The
NATIONAL STRATEGY FORUM REVIEW
An Online National Security Journal Published by the National Strategy Forum

Energy Performance in the Department of Defense

By Oliver Fritz [1]

Introduction

Energy has long influenced prosperity and security. The role of oil in motivating Japanese war aims in World War II, the stagflation aftermath of the OPEC oil embargos of the 1970s, $4 a gallon gasoline in 2008, and attacks on fuel convoys are only a few examples of how statecraft and military operations can be shaped by energy.[2] Faced with increasing operational vulnerabilities associated with the current and projected demand for energy, the Department of Defense (DoD) is implementing a series of time-phased improvements in the energy performance of bases and platforms, while posturing for a new, long-term architecture of alternative fuels.

Understanding the National Security Energy Challenge

The DoD is the largest user of energy in the U.S. Government and the single largest user of energy in the United States, spending over $13 billion on all forms of energy in 2009.[3] Of this overall demand, over 70% can be considered "operational energy," meaning the energy needed to

---

[1] Oliver Fritz is an analyst in the Office of Operational Energy Plans and Programs in the Department of Defense. Prior to this position, he was the Assistant Director of Strategic Planning at HQ U.S. Air Force. Mr. Fritz holds a master's degree from the Security Studies Program at the Massachusetts Institute of Technology, and is a Term Member in the Council on Foreign Relations.

DISCLAIMER: The views presented here are of those of the author only and do not necessarily represent the views of the Department of Defense or its components.

[2] Energy Information Administration, *Weekly U.S. Regular All Formulations Retail Gasoline Prices (Cents per Gallon), 1990-Present*, 27 Sep 2010; http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MG_RT_US&f=W.

[3] Office of the Deputy Under Secretary of Defense (Installations and Environment), *Department of Defense Annual Energy Management Report – Fiscal Year 2009*, May 2010, p C-3; http://www.acq.osd.mil/ie/energy/library/aemr_fy_09_may_2010.pdf.

power expeditionary bases and the aircraft, ships, and tactical vehicles being used to train, deploy, sustain, and employ forces around the world.[4] The remaining share includes the energy to power, heat, and cool permanent installations and power non-tactical fleet vehicles.

As an agency of the U.S. Government and a large consumer of energy, DoD is part of the larger geostrategic dilemma confronting the nation. Currently, the energy needed by the nation and DoD to enable transportation and movement is not found in the U.S. and possesses increasingly negative externalities. The costs of the U.S. energy system include distortions to national security priorities, lost benefits of resources sent overseas to import oil instead of being spent at home ($334 billion in 2008 and $199 billion in 2009), and increasing evidence of carbon-induced climate change.[5] As such a large user, the DoD alone estimates that even a $1 increase in the cost of a barrel of oil costs the DoD $130 million in increased annual energy costs, meaning resources that cannot be spent on more useful investments in combat power.[6] As a government agency and an outsized user of energy, DoD must be a part of the architecture for solving this national problem.

However, the large role of "operational energy" in its overall demand suggests the more specific challenges faced by DoD as compared to the commercial energy market. In particular, the DoD has a requirement for liquid fuel and the need to move this fuel across global distances. Even with emerging alternatives (solar, wind, geothermal) for generating electricity, the ability to store such energy will be unsuitable for powering large and heavy vehicles, ships, and aircraft. The difficulty of matching the high energy intensity of liquid fuel means that the liquid fuel likely will remain a presence across battlefields of the future, even with emerging alternates to petroleum.

As long as forward presence and the ability to project and sustain power globally are cornerstones of U.S. defense posture, DoD will have to rely on logistics and energy supply lines to move these heavy, bulky liquid fuels. This need to transport and distribute energy, often outside of commercial supply chains, is accompanied by the vulnerability of attack by states and non-state actors, the challenges of geography and distance, and the need to dedicate combat forces to protect these supply lines. Indeed, the evolving security environment will strain the assumption that energy will always be available.

Attacks on fuel convoys are a well publicized consequence of the need for energy in increasingly irregular operations. The confluence of weak states, non-state actors, and irregular warfare is center stage in the Afghanistan and Pakistan region. Not only do fuel convoys face the basic challenges of geography, such logistics lines also face attacks by insurgent groups at rallying points and main trunk lines. Most recently, the temporary closure of a key supply route led to

---

[4] Office of the Deputy Under Secretary of Defense (Installations and Environment), Ibid.

