Foreign Policy
at BROOKINGS

# Fueling the "Balance"
## A Defense Energy Strategy Primer

Jerry Warner
P.W. Singer

# Acknowledgments

The authors would like to thank Marc Grinberg, Ian Livingston, Heather Messera, and Karl Rabago, as well as the members of the Defense Energy panel for their assistance with this report.

# Fueling the "Balance"
## A Defense Energy Strategy Primer

The U.S. Department of Defense is the world's single largest consumer of energy, using more energy in the course of its daily operations than any other private or public organization, as well as more than 100 nations. There may be no aspect of American defense planning that is as important, and yet little understood and acted upon, as our defense energy security strategy. Increasing our energy efficiency is often framed as an environmental issue, when it has actually become a core national security concern for America in the 21st century.

Access to reliable and affordable energy resources is absolutely fundamental to the operations and readiness of the U.S. military. In recent years, rising costs, variability in supply, and a host of challenging technical and environmental objectives have elevated the issue of energy security for our armed forces. The challenges are particularly acute for petroleum-based fuels. Their availability and cost now significantly impact military budgets, combat mission execution, institutional capabilities, and, by implication, our national security. Yet, as a recent board of retired military leaders declared, "The nation's current energy posture is a serious and urgent threat to national security."[1]

After years of dithering, we must resolve the looming issue of energy security and its implications on the readiness of the U.S. military. The path to continued readiness requires reducing the overall amount of energy that the Department of Defense (DoD) uses and increasingly turning to alternative energy sources to meet fuel needs.

The energy issue is a matter of such strategic importance that it should be established as one of the target areas in the Quadrennial Defense Review (QDR), the document that determines the Pentagon's overall vision of strategy, programs, and resources every four years. With the next QDR due to Congress in early 2010, a closing window of opportunity must not be missed. The focus of the current QDR effort so far has been on how to bring "balance" back to the force as it faces a changing world of globalized threats. This is obviously valuable. But, it is important to acknowledge that the energy nexus is of such importance that it cannot be deferred again at the strategic level. We cannot effectively meet the goals to "preserve and enhance the force" without also facing directly the systemic challenges that threaten to undermine it from below. A force that is "rebalanced" to better deal with "hybrid" threats will still be highly vulnerable if the energy issue is ignored.

This is not just a matter of recognizing the energy and climate issue on the threats side of the ledger. In order to drive actual programming and yield resources, a defined and realistic target finally needs to be enunciated for the DoD in the energy usage realm. The DoD should set a clear and measurable target to reduce the baseline total consumption of energy in the Department of Defense by 20 percent by 2025 and to be a net-zero energy consumer at its bases and facilities by 2030.[2]

Underlying this effort are two complementary objectives. First, a significant percentage of the overall reduction in baseline energy will come from the department converting from petroleum to alternative forms of energy and increasing efficiency of use. Moving the DoD away from reliance on petroleum will also ultimately address the long-standing irony of

fueling our defense establishment from a system that threatens our nation's security. As such, our military can help "lead the way" for the nation by reducing its petroleum dependency.

Second, this effort can be accomplished without reduction of military capability in the resulting force. Indeed, pursuing lower energy consumption and petroleum dependency will ultimately *increase* the combat and sustainment capabilities of the DoD. Lower energy consumption and especially reduced reliance on petroleum-based products will give our military forces greater freedom of maneuver and reduced lines of communication across the entire spectrum of warfare from Expeditionary Operations to Disaster Relief and Humanitarian Operations. As a recent Pentagon report noted, "Energy is the key enabler of US military combat power."[3] The results will be practical, straightforward advantages achieved in a more efficient and economical manner.

In sum, the issues of energy, its links to national security, and most importantly, defined action at the department-wide level, have been deferred for too long. We must better manage defense energy security by implementing steps to increase energy efficiency and substituting alternative forms of energy to meet the military's fuel needs. What is needed is the establishment of clear leadership on energy issues, the institution of sound management, technology research, and procurement practices, and the provision of DoD with the resources it needs to improve its energy security.

## The State of Defense Energy Security: A Key Challenge for the Nation and its Military

The U.S. military's energy challenges reflect those of the nation as a whole. American reliance on foreign oil is at 60 percent of total national consumption and steadily rising. Overall, U.S. energy use per person has gone up by 57 percent over the last four decades, but less than 4 percent of that energy is drawn from renewable sources.[4]

The Department of Defense is the world's single largest customer for energy. Inside the U.S., it accounts for 0.8 percent of the country's total energy consumption, and uses 78 percent of the energy consumed by the Federal government. To put this in perspective, the Department of Defense burns 395,000 barrels of oil per day—about as much as the entire country of Greece.

