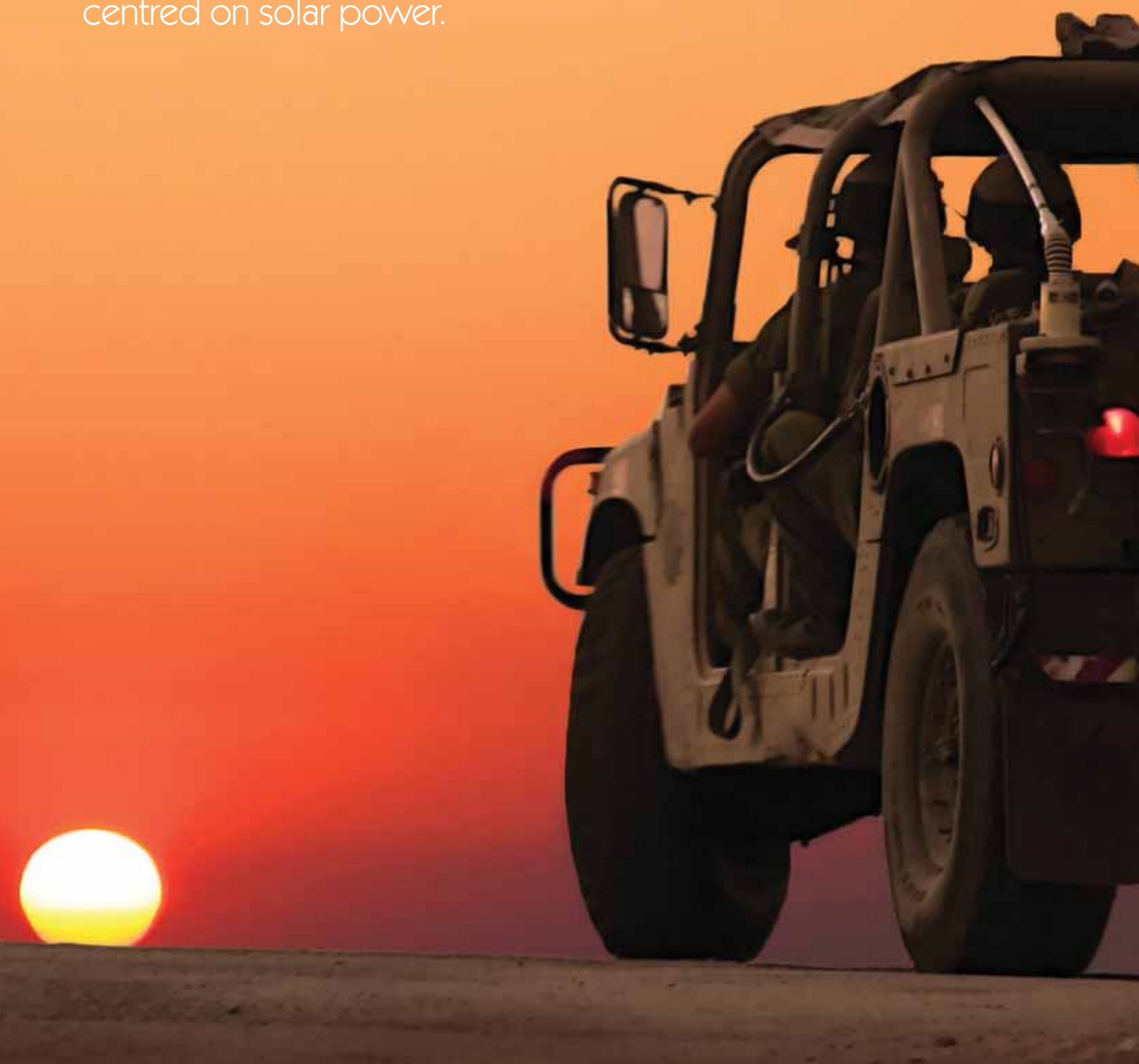
Solar: the military's secret weapon

Blessed with massive budgets, the military is often an 'early adopter' when it comes to technology. Recent reports suggest that US is putting up massive funding for three ground-breaking projects – all of them centred on solar power.



