Submission on developing the Aotearoa New Zealand Aerospace Strategy

Your name and organisation

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Organisation (if applicable)	University of Canterbury

Overview of the Aerospace Strategy

Question 1:	Do the four areas above provide the right basis for the Aerospace Strategy?
Question 2:	What are the critical factors that you see for aerospace sector development?
Question 3:	How would an Aerospace Strategy help you?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Question 1: Do the four areas above provide the right basis for the Aerospace Strategy?

UC is particularly supportive of the following elements in the draft:

1. We support the focus of the proposed four areas as a means of supporting the consultation and development of the Aerospace Strategy as the required steps to build an Aerospace Nation
2. The proposed goals in the Aerospace Strategy provide ample opportunity for international collaboration as well as domestic capability and capacity development to address significant global challenges
3. The Strategy builds on the Christchurch Sector Development Plan and Tāwhaki as examples of government leadership in space sector development, and
4. The alignment with UC's strengths in aerospace engineering, space life-support systems, astronomy, atmospheric and climate research, earth observation and geospatial systems.

Question 2 What are the critical factors that you see for aerospace sector development?

<u>Investment</u>

The expectation of the Strategy is that New Zealand will be taking an international leadership role in each goal. To realise this aspiration, the Strategy needs significant and ongoing investment through to and beyond 2030 for New Zealand to establish these global leadership credentials. The outcome of the Pathway (Action Plan) phase will be critical in establishing this quantum of investment commensurate with this expectation.

NZ Government investment is key and is expected to include both procurement of satellite-based services (Government-as-customer) as well as investment in education, research, commercialisation and international engagement (Government-as-investor). We see investment in New Zealand

originated companies with the establishment and growth of local start-ups and larger companies as critical to building the commercial sustainability of the domestic aerospace sector.

Capability and Capacity Development

Aerospace has an unparalleled ability to engage the broader public including inspiring more young people and underrepresented groups. However, education — which delivers on this inspiration to convert interest to the Strategy's desired outcomes — is not a key activity in the strategy.

1. There needs to be an overall National Aerospace Education Plan to allow people to develop the necessary skills to enter and support the Aerospace Strategy. This includes both vocational, tertiary and secondary school curricula including programmes for tamariki and rangitahi as well as an emphasis on diversity and Inclusivity.
2. Engagement with the Ministry of Education/Tertiary Education Commission to highlight the aspirations within the Aerospace Strategy and the need to lift investment in capability development funding based on a National Aerospace Education Plan.
3. New Zealand needs to build diverse, skilled and motivated human capacity to deliver science/engineering teams who can deliver to ambitious national and international missions.
4. Investment in core New Zealand-based infrastructure should be supported on a national-access basis and the sector development needs

Question 3: How would an Aerospace Strategy help you?

Aerospace technologies and activities take years to develop, and significant changes and advancement may take decades. A national Aerospace Strategy would help us to plan and deliver new educational initiatives, undertake deep technology research and partner with international leaders in science and engineering on projects with long-term goals.

Area One - A strategy for building our aerospace sector

Question 4:	Is the 2030 Future State set out in a way that enables New Zealand to build on its existing advantages to develop a leading place in the global aerospace economy?
Question 5:	Will the 2030 Future State support your ambitions for growth and participation in the sector?
Question 6:	What barriers are there to optimising sector growth?
Question 7:	How could the government and the sector work together to achieve the 2030 Future State?
Question 8:	How can the Government enable Māori ambitions for the sector?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Question 4: Is the 2030 Future State set out in a way that enables New Zealand to build on its existing advantages to develop a leading place in the global aerospace economy

Our concerns are as follows:

1. The 2030 Future State does not acknowledge or include a specific commitment to an iwi partnership based on the principles of Te Tiriti
2. That the sector is both sustainable in its own right and is commercially competitive at a global perspective by focusing on unique and niche services (rather than a dilution based on business-as-usual effort)
3. The statement "Technology development is enabled through iterative hardware and flight-testing capabilities that can transition seamlessly between low-altitude, high-altitude, sub-orbital and orbital operations." while ambitious does not incorporate other segments of the sector such as downstream data processing and professional services that will have significant potential future value for New Zealand.

