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MAJ Alice Bechtol, United States Army

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14. ABSTRACT

Since 2012, the U.S. has reinvigorated regional security relationships with India, Australia, and Japan, known as the Quadrilateral Security Dialogue (or the "Quad"), to maintain "a free and open Indo-Pacific," and to prevent an open conflict over Taiwan. Due to the nature of these security concerns, naval requirements are a specific consideration in any military response. Appreciating the link between resource availability and operational requirements helps prevent points of operational culmination, especially when building a diverse coalition force. Therefore, it is important to assess the nature of the existing Indian, Australian, and Japanese, hereafter referred to as the "Quad(-)," fuel resources in supporting a Quad-based effort against China.

The Quad(-)'s current naval fuel supply chain is vulnerable in conflict due to existing domestic energy security shortfalls, deficiencies in civilian and combat tankers, and geographic import dependencies. Understanding constraints in Quad(-) fuel operations suggest that U.S. Indo-Pacific policy should expand the Quad to increase collective fuel reserves, develop a coalition staff to help manage sustainment taskings and tanker allocations, and protect the Quad(-)'s sea lines of communication through Maritime Domain Awareness (MDA) collaboration and diversifying oil import routes. Despite efforts to stockpile resources and increase procurement options within the Quad, the singular reliance on diesel fuel stands out as a force flaw that the Quad must address to ensure endurance of maritime operations in conflict.

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Quad Quandaries: U.S. Leadership Must Plan for Quad(-) Fuel Gaps in Conflict

One of the United States (U.S.) Navy's military strategies today is to deter war with China, but current U.S. fuel accessibility in the Indo-Pacific may limit the operational power for an enduring conflict.[1] China's anti-access aerial-denial (A2/AD) capability and deliberate focus on destroying the U.S. maritime sustainment options are two serious operational considerations that show why the U.S. requires strong regional relationships to safeguard survivability and sustainment at sea.[2] Since 2012, the U.S. has reinvigorated regional security relationships with India, Australia, and Japan, known as the Quadrilateral Security Dialogue (or the "Quad"), to maintain "a free and open Indo-Pacific," and to prevent an open conflict over Taiwan.[3] Due to the nature of these security concerns, naval requirements are a specific consideration in any military response. Recent Quad naval exercises, like the Rim of the Pacific (RIMPAC) and coalition sustainment operations at sea, show the interoperability of Quad naval refueling systems and fuel types.[4] As the distance from continental U.S. (CONUS) will test the U.S.

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[1] "Advantage at Sea: Prevailing with Integrated All-Domain Naval Power," *Department of the United States Navy, Department of the Navy: United States Marine Corps, and the United States Coast Guard*, December 2020, 1-2. https://media.defense.gov/2020/Dec/17/2002553481/-1/-1/0/TRISERVICESTRATEGY.PDF/TRISERVICESTRATEGY.PDF.

[2] Christopher Woody, "In a War with China, the US Navy's Warships Might Not Be the First Target," *Insider*, June 5, 2020, https://www.businessinsider.com/in-war-china-us-logistics-fleet-would-be-major-target-2020-6;
Sakshi Tiwari, "Not Ready for China War! Pentagon Says US Lacks Logistics To Support Armed Conflict With Beijing," *The EurAsian Times*, May 6, 2022, https://eurasiantimes.com/pentagon-says-us-lacks-logistics-to-support-conflict-with-china/.

[3] Joseph R. Biden Jr., *National Security Strategy*, October 2022, 17, 21;
Lloyd Austin, *National Defense Strategy*, October 27, 2022, 8, 10, 14;
"Quad Leaders' Joint Statement: "The Spirit of the Quad," *The White House*, March 12, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/12/quad-leaders-joint-statement-the-spirit-of-the-quad/.

[4] Brad Lendon, "World's Largest Naval Exercises to Include All 4 Quad Nations and 5 South China Sea Countries," *CNN*, June 1, 2022. https://www.cnn.com/2022/05/31/politics/rimpac-navy-exercises-intl-hnk-ml/index.html;
Lt. Katherine Serrano, "U.S., Japan, Australia Integrate Allied Logistics during Tri-Lateral Operations," *U.S. Indo-Pacific Command*, November 21, 2022, https://www.pacom.mil/Media/News/News-Article-View/Article/3225183/us-japan-australia-integrate-allied-logistics-during-tri-lateral-operations/;
Lt. Katherine Serrano, "CTF 70 and 71 Conduct Bi-lateral ASW Training and Logistics Support with JMSDF," *U.S. Indo-Pacific Command*, December 9, 2022, https://www.pacom.mil/Media/News/News-Article-View/Article/3242023/ctf-70-and-71-conduct-bi-lateral-asw-training-and-logistics-support-with-jmsdf/.

Navy's ability to project timely fuel operations in the Indo-Pacific, leveraging Quad relationships for fuel access will become increasingly important.

Understanding this sustainment challenge will help leaders appreciate the link between resource availability and operational requirements to prevent culminating points, especially if exercising an untested maritime coalition force. According to Milan Vego, "Without an adequate and effective theaterwide logistical infrastructure, a campaign or major operation cannot be sustained logistically."[5] Therefore, it is important to assess the nature of the existing Indian, Australian, and Japanese, hereafter referred to as the "Quad(-)," fuel resources in supporting a Quad-based effort against China. The Quad(-)'s current naval fuel supply chain is vulnerable in conflict due to existing domestic energy security shortfalls, deficiencies in civilian and combat tankers, and geographic import dependencies. Upon recognizing these constraints in Quad(-) fuel operations, U.S. Indo-Pacific policy should expand the Quad to increase collective fuel reserves, develop a coalition staff to help manage sustainment taskings and tanker allocations, and protect the Quad(-)'s sea lines of communication through Maritime Domain Awareness (MDA) collaboration and oil import route diversification. Despite efforts to stockpile resources and increase procurement options within the Quad, the singular reliance on diesel fuel stands out as a force flaw that the Quad must address to ensure endurance of maritime operations in conflict.

