Power generators and fuel tankers provided by FEMA arrive from U.S. mainland to port in San Juan, Puerto Rico, October 2, 2017, as part of Hurricane Maria disaster relief efforts (FEMA/Eliud Echevarria)

DOD's Need for a Transportable Energy Solution

The Promise of Nuclear Power

By Aaron Horwood, Juan Vitali, Andrew Thueme, Ruddie Ibanez, and Travis W. Knight

In the 42 days following Hurricane Maria in September 2017, the Federal Government deployed 366 generators with a combined 122-megawatt electric (MWe) capacity to Puerto Rico.[1] This supported one-third of critical infrastructure on the island but fell far short of the ~2,400 MWe normally needed just in San Juan. This disaster highlights a profound Department of Defense (DOD) capability gap in providing large-scale transportable electrical power generation to the Defense Support of Civil Authority (DSCA) mission. This disaster should stand as a stark warning to planners as DOD refocuses on peer competition, fields ever more energy-intensive technologies, invests in forward synthetic fuel production, transitions to an all-electric ground, and addresses climate change. For context, the 500,000 gallons of fuel required daily by a single U.S. Army division would require at a minimum the equivalent of ~214 MWe of generating capacity to replace the current liquid fuel logistic system—and the Army represents only ~13 percent of annual

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DOD energy usage. The severity of this dual-capability gap will only grow as natural disasters abound, the U.S. power grid ages, and peer competitors invest more deeply into antiaccess/area-denial and merchant raiding capabilities. Failure to change course could result in the unnecessary suffering of American citizens at home and force a future retreat from global engagements—a retreat that we cannot afford.

Recent DOD energy innovation has occurred in the context of Iraq, Afghanistan, and global warming. Major lines of effort include efficiency improvements, adoption of wind and solar power, incorporation of biofuels and synthetic fuels, and the Strategic Capabilities Office's small 1–5 MWe modular nuclear microreactor (Project Pele), which is currently being built and will be in operation at the Idaho National Laboratory in early 2025. These efforts are valuable, but in their current forms they cannot meet the energy needs of today's DSCA mission, which is tomorrow's war.

This is not a new problem and there are historic solutions. Throughout World War II and the Korean War and during parts of the Vietnam War, the U.S. military projected large-scale electrical generation capacity at home and overseas through a three-part strategy. First it tied into, repaired, and upgraded existing infrastructure as able. Then it used large floating power plants to meet large-scale energy demands, such as port of entry, cities, or entire regions. Finally, it pushed small land-transportable generators forward to power critical or isolated military and civilian infrastructure and equipment. DOD will require multiples of gigawatt electric (GWe) of new clean, reliable generating capacity to meet its installation and operational energy needs. Moreover, it must regrow its atrophied small land-transportable capability tanker fleet and reintroduce a power-barge capability operating in the 25–50 MWe and 100–300 MWe ranges.

The only mature technology that can meet both the scale of this demand and meaningfully cut the tether of fuel is nuclear power. A reactor can go years between refuelings, is a clean carbon-neutral power source, and has the power density necessary to effectively produce synthetic fuels so that it can meet any combination of liquid fuel or electrical needs. For these reasons, the U.S. Navy adopted nuclear power after World War II for its aircraft carriers and submarines.

Reconstituting this capability will streamline communication and provide robust and assured energy to expeditionary forces and disaster relief operations. Fielding this capability could also be cost effective for the U.S. Government as the capability aligns with the needs of many commercial interests and countries for reliable clean energy, and there is the potential of them underwriting DOD costs in developing and shifting technology to become commercial off-the-shelf in time.

Military Needs

The Army is planning to have an all-electric vehicle fleet by 2050, 5 years after Argonne National Laboratory predicts parity on a kilogram-to-kilogram basis between gas and electric vehicles. Projecting electrical demand for this fleet is a complicated balance of new efficiency measures and new power requirements—an average, however, is that for every gallon of JP8 required for a ground vehicle, 10.26 kWh of generated electricity will be necessary as a substitute. Through history, military power requirements have only ever grown; a conservative approach, then, is to ensure that new energy technologies can at least meet that need and can be scaled up.

