

Air Power

Crude at Latitude: Fuel Supply and Force Projecting Air Power

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Keywords: Fuel supply, Australia's northern bases, Defence Strategic Review

<https://doi.org/10.58930/bp33146851>

Vol. 1, Issue 1, 2023

This paper explores the availability of fuel for military use in Australia. The case study focuses on combat aircraft operating in and from northern Australia to examine the development of Defence policy, programs and capability since 1976 in relation to military access to fuel. Despite ongoing awareness of the need of fuel to support military operations, the paper concludes that there are substantial risks to military fuel supply lines and that strategies regarding Australia's defence and broader national access to fuel supply remain largely untested.

Introduction

Military competition between the United States (US) and China is causing policymakers and defence scholars to examine some of the fundamental assumptions of Australia's defence policy. One of these core assumptions is that Australia will maintain technologically sophisticated combat aircraft (Kainikara, 2020)¹ that can be forward deployed in Australia's northern maritime approaches as security requires (Department of Defence, 1976). In practical terms, this means deploying combat aircraft either to the near region or to northern Australian 'bare bases' to conduct independent operations (Department of Defence, 2016a). The importance of sustaining military operations from Australia's northern bases has recently been made clear and was a key finding in the 2023 Defence Strategic Review (Department of Defence, 2023).

The availability and sustainability of fuel is a critical enabler to support air operations from Australia's north. This paper will explore military fuel sustainability² considerations for forward-deployed combat aircraft missions through case studies to identify the capacity of the Australian Department of Defence (hereinafter 'Defence') and the broader national support base to independently conduct operations and activities in support of a contingency that is central to the declared defence policy.

Fuel is both an essential requirement and a significant challenge for this contingency. This work deliberately focuses on military fuel sustainability; however, many other logistical and operational challenges could affect the forward deployment of combat aircraft, including demands to support concurrently deployed military platforms.

The supply of fuel to military forces has been a major challenge for all nations involved in warfare over the past century. Access to fuel influenced the outcome of World War II with German (Yergin, 1991) and Japanese forces (Gillison, 1962) both critically affected. The 1999 International Force East Timor (INTERFET) mission presented a major fuel supply challenge to Australia, despite its being considered 'as easy as it gets' under the operational scenarios envisaged in Australian defence policy, due in particular to its geographical proximity to Australia and largely uncontested operating environment (Australian National Audit Office, 2002a). In terms of fuel, the quantity required for the forward deployment of air power to conduct 'control-of-the-air' and 'strike' missions (Air Power Development Centre, 2013) is an order of magnitude than that which was required for the INTERFET mission (Joint Standing Committee on Foreign Affairs, Defence and Trade, 2009).

After conducting semi-structured interviews and a primary document analysis, this case study concludes that many of the measures necessary to achieve these declared air combat roles (e.g., highly capable combat aircraft units, bare bases and national legislation and federal coordination mechanisms associated with the prioritisation of fuel for military use) are already established. However, even if fuel were prioritised for military use, assured fuel supply remains problematic for Australia. In particular, there are limited available mechanisms to mitigate the risk of enemy disruption of military fuel supply lines, national preparedness remains largely untested and the supply of fuel to forward bases remains inherently logistically challenging.

1 This case study acknowledges that most military aircraft can have a role in combat. However, the term 'combat aircraft' will be used for brevity as described by Kainikara (2020). The term 'combat aircraft' refers to Australian military aircraft that perform roles, including 'control-of-the air' and 'strike' roles.

2 This case study uses the term 'military fuel sustainability' to describe Defence's distribution, tactical supply, protection and consumption of fuel, given its essential nature for the military mission.

Prepared for the worst

Australian policymakers prepare for and review a wide range of strategic risks. Often, this has been done by developing contingency scenarios, such as Australian Capability Context Scenarios, which are classified scenarios that 'reflect possible circumstances under which the future joint force might be deployed' (Department of Defence, 2010). Contingency scenarios support strategic defence policy and force design and provide a basis to periodically review and test military plans.

Australian policymakers and military planners also have the complex task of managing military readiness, which refers to the ability of the military to meet its assigned missions (Joint Chiefs of Staff, 2019). The level of readiness varies across different parts of the force, due to the costs, resources and assessed requirements of various capabilities. For example, many countries, including Australia, maintain reserve forces to provide supplementary capabilities and ensure they have the capacity to bring on additional elements should a specific need arise.

Further, military planners assess aspects of military and national preparedness for major conflict. Australian military doctrine defines preparedness in terms of the readiness of the military to conduct a mission and the duration for which a mission can be sustained (Department of Defence, 2004). Scholars, such as Betts (1995), highlight that preparedness is a broader issue for a nation and not just an issue for the military force. A nation can be considered militarily ready if it can convert potential capability into actual capability before it is required for conflict, which assumes a period of build-up. Drawing upon national resources outside Defence for military purposes has long been recognised by Defence as a critical aspect of military mobilisation (Department of Defence, 2004).

With their key roles, including air combat and 'strategic strikes' against land and maritime targets, combat aircraft have been a fundamental component of Australia's declared strategic concepts since 1976. Combat aircraft have been central to the 'Australian maritime strategy' (Joint Standing Committee on Foreign Affairs, Defence and Trade, 2004) and in the defence of the 'sea-air gap' (Department of Defence, 1989). The 2013 'Air Power Manual' notes that a maritime strategy is an enduring strategic requirement, and this strategy is 'substantially underpinned' by the Royal Australian Air Force (RAAF), which can respond to adversary actions 'as part of a joint force or as a single Service' (Air and Space Power Centre, 2022).

Combat aircraft have also been regularly cited by governments as capabilities that need to function independently of US support. For example, the Hawke Government's 'Australia's Strategic Planning in the 1990s' emphasised self-reliance as a 'key priority' of the maritime response and the interception of hostile forces in air and sea approaches (Department of Defence, 1989). Frühling noted that a simi-

lar requirement for strategic independence led to the decision to procure 24 General Dynamics F-111C aircraft in the 1960s (Frühling, 2009), with the 1976 White Paper describing the aircraft as being at the 'core' of Australia's military capability (Department of Defence, 1976).

Little has changed in Australia's understanding of the principle importance of combat aircraft capability, and the combat aircraft continued to be prioritised in the more recent transition from the F/A-18F Super Hornet to the F-35A Joint Strike Fighter. In the 2013 White Paper, combat aircraft were described as the 'principal [Australian Defence Force (ADF)] strike capability', which had the capability to establish 'control of sea and air approaches' (Department of Defence, 2013). The 'potency' and 'technologically advanced capability' of the RAAF fleet was reinforced in the 2016 White Paper (Department of Defence, 2016a).

Many other aircraft and supporting equipment have been procured with a specific role to support combat aircraft, further emphasising the centrality of combat aircraft to Australian defence policy. Such multi-billion dollar investments include the EA-18G Growler electronic attack aircraft, air-to-air refuelling aircraft, the Airborne Early Warning and Control aircraft, the Mobile Regional Operations Centre to control airfields and provide threat warning and the supporting pilot training system (Department of Defence, 2012).

Given the central nature of combat aircraft to Australia's defence policy, policymakers have mostly stated or inferred that the capability is effectively ready for operational employment. This stands in contrast to the stated readiness of platforms such as the Air Warfare Destroyer, which for some time, was described in terms that implied the requirement for a period of mobilisation; for example, in 2013, the Air Warfare Destroyer was said to offer the ability to 'expand strategic strike capabilities if required' (Department of Defence, 2013).

Indeed, the 2014 deployment of eight Super Hornet aircraft to Iraq is an indication that Australia's combat aircraft are able to be quickly deployed in some circumstances, particularly with US logistical support. The Abbott Government announced the decision to deploy the Super Hornet aircraft in September 2014, and the aircraft were operational in Iraq the following month (ABC News, 2014). The 2009 White Paper emphasised the procurement of the Super Hornet aircraft as evidence that there was 'no gap in our overall air combat capability'; this further indicated a political desire to ensure the readiness of combat aircraft was sufficient and uninterrupted (Department of Defence, 2009).