Background: U.S. Petroleum Gaps

The U.S. Navy has not had to contend with contested logistics in the Pacific since World War II, but now its national peacetime sustainment organization is unsuitable for a long war with China. Since the objective of the U.S. Navy is to gain and maintain necessary levels of sea

[5]Milan Vego, *Joint Operational Warfare: Theory and Practice*, (Newport, RI: Naval War College, 2009), VIII-75.

control and sea denial to facilitate required maneuverability in the region and support ground operations, China's ability to coordinate threats to prevent or deny access to certain areas in the Indo-Pacific will challenge the Navy's ability to sustain forces in a contested environment. Transportation timelines for strategic resupply, overcoming in-theater storage shortfalls, and oiler fleet constraints all affect the U.S.'s ability to provide responsive fleet logistics in conflict. Confronting these critical issues shows how the U.S. may have to rely on the Quad(-) for fuel support in the Indo-Pacific.

First, while the U.S. has significant domestic energy production capability, the extended timelines associated with transporting fuel from CONUS to the Indo-Pacific theater are a vulnerability. Any fuel coming from one of the U.S.'s 130 oil refineries or six years of strategic petroleum reserves would likely depart from the Gulf of Mexico due to the volume of the pipeline infrastructure and refinery capabilities available for maritime transport.[6] Consumption and fuel delivery rates would be dependent on operational requirements in the Indo-Pacific during war. However, it is important to understand it would take a minimum of 18 days to move CONUS-refined petroleum from the Gulf of Mexico to Hawaii via large vessels.[7] In addition, the U.S. only has 70 nationally flagged commercial tankers.[8] Competing military and domestic requirements for this tanker use, in addition to trip and delivery timelines, will control the fleet's

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[6] "Oil Stocks of IEA Countries," *International Energy Agency*, last updated January 18, 2023, accessed December 1, 2020, https://www.iea.org/data-and-statistics/data-tools/oil-stocks-of-iea-countries;
"When Was the Last Refinery Built in the United States?" *U.S. Energy Information Administration*, last updated July 8, 2020, accessed December 1, 2020, https://www.eia.gov/tools/faqs/faq.php?id=29&t=6;
Cynthia B. Foreso, "U.S. Becoming A Leading Exporter of Petroleum Products," *United States International Trade Commission*, December 2014, 1,
https://www.usitc.gov/research_and_analysis/documents/foreso_petroleum_products-12-1-14_final_0.pdf.

[7] "Sea Rates: Distances and Time," accessed December 15, 2022, https://www.searates.com/services/distances-time/.

[8] "Data Table: Number of Ships by Type, Oil Tankers," *United Nations Conferences on Trade and Development*, accessed December 15, 2022, https://unctadstat.unctad.org/.

availability for Navy needs. Understanding this time lag explains the U.S.'s pre-positioning efforts in the Indo-Pacific, but the military is facing challenges here.

Two key U.S. Indo-Pacific strategic storage sites outside of China's immediate A2/AD reach are receiving scrutiny.[9] The U.S. Navy is currently shutting down the Red Hill fuel storage site in Hawaii, causing the Department of Defense to relocate, rebuild, and reprioritize 250 million gallons of fuel in the region by identifying over a dozen new fuel sites.[10] Additionally, the U.S.'s lease of Diego Garcia expires in 2036, an island in the Indian Ocean with at least a 50,000-gallon fuel storage capability.[11] The loss of this site would eliminate a strategic ground site in the middle of the highly trafficked oil shipping routes and requires substitute solutions immediately. Identifying reliable storage sites is critical to the U.S. Navy's effectiveness, but vessel shortfalls would constrain the Navy's ability to push fuel out to requesting units.

Lastly, the U.S. remains unprepared to both supply itself or be the predominant sustainment supporter for any coalition operations in conflict because of limited combat logistic vessels and an overreliance on U.S. civilian mariners from the Military Sealift Command (MSC). The U.S. Navy's MSC holds the largest combat logistics fleet in the Quad with a total of 15 combat fleet oilers, five combat sustainment tankers, and two fast combat support vessels,

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[9] "China's Anti-Access Area Denial," *Missile Defense Advocacy Alliance*, August 24, 2018, https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/china-anti-access-area-denial/.

[10] "What is the Red Hill Bulk Fuel Storage Facility?" *United States Environmental Protection Agency*, last updated August 31, 2022, https://www.epa.gov/red-hill/what-red-hill-bulk-fuel-storage-facility;
Mahealani Richardson, "Plans for Fuel Storage Facilities in the Pacific Could Offer Alternatives to Red Hill," *Hawaii News Now*, updated January 25, 2022, https://www.hawaiinewsnow.com/2022/01/26/plans-more-fuel-farms-pacific-could-offer-alternatives-red-hill/;
Heather Mongilio, "SECNAV Del Toro: Navy Will Not Need to Build Fuel Facilities to Replace Red Hill Fuel Depot," *USNI News*, March 11, 2022, https://news.usni.org/2022/03/11/secnav-del-toro-navy-will-not-need-to-build-fuel-facilities-to-replace-red-hill-fuel-depot.