Historically, liquid fuel and water by volume represented between 70 to 90 percent of all logistical operations in Afghanistan and Iraq, and hostile attacks during its ground delivery accounted for roughly 52 percent of casualties.[2] The cost of a gallon of fuel ranged between $10 and $50, with common outliers of up to $400. If the United States were fighting a different kind of enemy—a sophisticated enemy that could strike assets on the high seas and in the United States—the resulting costs in human lives and dollars could be substantially higher than in those recent conflicts. The 249th Engineer Battalion (prime power) is responsible for the Army's expeditionary power capabilities and currently fields only 26 MEP-810 dual generators that provide approximately 1.3 MWe per platform, for a total organic capacity of roughly 34 MWe. Additionally, some systems such as the Terminal High Altitude Area Defense system require similar generators.

Expanding this system to meet the needs of an all-electric division is impractical. A single division would require a minimum of 165 MEP-810s (7 prime power battalions) operating at 100 percent of baseload power, and still would require approximately 360,000 gallons of fuel daily. Smaller tactical generators would be even more inefficient. For 50 kilowatt-electric generators, a division would require ~4,275 generators and ~465,000 gallons of fuel daily. This approach would be akin to the Tesla driver leaving home with a diesel generator and gasoline can in the car's trunk; the driver simply made a hybrid vehicle with extra steps. These numbers are best-case ones and could easily double once maintenance cycles, peak power requirements, and margins for combat losses are considered.

Problems With Renewables

Renewables such as solar and wind cannot meet operational energy demands and will struggle with DOD installation energy needs. Simply put, to reliably meet the scale of demand would require an impractical number of systems, both in terms of operation and cost. Assuming, generously, no atmospheric losses, an 8-hour daily window, a 20-percent-efficient solar panel, and a solar constant of a 1.367kW/m^2, a single division would need to be able to capture 2.58km^2 of sunlight. To put this number in perspective, the largest U.S. solar and wind farms would struggle to meet this energy demand.

Solar and wind can provide small amounts of power to individual Soldiers, sensors, and small systems in isolated or forward positions, but they cannot provide the bulk power that will be required in the operational and strategic support areas. When the full system-leveled cost of electricity is applied (which includes reliability and integration into the grid), the cost-effectiveness of renewables is questionable even for large-scale installation energy baseload use.