Fuel

Aircraft need fuel; a great deal of fuel. If combat aircraft are central to military strategy, the reliable supply of fuel to allow those aircraft to operate is of great importance.

Historically, there were few policy indications³ that the fuel supply required for a combat aircraft deployment was not at a high state of readiness (or could not be rapidly brought up to a high state of readiness), given that fuel availability is so intimately linked to the operational performance of combat aircraft. The Defence Strategic Review provided a sharper focus on improving fuel availability, noting that ‘immediate and comprehensive’ work on fuel storage and supply was necessary (Department of Defence, 2023). Defence policies call for high levels of readiness for combat equipment;⁴ however, this specificity does not extend to the minimum requirements for enabling elements, such as fuel. Defence doctrine explicitly incorporates ‘consumable resources’, including fuel, as a key component of readiness (Department of Defence, 2004). Additionally, there has always been a keen awareness of the critical nature of logistics and fuel in combat aircraft operations (Hattendorf, 2013).

In essence, Australia’s longstanding policy position is that combat aircraft must be rapidly and independently deployable across a range of scenarios that are central to the declared defence policy. However, while the policy has been consistent, the practicalities and logistics underpinning the policy have not been as explicit, and concepts, such as ‘independence’, have historically lacked clarity and have not had to be operationally tested. To further examine the concept of ‘independence’ in relation to fuel supply for combat aircraft, two likely options for combat aircraft deployment—to bare bases across northern Australia and to the nearer region—will now be considered.

Policy laid bare

Against the 1980s and 1990s backdrop of the Hawke Government declaring that ‘[t]here is now a realisation that Australia can ensure its own security’ with a ‘more independent approach’ (Department of Defence, 1989), remote air bases were established at Learmonth, Curtin and Scherger in northern Australia. The declared purpose of the ‘bare bases’ was to allow the force projection of aircraft into Australia’s northern approaches (Church, 2015). Air power remained ‘fundamentally dependent on the availability and capability of air bases’, which included fuel supply (Royal Australian Air Force, 2012), and the northern bare bases were established to allow aircraft and supporting elements to surge forward from permanent bases in the south in the event of a crisis (Thomas et al., 2013).

The three existing RAAF bare bases are Learmonth, Curtin and Scherger. The bare-base locations in northern Australia are shown in [Figure 1](#). RAAF Base Tindal, ap-

proximately 300 kilometres south of Darwin, was also originally a bare base (constructed in 1942), but was developed into a permanent northern Australian operating base in 1989 (Royal Australian Air Force, 2017). Each of the bare bases is remote from any major population centre: Learmonth is 1,600 kilometres from Perth, Curtin is 1,700 kilometres from Darwin, and Scherger is 1,300 kilometres from Townsville. Germane to this paper, each base has a fuel storage capacity of around two million litres.⁵

The historical strategic logic for Australia’s bare bases was considered tenuous by some. Bare bases were once described as ‘a product of entirely unrepresentative times’, resulting more from scaled back Australian defence spending rather than a realistic military strategy; where ‘a fiction had to be invented to provide a coherent supporting narrative’ (Davies, 2014). An early concept arising from strategic guidance in the 1987 White Paper (Department of Defence, 1987) resulted in the concurrent establishment of two bare bases and two ‘lesser point of entry airfields’ (O’Brien, 2009). However, the allocated resources never allowed the estimated level of forward-postured RAAF activity to be reached. Further, as the presence of two bases created difficult concurrency pressures, any estimates were consistently limited to the RAAF achieving a single bare base activation if given adequate time to prepare.⁶ With sufficient warning time and if faced with a major or existential threat, it is likely that multiple bare bases could be simultaneously established⁷; however, this could be at the expense of the capabilities resident in other Australian air bases.

Nevertheless, any perceived doubt over the strategic coherence of the bare-base strategy did not stop successive Australian governments from investing time and modest resources into the bases and establishing additional bases. The establishment of Scherger in 1998 was described as ‘completing’ the chain of northern bases (Department of Defence, 2003). The 2016 White Paper (Department of Defence, 2016a) placed the bare bases within ‘Strategic Defence Objective 1’, which aimed to deter and deny threats to Australia, its national interests and its northern approaches. Accepting that the chances of a military attack on Australia were ‘remote’, ‘Strategic Defence Objective 1’ required an independent response to threats in Australia’s air, sea and northern approaches. As a result, investment in national defence infrastructure in northern Australia, including the bare bases, particularly to support Joint Strike Fighter operations, was described as a ‘focus’ of the 2016 White Paper (Department of Defence, 2016a). This included some necessary investment in fuel infrastructure, such as

3 Previous white papers (e.g., Department of Defence, 2000) articulated an acceptance of risk associated with generic logistic support but did not do so specifically in the context of fuel or in the context of combat aircraft.

4 Such as the 72 Joint Strike Fighter aircraft. See Department of Defence (2016).

5 Interview with Air Commodore Martin Smith, Director General Logistics-Air Force (2019) conducted on 1 April 2019.

6 Interview with Air Commodore Philip Gordon, Director General Air—Headquarters Joint Operations Command (2017–2018) conducted on 12 March 2019.

7 Interview with Air Commodore Scott Winchester, Commander Combat Support Group (2015–2016) and Chief of Staff, Headquarters Joint Operations Command (2017–2018) conducted on 19 March 2019.



Figure 1. Map of Royal Australian Air Force bases in Australia (Royal Australian Air Force, 2017).

measures to avoid fuel contamination (a problem associated with bare bases and ageing infrastructure) (Richards & Noye, 2017). Recently, the Defence Strategic Review described a ‘network of northern bases’ that would support ‘logistics, denial and deterrence’ (Department of Defence, 2023).

Recent preparations for less-likely but declared contingencies were more forthright than those detailed in previous white papers. The 2013 White Paper determined that an upgrade of the bare bases to support ‘protracted high tempo combat operations’ was necessary (Department of Defence, 2013). The 1976 White Paper identified the bare base at Learmonth as necessary infrastructure for operations in Australia’s maritime approaches (Department of Defence, 1976), and the 1987 White Paper forecast the construction of the second and third bare bases at Curtin and Scherger with a view to these being central to long-range missions into Australia’s northern approaches (Department of Defence, 1987).

The centrality of the bare bases to Australian defence policy was regularly affirmed by political leaders in a bipartisan way. For example, in 2012, Defence Minister Smith stated that the bare bases were necessary for air combat and strike operations in Australia’s northern approaches (Smith, 2012). A Howard Government minister affirmed in 1997 that Learmonth was ‘vital to the air defence of north Western Australia’ to gain approval for major capital expenditure on the base (House of Representatives, 1997). In 1995, a Labor Government parliamentarian described the bipartisan approach, stating:

No one is asking why we are spending all this money and whether it can be justified. It is just accepted that we are spending ... 183 million dollars putting a bare base run-way off Weipa ... which will be used during the Kanga-

roo exercise—183 million dollars! ... no one even queried it (House of Representatives, 1995).

In 1992, the Shadow Minister for Defence, Alexander Downer, welcomed the development of the Scherger bare base as ‘an important part of any northern defence strategy’ (House of Representatives, 1992).

The RAAF established supporting concepts and doctrine around the requirements for the bare bases, and the language used reinforced the operational nature of the bases. A RAAF infrastructure plan stated, ‘Air Force requires ready access to secure airfields in its likely area of operations during contingencies (most likely in northern Australia)’ (Royal Australian Air Force, 2017). The RAAF’s capstone doctrine (Air Power Development Centre, 2013) described ‘small airbases’—which explicitly included bare bases in Australia—as fundamental components of air power able to accommodate and operate a small to moderate number of platforms. This capstone doctrine referenced the need for non-military bases to support the employment of air power and described ‘assured logistical support’ (including fuel) as essential to sustain tempo and intensity during a campaign (Air Power Development Centre, 2013).

The RAAF doctrine highlights the challenges associated with the maintenance of the bare bases. Germane to military fuel sustainability and the challenges of supplying bare bases, a RAAF study noted that ‘[t]he degradation of (combat aircraft) capability, even temporarily, could seriously reduce Australia’s ability to monitor and defend the air-sea gap to the north’ and ‘the importance of uninterrupted use of these northern airfields’ plays a vital role in the defence of Australia; their unavailability could lead to RAAF capability being ‘degraded or lost completely’ (Sidoti, 2001).

