

Great Green Fleet Prepares to Set Sail

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The guided-missile destroyers USS Momsen (l), USS Shoup (c) and USS Sterett cruise in formation behind the USS Halsey, firing synchronized five-inch guns and crew-served weapons. The Navy is preparing to deploy its Great Green Fleet, which will derive power from biofuel.

The Navy is steering toward alternative fuels and enhanced conservation in search of petroleum's off ramp.

U.S. sailors are protecting the ocean blue as they ride the waves, but they also are thinking green. The Navy is making great strides as caretaker of the waters and the air it requires for its operations while never forgetting that its primary mission is to win wars. The establishment of a Green Strike Group, a unit of powerful ships and assets that will operate at least part of the time on biofuels, reconciles the need for a healthier Earth along with the needs of enhanced security and mission effectiveness. The alternative fuel sources that the Green Strike Group will use meet specific criteria that save energy and benefit the American people.

The Great Green Fleet (also referred to as the Green Strike Group) is scheduled to participate in a demonstration of local operations in 2012, with a full deployment slated for 2016. The exact fleet that will employ the alternative fuels is still undecided, because the ships, aircraft and possible submarines that will use them require no modifications. Rather, as Rear Adm. Philip Cullom, USN, director, Fleet Readiness Division, explains, "We are engineering the fuel; we are not reengineering the ships. So that's why it doesn't matter which ships are included."

In addition to his fleet readiness leadership role, Adm. Cullom is the director of the Navy's Task Force Energy, under which most of his energy work falls. Task Force Energy focuses on producing a holistic energy strategy for implementation across the Navy. It includes numerous working groups such as ones focused on the areas of maritime, expeditionary, aviation and shore. They are led by flag officers, senior executives or both. The Office of Naval Research also runs a working group. Task Force Energy works closely with Task Force Climate Change, sharing ideas and personnel, to help members better understand the link between energy and climate.

Though the Navy has been looking at alternatives to fossil fuels for decades—for example, using nuclear power to fuel submarines—the sea service's current plans involve using biofuels, especially those made from algae and the camelina plant. The Navy already has demonstrated camelina-derived biofuel in the F/A-18 Super Hornet; it flew the "Green Hornet," an F/A-18 using the petroleum alternative, on April 22, 2010—Earth Day. "Essentially there were no modifications to prepare for the Wright Brothers moment," Adm. Cullom says. "I call it the 'Wright Brothers moment' because this was the first tactical aircraft to fly at supersonic speed on biofuel. That truly was a landmark historic moment."

Developers derived the Green Hornet's mixed biofuel from camelina grown in Montana. "It's a very attractive source for biofuels," Adm. Cullom says. In addition to the testing on jet engines, the Navy is experimenting with biofuel for the gas turbines used in destroyers and cruisers.

The admiral describes the Great Green Fleet efforts as a visible way to grade the Navy's progress in moving away from petroleum and ultimately requiring less oil from overseas. He explains that reaching that goal means not only finding alternatives but also using less fuel overall. "The barrel of fuel you don't burn, because you're more efficient and you conserve, is the barrel you don't have to buy somewhere else ever again," he states. "That's how we're able to reduce our reliance on foreign oil."

To conduct the Great Green Fleet's planned local operations two years from now, the Navy needs 40,000 barrels of biofuel to satisfy what the ships and aircraft will consume. For the fleet deployment in 2016, the Navy must have approximately 120,000 barrels on hand. The energy source used to power the vessels will be blended biofuel—50 percent petroleum and 50 percent neat, or pure, biofuel. "We can't run yet completely on neat biofuel because there are necessary things you have to add back to neat biofuel to safely run an engine," Adm. Cullom explains. "We know we can mitigate many of the risks early in our transitions by just using a 50-50 mix. Plus, that gives us great flexibility when the biofuel is not immediately available. We can switch back to petroleum and never notice the difference." The blended biofuels will look, smell and act the same way as traditional fuels, according to the admiral.

All the biofuel contracts for this work are run through the Defense Energy Support Center. "They essentially are the ones that are in the leadership of developing the specific fuels," Adm. Cullom explains. "We just try to make sure they know [our requirements]. We've also indicated that we have much greater interest in second- and third-generation biofuels." The standards the Navy sets for its biofuels are high: They must not be competing food crops, such as corn; they must grow on marginal land; they must flourish without massive amounts of water; and they cannot require large amounts of fertilization. "In that way we can ensure that the amount of energy needed to grow crops does not end up consuming the energy that we receive out of it," the admiral says.

Energy input versus output is one of the major disadvantages of ethanol. The energy received from ethanol is more than what is put in, but not much. The admiral explains that petroleum can be purchased at a fairly reasonable price because the energy it produces is much greater than the energy expended on making it a fuel source.

Algae and camelina also offer additional benefits. The two plants remove carbon dioxide from the atmosphere as they grow. That makes them much more carbon neutral than petroleum, Adm. Cullom explains. They also burn cleaner. The disadvantage of using them compared to petroleum is that they have a lower energy density. "But it isn't significant," the admiral states. The Navy is working on methods to boost the energy density so that the process essentially recovers any amount of energy being lost.

Outside of the military, this research could benefit the transportation industry on an even larger scale. If industry leaders can pick the right biofuel stock and create the right process to provide an economy of scale, then the price for biofuels will fall to practical levels. The admiral says a reasonable point is one where biofuels cost the same, or at least almost the same, as petroleum fuels such as JP-8 or JP-5. Price is another reason the Navy has so much interest in algae and camelina. Their high ratio of energy input to output means that experts should be able to design an efficient engineering process. Adm. Cullom explains that that process is how the cost of production for biofuels will be "either a little more, or hopefully the same, or, even better yet, lower than the price of

petroleum. That's what would give us an off ramp to petroleum. And that's what we're looking for."

