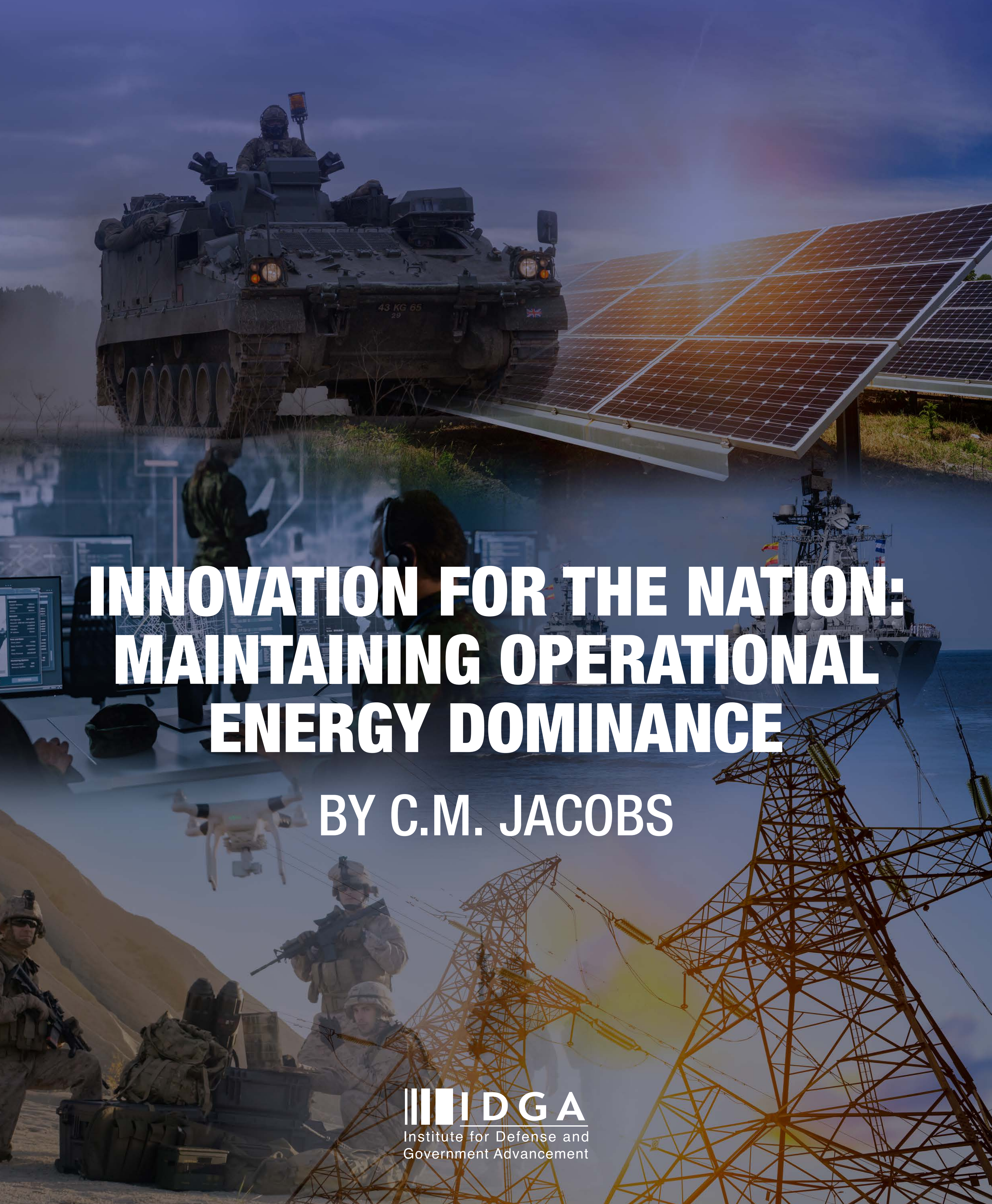
15TH OPERATIONAL ENERGY SUMMIT



INNOVATION FOR THE NATION: MAINTAINING OPERATIONAL ENERGY DOMINANCE

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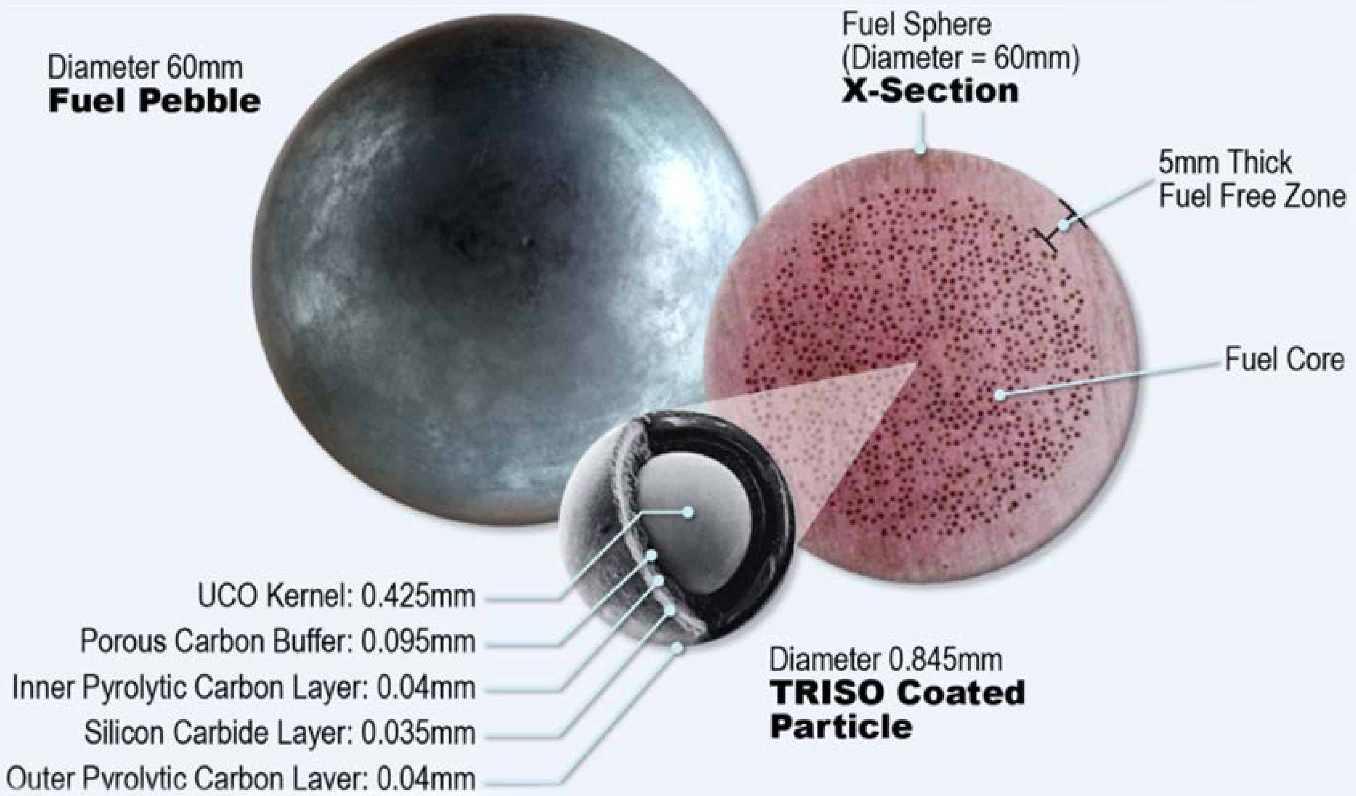
Recall last year the images of Russian vehicles and tanks stranded by exhausted supply chains and a lack of fuel. A critical aspect of military planning is understanding operational energy. Since the beginning of World War I, operational energy (OE) has played a decisive role in all major conflicts (Carpenter et al., 2021). It is critical that commanders and planners at all levels fully understand OE and integrate it into their plans.

Energy security and dominance have become cornerstones of DOD strategy, given the unbelievable amounts of fuel and energy consumed by the power-hungry systems the modern military depends on (Tingley, 2021) By statute the term "operational energy" (OE) means the energy required for training, moving, and sustaining military forces and weapons platforms for military operations (10 US Code § 2924). The term includes energy used by tactical power systems and generators and weapons platforms. The Department of Defense in its 2016 Operational Energy strategy further outlines OE to be the energy used in military operations, energy used in direct support and in training that shapes readiness for military operations. This includes energy that powers contingency bases. It encompasses energy used by tactical power systems and generators, as well as by weapons platforms themselves. The United States Department of Defense is the nation's largest single consumer of fuel (Bennett, & Owens, 2019). In FY 2020, the Department consumed nearly 78 million barrels of fuel to power ships, aircraft, combat vehicles, and contingency bases with a total cost of $9.2 billion. (FY 2020 Operational Energy Annual Report) It should be noted that operational energy does NOT include nuclear-powered submarines and aircraft carriers. This is due to the fact that by design, these systems are not subject to the logistical challenges of resupply as typical petroleum-dependent systems (Department of Defense 2016 Operational Energy Strategy).