High-level RAAF logistics doctrine further outlined the challenges of operating away from fixed bases within Australia and the heavy reliance on Expeditionary Combat Support Squadrons (Royal Australian Air Force, 2012), noting that these Expeditionary Combat Support Squadrons had previously been challenged by shortfalls in the number of fuel-tanker drivers.⁸ A previous Chief of Air Force explained that the bare bases must be defended by all 'non-aircrew' personnel and no civilians could be employed in those bases (Fisher, 1996). However, this position evolved due to Defence's reliance on the national support base, particularly for fuel supply functions. A senior RAAF operational planner indicated that logistics and fuel were the most significant limiting factors to sustained operations from bare bases and that each bare base differed due to infrastructure, remoteness and local contractor options.⁹

At various times, the expense and effort to maintain the bare bases were questioned, particularly as other expensive procurement programs, which supplied equipment that could come into immediate operational use, came into service.¹⁰ For example, the RAAF periodically considered whether to maintain Scherger given the major logistical challenges associated with the base (Royal Australian Air Force, 2017). However, steady bare-base investment continued with the Turnbull Government indicating its intent to 'enhance the Defence investment ... in national defence infrastructure [at] Tindal, Curtin, Scherger and Learmonth' (Senate, 2017). Indeed, based on the frequency of its use for exercises and for non-combat operational activities, such as the search for a missing Malaysian Airlines aircraft in 2017, the RAAF recently reclassified Learmonth as a 'forward operating base' rather than a bare base¹¹. A previous Secretary of Defence argued that adequate investment in the bare bases would ensure that the bases could be kept 'ticking over' with a small number of caretakers and enable training and Defence personnel to familiarise themselves with the bases should an activation be required but 'no more than that'.¹²

In summary, despite some initial questions about the rationale for their establishment, the bare bases maintained bipartisan support as a central element of declaratory Australian defence policy, and the RAAF established a credible doctrinal basis for their operational activation. The central nature of bare bases to declared defence policy was reaffirmed through modest but consistent expenditure with a view to activating these bases should an unexpected military contingency arise. Given the significant investment in bare bases over time and their central role in Australia's military disposition and force structure, it is therefore ex-

tremely important to examine the fuel supply required to enable the operation of combat aircraft from bare bases.

Pertamina, PTT Public Company Limited and Petron?

There is also a strong basis in declared policy for the independent deployment of combat aircraft into the nearer region. The 2016 White Paper noted that Defence needed to be able to 'operate over long distances to conduct independent combat operations in our region' and stated that air combat platforms would 'provide our forces with greater flexibility in responding to threats independently or as part of coalition operations' (Department of Defence, 2016a). The emphasis on operating independently in the nearer region was accepted in the 2009 White Paper, which noted the need to 'ensure that we could lead military coalitions ... in our immediate neighbourhood' and the 'need to maintain a strong capability to project military power from mounting bases and forward operating bases ... from strategically significant offshore territories' (Department of Defence, 2009). Independent combat operations were emphasised in the 2000 White Paper, which stated, 'the ADF, alone or with coalition partners, should be able to undertake significant operations within the region, particularly in our nearer region' (Department of Defence, 2000). The 2013 White Paper was less direct about the requirement for Defence to conduct forward-deployed combat operations. However, the centrality of its declared 'maritime strategy' and the need to 'deny adversary forces access to forward operating bases or the freedom to conduct strikes against Australia from beyond our maritime approaches' would demand a forward-based combat element in a range of circumstances (Department of Defence, 2013).

The RAAF doctrine (Air Power Development Centre, 2013) reinforced the need to be able to conduct forward-deployed, independent combat operations. However, it also indirectly highlighted the far greater challenges associated with the deployment of such operations outside Australia and the reduced ability to harness broader (often non-military) aspects of 'national air power' (Air Power Development Centre, 2013).

Nonetheless, senior commanders have regularly emphasised the ability to independently deploy combat aircraft offshore. For example, a RAAF strategist wrote in 2014, 'the Joint Strike Fighter will be able to deploy without being tethered to US support' (Ryan, 2014). A previous Chief of Air Force argued that Australian combat aircraft operations in Iraq demonstrated that Australia could deliver a 'completely autonomous, balanced, force package' to future contingencies (Brown, 2015). Indeed, operations from a for-

⁸ Interview with Air Commodore Scott Winchester conducted on 19 March 2019.

⁹ Interview with Air Commodore Philip Gordon conducted on 12 March 2019.

¹⁰ Interview with Air Commodore Martin Smith conducted on 1 April 2019.

¹¹ Ibid.

¹² Interview with a senior Defence official conducted on 15 April 2019.

ward operating base have been regularly and successfully conducted, with all of the planning considerations for bare bases also relevant to an expeditionary airfield but 'with less control over the start state and longer resupply lines'.¹³

Credible Australian defence scholars have reinforced the idea that the deployment of a combat force to a nearer region base was a reasonable contingency. Davies argued that Australian-based air power would only be relevant if 'the Indonesian archipelago (was) the absolute limit of (Australia's) geographical ambition' (Davies, 2010). A Lowy Institute study presented numerous feasible contingency scenarios, such as a 'show of force' scenario, that would require the forward basing of combat aircraft (Medcalf & Brown, 2014). This included two scenarios with limited or no US involvement. These scenarios included an independent 'deterrence' requirement with the deployment of maritime vessels and combat aircraft and a scenario requiring the protection of maritime routes (Medcalf & Brown, 2014).

The contingency of the independent offshore deployment of a combat element was therefore a consistently declared government position, assessed by others to be a feasible and necessary requirement and practised under different conditions. Based on the central and longstanding position of combat aircraft to declared Australian defence policy and their significant role in combat operations, it is reasonable to conclude that the forward deployment of combat aircraft would be credible during an Australian combat operation in the nearer region. The fuel provision implications associated with combat aircraft operations are fundamental to this type of deployment.

The next section will consider the military fuel sustainability aspects for both bare-base and offshore deployments for a combat aircraft squadron.

The demands of flying

Australian combat aircraft have been regularly deployed to the Middle East over the past two decades in support of US-led missions (Department of Defence, 2016c). The supply of fuel to Australian military units in the Middle East was rarely demanding for Australian logisticians,¹⁴ as fuel supply from the US and from other contracted sources was very reliable. Fuel supply line security remains firmly within the consciousness of the US military, given the heavy losses suffered during the conduct of fuel resupply operations in the Middle East (Vitali et al., 2018).

The independent deployment into a nearer region or to a bare base in northern Australia to undertake combat aircraft operations is a more logistically challenging proposition than the arrangements that were established to support US-led operations in the Middle East. The largest recent operational deployment of Australian forces into a

nearer region occurred during INTERFET, which was a predominantly land-based mission.

There are many requirements associated with the sustained deployment of a combat aircraft squadron. Notably, forward repair, engineering, communications facilities, the recovery of downed aircraft and personnel, intelligence and surveillance, an operation and control element and airbase security are all significant requirements in their own right. High-level RAAF logistics doctrine states that 'such capacity is likely to be initially based on organic logistic capabilities' (i.e., RAAF capabilities that are readily available from within the force) (Royal Australian Air Force, 2012). It would be challenging for Australia to independently sustain any of these single requirements from its currently available resources, and such challenges would be magnified if these elements were all required concurrently to allow combat aircraft to function effectively. A 2013 study noted that while '[US] Air Force units are generally regarded as self-deploying', that is only true 'with respect to the aircraft themselves' (Lostumbo et al., 2013). Access to support services such as fuel at the deployment location is critical and resource intensive.

