Aviation White Paper | Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA)
Boeing Australia submission

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Boeing in Australia

Boeing is one the world's largest global aerospace manufacturers. As a leading global aerospace company, Boeing develops, manufactures and services commercial aeroplanes, defence products and space systems for customers in more than 150 countries. Our diverse team is committed to innovating for the future, leading with sustainability, and cultivating a culture based on the company's core values of safety, quality and integrity.

In 2022, Boeing celebrated 95 years in Australia. With nearly 5,000 people in over 38 locations across the country, **our presence is one of the largest outside of the continental United States**, and supports some of the largest and most complex programs for the Australian government and our commercial customers.

Within Australian aerospace, we have employees and an extensive supply chain spread across many areas of advanced design and manufacturing. These include the manufacture of advanced composite components for commercial aircraft; defence systems design, development and support; unmanned systems, simulation and modelling; support and training, as well as world-leading collaborations and partnerships.

How to maximise the aviation sector's contribution to achieving net zero carbon emissions

The societal benefits of aerospace are immense. It protects and connects people, enables livelihoods and trade, provides humanitarian relief and national security, and allows for human exploration of space. Aviation currently contributes approximately 2.5 percent of global carbon emissions and 12 percent of the transport sector; however, this is expected to change as we see the sector grow, particularly in the Asia Pacific region, and other less hard to abate areas of the transport sector access low carbon technologies[1]. Australia's geographic location, economic and cultural connection to the rest of the world means that a focus on decarbonising aviation needs to be a key component in Australia reaching its net zero emissions ambitions. **The decarbonisation of aviation is intrinsically linked to the wider energy transition in Australia where low carbon energy carriers**, such as renewable electricity, green hydrogen and renewable fuels, will be prioritised to meet demand in different sectors. It is important to consider the hard to abate nature of aviation, with limited access to commercially viable low carbon technologies, when governments consider how to prioritise energy carriers and incentives in energy transition strategies.

Boeing believes the future of flight will take "everything for zero." Collaborations that foster a diverse portfolio of technologies that will mature at different times and be suitable for different aviation segments based around four key strategies: fleet renewal, operational efficiency, renewal energy transition and advanced technology.

Fleet Renewal – New and upgraded conventional aircraft has seen emissions from air travel have halved globally in the last 30 years. New aeroplanes provide significant efficiency gains by embedding innovation that can reduce fuel use and emissions by 15-25 percent. Traditional aviation innovation cycles and certification timeframes mean that the fleet being brought into service now will likely be in service for several decades. Many Boeing customers accelerated retiring older aeroplanes during the pandemic to optimise their fleets with the latest, most-efficient models. The latest Boeing commercial market

[1] Analysis by the Air Transport Action Group (ATAG) predicts that by 2050 air travel will carry over 10 billion passengers a year, for this growth to be sustainable the sector needs to decouple growth from emissions (CO2 and non-CO2) and increase access for all.

outlook forecasts that 49 percent of the 41,170 planes needed to meet growing demand by 2050 will be fleet replacements. Deploying the latest generation of aeroplanes is one of the most significant contributions to CO2 emissions reduction available over the next decade.

Operational Efficiency - Leveraging data, digital tools and platform modifications to improve the efficiency of the aircraft can also reduce emissions by approximately 10 percent. A modernised air traffic management system is a critical component of the civil aviation industry's commitment to meet net zero targets. Procedures such as continuous descent approaches and equipment upgrades such as GPS-based navigation for more direct routings, leveraging data for fuel and flight efficiency, optimise flight planning and provide pilots with real-time weather and traffic information can have significant emission reduction impacts. The industry and air safety authorities will **need to continue to collaborate on how to operate and fly more efficiently, adapt airspace to advanced technology, and facilitate greater accessibility and integration**.

Incentivising continuous improvements in manufacturing and production, material innovation and end of life custody is also important to decarbonising aviation. As Australia develops its domestic capability in modern manufacturing, there are opportunities for the aerospace sector and governments to collaborate and invest in facilities that use low carbon manufacturing equipment and processes and deploy renewable energy solutions.

Renewable Energy Transition – In civil aviation, over 90 percent of carbon emissions come from aircraft fuel when in use, so accelerating the energy transition to scale affordable renewable and low carbon fuels will contribute significantly to decarbonising the sector. Boeing takes a holistic view to decarbonisation and when we do, it is clear that sustainable aviation fuels (SAF) are a necessary lever. However, it will take a 'SAF and' approach to achieving net-zero by 2050, meaning a diverse portfolio of technologies that will mature at different times will be suitable for different aviation segments. The aviation sector needs access to renewable and sustainable fuels, green hydrogen and abundant renewable energy to make available these diverse technology options. Under any scenario for the introduction of future advanced aircraft products with new energy carriers, we will need massive amounts of SAF if we are to meet the civil aviation's commitment to net zero by 2050.

