AIR SPACE
ASPC's crowd-sourced blog
https://airpower.airforce.gov.au

Cole, B (2022) Air/Space Vol 2 BP29542709
Date Published: 5 December 2022

Decreasing reliance on fossil fuels to increase defence capability

Benjamin Cole
Australian Defence Force

The Australian Government has embarked on a program to reduce Australia's greenhouse gas emissions to achieve a net-zero economy by 2050. Implementing a program to achieve net zero within Defence would increase Defence operational independence and resilience, enhancing Defence capability. By adopting climate-friendly strategies to reduce ADF dependency on fossil fuels, specifically aviation fuel sourced primarily from overseas, the ADF will increase its operational independence and resilience. Implementation of Sustainable Aviation Fuels, research and development of advanced aerospace technologies, and operational improvements in flight will reduce fossil fuel dependency, increasing military capability while also contributing towards achieving a net-zero economy.

The recently legislated *Climate Change Act 2022* (Cth) sets in legislation Australia's greenhouse gas emissions reduction targets: a 43% reduction from 2005 levels by 2030 and net-zero emissions by 2050 (sections 10(1)(a)–(b)). The Powering Australia policy is the mechanism for the Australian Government to achieve these emission reduction targets. The policy includes a net-zero Australian Public Service by 2030, noting that 'the ADF and other national security agencies are exempted given their unique operational needs' (Australian Labor Party, 2022). However, implementing a policy within Defence to achieve net zero will not detract from Defence's operational needs but will, in fact, fundamentally enhance Defence capability.

As aviation fuel currently constitutes two-thirds of the fuel consumed by Defence—and thus a significant proportion of the ADF's carbon emissions—any discussion to achieve net zero in Defence must focus on aviation fuel. Within Australia and internationally, the broader commercial aviation sector and military coalition partners are actively working towards achieving aviation emissions reduction targets. Globally, governing bodies are setting policies to reduce reliance on fossil fuels within the commercial and military aviation sectors. Although there is no single solution to replace fossil fuels within the aviation industry, international aviation is collectively pursuing a range of measures to initially decrease reliance on fossil fuels, in conjunction with exploring a range of alternative fuels. This global trend presents the ADF with a unique and unprecedented opportunity to leverage these industry initiatives and decrease the ADF's dependency on fossil fuels.

Adopting a targeted policy to reduce the ADF's dependency on fossil fuels will fundamentally increase the generation of ADF military capability. Similar to domestic fuel

supply, the ADF relies entirely on the domestic oil market to sustain its fuel needs, sourced primarily from overseas. Developing a policy to reduce dependency on the overseas supply of fossil fuels, with a transition to domestically produced alternative fuel sources, will increase ADF operational independence and resilience while contributing to the government's net-zero public service by 2030. This paper will focus primarily on the policy and governance arrangements available to Defence to enable emissions reductions in the transition from fossil fuels rather than on applying specific technology.

Relevance of Achieving Net Zero

Achieving net-zero emissions within the aviation sector is the starting point to achieving the Australian Government's 43% emissions reduction by 2030 and net-zero emissions target by 2050. However, achieving net zero by 2050 alone will not be sufficient to meet Australia's fair share of emission reductions, given the cumulative emission of carbon by the Australian industry since the target was announced during the Paris Agreement in 2015. '*The climate change authority cumulative carbon budget for Australia, in order to limit Australia's contribution to global warming by just 2 degrees, was 10.1 billion tonnes CO2 emitted, during the period 2013–2050*' (Ha, 2021). Australia has already emitted 4.3 billion tonnes (Ha, 2021). Given the 10.1 billion cumulative CO_2 emissions limitation and Australia having already emitted 4.3 billion tonnes during this planned reduction period, a linear net-zero reduction in CO_2 emissions to 2050 will exceed Australia's planned cumulative carbon budget before the year 2050. Australia needs to reduce emissions significantly and urgently in all carbon-emitting sectors to meet its emissions reduction targets, or will contribute to increased global warming above 2 degrees Celsius.