Portable power packs

During a battle, the ability to redeploy troops swiftly and without detection can mean the difference between victory and defeat. A recent leaked report has claimed that the US Army is developing tents and uniforms made from flexible solar panels to make it more difficult to track soldiers.

Jean Hampel, project engineer in the Fabric Structures Group at the Army's Natick Soldier Systems Center, said the need to minimise the Army's logistics footprint sparked interest in developing lightweight solar panels. "We want to cut back on the things that soldiers have to bring with them," including generators and personal battery packs, Hampel said. In modern warfare, portable power for communications technology is every bit as crucial as firepower and manpower.

The Army is testing flexible solar panels developed by Iowa Thin Film Technologies that can be layered on top of a tent, or folded into a backpack to provide a portable power source. Tents using solar panels made from amorphous silicon thin film on plastic can deliver up to 1 kilowatt of energy, which is enough to power fans, lights, radios or laptops, according to Hampel.

Hampel said using solar tents would minimise the need for diesel powered generators and diminish the "thermal signature" that enemy sensors use to track troops. She said soldiers could carry smaller flexible solar panels and deploy them during the day to garner energy to recharge their personal communications equipment.

This would enable soldiers to lighten their loads of extra battery packs, which are often ditched and reveal the soldiers' presence, according to Hampel. While Iowa Thin Film's PowerFilm products are ready for field use, the Army's "type classification" process, which enables them to be rolled-out in bulk, will require one to two years of additional testing.

Iowa Thin Film's plastic-based products are a massive improvement over previous generations of solar panels that layer the panels onto less-flexible metal, company spokesman Mike Coon said. He believes the amorphous silicon products are also cheaper to produce because the panel connectors that focus the collected energy are laser-welded during the production process; standard photovoltaic panels have to be individually connected.

Coon said standard PV panels are uniform in size, but his company's products can be sliced into modules of different sizes, which maximises the efficiency of power collection. Coon said Iowa Thin Film custom-made the solar panel fabric that is layered onto tents for the Army and the smaller foldable panels became commercially available in late 2003. The PowerFilm products are more expensive than traditional solar panels, but improvements in the manufacturing process will enable them to be cost-competitive by 2010.

The Army's long-term vision is to have panels that can be camouflaged into tents or even uniforms, Hampel said. Her firm is working with Konarka Technologies to develop nanotechnology-based solar panels that can be woven directly into cloth. Konarka's technology replaces silicon with dye polymer plastics that transform any kind of light into electrical energy.

Using plastics as the basis for solar panels will result in a faster manufacturing process than silicon fabrication plants, said Russell Gaudiana, vice president of research and development at Konarka. Gaudiana likened the process to producing photographic film, and reckons the solar panels can be printed in any colour. "Our solar panels can be woven into any fabric, including tents, clothing or roofing material," he said.

The technology would reduce the price of installing solar panels on new buildings because they could be applied as part of the roof itself instead of as an additional step, according to Gaudiana. And rather than having a small solar panel on a handheld or notebook, the entire surface area could be used to boost the batteries.

Gaudiana said the technology is still in the research phase, and declined to give a timetable of its availability. It would likely be cost-competitive with other technologies initially and would be cheaper when it is mass-produced.

Companies have been producing solar panels using amorphous silicon on steel for several years, but several failed because they could not press ahead with the technology quickly enough to keep up with rigid photovoltaic systems, Maycock said. He explained the Army has continued to fund development of the technology because the materials to date have been too heavy and not cost-efficient.

"The technology has thousands of applications" if it can be made at affordable prices, Maycock said. "Imagine that if you go to the beach, the shade could be used to power a TV."

Army solar array

Meanwhile, the US military says it wants to build what could be the world's most powerful solar power plant, as part of a far-reaching effort to cut back on the service's dependence on fossil fuels.

Currently, the most powerful photovoltaic array in the United States is at Nellis Air Force Base, outside of Las Vegas. It generates about 15 megawatts of power. Other plants are in the works in New Mexico, Arizona and California that could garner up to 300 megawatts.

The army declared that it would "partner with the private sector to construct a 500-megawatt solar thermal plant at Fort Irwin, California, in the Mojave Desert, that will provide renewable power on the grid and provide the sprawling army post with added energy security against disruption of power supply."