[11] Chirayu Thakkar, "Overcoming the Diego Garcia Stalemate," *War On The Rocks*, July 12, 2021, https://warontherocks.com/2021/07/overcoming-the-diego-garcia-stalemate/;
"Repair Hydrant Fuel System," NOVA Group Inc., accessed December 15, 2022, https://novagrp.com/project/repair-hydrant-fuel-system/.

making a Quad naval response highly dependent on how the U.S. maneuvers its sustainment assets.[12] However, the MSC is underprepared to handle operations in a contested environment as it currently relies on contract support for annual defense requirements and does not have the manning available to operate vessels in conflict successfully.[13] Therefore, a deeper understanding of the Indian, Australian, and Japanese petroleum footprint helps to highlight additional challenges for coalition operations in a contested Indo-Pacific environment.

Quad(-) Strategic Fuel Storage and Refineries

Domestic refinement and strategic reserve capabilities reveal how unbalanced energy policy preparedness across the Quad(-) would likely inhibit naval sustainment efforts during a conflict. The diverse types and complexities of oil refineries, the type of crude oil, and the percentage of petroleum refined per barrel are all supply chain variables to consider for naval diesel fuel production.[14] However, looking holistically at the Quad(-)'s individual domestic resources is still a useful reference point. The number of existing refineries suggests the strength of internal refinery expertise and ability to accept crude or refined oil, which can matter if combat operations require robust domestic mobilization. Also, maintaining the International Energy Association's (IEA) 90-day strategic oil reserve requirement provides a measurement of

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[12] "U.S. Navy's Military Sealift Command," *Military Sealift Command*, January 2023, https://www.msc.usff.navy.mil/Portals/43/Posters/MSC_USNavyShips2023.pdf.

[13] Austin D. Folster, David C. Eggers, and Ryan Sawko, "Availability of Refined Fuel Within the Indo-Pacific Area of Responsibility," *Naval Post Graduate School*, December 2018, 43-44;
Todd Kutkiewicz, "Military Sealift Command's Combat Logistics Force in Contested Environments," *Naval War College*, May 12, 2017, iii.

[14] Anand Toprani, "A Primer on the Geopolitics of Oil," *War On The Rocks,* January 17, 2019, https://warontherocks.com/2019/01/a-primer-on-the-geopolitics-of-oil/;
"Oil and Petroleum Products Explained: Refining Crude Oil," *U.S. Energy Information Administration,* last updated April 19, 2022, https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil.php;
Folster, Eggers, and Sawko, "Availability of Refined Fuel," *Naval Post Graduate School*, 2018, 10-15.

national preparedness.[15] Studying how the war in Ukraine has influenced global energy markets offers insights into the Quad(-)'s sustainment responsiveness in a conflict.

Despite being located in the Indo-Pacific theater, the Quad(-) has significantly fewer domestic fuel capabilities when compared to the U.S. and will be struggling to accommodate large Quad military efforts. Australia is a full IEA member, but its ability to uphold large energy security measures is questionable. Today, only two oil refineries remain in country, a reality which significantly limits Australia's import diversity and petroleum mobilization capacity.[16] After Russia's invasion of Ukraine in February 2022, Australia condemned Russia's actions, released barrels of oil to support IEA financial initiatives, extended sanctions, and created the 2021 Fuel Security Act to devote more attention to improving their low strategic reserves and energy security.[17] In particular, Australia has a goal to maintain at least 32 days of diesel fuel by 2024.[18] While Australia works on its domestic shortcomings, its current ability to fulfill any strategic fuel requirements for the Quad, especially in a moment of crisis, is weak.

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[15] "Oil Stocks of IEA Countries," *International Energy Agency*, 2023.

[16] Renju Jose and Sonali Paul, "Australia to Pay Last Two Oil Refineries up to $1.8 billion to Stay Open," *Reuters*, May 16, 2021, https://www.reuters.com/business/energy/australia-prop-up-its-last-two-refineries-with-up-179-bln-2021-05-16/;
"Oil Stocks of IEA Countries," *International Energy Agency*, 2023.

[17] Chris Sheedy, "In An Emergency, Austrlia Might Not Have Enough Fuel to Meet its Needs," *Create Digital*, May 20, 2019, https://createdigital.org.au/emergency-australia-fuel-needs/;
"Australia's fuel reserves boosted to strengthen resilience and supply," *Department of Climate Change, Energy, the Environment and Water, Australian Government*, November 14, 2022, https://www.energy.gov.au/news-media/news/australias-fuel-reserves-boosted-strengthen-resilience-and-supply;
Tom Oakley-Newell, "Australia to Tap into Oil Reserves," *Convenience and Impulse Retailing,* March 3, 2022, https://www.c-store.com.au/australia-to-tap-into-oil-reserves/;
"Russia-Extension of Sanctions on Russia to Prohibit the Import into Australia of Russian Oil and Other Energy Products," *Australian Government*, March 11, 2020, https://www.dfat.gov.au/news/news/russia-extension-sanctions-russia-prohibit-import-australia-russian-oil-and-other-energy-products.

[18] "Australia's Fuel Reserves Boosted to Strengthen Resilience and Supply," *Department of Climate Change, Energy, the Environment and Water, Australian Government*, November 14, 2022, https://www.energy.gov.au/news-media/news/australias-fuel-reserves-boosted-strengthen-resilience-and-supply.

Looking northward, Japan is the most energy-prepared Quad(-) member in theater. Japan is an IEA member, supports 21 domestic refineries, and maintains around seven months of strategic reserves.[19] For military considerations, Japan also maintains a 137-day fuel reserve for government-specific fuel products.[20] While Japan has released some of its strategic reserves as requested by the IEA, the war has caused Japan to more thoughtfully manage how they can diversify from fossil fuels without creating vulnerabilities, ultimately remaining extremely reliant on oil in the short term. [21] Even today, Japan is still dependent on Russia's oil near Sakhalin Island.[22] Despite its diligent and substantial fuel initiatives to bolster its energy security, Japan has shown it is still tethered to transactional, resource-based relationships.