The long-term implications of this energy consumption on national security as a whole are manifold, from bolstering illiberal regimes that control oil reserves and indirectly financing terrorist groups to driving climate change that endangers global stability and the American economy. But even if none of these factors were in play, the DoD would still face particularly acute issues surrounding petroleum access and fuel costs. Its combat operations are completely dependent on a large and steady supply of petroleum. For example, the U.S. Army's new wheeled Stryker vehicle, while relatively efficient compared to counterpart vehicles like the Abrams tank (which gets 0.6 miles per gallon), still runs at only five miles per gallon. MRAP (mine resistant, ambush protected) vehicles come in at roughly three miles per gallon, while up-armored HMMWVs get four miles per gallon.

But to focus on combat vehicles is to miss the more important usage and dependency trends. In a study of fuel use in Iraq, the Marines found that only 10 percent of their consumption was by armed vehicles. The remainder was consumed by logistics vehicles.[5] For the Army, only two of its top ten fuel consumers are combat vehicles. Ironically, three of the four least fuel-efficient Army vehicles are trucks that haul fuel. As a Rocky Mountain Institute report noted, the current situation echoes "shades of Civil War logistics, when mule teams hauled wagons of supplies, half of whose tonnage was feed for the mules."[6]

These consumption patterns create huge operational demands across the tactical spectrum. Fuel delivery and supply line protection in the field require manpower that could otherwise be dedicated to combat operations; roughly one half of logistics tonnage for operations in places like Iraq is solely the movement of fuel.[7] Indeed, the consumption of fuel at American forward operating bases in conflict zones has gone from 50 million gallons to 500 million gallons a year over the last five years.[8]

Reducing these numbers would enhance mobility and lighten footprint, crucial goals in both conventional operations and a counterinsurgency campaign. Even more important, by limiting the numbers of vehicles and troops required to operate and protect such often vulnerable and exposed supply lines, it would also save lives. An Army study, for instance, found that a mere 1 percent improvement in energy efficiency would mean that soldiers in Iraq would have to serve on 6,444 less convoy missions, a role considered one of the most dangerous in the operation.[9] Indeed, when he was asked at a Brookings meeting in 2007 about what was the most important area of research that was needed to aid his men and women, Marine General James Mattis responded succinctly, "Unleash us from the tether of fuel."[10]

The financial costs of this dependence are also considerable. In 2007, the DoD consumed 5.544 billion gallons of petroleum at a price of $12.6 billion. With the rising costs of energy, this figure reached roughly $20 billion in 2008.

These costs are best understood as severe lost opportunities for the force. Over the last year alone, the price of oil fluctuated between a low of just under $40 per barrel to a high of $147 per barrel. These fluctuations not only brought a significant portion of the DoD budget under great uncertainty, but also ended up exacting great costs from its end mission. Overall, each and every $10 increase in the cost of a barrel of oil increases the price of DoD operations by $1.3 billion. To put this into context, each $10 price increase is equivalent to a loss of almost the entire U.S. Marine Corps procurement budget.

If the costs of what it takes actually to get the fuel to the ultimate consumer are factored in, the price is often far higher. For example, an Office of Naval Research report found that the fully accounted costs (when fuel transportation, storage, and other logistical expenses are factored in) for a gallon of gasoline on the battlefield in Iraq and Afghanistan actually ranged from $15 a gallon to as much as $400 per gallon, dependent on the situation.[11] In flight delivery of fuel for the Air Force runs at approximately $42 a gallon.[12]

The same massive energy use happens at installations and bases. The DoD uses over 30,000,000 MegaWatt Hours (MWH) of electricity per year, at a cost of over $2 billion a year. Almost 98 percent of the electricity supplied to DoD installations comes from the civilian market, which also makes it highly susceptible to the increasing spate of large-scale outages (caused by accidents, over-demand, as well as cyber-attack).[13] Indeed, the Defense Science Board described the national power grid as "fragile and vulnerable," and noted that the reliance placed on it by the DoD put "critical military and homeland defense missions at unacceptable risk of extended outage."[14]

In sum, these combined trends reflect a system with an exceptional appetite for energy, which is becoming untenable for our future security. Or, as a recent Center for Naval Analysis report by panel of retired military leaders concluded, the national security risks of this predicament are dire and real. "Inefficient use and overreliance on oil burdens the military, undermines combat effectiveness, and exacts a huge price tag—in dollars and lives."[15]

## Action, but Not Solution: The Current DoD Energy Strategy Predicament

"I see energy and energy issues crop up everywhere in our decision making," described Ashton Carter, the new Under Secretary of Defense for Acquisition, Technology, and Logistics.[16] Yet, despite the pervasiveness of the issue, one would be hard-pressed to describe the present response as strategic.