Globally, the aviation sector contributes approximately 5% towards carbon emissions (International Coalition for Sustainable Aviation, 2018). The Australian aviation sector contributed 22 million tonnes of CO_2 emissions in 2016, representing 17% of transport industry emissions and 2% of Australia's total emissions (Department of Infrastructure and Regional Development, 2017). It is, therefore, paramount that all CO_2-emitting industries, including the aviation sector, rapidly adopt measures to reduce CO_2 emissions at the earliest opportunity to ensure Australia's net contribution to global warming is not exceeded. The relevance for Defence in achieving net zero is that internal sources of fuel supply will be developed to decrease reliance on overseas sourced fossil fuels—national fuel security will be enhanced and, therefore, military capability.

Civil Aviation Policy

The Australian aviation governing body aims to develop a net-zero policy in line with the Federal Government's net-zero strategy. At the Sustainable Aviation Fuels (SAFs) breakfast, the Hon. Catherine King, Minister for Infrastructure, Transport, Regional Development and Local Government, announced the delivery of a new aviation white paper, which will '*focus on how to maximise the sector's contribution to achieving net zero carbon emissions*' (Minister for Infrastructure, Transport, Regional Development and Local Government, 2022). The announcement also included the intent to establish a group similar to the '*Jet Zero council in the UK or Council for Sustainable Aviation Fuels in Canada*' (Minister for Infrastructure, Transport, Regional Development and Local Government, 2022). In addition, in November 2021, the Biden Administration announced a goal to achieve 20% emissions reductions in the aviation industry by 2030 and net zero by 2050 (Shepherdson, 2021).

The Australian Government's target to achieve net zero aligns with international aviation governing bodies' strategy of reducing carbon emissions, with all aspiring to achieve net-zero carbon emissions in the aviation industry by 2050. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is the first global market-based measure by the

United Nations coursed through the International Civil Aviation Organization (ICAO) to reduce carbon emissions from international aviation (ICAO, 2022). The member states of the CORSIA have a collective goal of keeping the global net CO_2 emissions at the same level as in 2020 through market-based measures. The ICAO has defined a range of measures for CORSIA members to achieve this global aspiration—technological improvements (lighter airframes, higher engine performance), operational improvements (improved ground operations and air traffic management) and widespread adoption of SAFs in addition to market-based measures (ICAO, 2018). Similarly, the International Air Transport Association (2021) has a goal to reduce collective dependency on fossil fuels and achieve net zero by 2050, with abatement of emissions achieved primarily through SAFs, which emit up to 80% less carbon than fossil fuels. Achieving emissions reductions in the short to medium term within the aviation sector can occur through implementing SAFs to replace fossil fuel usage partially. However, for the aviation industry to achieve net zero by 2050 while simultaneously supporting significant anticipated growth within the aviation industry, this can only occur through the implementation of technological advancements, which include alternative fuel development and operational improvements in flight. It is recommended that Australia adopt similar policies as those outlined by the ICAO to achieve the government's net-zero strategy.

It is recommended that the following strategies are implemented by Australia as part of an Australian aviation white paper and enabled through the establishment of a sustainable aviation group:

- Set the minimum Australian aviation fuel industry target for SAFs to 2% by 2025 and 65% by 2050.
- Support research and development into replacing the aviation industry's dependency on liquid fuels.
    - Foster increased research into green hydrogen aircraft by the Australian Renewable Energy Agency (ARENA; ARENA, 2022) through increased funding of the Renewable Hydrogen Development Funding round and expansion to include industry trials.
    - Promote investment in research and development for aircraft electrification, enabling smaller aircraft flight on shorter routes.
    - Encourage investment in regional airport infrastructure that supports hybrid electrified aircraft.
- Through funding civil aviation governing bodies, promote operational improvements in ground operations and air traffic management.

The rapid and scalable adoption of SAF will enable Australia's civil and military aviation sector to reduce emissions, follow the 'glide path' of legislated emissions reductions set by the Australian Government and be on par with reductions in the broader transport sector.