Green/Synthetic Fuels

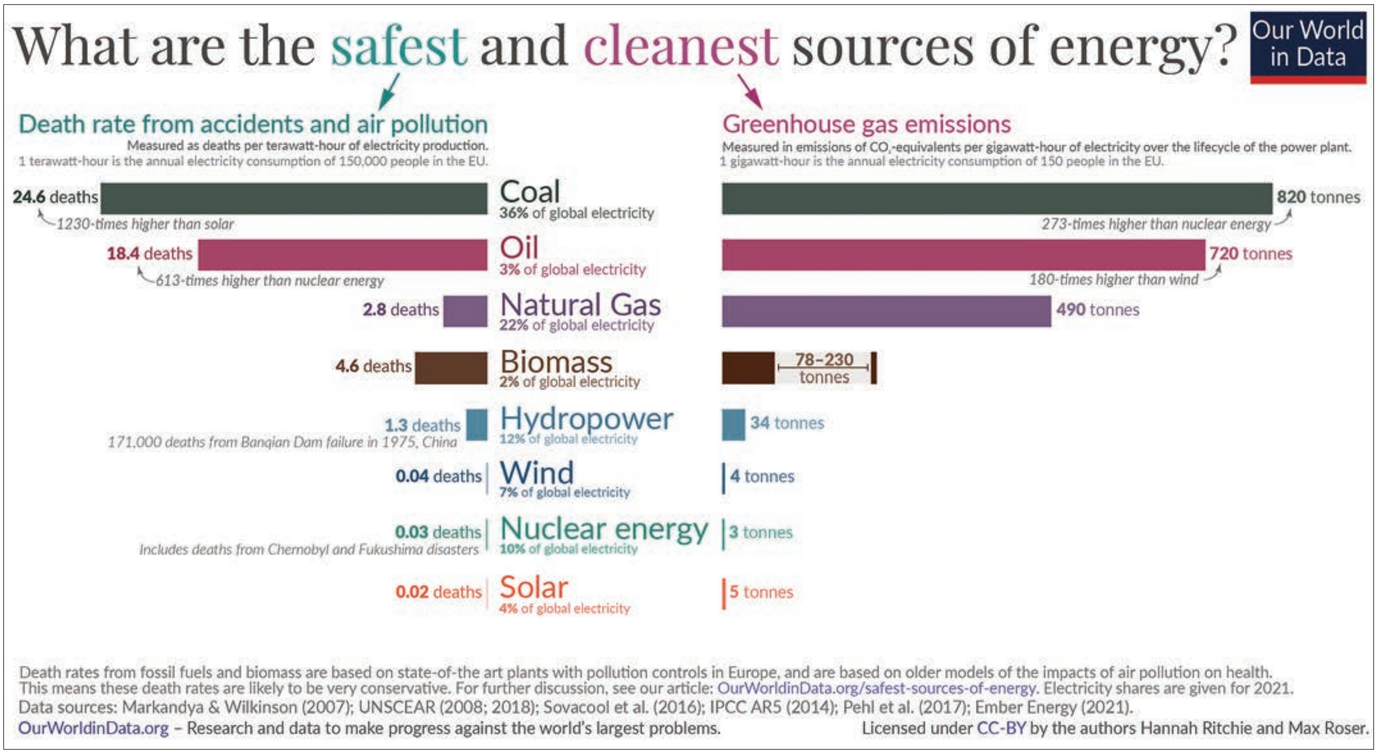
Even with a successful changeover to electric vehicles, some liquid fuel requirements will remain for small forward traditional generators and combat aviation assets. Biofuels and synthetic fuels are a carbon-neutral approach. Unless their production is in theater, these novel fuels will have all the problems of JP8 with none of its robust supply chain. Forward production of any synthetic fuel will require the creation of hydrogen from water through electrolysis or by thermochemical means. That hydrogen then can be used directly in a fuel cell, combined with carbon or nitrogen feedstock, or be pulled directly from the air or ocean to create any hydrocarbon or ammonia-based liquid fuel. Transportable nuclear reactors can provide the energy for large-scale transportable synthetic fuel creation. To show scale, a 2019 analysis from the Massachusetts Institute of Technology found the energy output from a single Navy aircraft carrier reactor could be used to produce approximately 300,000 gallons of JP5 a day, or around 107,000,000 gallons annually.[3]

Supply Chain Vulnerabilities

The ability to project force globally is a unique and decisive advantage of the American military, but the logistics of liquid fuel pose a severe vulnerability. A secured and lengthy supply line is required to get liquid fuel into theater: the line stretches from oil fields and refineries in the United States to the U.S. Merchant Marine, then to the port of entry, and finally to the end user. The sustainability of this system is not assured in today's threat environment, just as it has not been in previous periods. This same need for assured freedom of movement in the face of extended vulnerable supply chains is why the Navy adopted nuclear power in the 1950s.

Fuel requirements defined the Pacific theater in World War II. It is why the Japanese attacked, it defined what was possible in U.S. operations, and the loss of fuel was one of the primary causes of Japan's defeat. At Pearl Harbor, the Japanese failed to destroy the fuel farms or the fleet oilers on station. Regarding this failure, Admiral Chester Nimitz stated: "[H]ad the Japanese destroyed the oil, it would have prolonged the war another two years."[4] Historians believe that the loss of this oil would have forced a withdrawal of U.S. forces to the continental West Coast and prevented nearly all offensive or defensive operations for at least a year. As it was, the Navy was still largely bound to its ships' 4- to 5-day internal fuel supply, as it had only 11 of the 72 fleet oilers it required in the Pacific. Additionally, there were major fuel shortages, which by the end of 1942 were bad enough that the fuel in the sunken ships at Pearl Harbor was siphoned off for use. The Battle of Guadalcanal highlights this situation, as only 2 days into the battle the Navy was forced to withdraw to refuel, denying the ground troops critical air and naval artillery support.

