Moon Agreement appears to be Article 11.7 (d) which requires “An equitable sharing by all States parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon shall be given special consideration.” This requirement to share the benefits with developing countries and potentially other countries seems to be a major

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[economy.html#:~:text=The%20short%20answer%20for%20an,%22Probably%20around%20%24400%20billion.%22, accessed 13 February 2021.](#)

<sup>38</sup> ‘Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies’, United Nations Treaty, entered into force October 1967 see United Nations Office For Outer Space Affairs, url:

<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>, accessed 13 February 2021.

<sup>39</sup> ‘Agreement Governing the Activities of States on the Moon and Other Celestial Bodies’, United Nations Treaty, entered into force July 1984 see United Nations Office For Outer Space Affairs, url: <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html>, accessed 13 February 2021.

<sup>40</sup> Note that Article 1.1 of the Moon Agreement states that this treaty also applies to other celestial bodies in the solar system other than the earth.



sticking point for most space-faring nations even though it appears that this could be constructed in a manner similar to most existing mining royalty regimes.

Australia is in a unique position as both a country that has significant resource extraction expertise that will benefit from development of Off-Earth resource exploitation and as a signatory of the Moon Agreement with a seat at the table to develop the regime for those Off-Earth resource exploitation activities. Australia should use this position to develop an internationally agreed Off-Earth resource exploitation regime.

It should be noted that jurisdictions that have not signed the Moon Agreement and do not agree with its tenets sometimes feel that they must exclude Australian participation in Off-Earth resource exploitation activities for fear of being ensnared in the Moon Agreement provisions. This is creating some challenges for Australian participation in some of these ventures in spite of Australia's considerable expertise in mineral extraction.

It is clear that an internationally agreed regime for Off-Earth resource extraction (including addressing royalties or similar taxes/distributions) will be necessary to protect the sizeable investments needed for these endeavours. It is also clear that Australia has significant capability to play a major role in this emerging, high growth area. Whether the agreement is achieved inside or outside of the Moon Agreement framework an international agreement for Off-Earth resource extraction is needed and the Australian Government should take an active role in achieving this.

**APAC recommends that the Australian Government and the Australian Space Agency should use their resources towards achieving a practical agreement for an internationally agreed Off-Earth resource extraction regime to enable Australian mining companies to contribute their expertise into what is likely to be one of the most lucrative space activities in the coming decade.**

## Recommendation 10. Prepare for Early Entry into Suborbital Point-to-Point Travel

There is another emerging space technology under development that can potentially provide tremendous benefits to Australia – the prospect of Point-to-Point Travel via Suborbital Space. This is the main driver of the space tourism operators – the opportunity to transform the long-distance travel market by connecting far distant locations like Sydney-London with flights lasting under 60 minutes. No country will benefit from this technology more than Australia as it will be a real means of overcoming the tyranny of distance. Australia should position itself to be an early participant in this travel system of the future.

SpaceX is currently developing the vehicle technology for Suborbital Point-to-Point travel with other providers such as Blue Origin and Virgin Galactic also considering the potential. The technology will initially be used for fast package delivery of time-sensitive materials that are required urgently around the world such as organ transplants, legal documents or perishable items. Once the technology is proven as safe the way will be open for human passengers on intercontinental trips of 60 minutes or less.

The US military is already investigating the use of SpaceX Suborbital Point-to-Point transportation for rapid deployment of military cargo and supplies in an emergency. After a recent briefing from SpaceX about their plans and their current developments in Suborbital Point-to-Point transport US Army Gen. Stephen Lyons, commander of U.S. Transportation Command, announced an agreement



SpaceX to study the use of space launch vehicles to transport supplies in an emergency. General Lyons commented, *"I had no sense for how fast SpaceX was moving, but I've received their update and I can tell you they are moving very rapidly in this area."*<sup>41</sup>

Fast package delivery could commence by the mid-2020s with the potential for human suborbital point-to-point transportation services beginning before the end of the decade. Based on these timeframes is timely for the Australian Space Agency and Australian Government to position Australia to become an early participant in these suborbital point-to-point transport activities which have tremendous potential to transform long distance travel from Australia.

**APAC recommends that the Australian Space Agency and Australian Government to position Australia to become an early participant in suborbital point-to-point transport activities.**

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<sup>41</sup> 'U.S. Transportation Command to study use of SpaceX rockets to move cargo around the world,' S. Erwin, Space News, 7 October 2020, url: <https://spacenews.com/u-s-transportation-command-to-study-use-of-spacex-rockets-to-move-cargo-around-the-world>, accessed 13 February 2021.

## Concluding Comments

The authors of this submission offer these comments based on their experience of more than 25 years each in space industry both in Australia and internationally. They have direct experience in working with and advising space agencies worldwide and considerable experience and intimate knowledge of the Australian space sector. The authors welcome this opportunity to provide their comments on how the Australian Government might support and grow the Australian industry to support The House of Representatives Standing Committee on Industry, Innovation, Science and Resources in their enquiry into developing Australia's space industry. The authors remain available to support the Standing Committee in its enquiry in any practical way including via additional questions about this submission or other discussions deemed useful by the Standing Committee.

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