Clean Energy Innovation

Saving Fuel, Saving Lives

American Security Project

Fact Sheet

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Nadia Cortez

April 2019

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Alejandro Brito is President of Brito Development Group (BDG), LLP. In the last twenty years, Mr. Brito has overseen the design, construction, development and management of over 1,500 luxury housing units in Puerto Rico.

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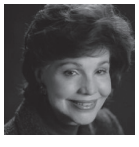
Robert B. Crowe is a Partner of Nelson Mullins Riley & Scarborough in its Boston and Washington, DC offices. He is co-chair of the firm's Government Relations practice.



Lee Cullum
Lee Cullum, at one time a commentator on the PBS NewsHour and "All Things Considered" on NPR, currently contributes to the Dallas Morning News and hosts "CEO."

Nicholas Clark
Nicholas Clark is the former CEO and Executive Director of Alexium International. He is also co-founder and Managing Partner at Viaticus Capital.

Admiral William Fallon, USN (Ret.)
Admiral Fallon has led U.S. and Allied forces and played a leadership role in military and diplomatic matters at the highest levels of the U.S. government.

Scott Gilbert
Scott Gilbert is a Partner of Gilbert LLP and Managing Director of Reneo LLC.

Vice Admiral Lee Gunn, USN (Ret.)
Vice Admiral Gunn is the President of the Institute of Public Research at the CNA Corporation, a non-profit corporation in Virginia.

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Chuck Hagel served as the 24th U.S. Secretary of Defense and served two terms in the United States Senate (1997-2009). Hagel was a senior member of the Senate Foreign Relations; Banking, Housing and Urban Affairs; and Intelligence Committees.

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Lieutenant General Kennedy was the first woman to achieve the rank of three-star general in the United States Army.

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John Kerry is a distinguished fellow for global affairs at Yale University. In 2013, Kerry was sworn in as the 68th secretary of state of the United States. Kerry served for more than twenty-five years as a U.S. senator from Massachusetts.

General Lester L. Lyles, USAF (Ret.)
General Lyles retired from the United States Air Force after a distinguished 35 year career. He is presently Chairman of USAA, a member of the Defense Science Board, and a member of the President's Intelligence Advisory Board.

Dennis Mehiel
Dennis Mehiel is the Principal Shareholder and Chairman of U.S. Corrugated, Inc.

Stuart Piltch
Stuart Piltch is the Co-Founder and Managing Director of Cambridge Advisory Group, an actuarial and benefits consulting firm based in Philadelphia.

Ed Reilly
Edward Reilly is Global Chief Executive Officer of the Strategic Communications practice of FTI Consulting.

LtGen Norman Seip, USAF (Ret)
Lieutenant General Norman R. Seip, USAF (Ret) served in the Air Force for 35 years. His last assignment was Commander of 12th Air Force.

David Wade
David Wade is a consultant helping global corporations and organizations with strategic advice, public affairs and thought leadership, crisis communications, political intelligence gathering, and federal and legislative strategy.

Introduction

Technological innovation is critical for retaining U.S. military superiority and security. The current system of fueling our military installations and forces is outdated and vulnerable to disruption, putting our troops at risk. Greater efficiency and alternative fuels allow troops to operate longer undetected in hostile environments, potentially saving lives. These technologies reduce waste, enhance efficiency, and reduce greenhouse gas emissions. While the Department of Defense (DOD) and the Department of Energy (DOE) have continued to develop clean energy and fuel-efficient technologies, more is needed. Increasing the development and use of fuel-efficient and clean technologies is vital for the future of military readiness and safety.

The Vulnerability of Dependence

Energy security is critical to the effectiveness of the U.S. military worldwide. The DOD is the largest consumer of energy in the U.S.,[1] and is heavily dependent on fossil fuels to meet its mission. That dependence creates vulnerability. The DOD estimates that more than half (52%) of the deaths during Operation Iraqi Freedom and Operation Enduring Freedom occurred from hostile attacks during liquid fuel resupply convoys in Afghanistan.[2] As the Iraq war continued, convoys carrying fuel and water were found to be the single largest cause of death. Lower fuel needs result in fewer convoys and fewer casualties from protecting those convoys.

Military installations in the U.S. are similarly exposed to risk. Installations rely on a vulnerable commercial grid and often use dirty, old, and loud generators for back-up energy. Bases need to develop microgrids that incorporate alternative sources of energy to maintain continuous power and readiness during extended grid outages. If the power goes down, communications and defense systems can also go down, potentially putting the base and its occupants at risk.

Current Advanced Energy Options

To combat these risks, the department has invested $1.6 billion a year in energy research and development of clean energy technology to support its operational energy needs and global installations.[3] Programs through the DOE, like the Federal Energy Management Program (FEMP) and the office of Energy Efficiency and Renewable Energy (EERE), provide support for the development of energy-efficient technologies and assessments for all military agencies. The push for efficient energy innovation comes at a critical moment as competition for dense energy generation and weapons between countries has peaked. This will mean future warfare platforms will require an increasing amount of energy to maintain endurance in the field.

Advanced Energy Options – On Military Installations

Military installations should continue to implement microgrids that incorporate alternative sources of energy to maintain continuous power and readiness during extended grid outages.

- Many bases and installations across the U.S. have built solar arrays to provide energy assurance and cost savings.
  - Fort Huachuca in Arizona has built the DoD's largest solar installation, over 17.2-megawatts, equivalent to 25% of the base's power needs.[4]
  - Nellis Air Force Base in Nevada has two solar arrays which add up to over 28 megawatts, enough to power the entire base during the day.[5]

A solar array at Nellis AFB comprises one of the largest in the DOD. USAF photo.