Sustainable Aviation Fuel

Currently, Australia does not have the sovereign SAF fuel production ability to achieve the proposed SAF targets of 2% by 2025 and 65% by 2050. Several research facilities have been established to investigate the viability of manufacturing SAF in Australia. BP has indicated the intent to reconfigure its existing refinery in Western Australia to produce SAF (Paul, 2022); however, there is currently no domestic production of SAF. The key to enabling the development of global SAF production facilities has been the agreements by airlines to buy SAF at a specific price over a period, providing certainty to SAF manufacturers. In March 2022, Qantas and Aemetis signed an agreement for 35 million gallons of blended fuel over seven years, commencing in 2025, from Aemetis Carbon Zero plant in Riverbank, California (Pate et al., 2022). Given the significant price differential between fossil fuels and SAF, at two to six

times more expensive, the establishment of this SAF production facility has only been enabled through US federal and state government policy, which incentivises the uptake of emerging renewable energy technology. Considering the proposed blended target ratios of 2% initially, the price difference to consumers would be minimal in the short term. In the medium to long term, adopting the 2% target will enable increased production, accelerating the development of a viable SAF industry. The development of alternative energy sources can mitigate potential economic and security disruptions. The U.S. Energy Information Administration (2017) has predicted a 1.5% expected annual growth in global jet fuel and a 2.7% annual growth in aviation fuel prices from 2016 to 2050. As aviation fuel is the only energy source for air transportation, a shift to SAF can mitigate price shocks associated with supply chain disruption and international political intervention. The adoption of SAF, therefore, promotes increased fuel security in Australia.

For Australia to establish a sovereign SAF manufacturing capability to meet proposed aviation emission reductions, significant changes to SAF renewable energy policy are required. Given the significant cost imposition for the aviation industry to transition from fossil fuels to renewables, a combination of supply-side and demand-side policies must be implemented at a national level. Demand-side tools available include the legislation of a graduated minimum of SAF usage by industry. The Government of Norway mandates that a minimum of 5% of an airline's fuel should be SAF, with a goal of reaching 30% by 2030 (Santos & Delina, 2021). This mandate provides certainty to manufacturers for a guaranteed revenue stream, which will increase in line with emission reduction targets or SAF mandates to enable investment in SAF production plants. Supply-side subsidies for SAF producers could include government-backed price floors during the initial phase of SAF production, which will provide certainty for the financial viability of investing in SAF manufacturing plants. Government-backed funding of these manufacturing plants would also decrease the risk associated with these investments. Tax incentives for investment in SAF production are also recommended to help reduce operating costs. Similar to the transition to other renewables, these policies will enable increased supply volumes and a rapid transition to SAF. For widespread production of SAF, the Australian Government can implement a range of policies to make it financially competitive to transition from fossil fuels.

Military Application

Although the ADF is a relatively small consumer of aviation fuel in the Australian aviation industry, there is significant combined market power to support a viable domestic SAF industry. The major commercial airlines broadly support using SAF within the Australian transportation sector. Qantas (2022a) and Virgin Australia (2022) have announced net-zero carbon emission strategies by 2050, to be achieved partly through SAF. Defence's total fuel consumption was approximately 310 ML in FY 20/21, which is approximately 0.6% of Australian domestic fuel sales (Joint Standing Committee on Foreign Affairs, Defence and Trade, 2021). However, Air Force's aviation fuel demand was 215 ML of this total consumption, corresponding to slightly more than 6% of the total Australian aviation turbine fuel market. With a significant market share of aviation fuel consumed by Australia's two major airlines, combined with Defence fuel demand, the Australian Government can undoubtedly fund sustained investment in SAF production for the domestic aviation sector in Australia. As an end user of aviation fuel, the ADF does not have the resources or agency to influence the development of a SAF industry independently. In line with government policy on SAF, Defence has the opportunity to position itself to be ready to enable the rapid uptake of SAF. Increased use of SAF within the ADF fuel supply chain will decrease the ADF's dependency on aviation fuel in future. Using 2021 fuel usage figures in Defence, the achievement of a 65% reduction in fossil fuel usage by 2050 by transitioning to SAF would translate to a reduction in fossil fuel usage by the ADF from 215 ML to 75 ML. This decrease in fossil fuel usage significantly reduces the current ADF fuel security risk, increasing independence and resilience.