Lastly, India is only an IEA Associate Member and is not subject to the 90-day storage obligation but maintains about a nine-day strategic oil reserve with 23 domestic refineries.[23] This data suggests that India remains unequipped to handle large shocks to its energy supply chain, despite its robust refinery infrastructure. While India did support the IEA's request to release strategic oil reserves, India has also maintained an economic relationship with Russia and

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[19] "Oil Stocks of IEA Countries," *International Energy Agency*, 2023;
"Location of Refineries and Crude Distillation Capacity in Japan," *Petroleum Association of Japan*, October 2022. https://www.paj.gr.jp/sites/default/files/2022-12/paj-9_%E7%B2%BE%E8%A3%BD%E8%83%BD%E5%8A%9B%E4%B8%80%E8%A6%A7E202212.pdf.
[20] Eric Johnston, "Japan's Oil Stockpiles Come into Spotlight Following Russia's Invasion of Ukraine," *The Japan Times*, March 3, 2022, https://www.japantimes.co.jp/news/2022/03/03/business/oil-reserves-japan/;
"08. Oil Stockpiling," *Petroleum Association of Japan*, January 16, 2023, https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.paj.gr.jp%2Fsites%2Fdefault%2Ffiles%2F2023-01%2Fpaj-8E_202301.xls&wdOrigin=BROWSELINK.
[21] Diana Schnelle, "Japan's Energy Mix After the Ukraine Crisis," *East Asia Forum*, May 10, 2022, https://www.eastasiaforum.org/2022/05/10/japans-energy-mix-after-the-ukraine-crisis/#:~:text=To%20relieve%20the%20financial%20burden,domestic%20oil%20and%20gas%20sectors;
[22] "Sakhalin Exception: the Russian Energy Japan Can't Quit," *Euractiv*, January 19, 2023, https://www.euractiv.com/section/energy/news/sakhalin-exception-the-russian-energy-japan-cant-quit/.
[23] "International Energy Agency Invites India to Become Full-Time Member: Puri," *Business Standard,* October 11, 2021, https://www.business-standard.com/article/economy-policy/international-energy-agency-invites-india-to-become-full-time-member-puri-121101100989_1.html;
"Indian Oil Corporation Limited," *Government of India,* accessed January 23, 2022, https://mopng.gov.in/en/refining/iocl.

capitalized on cheap crude oil imports.[24] Despite the majority of the international community condemning Russia's attack on Ukraine, India has shown it considers national and international politics when making energy security decisions, and its ability to support the Quad's fuel requirements may be hard to forecast. Overall, the Quad(-) maintains a variety of energy securities and vulnerabilities, and the prioritization of military threats against domestic energy gaps may prevent or limit combined fuel efforts in a conflict with China.

Expanding the Quad to more countries or finding ways to use other fuels not so geopolitically-dependent may be more beneficial in securing military requirements needed for maritime operations to counter China. Looking at Asia, both South Korea and New Zealand are regional allies that the Quad could feasibly include into coalition operations and fuel support. However, both countries are "energy islands," and therefore have no alternative land-based infrastructure to transport oil products. Attempting to ask Europe to contribute extra fuel to an Indo-Pacific conflict would also be difficult due to its own prioritization of reducing energy dependency on Russia. Regionally distant but oil-rich areas like Saudi Arabia may be an option due to their proximity to the region and oil resources, and the Quad members all have preexisting cooperative relationships with the Kingdom.[25] Overall, being transparent about the nature of the

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[24] ENS Economic Bureau, "IEA Releases Extra Oil to Calm Prices; India Backs Decision," *The Indian Express*, April 8, 2022, https://indianexpress.com/article/business/commodities/iea-releases-extra-oil-to-calm-prices-india-backs-decision-7858898/;
Nidhi Verma, India Says it is Exploring Ways to Support IEA Members' Oil Release," *Reuters*, April 7, 2022, https://www.reuters.com/business/energy/india-says-it-is-exploring-ways-support-iea-members-oil-release-2022-04-07/;
"Explained: How Ukraine War is changing India's Oil Purchase," *The Times of India*, June 13, 2022, https://timesofindia.indiatimes.com/business/india-business/explained-how-ukraine-war-is-changing-indias-oil-purchase/articleshow/92187596.cms.

[25] "Saudi Arabia Country Brief," *Department of Foreign Affairs and Trade, Australian Government*, accessed March 24, 2023, https://www.dfat.gov.au/geo/saudi-arabia/saudi-arabia-country-brief#:~:text=Australia%20and%20Saudi%20Arabia's%20friendly,(Riyadh%20and%20Jeddah%20respectively);
Yeshi Seli, 'Quad 2.0' in Offing? India, Saudi Embark on 'Partnership' Voyage, *The New Indian Express*, September 11, 2022, https://www.newindianexpress.com/thesundaystandard/2022/sep/11/quad-20-in-offing-india-saudi-embark-on-partnership-voyage-2496923.html;

Quad expansion would build shared understanding and purpose around fuel resources while also identifying points of division, especially if or when domestic needs could outweigh military support during a conflict.