- In addition, there needs to be further implementation of Smart and Green Energy (SAGE) technologies at base camps.
  - The SAGE program integrated a smart grid, renewable energy sources, energy efficient appliances and other technologies to test the effectiveness of reducing base fuel needs.[6]
  - Summary evaluations found that by implementing SAGE technology, base camps could reduce their fuel usage up to 84%.[7]

Advanced Energy Options - In the Field

- **Vehicles**
  - The future of military vehicles is electric. Electric vehicles can accelerate faster and move quieter through enemy terrain compared to those with internal combustion engines. Such developments could significantly lower casualties as troops move undetected and don't need to transport fuel with them.
    - In late 2018, Defense Advanced Research Projects Agency (DARPA) released a new "extreme" electric vehicle with independent motors for each wheel, providing on-demand torque immediately and limiting the heat signature of the vehicle.[8][9]
  - The department is also working on improving propulsion systems (both for aircraft and ships) to enhance fuel efficiency, saving money and increasing speed.
    - The Air Force estimates that it will provide 10 percent greater thrust and 30 to 35 percent more range while consuming 25 percent less fuel. The engine is being designed for the space available on the F-22 and F-35, but may also be scaled down to fit into the F-15 and F-16.[10]

- **Batteries**
  - Heavy batteries restrict movement and make troops vulnerable to thermal detection by adversaries, putting them at risk.
  - All services benefit from lighter weight battery packs. In particular, there is a need for lightweight battery packs that are cool to the touch for dismounted soldiers and small troop units. This allows for longer durations on missions and reduces thermal detection from adversaries.

Energy Innovation Opportunities

The U.S. military must continue to develop new technologies to protect troops on and off the battlefield. The department would be ill-advised to soon forget the lessons from the wars in Iraq and Afghanistan. High fuel use leads to more fuel convoys and more vulnerable targets. Some promising developments in recent years show the opportunity for the future to lower traditional fuel consumption and build resiliency.

Clean Energy Sources

- **Solar Photovoltaic (PV)**
  - Solar PV provides forward operating bases and forward deployed troops greater flexibility and mobility, allowing them to power necessary equipment without relying on fuel convoys or loud diesel-powered generators.
  - Future development of Modular Lightweight Load-carrying Equipment (MOLLE) vests[11] with integrated solar panels would reduce the soldier's physical load and provide sustainable power for communications, GPS, and night-vision goggles for extended amounts of time without having to return to base to recharge.

A soldier demonstrates a solar rucksack and equipment that generates energy from kinetic motion. US Army photo.

- **Thermoelectric Generators**
  - The use of thermoelectric generators would allow the military to convert waste heat from generators into electricity. This would greatly increase energy storage and reduce the need to transport fuel, limiting casualties.[12]
  - A test in 2014 by GMZ Energy proved that the technology works, integrating 5 thermoelectric generation solutions into a 1,000W diesel engine to convert exhaust waste heat into electrical energy.[13]

- **Small Modular Nuclear Reactors**
  - Self-regulating micro-nuclear reactors, designed to easily deploy safely in remote areas and forward-operating bases, can provide continuous carbon-free energy for a minimum of three years. These reactors minimize vulnerabilities created by petroleum fuel lines and convoys. [14]

Energy Storage

- **High Capacity Batteries**
  - While there have been some promising developments, there is still plenty of room for improvement in battery storage. At noted previously, heavy batteries add to the load troops must carry. There needs to be further investment in increasingly battery life while lowering weight.
  - New solid electrolytes that can address materials challenges and reduce costs and improve energy density and cycle life to support sources during an outage of the commercial grid.[15]
- **Hydrogen Fuel Cells**
  - Hydrogen fuel cells are proven to improve performance and viability: durability targets for stationary and transportation fuel cells are 40,000 hours and 5,000 hours, respectively.[16] Such developments could redefine transportation, replacing traditional vehicles and lowering risk to lives.

Conclusion

Clean energy and fuel efficiency innovation within the Department of Defense promotes resiliency and saves lives. The military acknowledges work within its community to facilitate environmental and energy integrity into contingency planning; however, further investment is needed to continue the research and development and drive down costs and accelerate large-scale adoption. Technical maturity, efficiency, cost, complexity and limitations to infrastructure requirements are the current road blocks preventing full development and deployment. It takes about a decade for a new power source technology to go from the lab to the field.[17] Partnerships with the private sector and collaboration between all federal agencies can bolster solutions.
Energy efficiency is a force multiplier, increasing the range and endurance of forces in the field while reducing the number of troops diverted into harm's way to protect energy supply lines. Solving military challenges through innovation is necessary to maintain the U.S.' superiority across the national security spectrum.

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The American Security Project (ASP) is a nonpartisan organization created to educate the American public and the world about the changing nature of national security in the 21st Century.

Gone are the days when a nation's security could be measured by bombers and battleships. Security in this new era requires harnessing all of America's strengths: the force of our diplomacy; the might of our military; the vigor and competitiveness of our economy; and the power of our ideals.

We believe that America must lead in the pursuit of our common goals and shared security. We must confront international challenges with our partners and with all the tools at our disposal and address emerging problems before they become security crises. And to do this we must forge a bipartisan consensus here at home.

ASP brings together prominent American business leaders, former members of Congress, retired military flag officers, and prominent former government officials. ASP conducts research on a broad range of issues and engages and empowers the American public by taking its findings directly to them via events, traditional & new media, meetings, and publications.

We live in a time when the threats to our security are as complex and diverse as terrorism, nuclear proliferation, climate change, energy challenges, and our economic wellbeing. Partisan bickering and age old solutions simply won't solve our problems. America – and the world - needs an honest dialogue about security that is as robust as it is realistic.

ASP exists to promote that dialogue, to forge that consensus, and to spur constructive action so that America meets the challenges to its security while seizing the opportunities that abound.

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