Military air forces globally are adopting SAF for their aircraft fleets. Australia's coalition partners are trialling and certifying SAF. The U.S. Air Force (USAF) certified its first aircraft for SAF usage in 2011 (Dowdell, 2011). Although the USAF Alternative Fuels Certification Office closed in 2013 due to budgetary pressures (Goldstein, 2013), the U.S. Navy has continued its certification program, with all U.S. Navy ships and aircraft certified to operate on 50% alternative fuel blends (Lane, 2017). The UK Ministry of Defence (2020) has amended its standards to allow 50% blended SAF. Certification and use of sustainable fuels will increase interoperability with our coalition partners into the future as militaries worldwide continue the transition away from fossil fuels. There is a global precedent for the widespread adoption of SAF within military aviation.

Continued expansion of SAF use cannot solely achieve the net-zero emissions target within the aviation industry by 2050. Government funding to increase investment into research and development of carbon-neutral aerospace technologies, like renewable hydrogen power and electric flight, combined with the adoption of sustainable aviation fuel, is the only avenue to achieve net-zero emissions in the Australian aviation industry by 2050. Increased partnering with industry is required to support research and development of alternative fuel sources for military aviation. Similar to ARENA, Defence capability would benefit from increased funding to support alternative fuel development, including the electrification of aircraft. The USAF recently conducted the first crewed flight of an electric aircraft with a capacity of five passengers and a range of 250 nautical miles (Milligan, 2022). This success demonstrates the military utility of electrified flight in small payload, medium-range scenarios, which should be explored further for applicability to Defence capability.

Improvements in operational flight management will deliver a reduction in Defence fuel usage. Qantas is striving for a 1.5% operational improvement dividend each year, achieved partly through the retirement of older aircraft and the acquisition of next-generation, lower-emitting aircraft (Qantas, 2022b). In addition to fleet modernisation, operational improvements in flight can deliver significant fuel reductions. Traditional civil and military flight planning is conducted pre-flight, with manual adjustments during flight. Recent advancements in data analytics related to flight planning have enabled real-time flight planning updates to be delivered to an aircraft in flight, optimising fuel efficiency. Qantas's trial of new real-time in-flight planning software is expected to deliver an estimated 0.6% annual fuel reduction across its fleet (Thomas, 2018). This software can potentially deliver similar fuel reductions in Defence where operationally feasible.

Adopting climate-friendly strategies to reduce the ADF's dependency on fossil fuels will increase the ADF's capability while also achieving the Australian Government's net-zero emissions strategy. By reducing reliance on fossil fuels sourced primarily from overseas, the ADF will increase its operational independence and resilience, translating to an increase in military capability. Defence is well positioned to reduce its dependency on fossil fuels. In addition to SAF, research and development of advanced aerospace technologies and operational improvements will reduce dependence on fossil fuels and achieve net zero. To achieve this vision, impediments related to cost that inhibit the rapid uptake of SAF in the Australian aviation sector must be overcome to allow widespread market adoption within the Australian aviation market.

References

Australian Labor Party. (2022). *Powering Australia plan.* https://www.alp.org.au/policies/powering-australia

Australian Renewable Energy Agency. (2022). *How does a green hydrogen aircraft operate?* https://arena.gov.au/blog/how-does-a-green-hydrogen-aircraft-operate/

Climate Change Act 2022 (Cth). https://www.legislation.gov.au/Details/C2022A00037

Department of Infrastructure and Regional Development. (2017). *Managing the carbon footprint of Australian aviation*. https://www.infrastructure.gov.au/sites/default/files/documents/managing-the-carbon-footprint-of-australian-aviation.pdf

Dowdell, R. (2011). *Officials certify first aircraft for biofuel usage*. U.S. Air Force. https://www.af.mil/News/Article-Display/Article/114221/officials-certify-first-aircraft-for-biofuel-usage/

Goldstein, E. (2013). *Military alternative fuels research: Air Force efforts face budget barriers*. Defense Media Network. http://www.defensemedianetwork.com/stories/military-alternative-fuels-research/

Ha, J. (2021). *Three charts on why net zero by 2050 is too little, too late.* Grattan Institute. https://grattan.edu.au/news/three-charts-on-why-net-zero-by-2050-is-too-little-too-late/

International Air Transport Association. (2021). *Net zero carbon emissions by 2050*. https://www.iata.org/en/pressroom/pressroom-archive/2021-releases/2021-10-04-03/

International Civil Aviation Organization. (2018). *Resolution A40–18: Consolidated statement of continuing ICAO policies and practices related to environmental protection.* https://www.icao.int/environmental-protection/Documents/Assembly/Resolution_A40-18_Climate_Change.pdf

International Civil Aviation Organization. (2022). *Carbon offsetting and reduction scheme for international aviation*. https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx.