Another metric of fuel importance in World War II is that the U.S. Merchant Marine sustained the highest casualty rate of any branch in World War II. In 1942, it suffered the destruction of a quarter of the U.S. tanker and oiler fleet. The British Falklands War is a more modern example where projection of



Death rates from fossil fuels and biomass are based on state-of-the art plants with pollution controls in Europe, and are based on older models of the impacts of air pollution on health. This means these death rates are likely to be very conservative. For further discussion, see our article: OurWorldinData.org/safest-sources-of-energy. Electricity shares are given for 2021.
Data sources: Markandya & Wilkinson (2007); UNSCEAR (2008; 2018); Sovacool et al. (2016); IPCC AR5 (2014); Pehl et al. (2017); Ember Energy (2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the authors Hannah Ritchie and Max Roser.

Gold crew of *Ohio*-class nuclear ballistic-missile submarine USS *Maine* officially returns boat to strategic service, Silverdale, Washington, May 2, 2020 (U.S. Navy/Andrea Perez)

liquid fuel was a primary problem that British logisticians faced. Another modern example is the Russian Federation's struggle to resupply its forces in Ukrainian areas only a few hundred kilometers from the Russian border.

Why Nuclear Works

DOD must scale up its liquid fuel system and expand its nuclear capabilities. Liquid fuel is something that DOD is comfortable using, but continued reliance on its traditional supply chain will not reduce the logistic constraints, vulnerabilities, or carbon emissions it imposes. Nuclear power is a high energy-density, low-carbon solution that the Navy has proved can be used to cut the tether of fuel for key DOD assets. It also proves that concerns about the use of nuclear reactors in military operations can be allayed—the Navy deploys them in its most valuable combat assets, while assets like a Pele microreactor or larger floating reactor would be largely constrained to DOD installations and strategic and operational support areas.

In the last 70 years, the Naval Nuclear Propulsion Program has operated over 526 reactor cores, and today's fleet operates around 93, with another 26 under construction or on order. These reactors operate in power ranges required by DOD and the commercial sector. Its submarine reactors operate somewhere around 50 MWe, and carriers carry two reactors each operating at 300 MWe. The reliability, freedom of maneuver, and near flawless history of the naval nuclear propulsion program has won the trust and acceptance of the American people, of the U.S. Government, and of many in the international community.

While the Navy has a substantial nuclear and nonnuclear generating capacity, it is currently not equipped or designed to provide significant and efficient ship-to-shore power, and doing so for any significant period would incur a high opportunity cost. For these reasons, a purpose-built fleet of nuclear power barges both in the ~25–50 MWe range and the ~100–300 MWe range would be ideal to provide the main bulk of DOD transportable energy needs. To be clear, these power barges/ships should use low-enriched or high-assay low-enriched fuel so that they can be deployed domestically and exported internationally for commercial use. These platforms do not require the high enrichment and yearslong staying power seen in Navy Nuclear Propulsion Program reactors. Deployment of such a capability would benefit the program, and commercialization would see a proliferation of American shipyards. Moreover, large-scale deployment of reactors commercially in the shipping industry could enable broader adoption of the technology in the Navy's surface ships and support fleet.

This transportable nuclear power capability was initially explored in the Army Nuclear Power Program from the 1950s to the 1970s. Several prefabricated nuclear reactors, a truck-mounted reactor, and the 10-MWe MH-1A *Sturgis* power barge were developed and tested. While these were technically successful, the energy needs of the Army did not justify the expense at that time.[5] The Strategic Capabilities Office's Project Pele is acting as a pathfinder that will provide the necessary legal, regulatory, supply-chain, and operational experience to allow for smoother fielding of future capabilities.