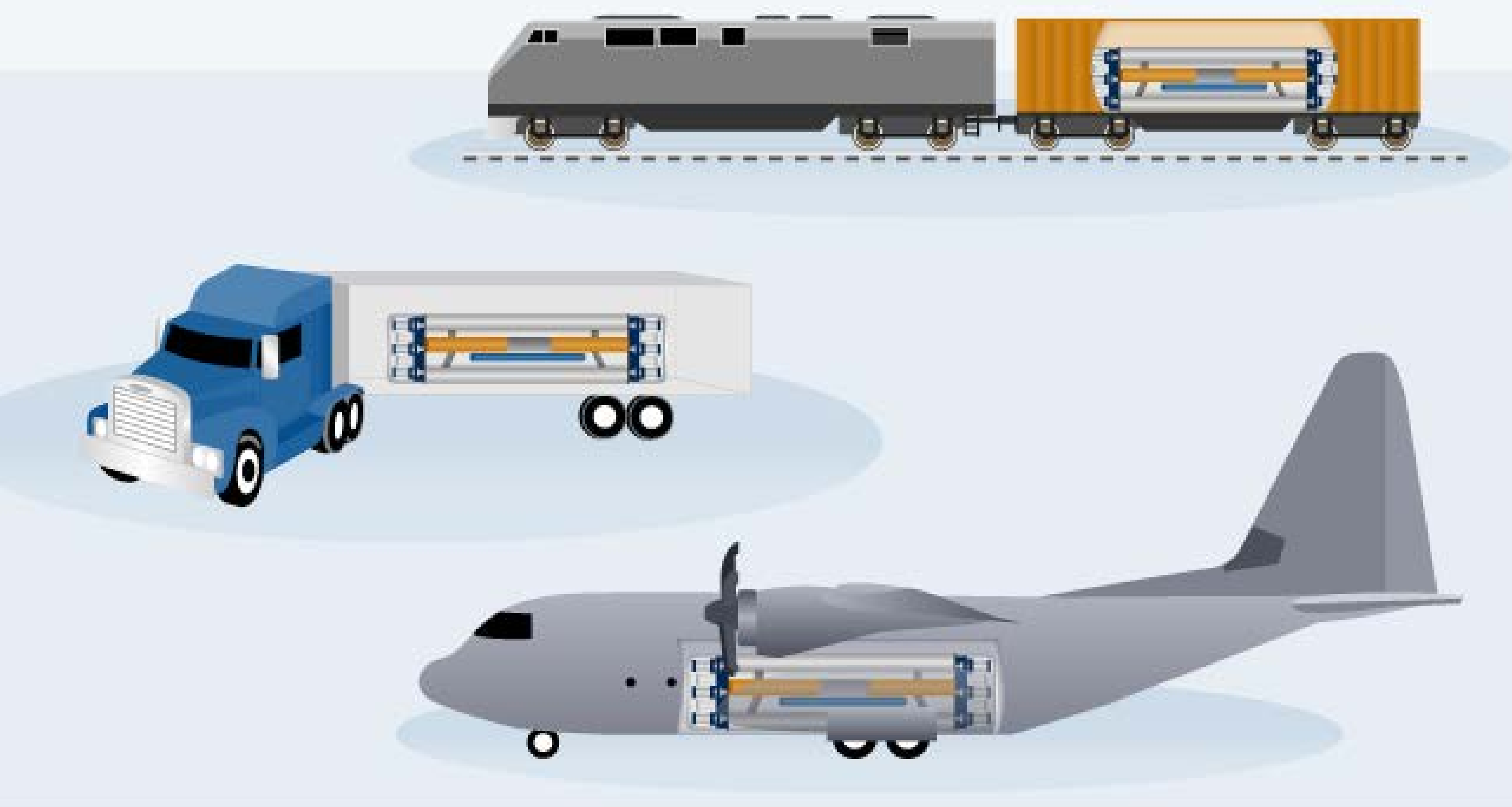
As technology has increasingly enabled soldiers, sailors, airmen, and Marines in warfare, the burden has increased. The basic fundamentals of, "shoot, move, and communicate," have become dependent upon technology – and the energy to power it – on the modern battlefield. The burden has increased significantly over the last 22 years. At the beginning of the Global War on Terror, a dismounted infantryman required a small bag of batteries for a mission of significant duration. With increases in technological enablement, the battery load has similarly increased. A good example of this is the PRC-154 Rifleman Radio. The radio has a battery life of about 7 hours and each battery weighs 0.8 pounds, so a 72-hour mission would require 8.8 pounds of batteries just for that radio (Mittal, 2020). The total battery burden for all a soldier's equipment may fall between 15-20 pounds. This is but one example. And beyond tactical equipment, established bases facilities, forward operating locations, place the greatest burden on operational energy requirements. Innovative technologies will play a role in how to power operations.