To be clear, the DoD has not ignored the energy issue in recent years. There are numerous DoD energy successes that demonstrate the department's ability to champion new technologies and procedures in the energy domain. For instance, outside Nellis Air Force base in Nevada, there is a 140 acre solar power array that now provides more than 30 million kilowatt hours of electricity per year. As President Obama noted when he visited the facility in May, "That's the equivalent of powering about 13,200 homes during the day. It's a project that took about half a year to

complete, created 200 jobs, and will save the United States Air Force, which is the largest consumer of energy in the federal government, nearly $1 million a year. It will also reduce harmful carbon pollution by 24,000 tons per year, which is the equivalent of removing 4,000 cars from our roads. Most importantly, this base serves as a shining example of what's possible when we harness the power of clean, renewable energy to build a new, firmer foundation for economic growth."[17] Programs like at Nellis have led the Air Force to be the 7th largest purchaser of alternatively sourced energy in the U.S. Another example of energy innovation is the deployment of tactical biorefineries to Iraq. These convert waste products in the field into biofuels for forward operating bases.

Moving forward, the recent economic stimulus package included support for some 51 of these type of energy projects (costing some $300 million) for the DoD, while the Pentagon's annual budget contained another $75 million in new energy-related projects, including an even larger solar farm at Fort Irwin, California.[18]

Notice two aspects of these endeavors, however. The first is that the vast majority of activity and innovation by the DoD on energy issues lies principally in the installation and base environment. The department has made great strides in pursuing alternative energy sources for bases, implementing energy efficiency measures to reduce electricity use, and has even recently developed an oversight structure for such measures. But, this is equivalent to insulating the roof of your house, but not the walls. That is, only about 25 percent of DoD's total energy use comes from installation and base power sources. By contrast, the other 75 percent,and the billions spent on force structure, fuel logistics and research and acquisition lacks similar imperatives and oversight structure.

The second aspect is that for all the activity, the overall effect is spotty and lacks a broad, cohesive strategy that cuts across the department as a whole. The programming tends to be ad-hoc and often focused on the lowest-hanging fruit. For instance, "net zero" bases are facilities that have a net zero energy consumption on an annual basis, giving them the ability to operate autonomously from the electricity grid if need be. There are presently plans for seven bases to be converted to net zero (Barksdale, McGuire, and Maxwell for the Air Force, Carson and Irwin for the Army, and Miramar and San Nichols Island for the Navy). However, there are more than 1,000 bases and facilities inside the U.S. and over 700 abroad.

Similarly, the Army recently announced plans to lease some 4,000 non-tactical electric vehicles, to be used on Army bases for passenger transport, security patrol, and maintenance and delivery services. The costs per vehicle will be an estimated $460 annually for the electric vehicle versus an estimated $1,200 annually for gasoline-powered cars, while the Army will reduce its fossil fuel consumption by 11.5 million gallons over a six-year period.[19] It is a program to be lauded, but one that does not reflect a mandate or requirement that cuts across the broader force.

While the energy issue is being given more credence than in the past, it still lags in institutional support. Without firm requirements, defense contractors that sell to the department don't yet know how seriously to program energy efficiency into their submissions, while the issue is yet to be seen as an operational concern by all. For example, when the head of coalition forces in western Iraq sent in a "priority 1" request for 183 solar and wind turbine-equipped stations that would help make forward operating bases more self-sufficient, the joint chiefs of staff back in Washington rejected it because it was viewed as unnecessary.[20]

A department-wide strategy, incorporating leadership, management structure, environmental requirements, and dedicated resources is needed to pull together the various components of the U.S. military to meet our energy security needs. This strategy would develop energy security solutions that save money, enhance mission capability, and benefit military and surrounding communities.