SAF is widely accepted today as a drop-in replacement for fossil jet fuel that works with existing aeroplanes and offers the largest potential to reduce carbon emissions over the next 20 to 30 years in all aviation segments. Hydrogen and electric flight concepts are in very early-stage development and not likely to be commercially available for long distance flights - where 70 percent of aviation emissions are generated - for decades. SAF is certified technology ready to scale. Under ASTM[2] certification SAF currently provides seven approved feedstock and production pathways to produce a drop-in fuel for use up to 50 percent blend. SAF can be refined from waste biomass and hydro-carbon based industrial and household waste as well as used cooking oils and fats; depending on the pathway SAF can reduce emissions across the lifecycle by 80 percent compared to fossil jet fuel. The challenge is supply and the domestic policy levers that can unlock an Australian industry. Boeing has partnered with the Sustainable Aviation Fuel Alliance Australia and New Zealand (SAFAANZ) to further industry and government partnership to scale the domestic production of SAF. Boeing also partners globally with the Roundtable for Sustainable Biomaterials (RSB) on creating ethical and sustainable criteria for assessing SAF feedstocks and production pathways. Boeing is currently partnering with the CSIRO to

[2] ASTM International, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards.

develop a SAF Roadmaps for Australia outlining research into feedstocks and fuel production potential.

A domestic SAF industry will require the implementation of national level government interventions, such as those outlined in the SAFAANZ "Bridging the Gap"[3] report. The first recommendation in the Report, **establishing an Australian Jet Zero Council is a critical element in ensuring an informed policy agenda**. The Jet Council and the policy guidance it delivers is needed as a matter of urgency. International incentives and mandates, such as the Refuel EU policy package; and renewable energy stimulus packages, such as the US Inflation Reduction Act, are signalling to SAF producers and feedstock providers that large-scale production will be viable in these regions. Australia has a diversity of potential SAF feedstocks which are attractive to SAF producers and there is risk that the international market will lock these into non-domestic SAF production if Australia is unable to establish a SAF industry in the near-term. **Stronger government intervention could deliver the growth of a new industry that leverages Australia's existing assets and brings opportunities to regional areas, to meet local and global aviation fuel demand**.

Advanced Technologies – Intersecting renewable energy carriers with advanced technology flying machines will enable a diverse portfolio of low carbon aviation solutions in the future. The future of flight will incorporate the latest digital design, test, and production tools, airframe innovation, propulsion and systems technology, and different power and energy solutions will apply to different market segments and aircraft sizes.

Electric aviation can enable the delivery of decarbonisation and decentralisation of mobility in Australia and the Pacific region. Alongside this potential, it must be acknowledged that there are complex planning, infrastructure, community and regulatory challenges. Meeting these challenges will take a multifaceted approach from industry and one-way Boeing is approaching this in Australia is undertaking a strategic partnership with Wisk Aero to deliver Advanced Air Mobility. Wisk will be the first company to bring an all-electric, uncrewed, vertical take-off and landing aircraft to market. Products like Wisk and electric aviation generally require coordinated and nationally consistent regulatory framework to ensure contribution to decarbonisation, industry standards, certification, autonomy and airspace integration. For electric aviation vehicles to be sustainable, they require access to affordable and reliable renewable electricity to charge power units for operation, and this should be considered in the infrastructure requirements and policy incentives for electrification of aviation.

With respect to hydrogen, the first, best and primary use of hydrogen in aviation should be used to develop and scale SAF. Hydrogen is required in some SAF pathways and we can take hydrogen and carbon and large amounts of renewable electricity to produce a synthetic 'electric fuel' that can also be classified as SAF. The industry also is considering using hydrogen as an energy carrier onboard aircraft. Boeing has innovated with hydrogen and fuel cell applications onboard aircraft for over 15 years. We have developed insights through six hydrogen technology demonstrations with crewed and uncrewed aircraft using hydrogen fuel cells and combustion engines and have substantial experience with hydrogen and especially cryogenic storage systems from our space and launch business. As production of green hydrogen relies on large amounts of renewable energy, we believe these technologies are a promising potential future pathway to decarbonising the sector aligned to affordable renewable energy being abundant within the Australian electricity network.