Former World War II Liberty Ship *Sturgis*, converted in 1960s to Army's first floating nuclear power barge, is towed to Brownsville, Texas, for final shipbreaking and recycling, after its MH-1A nuclear reactor was deactivated (U.S. Army Corps of Engineers/Rebecca A. Nappi)

Ship-to-Shore Power Viability

Today approximately 3 billion people live within 200 kilometers of the coast, and this number is expected to double by 2050. In the United States, 40 percent of the population lives in coastal counties, which account for over $9 trillion in goods and services annually and over $3.6 trillion in wages. If these coastal U.S. counties made up a country, it would have the world's third-largest gross domestic product. Navigable rivers expand the operational reach of power barge platforms even further. This concentration of resources and people is why today there are over 200 power barges in operation around the world. For example, the Russian nuclear power barge *Akademik Lomonosov* has two 35-MWe reactors and has been operational in Siberia since 2019. The rest are commercial generators using conventional gas, coal, or natural gas and an upper power range from 300–500 MWe. These platforms are locked into multiyear contracts, making their use in unexpected military or disaster relief operation difficult.

In World War II, the War Department faced a need to generate electrical power in support of theater-level operations. To meet this demand, it deployed large quantities of small generators and built five 30-MWe power barges, purchased one 20-MWe power barge, and converted 11 destroyers into power ships, each providing 4.4 MWe. This totaled 220 MWe and was equivalent to 1.5 percent of the prewar U.S. commercial electrical grid, equivalent today to roughly 5 GWe of generating capacity.

Following the D-Day landings in June 1944, the deep-water port of Cherbourg was the main Allied entry point for materiel and personnel into northern Europe. The port's power was provided by the USS *Donnell*, one of the Navy's converted power ships. Additionally, ~50 MWe of small generators were pushed into France in the days immediately following D-Day. Today this is equivalent to ~1 GWe.[6] As the Allies moved east, two of the Army's four purpose-built 30-MWe power barges were used to power Belgian ports as the offensive continued eastward. Following the liberation of the Philippines, power and clean water were provided to the devastated city of Manila by the converted power ships USS *Whitehurst* and USS *Wiseman* until local power had been restored. Power barges also served, among other places, at Pearl Harbor, in Okinawa, and in the continental United States to power rapidly built military bases and factors.

As the Korean War began, the Soviets cut hydroelectric power to South Korea. The purpose-built power barge SS *Jacona* was rapidly deployed and provided 20 MWe of power to sustain critical infrastructure across the South Korean power grid. As the war continued, two of the converted destroyers, the USS *Wiseman* and USS *Marsh*, as well as two of the 30

MWe power barges joined the SS *Jacona*. Together they were able to keep the vital deep-water ports of Pusan and Masan operational by providing electricity and water to the perimeter's defenders. Later in the initial build up in Vietnam, the Army converted 11 surplus T2 oil tankers into 5-MWe power ships and used them to provide power to major coastal bases to free up smaller generators to be pushed inland. Although the scale of the energy need has grown by orders of magnitude, this approach has been historically proven to work in large-scale combat operations.

The development of these technologies was stimulated leading up to World War II by an earlier civil support application. In 1930, the USS *Lexington* was dispatched to the city of Tacoma to provide power after a drought caused local hydroelectric dams to stop working. The ship provided ~13 MWe of power for a month until the drought ended. Another civil-use case was in 1947 when forest fires destroyed long-distance transmission lines, cutting Portland, Maine, off from the grid. In response, the Navy deployed the converted power destroyers USS *Foss* and USS *Maloy* to provide electricity to the town until normal services were restored. The MH-1A *Sturgis*, the Army's first—and so far, only—nuclear power barge, was dispatched to the Panama Canal zone in 1968 to provide power after a local drought reduced hydroelectric power output, impeding the operation of the Panama Canal. The *Sturgis* remained, providing 10 megawatts of consistent nuclear power until 1976, when it was joined by a Navy 20-MWe diesel power barge, the *Andrew J. Weber*.