[5] Energy Information Administration, *Annual Energy Review 2009; Report No. DOE/EIA-0384(2009)*, 19 Aug 2010; Table 5.20, Value of Crude Oil Imports from Selected Countries, 1973-2009; http://www.eia.gov/emeu/aer/txt/ptb0520.html.

[6] Miles, Donna, "Military Looks to Synthetics, Conservation to Cut Fuel Bills," *American Forces Press Service*, 6 Jun 2008; http://www.defense.gov/news/newsarticle.aspx?id=50131.

repeated insurgent attacks on fuel convoys in Pakistan, well before they even entered Afghanistan.[7] Reflecting the lack of front lines and dispersed ground force operations often prevalent in counterinsurgency, the challenge of irregular warfare is as much about doctrine and training as it is maintaining reliable supply lines with minimal casualties.

The proliferation of precision weapons in the form of guided rockets, artillery, missiles, and mortars will further increase the vulnerability of energy and logistics to disruption. While most indirect fire attacks on U.S. bases over the past 20 years have largely been inaccurate or ineffective, the spread of GPS guidance systems will transform the ability of non-state actors to affect centers of gravity that include energy.[8] At the higher end of the threat spectrum, the emergence of accurate and plentiful anti-access weapons ballistic and cruise missiles is not only causing the U.S. to re-consider its missile defenses and overall basing posture, but also should invoke concern over the assured delivery of energy through oilers, convoys, and regionally-based aerial refuelers and the storage of energy in large, above ground tank and bladder farms.

DoD Improvements to Energy Performance

Faced with these operational, fiscal, and opportunity costs, the DoD and the Armed Services are implementing a range of efforts to increase mission effectiveness by reducing the need for energy and the associated logistics.

At expeditionary bases across Iraq and Afghanistan, the need to generate electricity for lighting, heating, cooling, and communications systems creates significant demand for energy. The Army's recent effort to insulate tents in Iraq reduced air conditioning demand by 50% and reduces the need for fuel convoys to traverse treacherous roads in a theater with few front lines.[9] More broadly, the Marine Corp's Expeditionary Forward Operating Base – or "ExFob" – and the Joint NetZero Joint Capability Technology Demonstration are pursuing a broad range of demand reduction and power generation options that will minimize the need for re-supply, including insulation of structures, alternative means of lighting, solar powered perimeter lighting, demonstration of renewable power generation, micro-grids to better manage loads, and demand measurement systems.[10] After testing these concepts at home, a company of Camp Pendleton-

---

[7] For recent accounts, see Aaron Favila, "NATO oil tankers attacked in Pakistan," *The Associated Press*, 1 Oct 2010; http://www.armytimes.com/news/2010/09/ap-pakistan-blocks-nato-supply-line-093010/; and Sattar, Abdul, "12 NATO fuel tankers attacked in Pakistan," *The Associated Press*, 6 Oct 2010; http://www.washingtonpost.com/wp-dyn/content/article/2010/10/05/AR2010100506578.html?sub=AR.

[8] National Intelligence Council, *Global Trends 2025: A Transformed World*, November 2008, p 71; http://www.dni.gov/nic/PDF_2025/2025_Global_Trends_Final_Report.pdf.

[9] United States Government Accountability Office, *Defense Management: Increased Attention on Fuel Demand Management at DOD's Forward-Deployed Locations Could Reduce Operational Risks and Costs*, 3 Mar 2009, p 3; http://www.gao.gov/new.items/d09388t.pdf.

[10] Department of Defense, *Fiscal Year (FY) 2011 Budget Estimates: Research, Development, Test and Evaluation, Defense-Wide, Volume 3A*, February 2010, p 231; http://comptroller.defense.gov/defbudget/fy2011/budget_justification/pdfs/03_RDT_and_E/OSD%20RDTE_PB_2011_Volume%203A.pdf.

based Marines soon will be evaluating these technologies while deployed to Afghanistan.[11] While the immediate effect will be a reduction in the demand for energy associated re-supply and the enhanced ability to support far flung forward operating bases and combat outposts, these kinds of pathfinder initiatives will help identify best practices and improve the flow of operationally-tested technologies into theater.