In limiting this case study to military fuel sustainability, it is acknowledged that within the concept of 'fuel supply', many different aspects need to be considered in a forward-deployment scenario. For example, army logistics doctrine defines supply as 'procurement, provisioning, warehousing, returns, salvage, disposal and supply control activities' (Australian Army, 2018). All of these aspects of fuel supply need to be taken into account. Further, the RAAF includes other functions, such as engineering and security, in the supporting requirements for sustaining fuel supply to an airbase (Royal Australian Air Force, 2012). Finally, functions, such as filtration, pumping and transferring fuel between facilities in the forward location, would also need to be planned. The concept of 'fuel supply' is therefore quite complex itself.

Crude figures

Military fuel consumption figures and planned consumption figures for different contingencies are not always publicly available (Wong, 2010). Therefore, a number of examples will be considered to gauge the scale of fuel consumption that may be required into the future.

Different combat aircraft missions have different rates of fuel consumption. In one credible RAAF assessment, it was estimated that the operation of a US squadron of combat aircraft from a 'bare base' for only three weeks of high-intensity conflict during the Gulf War required almost five million litres of fuel (notably, the number of aircraft within US and Australian aircraft squadrons is similar) (Richard-

¹³ Interview with Air Commodore Philip Gordon conducted on 12 March 2019.

¹⁴ Australian military planners saw the relative fragility of fuel supply at various times. For example, during military operations in Iraq in 2003, RAAF C-130 aircraft transported US fuel supply trucks to forward-operating bases. The fuel trucks supplied rotary wing aircraft participating in the advance on Baghdad with the advance contingent on these fuel supplies.

son & Kainikara, 2009). Even more demanding is an Exercise Pitch Black estimate that one million litres of fuel was used in various 24-hour periods during large-scale, coalition combat aircraft operations.¹⁵ A senior RAAF logistics planner highlighted that a high-intensity combat aircraft mission with coalition aircraft operating from Australia could require a 'significant multiple of what was consumed during Exercise Pitch Black'.¹⁶ Conversely, other missions, such as the 'deterrence' scenario presented in a Lowy Institute study, may be less fuel intensive (Medcalf & Brown, 2014), and while factors, such as 'maximum on ground' throughput (the number of aircraft an airfield can support), will determine the capacity of an airfield (Lostumbo et al., 2013), the magnitude of fuel consumption for an Australian combat aircraft squadron would remain very high. This aspect of sustainability, as a key component of military readiness, would be challenging to achieve.

The relative consumption of fuel by each of the Services has changed over time. The extensive consumption of fuel by land forces during World War II has been well analysed (Yergin, 1991). Compared to the estimate of fuel consumption by a single combat aircraft squadron conducting combat operations during the first Gulf War for a three-week period (Richardson & Kainikara, 2009), empirical comparisons for land-based military operations were minimal but logistically challenging. For example, during the INTERFET mission, it was estimated that the entire coalition consumed 30,000 litres of fuel per day (Crawford & Harper, 2001). An Australian National Audit Office report estimated that the first five months of Australian operations in Timor-Leste resulted in the consumption of 2.79 million litres of jet fuel and 3.72 million litres of diesel (Australian National Audit Office, 2002b). This equated to 18,600 litres of aviation turbine fuel per day and 24,800 litres of diesel per day. Supplying this amount of fuel to Timor-Leste was ultimately successful but tenuous at times (Breen, 2008).

Based on these figures, it was estimated that the fuel (which included the aviation turbine fuel and diesel fuel combined) required by the entire INTERFET force was only (approximately) 18 % of that required for a single combat aircraft squadron to operate in a high-intensity mission in any given period.

In another example, during a major land exercise in 2015, an Australian Army Brigade, reinforced by other supporting units, used approximately 1.2 million litres of fuel (which equated to approximately 40,000 litres per day), almost half of which was consumed by Army aviation units.¹⁷ This was a high-intensity 'peer adversary' training exercise in which military equipment was operated intensively over the period. In this Australian-based exercise, significant commercial reliance and the pre-positioning of fuel was conducted to achieve the exercise objectives. This con-

sumption figure represented a similar percentage—around 17%—of the fuel that a single combat aircraft squadron would use in any given period.

In one of the largest examples of a land deployment, General Patton's Third Army (of approximately 230,000 soldiers and consisting of many airborne and armoured divisions), which undertook the highest intensity operations during World War II, consumed approximately 1.3 million litres of petroleum per day (Grassi, 1993). Extrapolating these figures, the entire US Third Army consumed just five times the amount of fuel in a given period than the estimate for a single combat aircraft squadron. The comparison spans decades; however, the difference in the magnitude between land and air fuel consumption can be clearly understood.

Further emphasising the relative consumption of fuel between the Services in the Australian context (and therefore the challenging nature of an independent combat aircraft deployment for Australia), despite the fact that the Army was the most heavily committed Service (in offshore military operations) in 2009, fuel consumption was much higher for the air and maritime services than the Army services. For example, in terms of the six-year average of fuel consumption, from 2002 to 2008, the aviation average usage was 204 million litres per year, which can be compared to the ground-based average usage of 27 million litres per year (Senate, 2009). A 2018 report highlighted that the relative RAAF consumption (of Defence's total fuel consumption) had reached 70 per cent (Australian National Audit Office, 2018).

As technology evolved after World War II and as military fuel consumption increased during every major conflict (Wald & Captain, 2009), fuel supply requirements became the most significant for the RAAF and the least significant for the Army (Australian National Audit Office, 2018). Based on planned Integrated Investment Program procurements and the ongoing high fuel consumption of all combat aircraft, these percentages are unlikely to vary in the near future.

In an offshore operation 700 kilometres from Darwin that was logistically 'as easy as it gets', Defence faced challenges in supplying fuel to units for the INTERFET mission. However, the magnitude of fuel required by a combat aircraft squadron to conduct military operations is much higher than that required by the INTERFET mission. Moreover, the low likelihood of a combat aircraft squadron being the only deployed unit undertaking Australian-led operations could mean that the fuel demand for a larger joint operation might be significantly higher. So, what are the fuel supply options available?

15 Interview with Air Commodore Scott Winchester conducted on 19 March 2019.

16 Interview with Air Commodore Martin Smith conducted on 1 April 2019.

17 Interview with a senior Australian Army logistic planner conducted on 1 September 2015.

The hurt in Curtin

Defence has made an exceptional effort to remediate longstanding domestic fuel sustainability concerns (White, 2021).¹⁸ Ministerial focus and significant funding has led to improvements across Defence's fuel infrastructure through the Defence Fuel Transformation Program (Levick, 2018). Notable investments have also been made in deployable fuel capabilities, such as two new Auxiliary Oiler Replenishment (AOR) vessels.

However, any medium-sized military force will generally not have high levels of redundancy in integral military platforms to supply bulk fuel to deployed forces. For example, similar to the Royal Australian Navy (hereinafter the Navy), the Canadian Navy maintains two *Protecteur*-class Joint Support Ships to conduct fleet sustainment (Royal Canadian Navy, 2020). Australia's overall military fuel deployment capacity may test declared RAAF doctrine, which indicates that initial deployments would likely have to be undertaken from within integral Defence resources (Royal Australian Air Force, 2012).

There is limited information in the public domain referencing how Navy oilers would support RAAF combat aircraft deployments, but the concept may be viable. The AOR vessels have only been operational for a short period; however, HMAS Sirius and HMAS Supply were platforms that provided replenishment support to deployed Navy vessels. HMAS Sirius, the Navy's bulk fuel supply vessel, was purchased and modified from a commercial oil tanker in 2004.

If the entire aviation fuel capacity of HMAS Sirius were dedicated to supplying a combat aircraft squadron, there may be sufficient fuel to allow such a squadron to conduct sustained operations. A Navy publication stated that the tanker could carry 5,486 cubic metres (5.486 million litres) of 'aviation fuel for use by Royal Australian Navy helicopters' (Royal Australian Navy, 2019a), a figure similar to the estimate of five million litres for three weeks of air combat operations identified earlier. Potentially, the entire fuel storage on the tanker—up to 29 million litres—could have been filled with aviation fuel if this was the operational demand;¹⁹ however, this configuration has not been historically tested, and this amount of fuel is an order of magnitude greater than the fuel storage capacity of a bare base. It is also possible that a single grade of fuel could be used to power ships and aircraft to simplify fuel supply chains, but this is not routinely done (Yildirim, 2020).