[3] The report can be found at: https://cdn.revolutionise.com.au/cups/bioenergy/files/ephcnscv89wbfzjz.pdf

Boeing takes a holistic view to decarbonisation including full lifecycle assessment and total climate impacts of energy carriers. We recognise that non-CO2 emissions must also be included in the decarbonisation of the sector, particularly those with impact on climate and human health. Boeing also recognises the transition of the aviation sector will take time and requires the use of verified and robust carbon offsets and carbon removal projects in the mid-term as we collectively work to scale up SAF and deploy advanced technologies.

To support the global aerospace industry as it maps a path to net zero emissions, Boeing created Cascade, a data modelling and visualisation tool that quantifies the potential of each of the strategies to cut emissions, including fleet renewal, operational efficiency, renewable energy and advanced technologies. The Cascade model allows the industry to visualise, for the first time, the real climate impact of each of our major paths to decarbonise aviation and to inform the most impactful and effective strategies to reach net zero by 2050. The Cascade model assesses the full lifecycle impacts of renewable energy by accounting for the emissions required to produce, distribute and use alternative energy carriers such as hydrogen, electricity, and SAF. The tool is used with airline operators, industry partners, and policymakers to inform when, where, and how different fuel sources intersect with new aeroplane designs.

Changing aviation technologies and ways to position our policies, regulations and systems to encourage uptake and manufacturing of new, more efficient transport technologies

Electric aircraft could be used on demand and as a permanent fixture of a transport systems to further encourage the interoperability of existing transport networks. The demand will not just be driven by existing mobility patterns and the evidence they present but emerging mobility patterns and improved access to mobility over the coming decades.

Uncrewed, electric aircraft can also be applied to a variety of challenges immediately. Insitu Pacific (a wholly owned subsidiary of Boeing Australia) manufactures crafts that can be used for land and infrastructure surveying and analysis. This is particularly helpful in understanding the impacts of major projects, agriculture and land-use change, as well natural disasters. Uncrewed electric aircraft are increasingly playing a role in courier and freight delivery. As the impacts of natural disasters become more frequent and severe through climate change, the ability to safely and efficiently understand and mitigate the impacts of disasters through `access facilitated by electric aircraft cannot be understated. An uncrewed electric aircraft could be used to survey landscapes and communities and provide analysis, informing relief efforts as well as providing direct support with freight and courier services.

For electric aviation vehicles to be sustainable, they require access to affordable and reliable renewable electricity to charge power units for operation, and this should be considered in the infrastructure requirements for electrification of aviation. The opportunity to ensure adequate provisions for electric aviation are made in the master planning activities, that are currently being undertaken at all levels of government, is critical. Future air and vertiport infrastructure cannot be designed in isolation and existing infrastructure cannot be future proofed without acknowledgement of the planning and grid capability challenges to support both eVTOL and eCTOL craft. **Whether crewed or uncrewed, electric aircraft requires significant new infrastructure coupled with renewable grid and battery access to ensure sustainability of use**.

Close relationships and collaboration with university and industry partners to continue developing new technologies and techniques is of critical importance. This can include expansion and continued development of resin infusion and factory robotics technologies that are currently in use to support future manufacturing.

Future industry workforce skills and training requirements

Boeing has developed strategic alliances with several Australian universities to develop a skilled and fit for purpose workforce for the aviation industry. By partnering with universities, Boeing is able to inform universities of the key skill needs and capture talent at the graduate and postgraduate levels. Shortages in technology skill areas for the Australian aviation, defence and space environment include software, modelling and simulation, human factors, robotics, autonomous systems and artificial intelligence (RAS-AI), space and satcom, and cyberworthiness to name a few.

Boeing Research & Technology Australia (BR&T-A) continues to collaborate with industry, government, regulatory bodies and universities to accelerate development of emerging technologies and transitioning value to our customers in Aviation, defence and space. BR&T-A has contributed to Australian Research Council grants, Defence CRC's, and PhD alliance agreements to enhance Australian industry capability and foster the next generation of scientists and engineers.

Beyond formal arrangements with Australian universities, the 2022 Skills Priority List[4] from the National Skills Commission highlighted a number of occupations which are experiencing shortages, particularly in the aviation industry. Specific examples include engineers, maintenance personnel, air crew, support staff, and ground crew. In the near to medium term Boeing anticipates increased demand for demand for pilots, cabin crew, engineers, technicians, ground support, and air traffic controllers to support expected continuation of aviation industry growth.