Risk Analysis

There is no perfect solution to military energy needs; there are only tradeoffs. The risks of military nuclear power must be measured at the tactical, operational, and strategic levels against the risks of the existing liquid fuels systems and in the context of expected future conflicts, normal operational risks, the effectiveness of protective measures, and the ability to recover after failure. While every reasonable effort should be made to protect individuals, there is an intrinsic need in war for appropriately high individual risk tolerance. In those moments are reflected the highest traditions and sacrifices of U.S. Servicemembers—from the sacrificial last stand of Navy destroyers Taffy 3 in the battle of Samar in the Philippines, to the Army Air Corps' B-17 crews conducting daylight bombing campaigns in Germany, to the Army's 101st Airborne Division's stand at Bastogne in Belgium, and the U.S. Merchant Marine suffering the highest casualty rate of any service in World War II. Only within context can our Nation's leaders and citizens make an informed decision on the risk and merit of this technology.

During normal operations, including every nuclear accident such as Chernobyl and Fukushima, nuclear power is one of the cleanest and safest forms of energy available to us today. The traditional liquid fuels that DOD uses to generate electricity are 613 times deadlier than nuclear.

Regarding the use of nuclear power in an operational setting, it is important to note that the Project Pele microreactor is not intended for forward use on the battlefield—it is intended to power critical and isolated assets well behind the lines. Floating systems would be employed in the same way and essentially share the same risk profile that the Navy's nuclear assets face. In both cases, the concrete, steel, water, and earth required to properly shield a reactor core also provide substantial material shielding from external attack. In the case of floating assets, they also could be made to be fully or semisubmersible, making them a substantially harder target.

If a land mobile reactor were successfully attacked, the amount of radiological material would be measured in kilograms and affect a far smaller area than seen in many common industrial accidents. A lost, larger floating reactor would at least be cooled by the water and have any released material diluted into the ocean, joining the four billion tons of uranium naturally occurring in the world's oceans. The effect of this can be seen in that although two U.S. and approximately five Soviet nuclear submarines and crews have been lost at sea (with the U.S. losses stemming from nonnuclear mechanical failures), in the intervening decades, there has been no measurable environmental impact or concern to even make their loss common knowledge. Additionally, substantial safety gains in reactor design and new fuels such as TRISO will make the next generation of reactors far safer than current designs. That said, any attack on a reactor could have a significant effect on the well-being of surrounding personnel and on the environment, but those costs must be weighed against the alternative.

Fuel farms, especially mobile ones, are a high-priority target in a war, and require far more personnel to operate. In comparison to a nuclear reactor, they offer the fuel little shielding from attack. The Pele microreactor provides a sustained output of energy that would require a fuel farm of several million gallons to match, while fuel stockpiled at a major port of entry can run into the hundreds of millions of gallons. The 11-million-gallon *Exxon Valdez* disaster cost $3.8 billion to clean up, while the Deepwater Horizon spill resulted in the loss of ~134 million gallons and cost $62 billion in cleanup efforts. With each American-owned, -flagged, or -contracted fuel tanker being a legitimate target in a major war, the risk of loss of life and direct environmental impact is at least as significant as the risk posed by nuclear power. Beyond the local level, the effect that assured energy can have on a war, and the follow-on impacts on society, are incalculable. What is it worth to deter a future conflict? What was it worth for World War II to end in 1945, not 1947?

Weighing these risks is hard and requires open and informed conversation. This is especially true as ideological opposition has already formed against Project Pele. An example is a 2021 report by the Nuclear Proliferation Prevention Project at the University of Texas at Austin that asserts that Pele meets no valid need and is simply a paycheck to defense contractors, that DOD dramatically and intentionally inflated casualty statistics and distorted technical data, and that the liquid fuel problem had already been solved.