The primary purpose of HMAS Sirius was not to support a combat aircraft squadron. The role of the vessel was to 'significantly extend the Royal Australian Navy's operational reach and endurance at sea' (Royal Australian Navy, 2019a). As a secondary role, it could 'also provide limited support to deployed Army and Air Force units'; however, the provision of major logistics support to a different ser-



Figure 2. HMAS Sirius (Royal Australian Navy, 2021b).

vice was not a common practice. An Abbott Government Minister highlighted that HMAS Sirius did not 'provide the full level of capability that the Navy needs' (Senate, 2015). HMAS Sirius was not commonly viewed as a joint platform. Indeed, the 2013 White Paper described the role of HMAS Sirius exclusively in Navy fleet support terms (Department of Defence, 2013). The ability of HMAS Sirius to supply fuel to a combat aircraft squadron, as its primary task over a defined period, has not been tested.

Assigning HMAS Sirius to support a forward-deployed combat aircraft squadron would have entailed a significant opportunity cost. The remainder of the Royal Australian Navy fleet would not have exclusive support from its principle fuel supply vessel, which could have potentially affected the endurance of other Navy vessels (Royal Australian Navy, 2016).

Until 2019, the Navy also maintained another supply vessel capable of providing fuel and conducting replenishment at sea, the aged HMAS Success. This vessel had the ability to transport aviation fuel and a capacity of up to 1.3 million litres (Royal Australian Navy, 2019b), approximately one quarter that of HMAS Sirius. Similar to HMAS Sirius, HMAS Success had other logistical responsibilities supporting maritime elements, but if the combat aircraft mission was of strategic importance, it was possible for HMAS Success to be used.

Australia's two AOR vessels, HMAS Supply and HMAS Stalwart, have now been commissioned, representing a significant capability enhancement. These vessels can each carry a quantity of aviation fuel similar to that of HMAS Success (Royal Australian Navy, 2021a) and have design features, such as combat management systems, that will improve their combat survivability. The AOR vessels can be used to support Joint Force operations (Vavasseur, 2021).

The opportunity cost of using the AOR vessels to support a combat aircraft squadron is an important consideration,

¹⁸ Interview with Major General David Mulhall, Commander Joint Logistics (2017–2019) conducted on 26 February 2019.

¹⁹ Interview with a senior Navy commander conducted on 16 March 2019.

as a forward-deployed Squadron is unlikely to be the only force element conducting independent Australian military operations. If a particular mission is of sufficient importance or faces sufficient threat to warrant a squadron deployment, it is most likely that combat elements from all three Services would be required, and the competing demands on the AOR vessels may affect the Navy's operational capacity. In a planned procurement of replacement US Navy oil tankers, a report to the US Congress specifically highlighted that 'an absence of fleet oilers would significantly complicate the [US] Navy's ability to operate at sea on a sustained basis in areas such as the Western Pacific or the Indian Ocean' (O'Rourke, 2015). Such areas are Australia's defined primary operating environment. It is also likely that other nations would be involved in a coalition, and the INTERFET mission demonstrated that the lead nation in a coalition task force is often expected to provide sufficient logistical and fuel supply support for other nations (Gibbons, 2001). Therefore, if an AOR vessel was assigned primarily to supply aviation fuel to a combat aircraft squadron, competing operational demands would need to be managed.

The issue of vessel availability also presents a challenge, but the newer AOR vessels are likely to have significantly better availability than their predecessors. For example, in 2011, HMAS Sirius spent six months in planned maintenance, before immediately having to undergo another extended period of inactivity to rectify additional defects (News Corp Australia, 2011). All maritime vessels have long periods of planned maintenance. It may be possible to defer planned maintenance if an operationally urgent requirement emerges, but in some cases 'the ship cannot just be put back together to deal with an emerging contingency'.²⁰ In 2016, Defence Minister Payne foreshadowed the declining availability of HMAS Sirius and HMAS Success, stating:

So frequent are maintenance requirements for the two vessels, there are times when both Sirius and Success are undergoing repairs at the same time and Australia relies on the Royal New Zealand Navy's HMNZS Endeavour. This is what is known as a capability gap (Senate, 2016).

The unavailability of HMAS Sirius presented significant concurrency challenges, which were highlighted regularly in media reporting. Commentary identified Australia's previous reliance on the New Zealand vessel to support Royal Australian Navy training (Ellery, 2012), and the 2013 White Paper highlighted that a Spanish Navy vessel was 'assisting Australia's afloat support requirements while HMAS Success is in refit' (Department of Defence, 2013). The declared 'capability gap' created by the regular unavailability of the supply vessels was considered important enough to seek to expedite their replacement.

The periodic non-availability of HMAS Sirius through the 2010s did not prevent the Navy from meeting its operational commitments (News Corp Australia, 2011), and in-



Figure 3. KC-30A Multi-Role Tanker Transport (Royal Australian Air Force, 2016).

teroperability with the US—central to Navy doctrine—minimised any risk (Royal Australian Navy, 2016). The new AOR vessels will have greater availability, but small vessel numbers within any particular class means that the effect of any unavailability could still be significant. Nonetheless, the provision of AOR vessel support to a deployed combat aircraft squadron is a realistic possibility.

Another military option to allow tactical fuel supply for a combat aircraft squadron is the support provided by an air-to-air refuelling aircraft. Defence operates nine KC-30A air-to-air refuelling aircraft (Department of Defence, 2016b). In 2014, Australian KC-30A airborne refuelling aircraft supported a Super Hornet deployment to Iraq. In a typical mission in Iraq, in which there was no air-to-air threat and a limited ground-to-air threat to combat aircraft, the KC-30A repeatedly 'tanked' two Super Hornets for eight to nine hours to extend their mission (Blenkin, 2014).

The refuelling aircraft cannot permanently remain in place, and air-to-air refuelling in the Middle East required the aircraft to regularly return to an air base (Air Power Development Centre, 2013). With a KC-30A refuelling capacity of 111 tonnes (Royal Australian Air Force, 2019) (which converts to just over 300 cubic metres), this aircraft has been proven to effectively distribute fuel to aircraft in combat and extend flight time for a specific mission. However, it is difficult to factor-in the KC-30A into the operational theatre as it marginally adds bulk fuel capacity for sustained aircraft operations over time (considering one fully loaded KC-30A aircraft only adds approximately one-twentieth of the aviation fuel supply of the declared aviation fuel capacity of HMAS Sirius). Further, the KC-30A is optimised to provide support to combat aircraft during specific missions rather than conducting more strategic fuel transport missions into an airbase. The inclusion of a KC-30A capability with a combat aircraft squadron on a bare base also adds complexity to the logistical support that would need to be deployed forward (e.g., for aircraft repair).

²⁰ Interview with a senior Navy commander conducted on 16 March 2019.

Similar to the challenges associated with HMAS Sirius, the KC-30A is not optimised to be exposed to significant enemy threat. The KC-30A is a modified A-330 aircraft with 'advanced communication and navigation systems' and an electronic warfare self-protection system (Royal Australian Air Force, 2019). These features improve the KC-30A's survivability, but the use of the aircraft could 'introduce an additional level of vulnerability (which) should be mitigated by ... dedicated force protection' (Air Power Development Centre, 2013).

The KC-30A air-to-air refuelling aircraft would almost certainly be considered an essential component of a forward-deployed combat aircraft squadron, as would capabilities, such as Forward Air Refuelling Points and fuel provision, of air mobility platforms. However, the primary purpose of the KC-30A is for the forward distribution of fuel to combat aircraft engaged with the enemy rather than the more strategic movement of bulk fuel to a forward base.

A weak bladder?

A combination of fuel supply options would be sought for a major combat operation in order to take into account technical risks, such as the risk of fuel contamination if using fuel bladders established for refuelling purposes. If the AOR vessels were not able to support a forward-deployed combat aircraft squadron or their support was constrained, Australian military planners would be compelled to look outside Defence for options (and to do so even if the fuel tanker was available). Military partners, such as the US and New Zealand, might assist; however, their support would be predicated on their military commitments, their speed of deployment and their level of support for the Australian military objectives being pursued. Relying on such an approach would be imprudent, given the vagaries of international politics, the military schedules of other nations and the willingness of other nations to expose their own fuel supply dilemma. Such an approach would also not meet the declared policy intent central to the 2016 White Paper of Defence being 'able to independently and decisively respond to military threats, including incursions into Australia's air, sea and northern approaches' (Department of Defence, 2016a). Nonetheless, seeking fuel supply from another nation's military is a potential option and could be pursued in certain circumstances.