One of the objectives of the 2016 Operational Energy Strategy was to identify and reduce logistics and operational risks from operational energy. Part of this suggests moving away from traditional operational energy fuels and look for alternatives. The Office of The Secretary of Defense (OSD) requested $60 million dollars for Project Pele, which is aimed at developing a new, transportable nuclear microreactor to provide high-output, resilient power for a wide variety of Department of Defense (DOD) missions. The DOD goal in the next few years is to have prototype reactor design, which will eventually be capable of producing one to five megawatts (MW) of electricity and operate at peak power for at least three years. By comparison, the S9G reactor on a Virginia-class nuclear submarine can produce up to 40 MW. (Tingley, 2021). Not only will these new generation reactors be smaller and more efficient than current nuclear power plants, but scientists and engineers claim they'll be virtually meltdown-proof. Why is this? The secret is millions of submillimeter-size grains of uranium individually wrapped in protective shells. This innovation is called "tristructural isotropic" or triso fuel for short (Oberhaus, 2020).



Paul Demkowicz is the director of the Advanced Gas Reactor Field Development and Qualification Program at Idaho National Laboratory. Among his duties is simulating worst-case scenarios for next-generation nuclear reactors. “In the new reactor designs, it’s basically impossible to exceed safe temperatures, because the reactor kind of shuts down as it reaches these high temperatures,” says Demkowicz. “So if you take these reactor designs and combine them with a fuel that can handle the heat, you essentially have an accident-proof reactor.” (Oberhaus, 2020).

Initially, there will not be the intent to deploy these new reactors to tactical areas. But they could certainly be used to power facilities domestically or away from the battlefield. According to the Government Accounting Office (GAO), these microreactors are also envisioned to be deployed after a natural disaster support faster restoration of critical services such as hospitals, communications, and the water supply to the local community (Government Accounting Office, 2020). The compact size of these microreactors will enable a number of transportation platforms to be used to deliver these units to their destination.



Source: GAO. | GAO-20-380SP
(Government Accounting Office, Science &; Tech Spotlight: Nuclear Microreactors 2020)

While microreactors might not be ready for combat zones, another technology is already being used with more innovation on the way. Modular solar generators can be deployed in shipping containers to remote zones around the world. There are numerous commercial corporations and DOD-funded organizations researching and developing methods to leverage the largest fusion reactor - the Sun - to provide energy for forward operating bases and other expeditionary operations (Tingley, 2021). Some of these systems are mobile as well and are already in service with the Marine Corps and the US Army and are being used to power systems at forward operating locations.

But the Army and Marines are not the only services harnessing the sun. Indeed, The Air Force Research Laboratory has been developing a concept known as the "complete expeditionary microgrid system." The system is made up of silicon solar panels placed on the tops of tents, along with batteries and a command, control, and communication software package. This microgrid can supply on-site, mobile energy for expeditionary forces (Tingley, 2021). The on-going project hopes to meet the Air Force Civil Engineer Center's 2035 vision to create a totally deployable, self-sustaining power system (Lindner, 2017). This mobile, hybrid energy storage and management system able to supply renewable energy power for forward operating bases is the latest addition to the Air Force-led effort to meet the long-term energy needs of military forces. Batteries and a microgrid command, control and communication software package can act as a power source, better able to supply on-site, mobile energy for expeditionary forces. It fits in a 10-foot trailer and can be up-and-running in 30 minutes (Lindner, 2017). A 2012 Marine Corps case study conducted in Afghanistan revealed solar panels reduced diesel demand by 50% at forward operating bases. This is an incredible reduction to when one considers the logistical footprint of moving that much fuel to these deployed locations. (Tingley, 2021).


(Simpliphi, 2023)


(Lindner, 2017)

Since World War I the U.S. has enjoyed energy superiority, but world is evolving, and U.S. energy predominance is being challenged by nations like China. Based on historical conventional warfare, the victor dominates energy capability. Therefore, OE is a technical capability in which the U.S. must lead. Indeed, OE is part of the multi-domain environment. Victory through OE domain happens when 1) there is efficient, effective, and sustained production of combat power when and where it is required by friendly forces, while 2) the enemy combat power production is disrupted, degraded or destroyed. (Carpenter et al., 2021). OE superiority is the ability to fully exploit one's own energy capabilities while preventing the adversary from doing the same. These should be the primary U.S. goals and ones America must attain to stay dominant (Carpenter et al., 2021). Through continued innovation and integration of evolving technologies and by continued partnerships between the U.S. government and private industry the nation can succeed.

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