Alternatively, the Quad could collectively invest in alternative fuel sources that would deepen Quad relationships, interoperability, and reduce dependency on global energy markets. One trending solution for coalition would be pursuing more efforts towards hydrogen fuel. Hydrogen fuel is more efficient than combustion engines, and individual hydrogen capacities are already growing across the Quad(-).[26] Hydrogen has been safely developed and transported by United States entities for decades, and Japan, India, and Australia have been embracing hydrogen strategies to help with their domestic needs.[27] While some might argue that investing in alternative maritime fuel strategies is too costly and time-consuming, hydrogen energy investment presents an opportunity to realign Quad energy interests before a conflict creates fissures in diplomatic unity, as seen with continued Russia dependency. State energy prioritizations across the Quad(-) must be considered when determining the bandwidth for crisis

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"The 6th Saudi-Japan Vision 2030 Ministerial Meeting Held," *Ministry of Economy, Trade and Industry*, November 8, 2022, accessed March 24, 2023, https://www.meti.go.jp/english/press/2022/1108_003.html;
Nidhi Verma, "Saudi Overtakes Russia to be India's No.2 Oil Supplier in August," *Reuters*, September 5, 2022, https://www.reuters.com/business/energy/saudi-overtakes-russia-be-indias-no-2-oil-supplier-august-2022-09-15/.

[26] Erik Limpaecher, "Secure Alternative Fuel Environment (SAFE) Concept: Fuel for Contested Logistics, in an Era of Climate Change Adaptation," *Naval Post Graduate School Energy Program*, December 7, 2021, https://www.nps.edu/web/nps-video-portal/-/secure-alternative-fuel-environment-safe-concept-fuel-for-contested-logistics-in-an-era-of-climate-change-adaptation.

[27] Limpaecher, "Secure Alternative Fuel Environment (SAFE) Concept," *Naval Post Graduate School Energy Program*, 2021;
"Australia's National Hydrogen Strategy," *Department of Climate Change, Energy, the Environment and Water, Australian Government*, accessed March 24, 2023, https://www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy#:~:text=Australia's%20National%20Hydrogen%20Strategy%20sets,explores%20Australia's%20clean%20hydrogen%20potential;
Jane Nakano, "Japan's Hydrogen Industrial Strategy," *Center for Strategic and International Studies*, October 21, 2021, https://www.csis.org/analysis/japans-hydrogen-industrial-strategy.
Sarita Chaganti Singh, "India OKs $2 billion Incentive Plan for Green Hydrogen Industry," *Reuters*, January 4, 2023, https://www.reuters.com/business/environment/india-approves-2-billion-incentive-plan-green-hydrogen-industry-2023-01-04/.

production, but the Quad(-)'s shipment deficiencies to transport fuel provides continued cause for concern.

Quad(-) Fuel Transportation

National and military tanker availabilities indicate that the Quad will be reliant on heavy civilian vessel support, while operating under U.S. operational control, in an Indo-Pacific conflict. Examples of sustainment operations in the Pacific during World War II highlight the importance of the connection between industrial capacity and the forward-deployed forces. Civilian vessels became stationary tankers that either provided fuel storage or helped transfer fuel to land storage tanks in theater.[28] Additionally, resupply operations at sea with combat logistics ships was one of the biggest benefits to the Allied coalition in World War II, allowing ships to return to operations quickly.[29] Today, merchant oil tankers are configurable to carry crude or refined petroleum, and some ships, like nuclear aircraft carriers, can also conduct fuel resupply operations, but the tank conversion time and mission taskings might limit these assets for fuel missions.[30] As all of the Quad navies use the same diesel fuel, the opportunities for mutually supporting operations seem infinite.[31] However, reviewing civilian and military logistics platforms more generally provides a deliberate analysis of potential sustainment vessel availability for Indo-Pacific military operations.

The sustainment capabilities across country vessels are limited in their maritime support, which creates concern for operations during conflict. The Royal Australian Navy (RAN) has

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[28] Folster, Eggers, and Sawko, "Availability of Refined Fuel," *Naval Post Graduate School*, 2018, 37.
[29] Folster, et al., "Availability of Refined Fuel," 38.
[30] Folster, et al., "Availability of Refined Fuel," 17.
[31] "Military Sealift Command: 2021 In Review," *United States Navy*, 45;
Adreesh Ghoshal, "Indian Navy to Use a New Type of Diesel," *Medium*, January 20, 2020, https://adreesh-ghoshal.medium.com/indian-navy-to-use-a-new-type-of-diesel-cf99319428e6;
Serrano, "Allied Logistics during Tri-Lateral Operations," *U.S. Indo-Pacific Command*, 2022.

around 42 platforms highly dependent on petroleum but holds only two specific sustainment ships capable of fuel resupply.[32] Australia's national merchant fleet has only six oil tankers, but the government has rapidly stood up a Strategic Fleet Task Force in October 2022 for the construction of a Maritime Strategic Fleet to strengthen national and economic security. [33] Australia continues to address its energy security gaps, but as an island nation, its collective tanker fleet does not provide a robust platform capacity to support domestic and international fuel transport requirements.

While Japan also has a limited amount of combat oilers, its strategic capabilities could prove advantageous to broader sustainment efforts. Japanese Maritime Self-Defense Force (JMSDF) is relatively small with about 114 naval vessels with only five refueling ships, but the JMSDF has recently invested in two large oil tankers to help further enhance their logistical capabilities.[34] Surprisingly, Japan's national fleet supports almost 700 oil tankers, the highest in the Quad, which is around 12 percent of their nationally flagged ships.[35] While the JMSDF takes on more sustainment capabilities, protecting and exercising Japan's national fleet within coalition operations would be the most beneficial in extending the operational range and resupply efforts of the Quad.

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[32] "Current Ships," *Royal Australian Navy,* accessed December 12, 2022, https://www.navy.gov.au/fleet/ships-boats-craft/current-ships.

[33] "Australian Government Names Task Force to Setup Strategic Fleet," *The Maritime Executive*, October 20, 2022, https://maritime-executive.com/article/australian-government-names-task-force-to-setup-strategic-fleet;
"Data Table," *United Nations Conference on Trade and Development*, 2022.