Defence could seek commercial shipping and overland transport for fuel supply. Indeed, while this case study specifically considers a combat aircraft squadron deployment, the challenges inherent in supplying bulk fuel to deployed Defence units are applicable against other contingencies, and commercial fuel supply options would be central to any contingency planning for independent Australian military operations. Indeed, even the US relies heav-

ily on contracted fuel supply to sustain its military operations; for example, contractors delivered 115 million gallons (435 million litres) annually to 13 different sites in Afghanistan for a number of years (Special Inspector General for Afghanistan Reconstruction, 2018), a model that proved effective during this lengthy mission.

Defence doctrine highlights that commercial supply would be central to an Australian military deployment. Indeed, US military commanders and planners now view a reliance on contractors for fuel supply in tactical areas as 'the norm'. The US Navy still maintains 15 'fleet replenishment oilers' to ensure it is self-sufficient when necessary (United States Navy, 2019a). Capstone Royal Australian Navy doctrine argues that strategic 'effective sea lift' relies even more on commercial vessels than it does on naval vessels to conduct logistical replenishment into operational areas.

A desire to use chartered shipping would require an understanding of available vessels from a national register or chartered vessels from overseas if no satisfactory vessels resided in the (relatively small) Australian national inventory (Royal Australian Navy, 2010). It was argued that the small number of Australian flagged vessels (14 in 2019, which can be compared to China's 4608 and the United Kingdom's 1157 flagged vessels) presented a national security risk, and this became a minor Australian election issue in 2019 (Albanaese, 2019). Similarly, high-level Navy logistics doctrine emphasises the role of commercial support vessels, arguing, '[h]istorically, navies have a larger civilian/commercial support footprint than the other Services' (Royal Australian Navy, 2010). The concept of employing a 'Ship Taken Up From Trade' for military operations is not new (Other & NHSWebmaster, 1990) and would be considered a valid option in the event of a contingency.

For bare-base operations in Australia, commercial road transport supply is the most common method of supply; however, it varies between the bases. Learmonth regularly relies upon the 1,600-kilometre road trip from Perth for fuel supply. Curtin also relies upon a lengthy road transport journey from either Perth or Darwin, and the Port of Derby represents a challenging supply option due to extreme tidal variation. Conversely, Scherger has to rely on the maritime supply of bulk fuel using the Port of Weipa and road transport between the Port and an airbase via a challenging 30-kilometre unsealed road²¹ that can become impassable at times.

The road transport of fuel was used for most major exercises conducted from the bare bases and generally sufficed for short exercises if sufficient pre-planning and stockpiling occurred. A senior Defence logistics officer indicated that the importance of logistics planning for major exercises could not be understated and that the preparatory fuel and logistical demands were not widely understood in suf-

²¹ Interview with Air Commodore Scott Winchester conducted on 19 March 2019.

ficient detail.²² Fuel supply for short major exercises had worked; however, ensuring sufficient fuel remained challenging, and the fuel supply system needed to be tested against a scenario in which there was a real threat.²³ The provision of fuel supplies via road transport is more reliable in Learmonth and Curtin due to the existing mining infrastructure in those regions; however, Scherger is more problematic, as it has less fuel infrastructure and frequent road closures due to weather.²⁴ RAAF logistics planning recognises that if the bare bases are being used for high-intensity combat operations, each road transport vehicle would only be able to provide a fraction of the resupply necessary and the number of vehicles required would be large.²⁵ Further, the importance of the road transport vehicles is elevated given the technical challenges that make on-site fuel storage options (e.g., underground storage) challenging in periodically activated bases.²⁶

Senator Jim Molan argued that the bare bases could be important, but his primary concern was that they are 'totally undeveloped'.²⁷ He cited multiple iterations of Exercise Pitch Black in which the bare bases had to be supplied with fuel by 'parking a tanker in Darwin Harbour' to support the extent of the exercise. He was critical that on two different occasions, the exercise was disrupted by fuel problems; once due to contamination and once due to heavy consumption. He argued that this weakness in capability was symptomatic of a lack of a national security strategy and that in the absence of a clear declaration of contingencies, Australia need to be prepared. If the strategic guidance was clear, he believed that Defence could do more to be prepared.

Others offered more nuanced views of Exercise Pitch Black. A senior Army logistics commander argued that Exercise Pitch Black had at least trained the RAAF to get its basic fuel processes to a level at which there was some understanding of how to prepare for a conflict being fought from a bare base.²⁸ A senior RAAF operations planner indicated that early planning for this major exercise significantly reduced any training value for fuel and logistics units and methods.²⁹ Another senior RAAF officer believed that the RAAF also used the US Exercise Red Flag in Nevada to gain high-intensity combat expertise (with fuel supplied by the US).³⁰

A study, funded by the US Department of Defense, examined the ability of the US military to operate in the Asia-Pacific region from Australia (Lyon, 2013). The study raised issues about the current system of fuel supply for intensive military operations from northern Australia. The strategic premise upon which the report was based was heavily questioned; however, the logistical and extended supply line challenges were valid. Many of the findings relating to fuel supply were consistent with the challenges identified during World War II when fuel was strategically sought to be positioned for military operations (Gillison, 1962). The study determined that there were 'insufficient pipelines to pump fuel to northern operation locations' and reported that the fuel had to be transported by rail to Darwin and then 'trucked or pumped through local pipelines to the other bases' (Thomas et al., 2013). Pipelines to supply bare bases have been considered previously in Australia, but no substantive proposals or actions have occurred.³¹ Further, the US study stated:

Unfortunately, during the rainy season, roads connecting the bare bases to northern ports might be impassable ... improving highway and rail links to these bases and strengthening the nation's infrastructural 'endoskeleton' should be a priority (Thomas et al., 2013).

Recognising the problems associated with fuel supply in northern Australia, the US released a 'request for proposal' to construct two 7,950,000-litre fuel storage tanks at RAAF Base Darwin at a cost of between 50 and 100 million US dollars (2019 figures) (United States Navy, 2019b). This storage is for US purposes and based upon an expectation of increased US Air Force operations in northern Australia, but such a storage facility could be drawn upon by the RAAF. This storage may moderate some of the logistic challenges associated with supplying fuel to the Curtin and Learmonth bare bases; however, the distance of those bare bases from Darwin means that road transport would continue to be a challenge.

There is the potential to rely on Defence platforms and other military forces for the supply of fuel. However, such approaches involve some risks. Apart from these approaches, there is also potential for commercial providers to supply a forward-deployed combat aircraft squadron to

22 Interview with Major General Andrew Freeman, Head of Australian Defence Staff-Washington (2020), Commander 17th Combat Service Support Brigade (2018–2019) conducted on 18 February 2019.

23 Interview with a senior RAAF commander conducted on 15 February 2019.

24 Interview with Air Commodore Michael Kitcher, Commander Air Combat Group (2018–2019) conducted on 21 February 2019.

25 Interview with Air Commodore Martin Smith conducted on 1 April 2019.

26 For example, periodic activation can mean that corrosion is a major issue for underground fuel infrastructure.

27 Interview with Senator Jim Molan, Senator for New South Wales (2018–2019) conducted on 7 March 2019.

28 Interview with Major General Andrew Freeman conducted on 18 February 2019.

29 Interview with Air Commodore Philip Gordon conducted on 12 March 2019.

30 Interview with Air Commodore Scott Winchester conducted on 19 March 2019.

31 Ibid.

undertake independent operations. However, this would depend heavily on the commercial provider's capacity to mitigate enemy threats that may actively target fuel supply. It should be noted that the fuel supplies were historically a high-value target for an enemy force due to the risk a lack of fuel posed to tactical operations.