Question 5: Will the 2030 Future State support your ambitions for growth and participation in the sector?

As an aspiration, the 2030 Future State will support our ambitions for the development of a vibrant and productive centre of research and capability development to support the growth of the NZ aerospace sector

Question 6: What barriers are there to optimising sector growth?

The barriers to optimal sector growth includes:

1. Dilution of effort in the sector rather than a targeted approach to solve New Zealand issues with space-based technologies and services that have global applicability

2. Lack of investment especially in Government-as-customer and Government-as-investor funding to drive domestic industry capability and capacity development
3. No commitment to national missions to solve New Zealand issues and to build operational capabilities with flight heritage
4. A mechanism to support national research coordination on national aerospace missions (a potential future pathway such as a national research platform may be the appropriate mechanism).
5. No national Industry Transformation Plan
6. While international partnerships and collaboration are recognised as important, a lack of domestic focus based on the establishment and growth of local start-ups and larger companies will prevent beneficial domestic sector growth.

Question 7: How could the government and the sector work together to achieve the 2030 Future State?

We recognise the government and sector have worked together to achieve significant progress up to now. The joint-development of the Strategy and the Action Plan will be required to accelerate this process and lay the platform for the 2030 Future State. Specifically, this includes the government providing long term anchor investment to enable the sector to plan long term activity (such as education, research, commercialisation and commercial activity).

Question 8: How can the Government enable Māori ambitions for the sector?

There is a genuine opportunity for the inclusion of iwi Māori and Te Tiriti in the Aerospace Strategy development process:

1. This will produce a more robust, substantial and inclusive aerospace sector/space industry. We can lead internationally by example. Initiatives like Tāwhaki should be continued systematically, not left as a one-off initiative.
2. Partner with iwi/ hapū to ensure that rangatahi Māori and iwi Māori have opportunities for employment at all stages, and partner with schools/other local educational institutions to train youth in related STEM subjects. This also includes Te Ao Māori input into a National Aerospace Education Plan to support pathways for rangatahi Māori to enter the aerospace sector.
3. Collaborate on development of aerospace facilities and infrastructure, to ensure that associated construction projects reflect local iwi/hapū histories and narratives in landscape architecture and structural/architectural design; training should include holistic environmental ecological/design of facilities/infrastructure.
4. Use these construction projects and opportunities to foster ecosystem restoration, and climate/disaster resilience.
5. Partner with relevant iwi organisations and businesses to ensure the flow of remotely sensed and other data to them for environmental management of their rohe, land and marine, and ensure upskilling at all ages to be able to consume, analyse and map the data.

Area Two - Building strong foundations (Three Pillars)

Question 9:	What do you think of the Three Pillars and do you think they will support the 2030 Future State?
Question 10:	What else would you like to see in the Three Pillars?
Question 11:	What actions and initiatives could the sector focus on to support the Three Pillars?

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Question 9: What do you think of the Three Pillars and do you think they will support the 2030 Future State?

In principle we support the concept of foundation Pillars but the way they are described currently is not well defined. We would like some changes in emphasis and description as follows:

1. Pillar 1: Is about investment to enable the sector to reach its potential. It should include government as an early adopter and anchor investor in aerospace technology (currently described in pillar 2) and specific mention of international partnerships as a mechanism to grow capacity and capability while simultaneously building domestic capacity and capability.
2. Pillar 2: Is about future focused regulatory environment and infrastructure; the reference to early adopter investor should be removed. The Parliamentary Commissioner for the Environment recently reported in the deficiencies in our environmental data collection, and it is expected that there will be a major reset around funding, collection and management. Pillar 2 should be cognisant of this and explore how earth observation could be incorporated into the new model. What other critical national infrastructure is required to support the strategies aspirations. Publicly funded launch facilities, ground stations and satellites such as SouthPAN. Infrastructure could equally fall within pillar 3 creating a pillar solely focused on capacity and capability.
3. Pillar 3: The first part is about social license (not a given) and should therefore incorporate Te Tiriti and establish a principled approach to sustainable development of space. Our principles should be the foundations of our policy and regulations and also influence our international policy work. This is clearly related the Pillar 2 and should therefore be incorporated above. The second paragraph of pillar three is on capacity and capability development. It is definitely a foundation underpinning the success of the strategy and is sufficient as a pillar in its own right.