The army has been making many bold declarations in recent years about the need to wean itself from fossil fuels. It is "imperative" that the Department of Defense "apply new energy technologies that address alternative supply sources and efficient consumption across all aspects of military operations," concluded one Pentagon report.

"Effectively immediately," thunder another, Pentagon planners must factor in "energy efficiency" when designing "all tactical systems." That's because the Defense Department is not only one of the world's largest consumers of oil and gas — guzzling "110 million barrels of premium fuel and 3.8 billion kilowatts of electricity at a cost of $13.6 billion." It is also ridiculously expensive: war-zone fuel prices can reach up to $400 per gallon.

The military's record of answering those green clarion calls has been uneven, however. For every promising, isolated effort — wind-powered bases, waste generators in Baghdad — there have been disappointments, too. Long-promised hybrid Humvees [four wheel drive trucks] never materialised and "urgent" pleas from battlefield commanders for green power stations were nixed by the Pentagon.

In a statement, the Army claims this effort will be different, because it's recruiting a "Senior Energy Council to serve as a board of directors focusing on Army energy policy, programmes and funding to leverage the Army's nationwide energy-conservation efforts."

The service also announced a number of "test" programs that the new council will oversee. There's the solar plant at Fort Irwin. A "geothermal project at Hawthorne Army Depot, Nevada, with the capability of producing 30 megawatts of clean power." Plus, six more posts that will experiment with "biomass to fuel" efforts. And the purchase of 4,000 electric vehicles "to replace oil-powered vehicles traditionally used by maintenance and operations staff for use on its posts." Whether any of these projects will actually be completed remains to be seen.

Space solar plan

Last year, a futuristic scheme to collect solar energy on satellites and beam it to Earth gained a large supporter in the US military. A report released by the National Security Space Office recommended that the US government sponsor projects to demonstrate solar-power-generating satellites and provide financial incentives for further private development of the technology.

Space-based solar power would use kilometre-sized solar panel arrays to harness sunlight in orbit. It would then beam power down to Earth in the form of microwaves or a laser, which would be collected in antennas on the ground and then converted to electricity. Unlike ground-based solar panels, power satellites placed in geostationary orbit above the Earth could operate at night and during cloudy conditions.

"We think we can be a catalyst to make this technology advance," said US Marine Corps lieutenant colonel Paul Damphousse of the NSSO at a press conference in Washington, DC, US. The NSSO report recommends that the US government spends $10 billion over the next decade to build a test satellite capable of beaming 10 megawatts of electric power down to Earth.

At the same press conference, a dozen space advocacy groups announced a new alliance to promote space solar power - the Space Solar Alliance for Future Energy. These supporters believe the technology has the potential to provide more energy than fossil fuels, wind and nuclear power combined.

The NSSO report says that solar-power-generating satellites could also solve supply problems in distant places such as Iraq, where fuel is currently trucked along in dangerous convoys and the cost of electricity for some bases can exceed $1 per kilowatt-hour - about 10 times what it costs domestically. The report also hypes the technology's potential to provide a clean, abundant energy source and reduce global competition for oil.

Space-based solar power was first mooted in 1968 by an engineer at the consulting firm Arthur D. Little. Early designs involved solar panel arrays of 50 square kilometres, required hundreds of astronauts to build and were estimated to cost as much as $1 trillion, says John Mankins, a former NASA research manager and active promoter of space solar power.

After conducting preliminary research, the US abandoned the idea as economically unfeasible in the 1970s. Since that time, says Mankins, advances in photovoltaics, electronics and robotics will bring the size and cost down to a fraction of the original schemes, and eliminate the need for humans to pull together the equipment in space.

Several technical challenges remain to be overcome, including the development of lower-cost space launches. A satellite capable of supplying the same amount of electric power as a modern fossil-fuel plant would have a mass of about 3000 tonnes - more than 10 times that of the International Space Station. Sending that payload into orbit would require more than a hundred rocket launches. The US currently launches fewer than 15 rockets each year.

In spite of these challenges, the NSSO and its supporters say that no fundamental scientific breakthroughs are necessary to proceed with the idea and that space-based solar power will be practical in the next few decades.

Above image from the Nellis Air Force Base http://www.nellis.af.mil/photos/