## Key Elements of a Defense Energy Strategy

While politics would ideally not be the determinant for action in the national security realm, experience shows that it does set the context. Fortunately, the timing of

for developing a defense energy strategy could not be more politically opportune, indeed, it cuts across party lines like no other. When asked to name a key issue to solve, the one commonality between GOP, swing, and Democratic primary voters in the 2008 election was to cut America's dependency on foreign oil.[21]

The goals of the strategy would be to establish the leadership, management, technical scope, and resources needed to resolve the DoD energy security challenge. The energy security strategy will would have to be comprehensive and robust, with measurable goals and support to reduce energy consumption in all DoD activities, from the platforms our troops use in the field to the bases back at home. A significant percentage of the overall reduction in baseline energy could be realized through a major new emphasis on increasing efficiency of energy use. Reductions in use should also be complemented by an aggressive effort to convert from petroleum-based fuels to alternative forms of energy.

***Create DoD Energy Leadership***

The key aspect to recognize is that as daunting as the challenge appears, it is far from irresolvable. Rather, as the Defense Science Board Task Force concluded, it is a lack of leadership that "is a root cause of the DOD's energy problem."[22]

In response to the Defense Science Board and Government Accountability Office recommendations, the FY 2009 Defense Authorization Bill called for the creation of a "Director, Operational Energy Plans and Programs." The post would be responsible for consolidated oversight within the department for energy related issues.

Establishment of this position was initially refused by President Bush in a "signing statement." However, the new administration has resurrected the post and is in the process of bringing it into being. This new position and office will be responsible for the development and implementation of an operational energy strategy supported by key metrics, including energy efficiency Key Performance Parameters (KPP). Further, the Secretary of each of the military departments will designate within each service a counterpart responsible for operational energy plans and programs.

As noted, the energy issue is of such importance that the leadership challenge is not solved by the creation of these important new positions alone. In order to demonstrate the criticality and the level of support by the Secretary, the requirements of defense energy security merit inclusion in the broad strategic goals being established in the QDR, which is the document from which overall department planning and strategy is to flow. This should not just be a discussion of the problem and a lauding of ongoing DoD projects, as often happens in such documents, but a true call to action for the department as a whole. The QDR should set a clear and measurable target to reduce the baseline total consumption of energy by the Department of Defense.

Using the standard of the "baseline total consumption" would seek to balance long-term needs with the flexibility that is required in currently fighting two wars. That is, akin to the difference between the annual DoD budget and the supplemental, it would consider the energy consumed in "normal" operations of the force. Savings in these contingency operations are, of course, hugely important (and, indeed the strategy outlined here would redound greatly to savings within these operations). However, using a clear and definitive standard of the baseline would better reflect any progress in systematically reducing consumption, as well as avoid any accusations that the new strategy might undermine current war efforts.

Based upon existing analysis and discussions with defense energy experts of what would be an ambitious but achievable goal, it is our contention that a target can be set for an overall reduction goal of 20 percent by 2025 and for the DoD to be a net-zero energy consumer at its bases and facilities by 2030.[23] This would set the goals for the new office, as well as clearly define missions and delineate responsibilities that would then flow out on the issue. That is, it would not just mandate the development of energy security plans and strategies in all key commands and directorates, but give them a firm target to aim for.

Finally, like all issues, politics and perception matters. Akin to the "signaling" function he has carried out on the "balance" issue with speeches at the major defense schools, the Secretary of Defense should lay out his defense energy vision in a major speech at a defense research and technology center, such as the Defense Advanced Research Projects Agency (DARPA) or Office of Naval Research (ONR). The goal of such a speech would not just be to outline a broader vision, but also to demonstrate his personal investment in the issue and recognition of its seriousness, creating a call to action for both military institutions as well as contractors. This opportunity might also be used to announce the creation of certain programs and incentives, including innovative competitions along the lines of DARPA's Grand Challenge, which helped jumpstart the unmanned systems realm. Ideally, such competitions would prioritize candidate technologies where the DoD can make a special contribution to technologic breakthroughs and aid market standardization that will drive down costs.

***Streamline DoD Energy Management***

Streamlining the management of energy issues in the Department of Defense is a key aspect of any successful strategy. The goal should be to identify and implement new procedures to encourage the rapid adoption of energy efficiency measures throughout the DoD complex. This will include applying funds saved on fuel costs within the DoD budget to future energy initiatives to create a self-reinforcing process, strengthening control and flexibility on energy issues within local installations, and removing roadblocks to implementation of efficiency measures.

Part of achieving success is having the metrics on hand to implement measurable standards across the DoD and know what type of progress (or not) is being made in usage on an annual basis. The DoD's capacity to measure energy usage at both facilities and within operations has grown in recent years, largely due to legislative and executive orders, but still requires a systemic-wide setting of requirements and standardization. As part of aiding this, the Secretary should designate the "point person" for such an annual report to be delivered to his office and Congress on DoD-wide energy usage and spending.