Question 10: What else would you like to see in the Three Pillars?

The pillars as they are currently framed lack focus. We have attempted to address this in the comments above but there may be a need to create a fourth pillar (capacity and capability) to ensure each pillar in the Aerospace Strategy has a clear focus.

11. What actions and initiatives could the sector focus on to support the Three Pillars?

The pillars will require final definition during the Aerospace Strategy submission process and the Pathway (Action Plan) phase will define the appropriate actions and initiatives to support the final strategic space pillars.

Area Three - Goals for 2030

Question 12:	What do you think of the Goals for 2030?
Question 13:	Are the goals framed in a way that will enable New Zealand to build on its strengths and comparative advantages to achieve the 2030 Future State?
Question 14:	What activities and milestones can help us achieve these Goals?
Question 15:	Where do you see yourself in realising these Goals?

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Question 12 What do you think of the Goals for 2030?

University of Canterbury is comfortable with the Goals for 2030 and we have reiterated some of our relevant comments from our previous response to the "Goals for 2030 – New Zealand aerospace strategy" document in March 2022:

Goal 1: Building a sustainable, long distance passenger journey

Overcoming the low carbon emissions of long-distance air travel is an acute issue for a remote country like New Zealand and it is a worthy goal within the strategy. Engine manufacturers such as Rolls-Royce are stating that all their large commercial jet engines will be 100% Sustainable Aviation Fuel (SAF) compatible by 2023, aligning with the "UN Race to Zero" breakthrough goal of 10% of all the fuel used in aviation being SAF by 2030.

We have good links with large international manufacturers and an enabling environment (integration trials) to attract research and development partnerships. We also have very capable and innovative engineering capability already investigating high power electric motors for large-scale transport, novel composites and materials, development of biofuels for which we have plentiful resources, international partnerships investigating green hydrogen fuel and regionally the development of sustainable airport infrastructure (electric fast-charge, hydrogen integration etc) and with an aim to enter international supply chains for both sustainable airport infrastructure and niche aircraft systems and componentry.

Goal 2: Safely integrating all forms of autonomous aerial vehicles

New Zealand has a world leading regulatory environment which is attracting companies to NZ to develop innovative aerial vehicle technologies. This goal addresses the next challenge, which will enable these start-ups to become a reality, and New Zealand is well positioned to develop the world's first "drone road system". Goal 2 is well scoped and suitably ambitious. However, the specific activities required to create the appropriate regulatory environment are not described as most of the activities appear to be early demonstrator projects which are intended to test the regulations.

Goal 3: At the forefront of global sustainable space activities

The Goal is suitably ambitious, but its scope is limited, focussed on a single issue of space debris (e.g. the entirety of paragraph 1). International endeavour is rapidly recognising the shared space environment as a place for conservation of available resource, in an absence of regulation of

common activity. A Te Ao Māori approach to develop a world-leading NZ regulatory framework for sustainable space launch activities is needed that can be used as an example/taken to UN to revamp existing treaties based on rule-based and risk-averse principles, such as international waters or Antarctica.

