

IN THE QUEST TO BRING DOWN THE COST OF WAR, THE U.S. ARMED FORCES ARE ALSO REDUCING THEIR IMPACT ON THE ENVIRONMENT. WELCOME TO THE WORLD OF GREEN MILITARY.

■ BATTLING FOR THE PLANET

BY DANIEL WEISS

PHOTO: PETER MEBRIDE/AURORA PHOTOS

THE U.S. ARMED FORCES CONSUME MORE ENERGY THAN ANY OTHER ORGANISATION IN THE WORLD.

Tanks, planes, ships and bases burn through approximately 54 million litres of oil a day, racking up a bill of up to US\$18 billion every year. The military's main battle tank, the M1 Abrams, gets just a quarter of a kilometre per litre and burns 38 litres an hour while idling. If it were a country, the US military would rank 37th in terms of oil use, just behind the Philippines, whose population tops 90 million.

This thirst for fuel has dire costs on the front lines in Iraq and Afghanistan. Dan Nolan, the former head of a task force that studied how energy was being used on the front lines, found that in Iraq "the most dangerous job there was to drive five gallons [about 19 litres] of diesel out to a Syrian border site in order to re-fuel generators."

Nolan's task force found that most

energy on the front lines was used not on vehicles, as one might expect, but on generators that produced electricity to heat and cool poorly insulated tents. "When you've got a tent in the desert, after about six months, it's pretty close to cheese-cloth on sticks," he says. The solution was to coat the tents with an insulating foam that cut energy use in half. So far, more than 1,200 structures in Iraq have been foamed, along with several hundred in Afghanistan.

Brigadier General Steven Anderson, who was in charge of logistics in Iraq when the foam insulation programme began in April 2007, estimates savings of some 400,000 litres of fuel per day have been achieved, or about US\$750 million per year. More importantly, by keeping convoys off the roads, the human toll is reduced too. "I am absolutely convinced that the application of foam insulation has saved lives," says Anderson.

A variety of other energy-saving

measures are in the works. Last year, the Army tested the Tactical Garbage to Energy Refinery (TGER) in Iraq. TGER is designed to transform about a tonne of rubbish per day into fuel to run a 55-kilowatt generator - reducing the amount of fuel trucked in and waste trucked out. Paper, plastic and cardboard are heated to produce a synthetic gas similar to low-grade propane, while food slop is fermented to yield ethanol.

The next step is to make TGER robust enough to serve on the front lines. "We were looking for the most austere and harsh conditions possible," says James Valdes, an advisor who oversaw TGER testing. "And we got them." Dust jammed the filters and temperatures of up to 50°C overwhelmed the chiller that condensed the ethanol.

Now US\$7.5 million has been

The M1 Abrams may be the US military's flagship front-line tank but its fuel efficiency is woeful.

PHOTO: U.S. MARINE CORPS

US MILITARY GAS GUZZLERS Army >> | Cougar Armoured Fighting Vehicle: around 3.8 km per litre, depending on conditions | Buffalo Mine Protected Vehicle: around 1.5 km per litre

| High Mobility Multipurpose Wheeled Vehicle (HMMWV aka Humvee): around 1.7 km per litre when heavily armoured



THE DELIVERY COST OF FRONT-LINE FUEL IS AT LEAST US\$5 PER LITRE



MILITARY RESEARCH HELPS CIVILIANS TOO

The Defense Advanced Research Projects Agency (DARPA) is sponsoring research on making much more efficient solar panels, on turning algae into jet fuel, and on making fuel cells tough enough for grunts in the field to rely on them.

The agency's goals are ambitious, but it has a long track record of turning innovative concepts into concrete results. Indeed, two of the greatest technological advances in recent decades – the Internet and GPS – both got their start under DARPA.

The ARPANET, a military computer network set up by DARPA in the 1960s, was designed to keep working even if parts of it were damaged. It had the ability to send data in discrete chunks rather than constant streams, which allowed single computers to communicate simultaneously with many others – the same principle that today allows more than a billion Internet users to interact with each other, and more than a trillion web pages, without a complete breakdown.

As early as the 1960s, satellites were launched to help US Navy ships locate themselves at sea. The current fleet of 24 GPS satellites, launched starting in 1989, can pinpoint the location of a receiver to within approximately 10 metres anywhere on Earth. One commander credited it with giving US forces an overwhelming advantage over Iraq in the 1991 Persian Gulf War.

Today, the rest of us depend on it to help us navigate the world.



allocated to “ruggedise” TGER, and Valdes predicts that within a few years turning trash into fuel will be standard operating procedure at forward operating bases.

FUEL-FREE FIGHTING FORCE?

The Army's ultimate goal is to eliminate fuel requirements at forward operating bases altogether. A base that aims to be completely self-powering is being built at the National Train-

The TGER system (left) will help cut the number of vulnerable fuel supply convoys required by US troops in Iraq (top and right).

ing Center at Fort Irwin, California. The tents have already been foam insulated. The next step is to install a smart micro-grid, which senses how

much power is needed at any given time and shuts off unnecessary generators. Then solar generators will be added.