The new leadership should also oversee the implementation and auditing of the Joint Staff Capabilities requirements for energy efficiency in new platforms. This should also ensure that the "Fully Burdened Cost of Fuel" is accounted for in all life-cycle-design and program budgeting. The full life cycle impacts of each acquisition, construction, and operations strategy should be assessed through the lens of energy security and sustainability.

Usage must also be understood as reliant not just on the end product, but also on what goes into the manufacture of the systems itself. A DoD commission should be tasked with a detailed analysis of existing materials management systems to determine energy security implications of issues such as import dependency, rare metals mining, and bio-based materials. In an ideal world, the Secretary would also make provisions for the rapid implementation of key recommendations.

As noted earlier, the energy issue is not an open field. Where possible, the new leadership should seek to work with other government agencies, especially the Department of Energy, expanding upon and resourcing existing energy efficiency policy/directives, and seeking to align DoD equities with the broader interagency efforts. For instance, the current government-wide energy efficiency policy (i.e., directed most by the Energy Policy Act of 2005 and Executive Order 13423) addresses federal agency infrastructure and fleets, but neglects the tactical and overseas operations that have become more common. As such operations have also become more "whole of government" in their vision and scope, so too should their energy usage side. To put it another way, it is not in the DoD's interests if only military forces in the field raise their energy efficiency but their interagency partners do not.

***Lead the Way with New Technologies***

Resolving DoD issues with energy security will require the department to embrace and champion new technologies. The DoD has a long and successful history of performing this role, leading the way on revolutionary technologies that moved into the civilian sector like GPS, radar, and the Internet. With

proper leadership and dedication, this can be the next great defense hurdle to be scaled with wider benefit to America.

The scope of new technologies and applications addressing energy security is large and complex. Opportunities may lie in a wide range of areas, including but not limited to synthetic jet fuels, advanced propulsion and prime power, battery miniturization and life extension, energy storage systems and fuel cells, advanced power management schema and systems, strategic-operational- and tactical fuel manufacturing technologies, new materials, energy efficient platforms, net-zero housing, installation use of solar, wind, geothermal energy harvesting technologies, and other alternative and renewable energy sources for broad application. Alongside such future choices in technologies, the environmental impacts of alternative energy resources such as clean coal, nuclear, and biofuels are necessary considerations for the long-term viability of their use. In this, the DoD should also seek to take maximum advantage of its many large land size holdings, away from civilian populace, for location.

To help focus the DoD effort, a list of basic priorities should be developed by the senior leadership, emphasizing development policies and competitive approaches. Technical development policies should follow a strategy of accelerating new technology adoption with four key priorities: (1) reduction in use; (2) conversion of petroleum-driven equipment to non-petroleum energy sources; (3) substitution of petroleum with alternative fuels, bolstered by (4) factoring lifecycle energy costs into development and purchasing.

Where possible, the DoD should seek to build partnerships and collaborative efforts, as the challenges in this sector are not faced by the military alone, nor do they come with the usual requirements of classification and secrecy. Cooperation should not merely be sought along international lines, such as by raising the issue's importance within NATO's cooperative research, training, and doctrinal structures (akin to how the "transformation" agenda was cross-pollinated into NATO via JFCOM earlier in the decade). It can also be carried out with local and state partners on the domestic front.

For instance, 21st century "smart grids" use digital networking and respond to changing conditions in the supply and demand of power (rather than the 20th century model of simply pushing out power regardless of circumstance). These grids are not only better protected against accidental or deliberate outages, but are far more efficient in their allocation of energy use; they also make it easier to link in alternative sources. In short, they save both money and energy, while increasing reliability and security.[24] They are of such obvious appeal that every DoD base should be brought to this standard (indeed, the Army estimates that using smart "microgrids" at forward deployed installations would reduce energy consumption in the field by 25 percent to 40 percent).[25]

As it seeks to utilize these systems for its own installations, the DoD is in a unique position. It has a trusted presence in communities across the nation, and thus can help work with the patchwork of regional utility companies and local and state regulatory agencies, to share its experiences and validate standards that have worked in similar situations. The benefits of helping to spur expansion of smart grid technology for the nation could reach as much as $117 billion, simply from greater efficiency.[26]

The private sector will be a critical partner in new technology development. The DoD should engage technology development companies and researchers with bold initiatives to transform the energy footprint of the DoD. It should sponsor competitive incentive programs with transformational initiatives, such as bio-refineries, new generation combat vehicles, and the goal of net zero installations. As a candidate, Barack Obama addressed the importance of civilian technological innovation through his proposed 'Green Vets program,' and it is highly appropriate for DoD to attempt to build upon this goal.[27]

By setting clear and defined goals, DoD will be signaling to industry that it is serious, allowing them to make the needed changes in their structures and research. If industry senses any ambivalence (as is the case now), firms will be less likely to take such risks.