Some principles might include satellite life-cycle design, minimising constellation build-out (i.e. doing more with fewer satellites), access to space (i.e. launch windows), international standards for reliability, and mandatory insurance. Stronger international legal obligations are required to incentivise more thought on what is launched. There are already business cases for creating satellites that mitigate their impacts on their environment (e.g. their visual and radio brightness is minimised, to reduce impact on the night sky), and which optimise their demisability. A key absence in this Goal is any mention of the mitigation of visual and radio pollution associated with satellite constellations (from both technical and regulatory standpoints) — recognising the cultural value of the night sky, the growing economic value of dark skies tourism, and the impact on optical astronomy. The development of de-orbiting and satellite collision manoeuvres are a vital part of sustainability of space, but require reliable onboard and ground communication systems and ground tracking and ranging. 25% of small cubesats currently become space junk due to a failure in their communication systems. The problem is that existing low-cost transceivers and ground segment equipment, require extensive customisation of individual missions, are not user-friendly and are unreliable in orbit. There are significant opportunities to address these gaps in the New Zealand research community.

It is also noted that the Goal is mostly focussed on activity in space rather than considerations of how space activities impact Earth's ecosystems, and in particular the impacts on Earth's atmosphere. NZ should be a leader in developing environmentally friendly rocket propellants, and in assessing the impacts of rocket emissions on atmospheric composition (e.g. do they deplete the stratospheric ozone layer?) and climate (e.g. do they heat the atmosphere?). Many of the propellants currently in use worldwide do both. The environmental impacts should be a factor in a Te Ao Māori approach to a NZ regulatory framework. Currently, it is outside the remit of the NZ Space Agency. Ministry for the Environment, who are responsible for ensuring we meet our Montreal Protocol obligations to protect the stratospheric ozone layer, do not gather data on emissions from rocket launches. So at present, there is a policy black hole. There is also the question of what space debris from standard re-entry demisability procedures does to atmospheric composition, which has also been largely ignored to date.

<u>Goal 4: Actively supporting a permanent human presence in space</u>

The title for this Goal caused some consternation, as the wording used has a clear technical meaning, used extensively by the international space community: 'permanent human presence' refers to astronauts.

We are appreciative that additional comments clarified that the intent of the Goal is to be much broader, specifically to encompass the activities of robots, autonomous vehicles, telepresence, etc., which are accepted and standard parts of human activities in space. The Goal is clearly not intended that NZ only commit its future efforts to supporting human spaceflight, which is otherwise what our international partners will infer from the current title. Thus, the wording needs amendment.

We propose the new title: "Actively supporting ongoing human exploration in space"

The overall aim of the Goal is excellent, and we support it strongly.

While the stated aim is for each goal to be an area "that Aotearoa New Zealand can take a leadership role in", in this Goal's case we are "supporting". Thus, the implementation of this Goal needs to focus much more specifically on building capabilities/critical mass in people and tech, so that we can make genuinely valuable and unique contributions to international robotic exploration and human spaceflight. This will let us build reasons for partners to want to work with us.

We see significant advantages for including ambitions related to food production, life support systems and extreme environment habitat development within this Goal. There is significant scope to integrate New Zealand's current strengths in innovating within primary industries and agricultural sectors of the economy, as well as our leadership in Antarctic programmes (both regarding policy/international partnerships, as well as infrastructure/logistics in extreme environments).

There should also be strong linkages between the implementation of Goal 2 and this Goal, in the nascent opportunities for technical skill development.

Goal 5: Critical decision-making made easier through aerospace-enabled data, tools and applications

The Parliamentary Commissioner for Environment report *Focusing Aotearoa New Zealand's Environmental Reporting System* identifies that the current environmental monitoring network 'is rather more slapdash than ideal'. This supports the case for addressing gaps in the current monitoring network. Access to satellite data is a critical requirement and FAIR data access should be promoted. Government level partnerships for access to data would be a huge spur to innovation. Foundational knowledge around understanding how optical remote sensing can be used given things like obscuring clouds over much of the NZ landmass could be a game changer. Distributed data access and compute infrastructure for NZ Inc would also make a huge difference.