[34] Kyle Mizokami, "Japan's Navy is a Lot More Powerful Than You Realize," *The National Interest*, July 15, 2021, https://nationalinterest.org/blog/reboot/japans-navy-lot-more-powerful-you-realize-189542;
"Supply Ship "Towada" Class," *Japan Maritime Self-Defense Force*, accessed December 15, 2022, https://www.mod.go.jp/msdf/equipment/ships/aoe/towada/;
"Supply Ship "Masyuu" Class," *Japan Maritime Self-Defense Force*, accessed December 15, 2022. https://www.mod.go.jp/msdf/equipment/ships/aoe/masyuu/;
Takahashi Kosuke, "Japan Maritime Self-Defense Force Commissions First Yard Oil Tanker," *The Diplomat*, April 26, 2022, https://thediplomat.com/2022/04/japan-maritime-self-defense-force-commissions-first-yard-oil-tanker/.

[35] "Data Table," *United Nations Conference on Trade and Development*, 2022.

Lastly, as the Indian Navy (IN) looks to expand its force, India will need to subsequently expand its oiler strength. The IN seeks to grow from 137 to 200 ships by 2027, but currently has only four combat sustainment vessels. [36] In addition, the country maintains a national merchant fleet of 134 oil tankers, which is unsatisfactory to senior military leadership.[37] Retired IN Admiral, Arun Prakash, has voiced concern about India's small national merchant fleet size and high foreign vessel dependency for commerce, voicing that a "nation's merchant navy is a strategic asset" because of the reliability to provide raw materials to civilian populations during war.[38] India's ability to provide combat fleet assets to a coalition effort would be limited, but continuous domestic pressure to expand oiler capacities may translate to platform redundancies within the Indo-Pacific. Overall, while the character of a conflict with China is unknown, the Quad(-)'s limited combat logistics ships and variations in merchant fleet sizes require deliberate platform management to prevent failure.

Using World War II's naval operations as a guidepost, the success and survivability of a coalition sustainment fleet will require effective asset coordination to sustain Quad operations in a conflict with China. A coalition response would likely see an overreliance on U.S. sustainment strategy because the U.S. holds over half of the Quad's combat logistics ships, but each nation's merchant fleet would have to balance domestic obligations with military requirements. To support both lines of effort and the management of vessel activity, the Quad needs to develop an

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[36] Aman Thakker," A Rising India in the Indian Ocean Needs a Strong Navy," *Center for Strategic and International Studies*, October 17, 2018, https://www.csis.org/analysis/rising-india-indian-ocean-needs-strong-navy; "Fleet Tankers, Torpedo Recovery Vessels, Ocean Going Tugs, Nireekshak Class," *Indian Navy*, accessed December 15, 2022, https://www.indiannavy.nic.in/content/fleet-tankers-torpedo-recovery-vessels-ocean-going-tugs-nireekshak-class.

[37] "Data Table," *United Nations Conference on Trade and Development*, 2022.

[38] Admiral Arun Prakash (Ret.), "India's Merchant Navy is Sinking. But Foreign Shippers are Riding High, Filling their Coffers," *The Print*, July 29, 2021, https://theprint.in/opinion/indias-merchant-navy-is-sinking-but-foreign-shippers-are-riding-high-filling-their-coffers/705312/;
Anil Devli, "Building an India-owned merchant fleet," *Gateway House*, December 26, 2019, https://www.gatewayhouse.in/india-owned-merchant-fleet/.

integrated military organization that can serve as a management conduit from combat sustainment to government fuel demands. At a minimum, the Quad should create an Energy Working Group for the strategic level that looks at minimum state requirements, which could help feed and build potential merchant fleet numbers for military operations. For example, the European theater has the NATO Support and Procurement Agency (NSPA) that serves in this fuel oversight capacity.[39] Additionally or alternatively, the Quad could also create a permanent coalition staff more focused on operational energy requirements for a potential conflict. While the Quad has a fluctuating history, establishing internal Quad institutions to discuss energy needs is a crucial requirement in preventing operational failures, especially if China plans on targeting sustainment assets. However, despite these platform limitations, the Quad(-) is also bound to vulnerable maritime routes for oil imports, and the security of these routes during conflict may still limit coalition participation.

Quad(-) Geographic Challenges

The Quad(-) is reliant on petroleum shipments through narrow geographic waterways, and any interruption in these routes may stress their national energy security and limit their military support during conflict. The majority of the Quad(-) energy imports must transit through the Indian Ocean and three major maritime chokepoints: the Strait of Bab-el Mandeb at the southern tip of the Red Sea, the Strait of Hormuz between the Persian Gulf and the Gulf of Oman, and the Strait of Malacca.[40] These waterways strategically connect the Pacific and Indian

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[39] "NSPA: Support to Operations," *NSPA - NATO Support and Procurement Agency*, accessed January 22, 2022, https://www.nspa.nato.int/about/support-to-operations.

[40] "World Oil Transit Chokepoints," *U.S. Energy Information Administration,* last updated October 15, 2019, accessed December 10, 2022, https://www.eia.gov/international/analysis/special-topics/World_Oil_Transit_Chokepoints;
Darshana M. Baruah and Caroline Duckworth, "We're Thinking About the Indian Ocean All Wrong," *Carnegie Endowment for International Peace*, May 2, 2022, https://carnegieendowment.org/2022/05/02/we-re-thinking-about-indian-ocean-all-wrong-pub-87028.