“We figure with just the spray-foam insulation and a microgrid, we can easily save 60 to 70 percent of power, which is very significant,”

PHOTOS: CORBIS; GETTY IMAGES

says Joe Sartiano, a consultant working on the demo bases. “So what does that mean? If you're running a fuel convoy every week, now you can run that convoy every two weeks.”

There is also a movement towards large-scale renewable power installations at permanent bases. Nellis Air Force Base near Las Vegas boasts the largest solar photovoltaic array in North America, with 72,000 solar panels that produce 14 megawatts of electricity, a quarter of the total used by the base. Not to be outdone,

the Army is planning the largest solar photovoltaic array in the world at Fort Irwin. Once completed, it will produce a staggering 500 megawatts of power.

Older technologies play their part too. The Navy's China Lake Air Weapons Station in California produces more than 250 megawatts from geothermal energy, enough to power 250,000 homes. Steel pipes plunging as deep as 4,000 metres underground conduct hot, pressurised water up to the surface. The water's pressure is



MILITARY BASES SHOULD GET OFF THE PUBLIC GRID

reduced, turning it to steam, which drives generator turbines.

Military bases are well positioned to pursue these projects because they control broad swathes of land in sparsely populated areas. The benefits include saving money on power bills and, arguably more importantly, the potential of gaining independence from the public power grid.

"Because of the acute physical and cyber vulnerabilities of the electric grid, bases can't count on it for mission continuity and should get off it," says Department of Defense advisor Amory Lovins, founder and chief scientific officer of the Rocky Mountain Institute, an independent think-tank that promotes energy efficiency.

In addition to generating their own energy, Army bases will soon be home to a fleet of 4,000 electric vehicles. With a top speed of 50 kilometres per hour, the vehicles are perfect for driving personnel around the base - and will save an incredible 6.5 million litres or so of fuel a year. Movement towards more efficient

tactical vehicles, however, has been slower. Plans for diesel-electric Humvees and tanks, for instance, have encountered battery problems.

The Navy is considering hybrid electric drives on some ships to save fuel when moving at slow speeds and ultimately hopes to transition to an all-electric fleet. "It's part of the Navy's imperative to reduce our dependence on foreign, non-renewable sources of energy," says Glen Sturtevant, the Navy's director for science and technology for surface ships.

The military is beginning to take into account the "fully burdened" cost of fuel to its operations, including delivery costs - estimated to be at least US\$5 per litre on the front lines. This could lead to a revolution in efficiently designed tactical vehicles that could filter down to everyday use. "It will be similar to the way military R&D in the past gave us the Internet, GPS, the jet engine and the microchip industries," says Lovins. "Only this time the innovations will be in advanced ultra-light materials, aerodynamics, hydrodynamics, propulsion and design integration."

But there is a limit to the commitment to cutting energy use. "We need to consider energy efficiency everywhere we can," says Kevin Geiss, the Army's programme director for energy security. "But at the end of the day if your tank or mobilised vehicle doesn't get somewhere fast enough, people may end up dying regardless of how efficient that system is." ■

A NOBEL DILEMMA

During his life, 19th century Swedish industrialist Alfred Nobel was famous for inventing dynamite. The explosive harnessed the tremendous power of nitroglycerin, a liquid that had the



unfortunate habit of exploding when it was jostled. By contrast, dynamite was packed into rods that exploded only when a detonator was ignited via an attached fuse. Patented in 1867, it was revolutionary.

Nobel, a pacifist and poet, hoped his invention would be used to advance civilisation. Indeed, it facilitated construction of public works by making blasting stone, drilling tunnels and carving canals easier.

However, the military were soon using it to make bombs. Dynamite became so identified with war that, in 1888, when a French newspaper mistakenly ran an obituary of Nobel, its headline translated as: "The merchant of death is dead."

Disturbed at the prospect of being remembered in this way, Nobel specified in his will that his fortune - amassed largely from the profits of dynamite - should fund a set of annual prizes to those who "have conferred the greatest benefit on mankind". Since they were first awarded in 1901, the Nobel Prizes have become the most prestigious of their kind, recognising achievements in science, medicine, literature and peace - and inspiring many to make the world a better place.



With so many troops and bases located in sun-drenched areas such as Iraq (above), a greater emphasis on solar power is evident throughout the US military: the 72,000 solar arrays at Nellis Air Force Base (left) save up to US\$1 million a year in energy costs; even in cold Alaska, a USAF sergeant uses a solar pathfinder to find the best spot to locate solar panels (bottom, left). Other green measures include recycling plastic bottles in Iraq (bottom, right) and the Stratotanker which carries 50 percent more fuel, is 25 percent more fuel-efficient and costs 25 percent less to operate than its predecessor (opposite page).



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