Besides Earth observation capability, space communication technologies and applications should also be pushed. Data rate of space communication systems is always a bottleneck to earth observation. Innovative technologies to improve space communication data rates will significantly increase the value of earth observation. New Zealand would also benefit from Space IoT applications. IoT devices can be implemented to track people and assets, and monitor environment in rural and offshore areas, from space. This will greatly improve current management networks. There are many areas in New Zealand that do not have good mobile or/and internet connectivity. Space communication systems have been proved to be a solution to improve connectivity issues. However, this should exist in strong harmony with Goal 3: communications should be via environmentally responsible satellites.

Question 13: Are the goals framed in a way that will enable New Zealand to build on its strengths and comparative advantages to achieve the 2030 Future State?

New Zealand's strengths and competitive advantages are well defined in terms of our geographical advantages, our innovative approach to the application of engineering and science and the whole-of-government approach in the initial development of the New Zealand space sector.

The next stage of development supported by the Aerospace Strategy is to develop industry scale and focus to demonstrate New Zealand can play a role in the global space economy while concentrating on areas of national significance by exploiting our strengths and competitive advantage. This is not an easy task given the increasingly competitive global market. Our strengths and competitive advantages for developing space businesses, attracting investment and entering international supply chains (and ultimately achieving the goals) are not well-defined allowing

significant flexibility in what is a rapidly evolving sector but what may not be ultimately commercially sustainable.

This is the challenge that the proposed Pathway (Action Plan) under the Goals must address.

Question 14: What activities and milestones can help us achieve these Goals?

This is the challenge that the proposed Pathway (Action Plan) under the Goals must address.

University of Canterbury has reiterated some of our relevant comments from our previous response to the "Goals for 2030 – New Zealand aerospace strategy" document in March 2022:

All Goals:

Activities:

- Ensuring our engagement with iwi Māori are respectfully enabled for ongoing future collaboration in environmental monitoring and potential commercial dealings.
- Building capacity for the aerospace/space industry by collaborating with our stakeholder partners and iwi Māori to promote education programmes. These programmes will include scholarships and internships for Tertiary students across interdisciplinary sectors.

Goal 1

Activities:

- Harnessing clean, renewable energy resources to become the forefront of use of SAF and seek potential for future domestic production, ensuring the supply can be sustainable.
- Developing high-density storage systems for electrical energy and hydrogen for use in the emerging alternative technologies for aviation.

Infrastructure

- A pilot scale demonstration plant for biofuel and hydrogen integration in an airport infrastructure.

Goal 2

Activities

- Accelerate the use case for aerial vehicles using advanced sensors, tools with mm precision, wireless communications and artificial intelligence to ensure faster, more cooperative and more successful search and rescue operations and supporting post-disaster recovery and impact assessments.
- Accelerate the use case for automated aerial technologies in forestry, conservation, agriculture and horticulture, management of natural ecosystems, environmental monitoring of pests and diseases, and to enhance productivity and improve safety vin construction.

Infrastructure

- The development of a Beyond Visual Line of Sight test area. This allows companies to test their Autonomous Aerial Vehicles in a safe environment. This in turn allows MBIE, MoT (Ministry of Transport) and CAA to see successful demonstration of such capabilities and feel confident in enabling integration into the aviation system. The existing site run by University of Canterbury is no longer compliant, and the opportunity exists to develop a more comprehensive testing facility with neighbouring Tāwhaki on Kaitorete Spit.

Goal 3

Activities

- Building Aotearoa New Zealand's capabilities in fundamental areas of active debris removal operations, sustainable space access, satellite environmental mitigation, space situational awareness and space traffic management, such as rendezvous and proximity operations.
- Becoming a leader in international forums for proactive satellite environmental stewardship, playing an active role in policy and regulatory negotiations for responsible behaviour in orbit, removing international debris, satellite effects on night skies, global space traffic management and situational awareness.
- Developing and integrating a domestic regulatory framework to align with international obligations in Aotearoa New Zealand to support global sustainable efforts. This regulatory framework will inform regulation, monitoring, international coordination and demonstration of mitigating and deorbiting space technologies, including large-scale commercial active debris removal activity.