Occlude the crude

Supply lines have been commonly targeted in conflicts throughout history. The US military found that the security required for land-based fuel resupply was onerous in Iraq (Schlesinger & Carns, 2009). Across a long maritime route, the task of securing supply lines could be particularly difficult. When planning for the US 'pivot' to the Asia-Pacific region, the US Department of Defense assessed that there would be a greater reliance on aviation and maritime fleets (compared to that required to operate in the Middle East) due to the vast distances involved (Assistant Secretary of Defense for Energy, Installations and Environment, 2016). For any nearer region forward deployment, supply lines are likely to be hundreds or thousands of kilometres. For example, the closest country, Papua New Guinea, is 150 kilometres from Australian territory, while Timor-Leste is over 700 kilometres from Darwin. Even in smaller areas of operation during training exercises, Royal Australian Navy vessels found it difficult to protect HMAS Sirius (as the 'high-value unit') in an environment with surface, sub-surface and land-based threats.³²

In contrast to the US planning considerations and despite the challenges in Afghanistan and Iraq, ensuring the security of fuel supply lines against a capable threat force has not been a Defence task in any recent operation. Defence has little recent experience in providing fuel supply security against a peer threat.

A senior Army logistics commander stated that fuel for training activities was 'often moved in an "out of exercise" manner'; that is, with administrative expediency and with no consideration of operational factors, such as the security of supply lines.³³ This approach represented 'best-case' military planning and failed to account for the challenges associated with conflict. A former Australian Chief of Joint Logistics said:

Our deployments are normally to places where there is some form of devastation ... (which) usually results in there being limited or in some cases no commercial infrastructure or services we can draw on during the initial periods. The support the military force needs must be delivered in an environment that is less than orderly, has disrupted or poorly developed infrastructure and is subject to interference by a range of forces (Cotterill, 2008).

The security of military fuel supply lines is a particular challenge. Some have highlighted the challenges to Australia and identified a need to enhance security procedures

around the northern bases and within the vicinity of fuel depots (Thomas et al., 2013). An offshore deployment away from a national support base and with potentially unsecured supply lines well beyond Australia's influence would be an even more significant challenge.

The security of military supply lines has not often featured as a key task in defence policy. The protection of military logistics was not mentioned in the 2013 and 2016 White Papers (Department of Defence, 2013, 2016a). Securing 'sea lines of communications' in the context of national trade was discussed in those White Papers, albeit with few specifics. 'Sea control' is a feature of Australian maritime doctrine and is considered 'fundamental to maritime nations, such as Australia, in achieving their strategic goals', but Defence has no contemporary experience in independently achieving sea control (Royal Australian Navy, 2010).

Capstone RAAF doctrine identified national security as being dependent on secure 'sea lines of communication' (Air Power Development Centre, 2013), but the discussion on logistics and supply centred on their importance for air operations and made no reference to enemy interdiction of logistics. Logistics was contextualised as more of an administrative function than an operational function. This is not a particularly unusual emphasis. It reflects the lament of classical military logistics theorists over centuries that logistics is not given sufficient thought or priority (van Creveld, 1977). The limited reference in Australian policy and doctrine to military supply line security is an indication that such a task is not necessarily expected and has not been a recent strategic problem.

A 2004 parliamentary review into Australia's 'maritime strategy' was pessimistic about the level of security that Defence could provide to 'sea lines of communication'. A Defence submission to this inquiry indicated its limitations, stating:

The employment of Australian Defence Force maritime assets in the protection of shipping would be quite selective. Our efforts would likely be devoted to the protection of strategically important cargoes (Joint Standing Committee on Foreign Affairs, Defence and Trade, 2004).

The review acknowledged the 'significant challenges' to providing comprehensive protection for sea lines of communication, and there was some acceptance that the necessary security could only be achieved with multi-national cooperation (Joint Standing Committee on Foreign Affairs, Defence and Trade, 2004). Therefore, it is reasonable to conclude that the security of military supply lines would be an enormous challenge for Defence to undertake and may require the mobilisation of additional military capability (Air Power Development Centre, 2013). Further, given the enormous area, it is challenging for Defence to keep an entire national sea trade route open using its current force, as

³² Interview with a senior Navy commander, conducted on 16 March 2019.

³³ Interview with Colonel Mark Baldock, G4 Headquarters Forces Command (2019) conducted on 20 February 2019.

outlined in the 2013 and 2016 White Papers (Department of Defence, 2013, 2016a).

If using military fuel supply assets to support a forward-deployed combat aircraft squadron, the vulnerabilities associated with resupply vessels, particularly given their slower speed and potential status as high-value targets, are notable (Ellery, 2012).

If a commercial fuel supply was used (an almost certain approach), potentially diversified across a number of different commercial providers, security vulnerabilities would exist. Unless provided by Defence, the lack of integral security for commercial fuel vessels would make them exposed targets, perhaps similar to the risks that Australia and General MacArthur faced when relying on commercial fuel supply to Australia during World War II (Gillison, 1962). With contemporary surveillance technology, the locations of fuel supply vessels could be readily spotted by the enemy making them easy targets. Further, as Navy doctrine has identified, the chartering of vessels can be most difficult to achieve in emergencies when there may be other pressures on the commercial fleet (Royal Australian Navy, 2010). This case study specifically examined combat aircraft; however, the likelihood of other military demands on commercial shipping would be almost certain in any scenario.

Once the fuel is on an Australian military base, the base security employed to primarily protect the fuel (as a separate issue to broader aspects of security) would be intensive, given that each bare base can hold approximately two million litres. The provision of such security at an offshore base would be even more difficult given the large sizes of the air bases and runways and the volume of the stored fuel. A RAAF study highlighted the many challenges associated with keeping fuel supplies on an airbase secure from enemy action during combat operations (Sidoti, 2001), and this would further increase the size of the Australian military force required to support a combat aircraft squadron. The 2019 drone and missile attack on Saudi Arabian upstream oil facilities demonstrates new asymmetric threats that are difficult to defend (Hearst, 2019; Pargoo, 2019).

There are many ways to improve the security of military fuel supply. The obvious way is to allocate additional military forces to provide that security. Another option is to separate the KC-30A tanker from the combat aircraft squadron and operate the tanker from a permanent base, like Darwin, to reduce the amount of fuel stored at the bare base. Additionally, if there was sufficient warning time, the Australian Government could expand its oil tanker inventory with both military platforms and commercial options. Actions to improve security may be onerous or expensive; however, if the mission was important, policymakers would, wherever possible, take the necessary actions to achieve mission success for the exceptional military task. However, the current Defence options appear vulnerable to fuel supply line interdiction.

In summary, there are obvious challenges in supplying fuel to a forward-deployed combat aircraft squadron conducting independent operations, and these challenges were

acknowledged in the Defence Strategic Review (Department of Defence, 2023). The logistical challenges in Australia to allow for a functioning bare base are magnified in offshore locations. The basic mechanics for supply are in place and are well understood by the RAAF through a regular exercise regime. However, independent fuel supply line security is an unfamiliar task for Defence, and this resource-intensive task is central to the effective functioning of a combat aircraft squadron. The use of military platforms to conduct fuel supply tasks is possible but carries opportunity costs for the Navy. Moreover, the use of commercial fuel providers can be pursued, but any threat to fuel supply lines would be hard to mitigate. Notably, if a combat aircraft squadron is deployed, it is almost certain that a much larger Australian military force could be deployed on the same mission as that Squadron, and this could amplify the challenges relating to fuel supply and logistics.

This case study will now turn to emergency national legislation that could be enacted to support military operations.

Lining up for fuel

In the event of a bare-base activation and the forward deployment of a combat aircraft squadron for military operations, it could be envisaged that the security threat faced by Australia (e.g., Australia facing an existential threat) would be of such magnitude that the national prioritisation of fuel for military use had to be considered. A RAAF publication highlighted that while the RAAF relied on commercial fuel suppliers, their commercial imperatives did not always have national security objectives in mind, and market-based mechanisms may need to be reconsidered (Clapton, 2017). The Australian Government agreed in principle to a Defence Strategic Review proposal to create a national 'Fuel Council' (Department of Defence, 2023) to provide greater oversight and management during periods of crisis. There can be a number of challenges in achieving fuel prioritisation for the military, as this section will outline, but an exceptional military operation could compel policymakers to take extraordinary action to prioritise fuel supply.