The report presents no evidence to support many of its claims and distorts technical data and casualty statistics to come to its conclusions.[7] It makes no effort to put the risks of military nuclear power in the context of viable alternative energy sources and is purely focused on the energy needs of the back half of the Iraq and Afghanistan conflicts and not on what future conflicts will require. This was epitomized by the response of the report's lead author when he was asked at a press conference how he would fix the Army's energy problems. His answer was that the energy problem had already been solved by energy efficiency measures, such as adding insulation and thermostats to temporary military buildings.[8]

DSCA Mission

Although Hurricane Maria made its devastating landfall in Puerto Rico on September 20, 2017, the real human cost was incurred in the months that followed. There were an estimated 4,600 excess deaths, far larger numbers of significant medical issues, a tripling of the suicide rate, and an exodus that would see 4 percent of the population leave the island in the face of a collapsed economy. The average Puerto Rican was without power for 74 days, without clean water for 32 days, and without cell phone coverage for 60 days. On average, services were restored by November 17, 2017, 58 days after landfall. Many areas, however, did not have power restored until May 2018.

Among the island's problems was the loss of 80 percent of the long-distance power lines on the island, cutting off power plants from relatively intact city power grids. This loss, combined with damage to local grids and some severe policy limitations, contributed significantly to the loss of access to electricity, clean water, wastewater treatment, and cell phone networks for the average Puerto Rican. The second-order effect of this was the loss of home refrigeration necessary for many medications, inability to use home medical devices, and loss of air conditioning, all of which drove substantial spikes in medical emergencies. A Harvard medical study identified the loss of power as the single most significant factor leading to the increase in deaths and medical issues across the island.[9]

The U.S. Army Corp of Engineers is charged with providing temporary emergency power to critical facilities under the Federal Emergency Management Agency (FEMA)'s Emergency Support Function #3. Although having this operational energy capability would not have fixed all the problems Puerto Rico faced, it would have been an extremely powerful tool in the hands of those leading the response on the island to restore power quickly to pockets where the grid was relatively intact and to allow for better optimization of the limited resources available to repair island infrastructure. This capability could have saved American lives and sped recovery.

Beyond generating electricity, these temporary emergency power assets are used to produce potable water and

Russia's floating nuclear power barge *Akademik Lomonosov*, with two nuclear reactors with capacity of 35 megawatts each, leaves Saint Petersburg under tow for Murmansk, April 28, 2018 (NurPhoto/Valya Egorshin)

synthetic fuel on location. Every shipment of water and fuel into a disaster area prevents another shipment of tarps, food, medical supplies, or aid workers from arriving. The ability to move several GWe of generating capacity is a powerful tool to respond not only to weather-driven disasters but also to large-scale earthquakes, volcanic eruptions, and solar storms. It also can be used to mitigate more mundane grid disruptions caused by droughts, wildfires, and winter cold snaps; these conditions have caused rolling brownouts and blackouts across Texas and California in recent years.

This capability would also be a highly effective soft-power foreign aid tool in a variety of contexts. Short-term uses could include responding to major natural disasters, supporting and stabilizing local power grids, or sustaining an ally country through an energy blockade or embargo—for example, the Soviet blockade of West Berlin that resulted in the Berlin Airlift, Europe's loss of Russian natural gas due to the Ukraine War, and a potential future blockade of Taiwan. Longer term uses could be an American reactor leasing deal with allied countries. Having the reactor built, refueled, and retired in-country and under U.S. supervision while operating abroad could radically decrease proliferation concerns and enable countries without the technical base to efficiently incorporate nuclear power into their grids. This use is what Russia is exploring currently in Africa. Energy has long been a proxy measurement for human prosperity, and bundling reactors with other advanced technologies (fuel, water desalinization, food, medicine, manufacturing) could have a significant impact with such partners. America's efforts over the decades to build deep ties with friendly developing countries is extremely valuable, and helping these countries to establish nuclear power may be one of the only realistic and moral ways to reduce those nations' greenhouse emissions without adversely affecting their citizens.

Cost-Benefit Analysis

The direct opportunity cost of not having this capability in future military operations is hard to gauge. However, in a peer fight with an enemy that can threaten U.S. shipping globally, fuel prices could easily exceed the highwater $200 to $400 a gallon seen in Afghanistan and Iraq. Fuel defined much of the course and outcome of World War II, and in a future conflict, the costs of not being able to support U.S. forces abroad with enduring energy are incalculable. Additionally, in times of peace these assets can be used to offset normal DOD power bills.