Improving energy performance in aviation – which comprises 63% of all DoD energy demand and powers the core of the U.S. conventional deterrent – is the subject of a broad range of operational changes, mid-life upgrades, and design changes.[12] In addition to benchmarking with commercial airlines and implementing the right information technology tools to track fuel consumption in its airlift and aerial refueling aircraft, the Air Force is pursuing a range of changes in operations and training that include "flight simulators for crew training and proficiency, optimizing cargo loads, decreasing empty legs, optimizing aircraft routing through better diplomatic clearances, and reducing aircraft weight."[13] In addition to these changes to current operations, there is more to be done. For instance, both the Air Force and Navy are funding the development of advanced jet engines that aim to reduce specific fuel consumption by up 30%.[14]

At sea, the Navy is funding the development and testing of high payoff investments like hybrid electric propulsion systems to reduce the need for gas turbine engines over a given cruise and improving hydrodynamics through additions like stern flaps and underwater hull coatings. While often saving hundreds of millions of dollars over the lifetime of a single ship, these advancements will begin to make more significant progress toward reducing the frequency for replenishment and extending range and persistence. These increases in operational capability – over 900,000 gallons saved in one cruise of the hybrid-powered *USS Makin Island*, for instance – represent the real payoff for investments in energy performance.[15]

The Navy and Air Force also are leading the way in posturing the Defense Department to manage emerging alternatives to fossil fuels. Through its testing and certification program, the

---

[11] Marine Corps Air Ground Combat Center Twentynine Palms Public Affairs Office, "Solar powered Devil Dogs," 30 Jul 2010; http://www.usmc.mil/unit/29palms/Pages/SolarpoweredDevilDogs.aspx.

[12] Office of the Deputy Under Secretary of Defense (Installations and Environment), Ibid.

[13] Laura McAndrews. "Fuel efficiency among top priorities in AMC's energy conservation." *Air Mobility Command Public Affairs*, 5 Oct 2009, http://www.af.mil/news/story.asp?id=123171233.

[14] Daniel E, Thomson, Air Force Research Laboratory Propulsion Directorate. *Versatile Affordable Advanced Turbine Engines Provide Game Changing Capability with Superior Fuel Efficiency*, April 2010. Presented at the NDIA 11th Annual Science & Engineering Technology Conference/DoD Tech Exposition, p 5; http://www.dtic.mil/ndia/2010SET/Thomson.pdf. F/A-18E/F & EA-18G Program Office, PMA265, "Green Hornet Team for the FY 2009 Chief of Naval Operations Environmental Awards Program Category: Environmental Excellence in Weapon System Acquisition–Team," p 2; https://www.denix.osd.mil/portal/page/portal/Awards/FY09SECDEF/EEWSA%20NAVAIR%20Narrative.pdf.

[15] Surface Forces Public Affairs, "'Green Ship' Makin Island to be Commissioned," *Navy News Service*, 19 Oct 2010; http://www.navy.mil/search/display.asp?story_id=49049.

Air Force will ensure that all of its aircraft and systems can use a 50/50 alternative fuel blend by 2011, and aims to meet 50% of its domestic aviation fuel requirements by 2016 with cost competitive alternative fuel blends that emit fewer greenhouse gases than conventional petroleum.[16] Similarly, the Navy has already flown F/A-18E/F "Green" Hornet powered by biofuel blend with JP-8, and is aiming to sail a "Great Fleet" of "nuclear ships, surface combatants with hybrid electric power systems using biofuel and aircraft flying on only biofuels" by 2016.[17] On top of this operational test, the Navy plans to use alternative sources of energy for half of all Navy energy requirements by 2020.[18] While alternative fuels may lack the clear operational benefits compared to changes in the duration and persistence of the force, they nonetheless represent an "insurance policy" in a rapidly changing energy marketplace.[19]

Operational concepts are also being adapted to increase warfighting capability while reducing the risks associated with assuring the delivery of energy in the face of a broad array of air, sea, and undersea threats. For instance, the Air Force and Navy are cooperating on AirSea Battle to, in the words of the Air Force Chief of Staff, "rethink legacy force projection concepts," and "ensure continued access to, and ability to operate in, these increasingly contested environments."[20] In the recently released *Marine Corps Operating Concepts*, the need for distributed operations means that energy efficiency is a "central enhancement" that will "allow the MAGTF [Marine Air Ground Task Force] the ability to conduct operations in the most austere of environments—where excess and luxury is [sic] not practical."[21] These changes at the conceptual level of warfare do not immediately affect operational energy demand, but begin the process of revising the warfighting strategies across air, land, and sea that directly feed the requirements and acquisition processes.