The demand for biofuels has to develop in markets other than the Navy or even the military. Though the Defense Department accounts for more than 90 percent of the federal government's oil usage, the government represents only approximately 2 percent of the country's oil consumption. "By ourselves, we're not going to make the market," Adm. Cullom says. However, he believes that if the military can be an early adopter and lead the way toward using biofuels, many others will follow, including the transportation and shipping industries, who would like the insurance that comes from not being dependent on fossil fuels. This will lead to biofuels becoming competitively priced. As a frontrunner in the biofuels initiative, the Navy can drive down costs, helping farmers who grow these crops, and causing infrastructure construction investment.



The guided missile destroyer USS Shoup (DDG) is shown underway in the Pacific Ocean. The Navy plans to install hybrid electric drives on DDGs to reduce fuel consumption and increase combat capability.

The potential savings the Navy could realize from alternative fuels and conservation methods are significant. Adm. Cullom explains that he has the collateral duty of director of Task Force Energy because in his primary director position he ensures that the Navy has the money it needs to fly planes, drive ships and maintain them all. "Basically, I pay the gas bill," he says. "We have big bills." In 2007, for example, petroleum cost the Navy \$1.2 billion. In 2008, when oil prices skyrocketed, the cost rose to \$5.1 billion.

Biofuels could offer more stable energy sources free from spikes associated with disasters such as hurricanes or manmade interference to the supply chain. However, the Navy's plans focus not only on the development of biofuels but also on overall efficiency. "The barrel saved by changes to behavior or changes to technological efficiency, that's the barrel you save forever. Those are dollars you save forever, and that's much less carbon that's contributing to greenhouse gases," the admiral says.

He describes the Navy's green initiatives as "the right thing to do," adding that, "As Navy professionals, I think we pride ourselves on trying to be good environmental stewards of the resources at sea. I think this is just one more way we can do that."

Another Navy initiative to reduce dependence on foreign oil is to install hybrid electric drives (HEDs) on the DDG class of ships. One of the destroyers in the Great Green Fleet will be an HED destroyer. These drives are more efficient at the moderate speeds at which ships spend much of their time. Instead of requiring large LM2500 gas turbine engines, the drives can run off of Allison generators normally used to supply electrical power.

"The greatest advantage of the HED is significantly increased range," Adm. Cullom says. "An HED destroyer will not have to refuel every four to five days. It can be extended significantly because it's conserving more fuel. We believe, and this is a very conservative estimate, that a destroyer with an HED modification will probably save 8,500 barrels of fuel per ship per year."

Outside of its own ranks, the Navy is working with other military branches and government agencies to pursue reductions in oil dependency. In January, Secretary of the Navy Ray Mabus and Secretary of Agriculture Thomas Vilsack signed a

memorandum of understanding to reduce energy consumption of fossil fuels and increase energy production from renewable resources. This work is intended to benefit not only the military, but also the entire United States.

All of these Earth-friendly measures have a larger purpose for the Navy as well—namely, to enhance its ability to conduct its missions successfully and to care for its sailors. Adm. Cullom is direct when explaining why the development of a Great Green Fleet is important. “First and foremost, it’s important to us because it improves our combat capability,” he says. That happens in a couple of ways. First, having a source of fuel aside from petroleum ensures mobility. “It allows us to continue our missions no matter what somebody wants to do to the supply of oil around the world,” Adm. Cullom explains. Second, biofuels and conservation expand the Navy’s tactical reach.

For example, by making a Super Hornet’s F414 engine 3 to 4 percent more efficient, pilots have that much more flying time. And on a dark and stormy night, when an aircraft carrier’s deck is pitching and rolling, that 4 percent could be the difference between having one more chance to come around for a landing attempt and having to divert to a landing field, or worse, eject. “Overall at the end of the day, it’s about warfighters,” Adm. Cullom says. “Our energy plan is about warfighting. It’s about being able to do our job better and giving us more combat capability.”

The Navy’s energy strategy demonstrates that energy awareness relates directly to that combat capability. “The people who know that probably most clearly of all are the people, the sailors, Marines, soldiers and airmen, who are in Iraq and Afghanistan,” Adm. Cullom explains. “Right now, they’re being resupplied by a fuel tether that comes by convoy. Anything they can do to reduce the number of convoys is going to translate directly into saved lives.”

At sea, the situation is the same. Though no oiler has suffered an attack since World War II, it is a point of vulnerability. “Logistics and logistics resupply are critical pieces of our ability to successfully conduct our missions—at sea as well as on land,” the admiral says. “I think what we’re going to see come out of the energy strategy more than anything is an awareness that all the way down to the deck plates you have to be smart about energy, and you have to try to conserve as much as you can because that saves lives.”

The admiral relates the story of the Navy’s embarkation on its energy strategy. “All the flag officers and senior executives in the room for Task Force Energy—we kind of formed a pact,” he explains. “And the pact was that we weren’t going to be funding things that didn’t somehow contribute to combat capability for sailors at the pointy end of the spear. And we’ve kept true to that ... All the efforts we’re trying to do somehow deliver a more capable Navy to the sailors that will be operating the ships, planes and submarines 20 to 30 years from today ... You have to keep an ‘Art of the Long View’ in mind when you look at that. I think what we’re really doing is providing a mission-capable Navy 20 to 30 years from today no matter what happens to petroleum.”

Web Resources:

Navy-USDA Memorandum of Understanding: www.chinfo.navy.mil/pages/energy-mou.html

Defense Energy Support Center: www.desc.dla.mil

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<http://www.afcea.org/signal/>