This can be bolstered in a number of innovative ways that will redound to the benefit of both DoD and the nation as a whole. For instance, if lifecycle costs were considered when purchasing non-combat vehicles, at least 25 percent of the fleet would be electric or hybrid under current prices, yielding DoD as much as $117 million in savings over the next 5 years.[28] Even more, it would help the broader U.S. auto industry in driving down the costs of such vehicles for the wider market, while also cutting fuel consumption and pollution. And note that this is a minimal goal, not even setting the broader goals of reduced DoD energy consumption.

The administration should also seek to work with Congress and defense industry on how broader energy efficiency goals can be incentivized for DoD vendors themselves, which will redound positively to their own cost savings, as well as the broader economy.

***Provide Needed Tools and Resources***

Beyond organizational change, the establishment of goals and publication of strategies, the department must be given the tools and resources it needs to implement this vision. While initial increases in expenditure may meet resistance, investments in energy efficiency will provide cost savings in the long-term.

Congress must relook at the funding needed to transform our energy defense capabilities. In FY 2009, only $3.5 billion was allocated to such research throughout the entire U.S. government.[29] In FY 2010, this figure roughly doubled, if one includes funds from the stimulus American Recovery and Reinvestment Act (ARRA). If not, the amount actually decreased slightly. As a report from Harvard University's Belfer Center for Science and International Affairs concludes, "The proposed funding for FY 2010 and the resources from ARRA, however, do not guarantee that the United States will finally enjoy the predictable and consistent publicly-funded energy technology innovation effort that it needs."[30]

To be blunt, unless the United States makes the needed investments in energy savings, which actually pay themselves off many-fold, it will remain locked in its present and dangerous cycle of dependency.

## Conclusions

In order to strengthen mission execution capabilities, protect service men and women, assure energy continuity, and more efficiently invest defense funding, the DoD needs to be powered by secure and increasingly sustainable energy resources. Our military can also help foster the needed energy innovation to both address defense needs and benefit the wider American effort to switch to alternative, more efficient, and cleaner energy sources.

The QDR should set a clear marker for department-wide action. The goals of a defense energy strategy should be to support implementation of strategic initiatives to establish the necessary leadership, management, technical scope, and environmental policy to achieve the DoD energy efficiency goal of 20 percent reduction by 2025 and to be a net-zero energy consumer at all its facilities by 2030. The combination of these investments will soon pay for themselves with in reduced energy cost burdens on future budgets, as well as increased benefits to the American economy as a whole.

As both a model for action and an incubator for technological advancement, the U.S. military has the opportunity to lead the way again. It can provide cutting edge solutions for America's energy security concerns. All that stands in our way are the policy decisions needed to create actual change.

# Endnotes

[1] "Powering America's Defense: Energy and the Risks to National Security." Center for Naval Analysis, May 2009, p. vii.

[2] Baseline energy is the estimated O&M consumption of the DOD without supplemental warfare requirements.

[3] Gregory J. Lengyel, Colonel USAF, "Department of Defense Energy Strategy: Teaching an Old Dog New Tricks," Brookings 21st Century Defense Initiative, 2008, available at <http://www.brookings.edu/~/media/Files/rc/papers/2007/08defense_lengyel/lengyel20070815.pdf>.

[4] Anita Dancs, "The Military Costs of Securing Energy," National Priorities Project, Oct. 2008, available at: <http://www.nationalpriorities.org//Energy_Security/Energy_Priorities>.

[5] Thomas Crowley et al, "Transforming the Way DoD Looks at Energy: An Approach to Establishing an Energy Strategy." Report FT602T1. Logistics Management Institute, April 2007.

[6] "Winning the Oil Endgame: Innovation for Profits, Jobs, and Security." Rocky Mountain Institute, 2006. available at <http://www.oilendgame.com/pdfs/MediaKit/MediaWtOEg_MilFacts.pdf>.

[7] More Flight, Less Fuel." Report of the Defense Science Board Task Force on Energy Security. U.S. Department of Defense, February 2008, p 15.