Oceans, and they are no strangers to violence. The Tanker Wars of the 1980s between Iran and Iraq, and current acts of terrorism, like the use of floating mines, attack craft, and drone boats, show how bottlenecks have been used to disrupt freedom of the seas.[41] For example, in 2014, pirates attacked and stole oil from a tanker in the Malacca Straits.[42] Today, China's behaviors in the Indian Ocean can be considered dual-purposed. China seeks to safeguard its own fuel imports transiting these waterways, while also maintaining a physical presence that could hold the transiting fuel cargo of adversaries at risk.[43] While some think that Chinese military capabilities in the Indian Ocean region are too weak to pose a substantial threat, heavy-import island nations like Australia and Japan would be accepting a significant risk to ignore Chinese behaviors along major maritime routes.[44] Therefore, the Quad(-)'s energy supply chains rely on transit through the Indian Ocean region must be considered in a conflict with China.

The Quad(-)'s focus on securing oil shipments through the Indian Ocean may preclude any collective support measures in conflict because of their dependence on these sea lines of

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[41] Ronald O'Rourke, "The Tanker War," *The Proceedings: U.S. Naval Institute*, May 1988, accessed December 10, 2022, https://www.usni.org/magazines/proceedings/1988/may/tanker-war;
Rick Noack and Claire Parker, "The Last Time a 'Tanker War' Broke Out in the Persian Gulf, it Lasted for Years," *The Washington Post*, June 14, 2019, https://www.washingtonpost.com/world/2019/06/14/last-time-us-witnessed-tanker-war-persian-gulf-it-ended-tragedy/;
Tyler Lycan, Christopher Faulkner, and Austin C. Doctor, "Making Waves: Militant Maritime Operations Along Africa's Eastern Coast," *War On The Rocks*, November 4, 2020, https://warontherocks.com/2020/11/making-waves-militant-maritime-operations-along-africas-eastern-coast/.

[42] Reuters Staff, "Pirates Attack Malaysian Oil Tanker in South China Sea," *Reuters*, July 16, 2014, https://www.reuters.com/article/uk-malaysia-pirates/pirates-attack-malaysian-oil-tanker-in-south-china-sea-idUKKBN0FL0P520140716.

[43] Zack Cooper, "Security Implications of China's Military Presence in the Indian Ocean," *Center for Strategic and International Studies,* April 2, 2019, https://www.csis.org/analysis/security-implications-chinas-military-presence-indian-ocean;
Joshua T. White, "China's Indian Ocean Ambitions," *Brookings*, June 2020, https://www.brookings.edu/research/chinas-indian-ocean-ambitions/;
Hannah Reale, Emma Bingham, and Kara Greenberg, "Where Does China Get Its Oil?" *Colombia University,* July 12, 2020, https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/Where%20Does%20China%20Get%20Its%20Oil_%20-%20The%20Wire%20China.pdf.

[44] Zack Cooper, "Security Implications of China's Military Presence," *Center for Strategic and International Studies,* 2019.

communication. Australia is highly dependent on the import of refined petroleum, and most of these imports come from Singapore through the Strait of Malacca.[45] Subsequently, India primarily imports crude petroleum from Iraq, Saudi Arabia, the United Arab Emirates, the U.S., and Nigeria through the Straits of Bab-el Mandeb and Hormuz.[46] Lastly, using the three straits, Japan is a high importer of crude and refined petroleum from Gulf countries.[47] Overall, the Quad(-)'s dependence on specific maritime routes will likely affect their foreign policy and response to a conflict with China. The reliance of the Quad(-) and China on these same Straits, in addition to non-state actors with geopolitical influence, will make sea control and sea denial of these areas strategically decisive in the Quad's ability to mount a combined military response during conflict.

The Quad could improve its geographic constraints by expanding security infrastructure or the Quad(-) could diversify its import routes, which would relieve pressure on the safety of fuel shipments in a contested environment. Recently the Quad announced an initiative that includes satellite sharing to improve Maritime Domain Awareness (MDA), and the Quad should use this action as momentum to enhance interoperability.[48] Creating a shared operating picture, such as the U.S. Navy's Global Command and Control System – Maritime (GCCS-M), would

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[45] "Refined Petroleum in Australia," *Observatory of Economic Complexity,* last accessed December 10, 2022, https://oec.world/en/profile/bilateral-product/refined-petroleum/reporter/aus#:~:text=At%20the%20same%20year%2C%20Refined%20Petroleum%20was%20the%202nd%20most,%2C%20and%20India%20(%24913M).

[46] "Crude Petroleum in India," *Observatory of Economic Complexity,* last accessed December 10, 2022, https://oec.world/en/profile/bilateral-product/crude-petroleum/reporter/ind.

[47] "Refined Petroleum in Japan," *Observatory of Economic Complexity,* last accessed December 10, 2022. https://oec.world/en/profile/bilateral-product/refined-petroleum/reporter/jpn;
"Crude Petroleum in Japan," *Observatory of Economic Complexity,* last accessed December 10, 2022, https://oec.world/en/profile/bilateral-product/crude-petroleum/reporter/jpn;
"Japan Oil Security Policy," *International Energy Agency*, August 18, 2022, https://www.iea.org/articles/japan-oil-security-policy.

[48] "FACT SHEET: Quad Leader' Tokyo Summit 2022," *The White House*, May 23, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/05/23/fact-sheet-quad-leaders-tokyo-summit-2022/.

facilitate more operational collaboration on addressing security threats in the Indian Ocean. The Quad could also devote specific attention to increased cyber protection of the Automatic Identification System (AIS) data on commercial ships, like tankers, to ensure tracking of resources is timely and accurate. Alternatively, diversifying oil transits could also protect energy deliveries. While there are many ways to collect information on oil shipments, prioritizing unpredictable oil delivery schedules through Indo-Pacific chokepoints or using alternative maritime routes will add just another dimension of complexity to resource protection. Creating and routinely executing these national oil delivery branch plans would support the Quad(-)'s energy security efforts and increase governmental bandwidth for other Quad initiatives.