The population of Puerto Rico in 2017 was 3.34 million. Using the Harvard study and the above FEMA cost/benefit values, the amount that it would have cost to reasonably prevent the deaths, loss of potable water, and loss of electricity across the island was approximately $75 billion. This capability could have made a meaningful impact in the response and likely could have saved the Federal Government a sizable percent of that total. Although Puerto Rico is the extreme case, over the last 40 years the United States has experienced 290 natural disasters that each cost over $1 billion, for a combined total of $1.95 trillion of damages.

Commercial partners stand to gain various advantages when collaborating with DOD, which holds a unique position as the sole U.S. organization boasting a recent and consistent track record of successfully deploying nuclear power. Since the conclusion of the Cold War, the commercial sector has completed the construction of three reactors initiated in the 1970s and erected a singular new reactor—each with a GWe capacity and conforming to traditional stationary reactor designs. In contrast, during this same period, the Navy has constructed an impressive 50 transportable reactors.

The use of the transportable reactor model offers substantial benefits by enabling the establishment of short-term power purchase agreements spanning 5 to 20 years, avoiding commitment to the extended 40-to-80-year life cycle of traditional plants. Furthermore, the production of both land- and water-transportable reactors facilitates mass production, treating them as standardized products rather than unique mega-construction projects. This approach not only limits the required capital investment to a few hundred million dollars but also significantly diverges from the $10 to $15 billion investments seen with projects such as the new Vogtle Unit 3 reactor in Waynesboro, Georgia.

The substantially shorter proven build time for transportable reactors not only influences how interest on debt is managed but also results in a flattened J-curve, signifying a quicker realization of profitability and a more efficient use of resources. Overall, partnering with DOD presents commercial entities with a strategic opportunity to leverage DOD expertise and success in nuclear power deployment for a more efficient and cost-effective approach to reactor construction and operation.

There is potential for direct collaboration, like the U.S. Merchant Marine model, by holding reactors as commercial assets that could be activated for military use. Collaboration may also occur in gray areas where DOD interests and commercial interests intersect, such as in data and artificial intelligence centers used in cyber warfare. These centers are owned and partially operated by major private tech companies.

A recent 3-year, $9-billion Joint Warfighting Cloud Capability contract highlights the significance of electricity costs, constituting up to 70 percent of its expenditures. This underscores the key role of power consumption in such contracts, emphasizing collaboration opportunities between DOD and commercial entities in managing energy-intensive operations.

Conclusion

The current energy model—driven by liquid fuel and generators—falls short of adequately supporting today's DSCA mission or future military endeavors. Nuclear power stands out as the sole proven solution that is transportable and is capable of directly meeting the scale of electrical demand, all while facilitating large-scale forward synthetic fuel production. Project Pele, as a first step, merits support for its prototype development, and it should be elevated to the status of a program of record, ultimately deployed to address the most critical DOD energy requirements.

A subsequent step is essential to restore the historically effective three-part capability. This involves a deliberate expansion of DOD capabilities, incorporating floating reactors in the ranges of 25–50 MWe and 100–300 MWe to address larger installation and operational energy needs, facilitating extensive synthetic fuel production. Collaborating with commercial interests is crucial to underwrite costs for DOD, gradually transitioning the technology into a commercial off-the-shelf solution and projecting substantial soft power for the United States internationally.

While this initiative demands a significant initial investment, its costs could be shared with commercial partners and offset through direct and indirect cost savings, replacing existing DOD energy bills, and reducing future costs to the Federal Government. Additionally, it provides a proven launchpad for the global deployment of nuclear power, contributing to global reductions in emissions of greenhouse gases. DOD acknowledges a known problem and possesses a demonstrated solution. Failure to meet future energy needs in crises or conflicts can be attributed only to the organization itself. **JFQ**

In memory of Dr. Juan Vitali (June 24, 1962–February 19, 2024), loving husband, brother, nuclear engineer, Army thought leader, American immigrant, mentor, and friend. Rest in peace.

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