Its power is sometimes overstated and it has over time evolved from a military to an economic continuity focus, but the *Liquid Fuel Emergency Act 1984* (Cth) remains the primary legislative tool that allows for a prioritisation of fuel for the military to perform its role (White, 2013). National preparedness for existential conflict is impossible to fully test, but there is some confidence that the *Liquid Fuel Emergency Act 1984* (Cth) would support military mobilisation. Part 1 Section 6.1(a) of the Act specifies that the Energy Minister can exercise his or her powers for the purposes of 'defence of Australia', 'protecting the existence of Australia as a nation' and 'ensuring that trade or commerce ... may be carried on in an efficient, competitive and profitable manner'. Defence's senior military logistics officer indicated that the Act protected Defence's 'equities', and he was satisfied that the periodic reviews of the Act allowed Defence to ensure its requirements were under-

stood.³⁴ A former Senior Defence Official similarly felt that fuel resources could be built up relatively quickly, relating the issue to the unnecessary costs associated with building up too much fuel when there was no foreseeable military threat.³⁵

There is no specific reference to the 'warning time' or the time it might take to activate the provisions in the Act and prioritise fuel for the military. Nor does the Act focus on other concerns, such as the level of oil refining capacity in Australia (potentially relevant to this case study if there was a threat to fuel supply lines), as this remains primarily governed by commercial considerations.³⁶ The Coronavirus pandemic also revealed some risks that may be associated with the 'warning time' when a nation relies on long, just-in-time supply chains.

However, policymakers have regularly highlighted that the Act and the inter-departmental National Oil Supplies Emergency Committee is the primary mechanism for prioritising fuel for security purposes if a military need arises. The Act received bipartisan support and was defended by the Howard (House of Representatives, 2003), Rudd (Senate, 2008) and Turnbull Governments (House of Representatives, 2017). However, the claims stipulated in the Act have not been tested in crisis. The legislation for fuel prioritisation and the function of the National Oil Supplies Emergency Committee have been periodically exercised. However, the perceived low likelihood of needing to activate this legislation is a factor that influences military fuel sustainability.

In this case study, the question as to when emergency legislation and prioritisation mechanisms can be activated is fundamental. Preparedness and readiness are not always precise but are concepts that are generally well understood in a military sense. However, supporting mechanisms that may be necessary for the mobilisation of military forces, such as national fuel prioritisation, are not discussed in those terms. Part II Section 12.1 of the *Liquid Fuel Emergency Act 1984* (Cth) refers to the 'contingency planning powers' that reside with the Minister, including the ability for the Minister to direct 'relevant fuel industry corporations to maintain reserves' at 'specified places in Australia'. The Energy Minister can also act in the event of 'the likelihood of a shortage of liquid fuel' (as opposed to when the shortage had already occurred, or when the stocks had already been depleted). Therefore, some legislative mechanisms are in place to allow an Australian Government to increase the responsiveness of fuel prioritisation for military purposes, but the politics of pre-emptively restricting public fuel use to prioritise military fuel use may be difficult.

The lack of confidence in the *Liquid Fuel Emergency Act* 1984 (Cth) and the National Oil Supplies Emergency Committee is not without basis. The claims in the Act remain unproven; however, there have been some historical concerns relating to fuel prioritisation for the Australian military. For example, the Curtin Government faced challenges during World War II in prioritising fuel for military use, despite the fact that Australia was involved in a major or even existential conflict. National resources were prioritised for military use against a backdrop of serious external threat. As this case study has discussed, the difficult processes of resource prioritisation and supply route protection were implemented but with US support rather than independently (Butlin & Schedvin, 1955). Generations have passed since an Australian government was compelled to consider military resource requirements in a more holistic, national sense, where actions, such as the formation of the portfolio of War Organisation of Industry in 1941, were taken (Butlin & Schedvin, 1955). The level of political interest in military fuel sustainability, evident immediately after World War II,³⁷ has not been repeated since.

Despite the challenges, there are national mechanisms in place to allow fuel to be prioritised for military use in the event of a major or existential conflict. The exceptional nature of the military's role means that while there is little mindfulness about the efficacy of this prioritisation mechanism during periods in which there are no serious conflict or emerging contingencies, prioritisation would occur if necessary. Senator Molan's view that 'as soon as there is a serious situation, the cost is far less relevant, and the government would just be expected to pay it'³⁸ would almost certainly become the orthodoxy during contingency.

Case study findings

This case study examined a contingency scenario that has been consistently outlined in Australian Defence policy over numerous decades. The case study showed that a number of strategic requirements relating to fuel for the forward deployment of combat aircraft have been established. First, highly capable and operationally experienced combat aircraft squadrons exist. Second, there are a number of bare bases in Australia that could be activated; these bare bases are planned to receive additional fuel infrastructure investment, and these bases are tested periodically during major high-intensity, multilateral training activities, such as Exercise Pitch Black. Third, there are military, commercial platforms and other potential mechanisms, such as US fuel infrastructure investments, that could be called upon to

³⁴ Interview with Major General David Mulhall conducted on 26 February 2019.

³⁵ Interview with a senior Defence official conducted on 15 April 2019.

³⁶ Interview with Group Captain Tim Pedley, Director of Fuel Operations (2015–2018) conducted on 13 February 2019.

³⁷ For example, see parliamentary debates, including House of Representatives, *Parliamentary Debates* (National Oil Proprietary Limited Agreement Bill, Second Reading, 10 September 1937, 1).

³⁸ Interview with Senator Jim Molan conducted on 7 March 2019.

provide fuel to bare bases in Australia or to a forward-deployed element in the nearer region. Finally, there are legislative and federal coordination mechanisms in place to allow the national prioritisation of fuel for military purposes if the need arises.

This case study demonstrated that none of these strategic requirements are fully optimised or resourced to immediately allow high-intensity operations during a major conflict. A significant build-up of military logistics capacity for such operations needs to occur, and the Defence Strategic Review seeks to significantly enhance military fuel sustainability (Department of Defence, 2023).

However, there has been logic to Australia's minimalist approach. With many competing strategic demands, improving military fuel sustainability at bare bases or for forward deployments is desirable but could also represent unnecessary (immediate) expenditure and effort. A pragmatic approach to resource military fuel sustainability to meet existing tasks has proven sufficient in the past. The exceptional military task would be prioritised if required. Naturally, such an approach entails a level of risk, but risk management is the currency of senior leadership, and the scale of the problem is understood.

Achieving assured fuel supply to the bare bases or to an offshore location is a significant challenge and would be worth greater attention if independent Australian operations are deemed to be more likely. Successful and consistent fuel supply to a forward deployment is currently tenuous, due to limited integral bulk fuel transport, repurposed commercial platforms with few integral security features, the vulnerabilities of commercial options, the lack of assur-

ance of support from like-minded nations and the limited contemporary experience in contested supply line security.

Defence's logistics system survived when challenged by the fuel demands for the INTERFET mission (Australian National Audit Office, 2002), a land-based operation with minimal enemy threat. However, contested aircraft operations present an entirely different scale of fuel consumption and threat. Further, it is unlikely that a combat aircraft squadron would be the only unit required for an independent, high-intensity mission in Australia's northern approaches or other nearby regions. Indeed, this case study identified that the level of support required for the combat aircraft squadron alone would include other units to provide security for air bases and runways, security for supply lines and separate aircraft, such as KC-30A, air-to-air refuelling.

Perhaps most importantly, this case study demonstrated the complexities and risks of combating aircraft operations based on the fuel supply assets available to the current force. It should be noted that fuel is just one of the many logistical factors to be considered when deploying a single military unit. A joint or coalition mission involving multiple platform types would present a greater challenge. Again, if a military mobilisation period was anticipated, there may be time to enhance military fuel sustainability, but this would be a considerable undertaking.

Submitted: August 16, 2022 AEDT, Accepted: June 20, 2023 AEDT



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