[8] Steven Vogel, "Pentagon Prioritizes Pursuit Of Alternative Fuel Sources," *Washington Post*, April 13, 2009; Page A13.

[9] Kevin Geiss, "Army Energy Security: The Way Ahead," Society of Military Engineers presentation, May 20, 2009.

[10] Gregory J. Lengyel, Colonel USAF, "Department of Defense Energy Strategy: Teaching an Old Dog New Tricks," Brookings 21st Century Defense Initiative, 2008, available at <http://www.brookings.edu/~/media/Files/rc/papers/2007/08defense_lengyel/lengyel20070815.pdf>.

[11] Nancy McGuire, "Alternative Energy, Part I," ONR conference report, August 23, 2006, available at <http://www.onr.navy.mil/media/nre_navigator/news_articles/shownewsarticletext.asp?NEWSID=118>.

[12] "More Fight, Less Fuel," Report of the Defense Science Board Task Force on DoD Energy Strategy, February 2008, available at <http://www.acq.osd.mil/dsb/reports/2008-02-ESTF.pdf>.

[13] Department of Defense, *FY 2006 Energy Management Data Report, 2006,* table 1-1, 1-2.

[14] "More Fight, Less Fuel," Report of the Defense Science Board Task Force on DoD Energy Strategy, February 2008, available at <http://www.acq.osd.mil/dsb/reports/2008-02-ESTF.pdf>.

[15] Powering America's Defense: Energy and the Risks to National Security." Center for Naval Analysis, May 2009, p. 1.

[16] As quoted in Scott Harper, "Panel calls for a more energy efficient U.S. military," *The Virginian Pilot*, May 19, 2009.

[17] As quoted in "Transcript: Obama's remarks at Nellis," *Las Vegas Sun*, May 27, 2009.

[18] DoD Recovery Act: Near Term Energy-Efficient Technologies Recovery Plan, available at <http://www.recovery.gov/?q=content/program-plan&program_id=7761#ProjectsandActivities>.

[19] Paul Boyce, "Army announces historic electric vehicle lease," U.S. Army Media Relations, Jan 12, 2009.

[20] Noah Shachtman, "Joint Chiefs Neg "Urgent" Green Power Plea," *Wired.com*, June 25, 2007 available at: <http://www.wired.com/dangerroom/2007/06/the-joints-chie/>.

[21] Represented by the GOP (31%), Swing (32%), and Democrats (31%), in McInturff, Bill, and Liz Harrington. The New American Consensus on International Cooperation. United Nations Foundation. Better World Campaign, 2008.

[22] "More Flight, Less Fuel." Report of the Defense Science Board Task Force on Energy Security. February 2008, available at: <www.acq.osd.mil/dsb/reports/2008-02-ESTF.pdf>.

[23] Baseline energy is the estimated O&M consumption of the DOD without supplemental warfare requirements. Many may debate the figures, which we are quite open to. But, again, more important than the specific target numbers chosen is the need to set a clear and defined goal. Whether the end goal eventually determined is net zero by 2025 or 2035, the key is setting a fixed target to guide strategy and direct departmental action.

[24] For more on smart grids, please see Department of Energy, "The Smart Grid: An Introduction," available at <http://www.oe.energy.gov/1165.htm>.

[25] William Matthews, "California Greening," *Defense News*, August 3, 2008, p. 24.

[26] L. D. Kannberg, et el. "GridWise: The Benefits of a Transformed Energy System. Pacific Northwest," National Laboratory under contract with the United States Department of Energy, 2003, p. 25, available at <http://arxiv.org/pdf/nlin/0409035>.

[27] "To marshal their talents in building a new energy economy, I will launch an initiative to give our veterans the training they need to succeed in the Green Jobs of the future." Barack Obama, "A New Era of Service" speech delivered at University of Colorado, Colorado Springs, July 2, 2008.

[28] Rich Maze, "Bill encourages DoD to buy hybrids, electric vehicles," *Federal Times*, July 14, 2009.