International Coalition for Sustainable Aviation. (2018). *Contribution of the global aviation sector to achieving the Paris Agreement climate objectives.* https://unfccc.int/sites/default/files/resource/156_CAN%20ICSA%20Aviation%20TD%20submission.pdf

Joint Standing Committee on Foreign Affairs, Defence and Trade. (2021). *Defence annual report 2019–20.* Parliament of Australia. https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Foreign_Affairs_Defence_and_Trade/DefenceAReport19-20/Report/section?id=committees%2Freportjnt%2F024803%2F77866#footnote31target

Lane, J. (2017, 15 March). Readi for a 100% drop-in fuel: *The Digest*'s 2017 multi-slide guide to ARA's ReadiJet, ReadiDiesel. *The Digest*. https://www.biofuelsdigest.com/bdigest/2017/03/15/readi-for-100-drop-in-fuel-the-digests-2017-multi-slide-guide-to-aras-readijet-readidiesel/

Milligan, K. (2022). *US Air Force and BETA technologies make history with first airman flight of an electric aircraft through AFWERX agility program*. Air Force Research Laboratory. https://www.afrl.af.mil/News/Article/2964766/us-air-force-and-beta-technologies-make-history-with-first-airman-flight-of-an/

Minister for Infrastructure, Transport, Regional Development and Local Government. (2022). *Transcript: Sustainable Aviation Fuels breakfast* [Speech transcript]. https://minister.infrastructure.gov.au/c-king/speech/sustainable-aviation-fuels-breakfast

Pate, T., Wolynski, T. K., Andreeva, A. & Pullins, T. (2022). *From here to there: Challenges in meeting sustainable aviation fuel targets.* White & Case. https://www.whitecase.com/insight-alert/here-there-challenges-meeting-sustainable-aviation-fuel-targets

Paul, S. (2022). *BP aims to start producing green jet fuel by 2025*. Reuters. https://www.reuters.com/business/sustainable-business/bp-aims-start-producing-green-jet-fuel-australia-by-2025-2022-07-14/

Qantas. (2022a). *Sustainable aviation fuel. We're collaborating to accelerate the development of a Sustainable Aviation Fuel (SAF) industry in Australia*. https://www.qantas.com/au/en/qantas-group/acting-responsibly/our-planet/sustainable-aviation-fuel.html

Qantas. (2022b). *Operational and fleet efficiency.* https://www.qantas.com/au/en/qantas-group/acting-responsibly/our-planet/reducing-emissions.html

Santos, K. & Delina, L. (2021). Soaring sustainably: Promoting the uptake of sustainable aviation fuels during and post-pandemic. *Energy Research & Social Science*, *77*, 102074. https://doi.org/10.1016/j.erss.2021.102074

Shepherdson, D. (2021). *US sets goal of net zero aviation emissions by 2050*. Reuters. https://www.reuters.com/business/cop/us-sets-goal-net-zero-aviation-emissions-by-2050-2021-11-09/

Thomas, G. (2018). *Qantas launches world's most sophisticated flight planner*. Airline Ratings. https://www.airlineratings.com/news/qantas-launches-worlds-sophisticated-flight-planner/

UK Ministry of Defence. (2020). *Sustainable fuels to power RAF jets*. https://www.gov.uk/government/news/sustainable-fuels-to-power-raf-jets

U.S. Energy Information Administration. (2017). *International energy outlook 2017*. https://www.eia.gov/outlooks/archive/ieo17/

Virgin Australia. (2022). *Sustainable aviation fuel*. https://www.virginaustralia.com/au/en/about-us/sustainability/sustainable-fuel/