Taking its cue from Congress, DoD recently established the Director of Operational Energy Plans and Programs under the Under Secretary of Defense for Acquisition, Technology, and Logistics. Among the duties identified in the enabling legislation, the Director is responsible for coordinating Service activities related to the "consideration of operational energy demands in

---

[16] U.S. Air Force, *Air Force Energy Plan 2010*, p 8 – Figure 4, http://www.safie.hq.af.mil/shared/media/document/AFD-091208-027.pdf.

[17] Liz Wright. "Green Hornet to take Flight on Earth Day," *Navy Office of Information*, 30 Mar 2010; http://www.navy.mil/search/display.asp?story_id=52291.

[18] Wright, Ibid.

[19] Sharon E. Burke, Director of Operational Energy Plans and Programs, quoted in Erwin, Sandra I., "Next Up on the Pentagon's Efficiency To-Do List: Energy," *National Defense Blog*, 19 Aug 2010; http://www.nationaldefensemagazine.org/blog/Lists/Posts/Post.aspx?ID=178.

[20] General Norton Schwartz, USAF, "Air Force Association Air and Space Conference Keynote Speech," Given at Air Force Association's *Annual Air & Space Conference and Technology Exposition*, 14 Sep 2010, p 10; http://www.af.mil/shared/media/document/AFD-100914-056.pdf.

[21] US Marine Corps, *Marine Corps Operating Concepts, Third Edition*, June 2010, p 37; http://www.quantico.usmc.mil/uploads/files/MOC%20July%2013%20update%202010_Final.pdf.

defense planning, requirements, and acquisition processes."[22] This portfolio includes the use of an energy key performance parameter to fully account for the energy, logistics, and sustainment requirements that typically are not included with initial requirements and cost estimates. The explicit consideration of operational energy in requests for proposals should encourage the DoD to better balance a larger basket of requirements and use competition to increase the overall capabilities of the fielded system.

In addition, the legislation specified implementation of the fully burdened cost of fuel. Applied in analyses of alternatives and acquisition program design assessments, the fully burdened cost of fuel is intended to capture the full opportunity costs of procuring, storing, transporting, protecting, and distributing a single gallon of fuel to achieve the mission with a given platform. Initially popularized in a 2001 Defense Science Board report, the fully burdened cost of fuel should help incentivize the inclusion of energy performance further "upstream" in the analysis of alternative phases of the requirements process to more fundamentally change – and improve – the capabilities of fielded equipment.[23] While the precise methodology and application of both the fully burdened cost of fuel and energy key performance parameter will evolve over time, future capabilities certainly should benefit from a more realistic and deliberate consideration of the benefits of improved energy performance and risks of energy associated logistics.

Looking Ahead

Across a range of capability enhancement, risk mitigation, and requirements and acquisition efforts, the Department of Defense is taking recognizable steps to better understand and adapt its energy footprint to reflect a new operational environment. Moving beyond the multi-decade period of relatively cheap and plentiful energy provided through relatively secure means of transportation, DoD is making changes needed to fight and win in conflicts with increasing energy costs and proliferating threats to the assured delivery of energy.

While current operations are an appropriate and critical avenue for achieving immediate effects, DoD also is changing how the opportunity costs of energy consumption and logistics are integrated into large acquisition programs. At the foundation of this shift will be improvements in the way we use analytical tools to integrate the logistics and force structure consequences of energy needs across the entire force planning, requirements, and acquisition process. By valuing the opportunities and risks of operational energy, the Department will be better postured to deter adversaries during peacetime and, if needed, prevail more quickly in a time of war.

Oliver Fritz is an analyst in the Office of Operational Energy Plans and Programs in the Department of Defense. Prior to this position, he was the Assistant Director of Strategic Planning at HQ U.S. Air Force. Mr. Fritz holds a master's degree from the Security Studies

---

[22] *Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 - Public Law 110-417*, Sections 332 and 902, 14 Oct 2008; http://www.dod.gov/dodgc/olc/docs/2009NDAA_PL110-417.pdf.

[23] Defense Science Board, *More Capable Warfighting Through Reduced Fuel Burden*, May 2001; http://www.acq.osd.mil/dsb/reports/ADA392666.pdf.

Program at the Massachusetts Institute of Technology, and is a Term Member in the Council on Foreign Relations.

***DISCLAIMER**: The views presented here are of those of the author only and do not necessarily represent the views of the Department of Defense or its components.*