Goal 4

Activities

- Developing technologies and integrating a domestic regulatory framework to align with international obligations to support global efforts for sustained off-Earth presence.
- Obtaining flight heritage for NZ-created contributions to critical aspects of upcoming international missions, contributing science and engineering outcomes that are internationally unique (steering away from me-too missions)
- Building capacity, both in terms of technology and teams (ie. cohorts of experts capable of developing missions), for adding value to international partnerships (ie. our people and tech are internationally in demand)

Infrastructure

- A low-temperature climate simulation chamber. This could either be in NZ, or if access could be arranged, to international facilities for testing.
- A low-gravity simulation environment and regolith simulant facility. This could either be in NZ, or if access could be arranged, to international facilities for testing.
- A series of funding calls for the development of mission instrumentation.

Goal 5

Activities

- Creating a roadmap and testbeds for the use of air and space based platforms in environmental monitoring and research. To build our capability in this area we need to support the development of a range of air and space-based platforms as well as grow downstream data and software innovation, especially in geographic analytics (GIS), artificial intelligence and machine learning and the development of robust ground-truthed data sets.
- Developing strategic policy to align with existing domestic regulatory frameworks that will in-turn align with international obligations.

- Increasing the access of companies, institutes and other experts to multi-layered data sources and collaboration between institutes in this area which will also promote the development of aerospace-enabled products and services that improve decision-making, productivity and wellbeing across the economy.

Infrastructure

- A sovereign-owned satellite for earth observation purposes over New Zealand.

Question 15: Where do you see yourself in realising these Goals?

University of Canterbury considers the Aerospace sector as an important and long term research and education theme. The recent establishment of an aerospace engineering and space sciences research centre with the appointment of Professor of Aerospace John Cater as Director will significantly raise the university's profile in the space sector.

The University will continue to be active in developing and undertaking research activities in support of all of the goals in the Aerospace Strategy. This includes research in support of both upstream activities associated with space engineering and space science disciplines and applications as well as downstream research activities associated with other space sector applications such as legal, finance, data analysis and new space-based services.

Likewise, the University will continue to develop innovative educational offerings in response to demand for both undergraduate and postgraduate programmes as a pathway for increasing the capacity of human capital across the sector. The University has developed a significant on-line capability through its relationship with edX (UCX) for the delivery of micro-credentialling and professional certification which can be leveraged in the future for industry capability development.

The University will also continue to support its regional stakeholders in the space sector including Aerospace Christchurch, ChristchurchNZ Aerospace cluster and Tāwhaki.

Area Four - Pathway to the 2030 Future State

Question 16:	What policies, ideas, actions, and/or initiatives would you like to see in the Action Plan to help achieve the ambitious 2030 Future State?
Question 17:	What would be the benefits of these actions and how would they help grow the New Zealand aerospace sector?
Question 18:	How would you like to be involved in the delivery of the Aerospace Strategy?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Question 16: What policies, ideas, actions, and/or initiatives would you like to see in the Action Plan to help achieve the ambitious 2030 Future State?

UC believes the following initiatives would be useful inclusions in the Action Plan:

1. Development of a decadal plan with a national and regional focus, priorities and identification of niche opportunities for global impact
2. Commitment to National Mission/s to support the decadal plan and develop domestic operational capabilities
3. Development of Technology Roadmaps for key areas of development to support each goal, associated National Mission/s and facilitate international collaboration
4. Consideration of National Aerospace Education plan and funding to develop the capability and capacity required
5. National infrastructure identification, funding and access

Question 17: What would be the benefits of these actions and how would they help grow the New Zealand aerospace sector?

These actions will support focused development and prevent unproductive and unnecessary duplication, dilution and divergence of the sector.

Question 18 How would you like to be involved in the delivery of the Aerospace Strategy?

University of Canterbury would like to be involved by:

1. Inclusion in the sector-government taskforce
2. Inclusion in a National Aerospace Education Plan development and delivery
3. Commitment to sustained and ongoing space-focused research and education programmes including funding submissions, international research collaborations and new capability development programmes.