Regional Quad Fuel Preparations

Some might argue that the Quad's current initiatives regarding its maritime sustainment posture is addressing this fuel problem. Today, the U.S. military recognizes fuel storage, fleet concerns, and the Chinese military threat on naval logistics, and the Chief of Naval Operations (CNO) has a new strategy to address these problems. The CNO calls for a forward-deployed Navy with warfighting concepts that allow the U.S. to operate without overseas land bases with a resilient logistics base, which will help ensure credible deterrence.[49] Part of this vision is increasing the combat logistics ship capacity, adding subsurface and unmanned platforms for distribution, and conducting expeditionary logistics operations.[50] Current defense efforts are also looking at ways to create a plethora of preposition fuel stocks and increase fuel efficiency within existing platforms so consumption is less, reducing strain on resupply operations.[51] Additionally,

[49] "Chief of Naval Operations Navigation Plan 2022," *United States Navy*, 2022, 7.
[50] "Navigation Plan 2022," *United States Navy*, 2022, 10.
[51] Chauncey Goss, "The Pacific Deterrence Initiative," *Federal Budget IQ*, May 16, 2022, https://federalbudgetiq.com/insights/the-pacific-deterrence-initiative/;

the Quad(-) 's military expansion efforts continue to stretch maritime mobility and potential fuel storage options by providing more land-based facilities. India created agreements with Singapore to dock and resupply its ships when needed to counter Chinese presence.[52] India is also building a naval base on Mauritius to help with maritime domain awareness and offset the Chinese Seychelle base.[53] Australia continues to support defense storage depots, building a fuel tank farm at Tindal, as well as supporting the U.S. military with rerouted Red Hill fuel storage at Darwin.[54] Finally, the Quad has also created several mutual support logistics agreements to ensure fluidity between the nations to streamline coalition operations.[55] Collectively, the Quad recognizes the shortfalls in its sustainment footprint for its naval operations and is actively working to address these gaps.

However, all these efforts ignore a foundational fact. With few exceptions, the Quad's navies today are almost entirely dependent on diesel fuel, and they will not remain combat effective without a secure supply chain.[56] The U.S. is already starting at a sustainment disadvantage in conflict because CONUS-based resources are six-thousand miles from the Indo-

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"Partnership with U.S. Navy Works to Save Fuel for Ships," *National Renewable Energy Laboratory*, accessed January 24, 2023, https://www.nrel.gov/workingwithus/partners/partnerships-navy.html.

[52] Vishnu Som, "India's Warships Can Now Refuel At Singapore Naval Base," *NDTV*, November 29, 2017, https://www.ndtv.com/india-news/wary-of-china-india-gets-rights-to-use-singapores-latest-navy-base-1781527.

[53] Samuel Bashfield, "Why is India Building a Military Base on Agaléga Island?" *Al Jazeera*, August 5, 2021, https://www.aljazeera.com/opinions/2021/8/5/why-is-india-building-a-military-base-on-agalega-island.

[54] Bill Dorman, "Asia Minute: U.S. Military is Building New Fuel Storage Tanks in the Indo-Pacific," *Hawai'i Public Radio*, January 25, 2022, https://www.hawaiipublicradio.org/asia-minute/2022-01-25/asia-minute-us-military-building-new-fuel-storage-tanks-australia.

[55] Curtis et al., "Operationalizing the Quad," *Center for a New American Security*, 2022, 17.

[56] "Nuclear Powered Ships," *World Nuclear Association*, November 2021, https://world-nuclear.org/information-library/non-power-nuclear-applications/transport/nuclear-powered-ships.aspx;
"Kishida Cautious About Japan Acquiring Nuclear-Powered Subs," *Nikkei Asia*, June 19, 2022, https://asia.nikkei.com/Politics/International-relations/Indo-Pacific/Kishida-cautious-about-Japan-acquiring-nuclear-powered-subs;
Colin Clark and Aaron Mehta, "Will US Supply Australia with AUKUS Subs? 'That's Not Going to Happen,' Key US Lawmaker Says," *Breaking Defense,* December 5, 2022, https://breakingdefense.com/2022/12/will-us-supply-australia-with-aukus-subs-thats-not-going-to-happen-key-us-lawmaker-says/.

Pacific, which forces a reliance on partners.[57] But these Quad(-) partners face geopolitical complexities and physical needs that will drive how each country acquires fuel, manages fuel, and delivers fuel. The Quad needs more networked and redundant energy-focused solutions for coalition military efforts that enhance partner reliability and reduce external pressures. While RIMPAC and collaborative sustainment exercises provide confidence-building measures, conflicts come with fog and friction, like diplomacy standoffs and communication gaps, which can defy peacetime preparations. And as military coalitions routinely struggle with interoperability, developing policy solutions now that safeguard the Quad's sustainment readiness would be in the best interests of a combined effort.

Conclusion

The Quad coalition would see significant naval fuel challenges in an enduring Indo-Pacific conflict. Individual U.S. military preparations have heavily relied on forward fuel staging and peacetime civilian mariners, but these resources may be unavailable when needed. Looking at the Quad(-)'s domestic refinement, storage capacities, civilian and military ships, and fuel imports helps show the Quad(-)'s in-theater fuel vulnerabilities and suggests policy and military efforts that may help resolve these gaps. Embracing Quad allies and alternative fuels, establishing an enduring coalition support office, and continuously working on MDA efforts and diversifying fuel imports are all ways to ensure available energy for operations. Overall, the maritime sustainment challenge for the Quad is fierce, and every country's fuel challenges will impact any greater collective effort.

[57] "Sea Rates: Distances and Time," accessed March 20, 2023, https://www.searates.com/services/distances-time/.