Regions being empowered through new skills and qualification routes will be critical to ensuring a robust workforce. This includes upskilling opportunities for existing workforce participants to meet the unique technical and engineering demands of the emerging aviation industry. Specific formal skills sought include aerospace engineering, manufacturing and mechanical engineering, materials engineering, mechatronics and automation engineering; while formal skills are needed in aerospace trades as well as quality and inspection trades. Government programs and incentives can be implemented through institutions such as TAFE for individuals to explore these skills in educational settings and employers to facilitate upskilling.

Within the defence environment, Boeing predicts over 400 additional aircraft technicians will be required to meet the anticipated demand over the next five years. Many of these roles will be based in regional areas such as Toowoomba, Nowra and Townsville. Unfortunately, the current apprenticeship pathways process will not meet this demand, resulting in a significant risk to the Australian Defence Force's capability to meet national security requirements.

New pathways to accelerate training are required, as is a concerted effort to encourage school leavers to join a trade. Further, a concerted focus on non-traditional entrants is also needed to encourage women and indigenous workers to consider aircraft maintenance as a career.

[4] Skills Priority List website: https://www.nationalskillscommission.gov.au/topics/skills-priority-list

Boeing recommends consideration of the **development of specific policy to ensure a sustainable pipeline of workers from both targeted migration but also through the education and skills system** such as accelerated vocation pathways and the development of specific new talent pathways. Further, Boeing recommends **arrangements with training colleges need to be developed to create programs which train future technologies to ensure workers are future ready** (this includes software-based systems and repair of robotic manufacturing equipment).

Maintaining fit-for-purpose aviation safety, air navigation and aviation security systems and service delivery agencies

Unfortunately, Australia lacks a comprehensive vision and roadmap for aviation. This vision and roadmap should drive policy and regulatory settings, planning and investment across all sectors of Government and provide industry the greater certainty needed for ongoing industry investment. The vision should provide a consistent and phased view of the evolution of Australia's aviation ecosystem, and broadly, show how this future will continue to meet safety, sustainability, capacity and social expectations of the industry. The roadmap should outline the key challenges and underpinnings for these end states, providing a consistent and cohesive plan to support policy and regulatory development and to guide Government and industry investment. **Boeing recommends Government should work more closely with industry to develop the vision and roadmap for Australian aviation as a matter of priority.** The vision and roadmap should cover the goals and guiding principles governing the evolution of aviation and associated operational concepts. It should describe the associated changes in the respective pillars of a healthy aviation ecosystem (i.e. regulation, infrastructure, workforce, social licence, sustainability, and financial) needed to support the realisation of this vision.

The aerospace industry across the globe is undergoing a significant period of innovation. From the electrification of the general aviation fleet, transition to space-based communication, navigation and surveillance systems, to the use of data analytics and Artificial Intelligence (AI) – such innovation brings many potential benefits, however, this must be done without compromise to the high standard of safety we value today. **A regulatory ecosystem that fosters innovation will ensure Australia's aviation industry remains at the global forefront of safety, efficiency, and sustainability.**

Such innovation presents a challenge to the safety regulation of the aviation sector. The regulatory system must support the safe yet timely introduction of new technologies and operational concepts. The rapid emergence of new sectors (i.e., remotely piloted aircraft systems (RPAS), advanced air mobility (AAM), ultra-high-altitude air vehicles, and sub-orbital spacecraft) is one example of the large-scale innovation taking place today. Regulations remain both an enabler and impediment to the deployment of these technologies in a widening array of highly beneficial civil, commercial and defence-related applications. **Significant and ongoing regulatory reform will be required to ensure the safe and timely realisation of emerging aviation technologies and concepts of operation and the many benefits their applications can bring.**

The Civil Aviation Safety Authority (CASA) is widely considered as world leading in its efforts to manage the safe introduction of emerging aviation technologies and concepts of operation. **However, significant additional resources are needed to keep pace with the rapidly growing demand for regulatory services. Strategic investment is also needed to enable the authority and associated agencies (i.e., Airservices Australia) to design and field longer-term infrastructure to sustainably support these new users into the**

future. Government should recognise the increasingly important role for industry in assisting government in keeping pace with innovation.