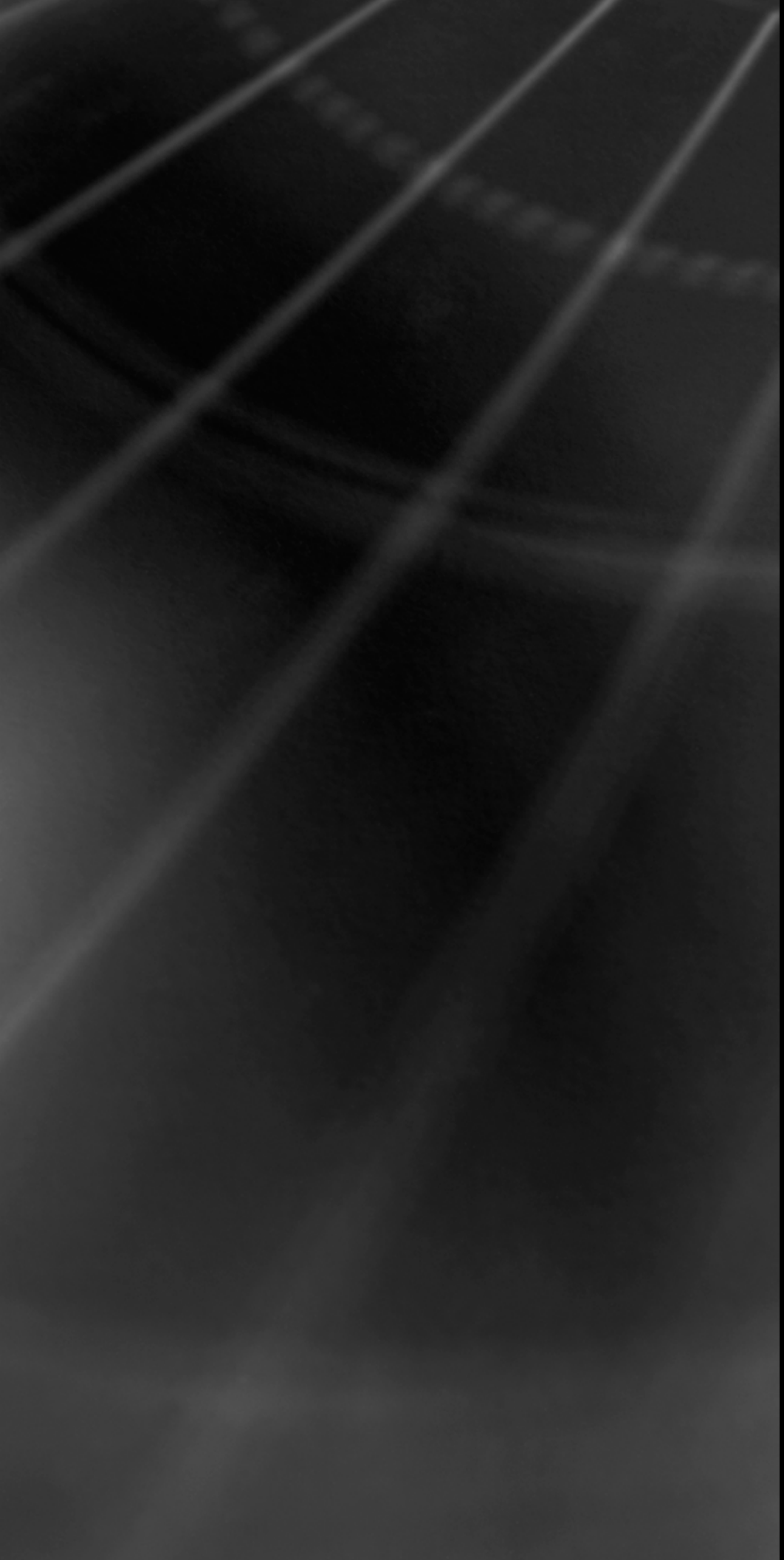
[29] Jeffrey W. Eggers, Cmdr, USN, "The Fuel Gauge of National Security," *Armed Forces Journal*, May 2008, pg. 44.

[30] Laura Diaz Anadon, "DOE FY 2010 Budget Request and Recovery Act Funding for Energy Research, Development, Demonstration, and Deployment: Analysis and Recommendations," Belfer Center for Science and International Affairs, Harvard Kennedy School, June 25, 2009, available at: <http://belfercenter.ksg.harvard.edu/publication/19168/doe_fy_2010_budget_request_and_recovery_act_funding_for_energy_research_development_demonstration_and_deployment.html>.

# About the Authors

Jerry Warner is a former combat officer and now a small businessman engaged in the development of alternative energy systems. In his personal capacity, he served as a member of the Obama '08 defense policy task force.

Peter Warren Singer is Director of the 21st Century Defense Initiative at the Brookings Institution and author of the book *Wired for War*. In his personal capacity, he served as coordinator of the Obama '08 defense policy task force.



BROOKINGS
The Brookings Institution
1775 Massachusetts Ave., NW
Washington, D.C. 20036
brookings.edu