Critical aviation infrastructure (i.e., air traffic management, communication, navigation, surveillance, airports, etc.) must also evolve to the changing needs of airspace use, support sustainable growth, and to ensure the benefits from ongoing technological advancements (e.g., automation, digital communications, space-based navigation and surveillance) are fully exploited. Aviation's commitment to a net zero future will be a key driver on the evolution of our aviation infrastructure – which will play a critical contributing role in enhancing the operational safety, efficiency, capacity, and resilience of Australia's aviation system. A significant challenge lies in the siloed way in which aviation technology investment has traditionally occurred. Examples of technology infrastructure planning, investment and execution ongoing today include: Airservices Australia OneSky/CMATS and Flight Information Management System (FIMS) programs, the National Drone Detection Network and proposed Drone Rules Management System, and CASA automated approval system. **The scope of the strategic vision and roadmap for aviation should include a technology integration plan that ensures coordinated government and industry investment in the critical digital enablers for a safe, sustainable, efficient and viable future aviation system.**

A contemporary aviation regulatory ecosystem is data-driven, whereby Government and industry decision making is based on the best available evidence. This evidence comes from **shared** Government and industry data. Australia lacks the data-sharing framework to enable global best practice decision making in the policy setting, regulation and oversight of the aviation industry. **Government, working in close partnership with industry, should develop a data sharing blueprint that seeks to leverage the many advantages of an increasingly digital and connected aviation industry.**

In the context of the safety regulation and oversight of aviation, ecosystem safety data sharing is essential to CASA's journey to becoming a contemporary risk-based authority and to enhancing industry-led safety management (i.e., through industry safety management systems). Established models like the European Data4Safety Program[5] and the Aviation Safety Information Analysis And Sharing (ASIAS) System[6] in the U.S., have substantiated the many benefits to enabling safety data sharing between Government and industry. Such data sharing will assist Government in the implementation of its State Safety Program. **A near term opportunity lies in establishing a trusted framework for safety data sharing in Australia.**

Compatibility with international regulations, and effective bilaterals that maximise and streamline recognition and acceptance between international safety authorities, will be essential to realising opportunity for the Australia aviation industry. In particular, streamlined "export paths" not only for Australian aircraft and equipment manufacturers, but for flight training and maintenance service providers. **Continued Government advocacy for international regulatory alignment will be even more essential now as nations seek to capitalise on early leadership in emerging sectors.**

A fit-for-purpose regulatory ecosystem for aviation starts with sound and best practice policy development. In this regard, policy development should:

- Adopt a "Whole of Government" approach that ensures a coordinated and consistent settings across all government departments and agencies

[5] European Data4Safety Program website: https://www.easa.europa.eu/en/domains/safety-management/data4safety
[6] FAA ASIAS website: https://www.faa.gov/newsroom/aviation-safety-information-analysis-and-sharing-program-1?newsId=23036

- Adopt a national approach that ensures consistent requirements across all levels of government (local, state and Commonwealth)
- Be co-developed through early and meaningful industry engagement

Industry engagement will be essential to Government developing and implementing a fit-for-purpose ecosystem for industry – national settings and investment that remains responsive to changing stakeholder needs, emerging risks and opportunities, and one that best leverages industry investment and resources. As an example, industry currently lacks a forum to engage Government on matters of airspace and Air Traffic Management policy, strategic planning, and implementation. **It is recommended that government review the current industry engagement framework with a view to ensuring more proactive and substantive consultation. Industry remains open to finding more ways to collaboratively work with Government to explore solutions to open challenges, and to support regional safety and efficiency outreach activities.**

Adequate and stable funding mechanisms that ensure agencies can meet immediate industry demand but also recognise the investment needed for the future, have been a long running issue. Activity-based funding models (e.g., fuel excise, aircraft movements) will need to be reviewed to ensure stability in agency funding but also a fair and proportionate contribution from all sectors, existing and emerging. Complete cost recovery and fee for service approaches will need to account for industry ability to pay and take a long-term and holistic view when it comes to the recovery of costs associated with strategic investments. The broader significant triple bottom line benefits from the aviation ecosystem should be a primary consideration. Should Government place greater emphasis on cost recovery from industry, there will be a corresponding increase in industry expectation for agency performance / service delivery. As such, Government would likely need to develop a more robust performance management framework that provides transparency and accountability for agency performance.

Conclusion

With strong partnerships across industry, government, education institutions, research organisations, and other interested parties, Australia has substantial opportunities to capitalise on its long-term experience in contribute to the growth and critical importance of global aviation. With our strong history and significant presence across Australia, our successful partnerships with Australia's world leading research and development organisations, and our advanced manufacturing sectors and small and medium-sized enterprises, Boeing stands ready to further assist Australia and our region to continue delivering to its full potential in aviation in the decades ahead.