

Windpower and the military: an uneasy alliance

The US military is taking a lead in using economically-viable wind farms to generate low-cost energy for its installations around the US and abroad. While, at face value, this seems to be excellent news for the renewables industry, there is a potential major flaw in the plan, as PES discovers...



It was recently reported that the US Army wanted to adopt a new type of renewable energy-based technology. More specifically, they want to be able to draw on wind power to provide energy to gadgets and devices and are therefore requesting prototypes of small-scale, portable wind turbines. In recent years, the US military has placed increasing emphasis on developing and implementing environmentally-friendly technologies. In terms of sheer size, the US Department of Defense can make un-ignorable waves in this business, since it accounts for an impressive 1.5% of the nation's energy consumption.

The military has now set itself an enviable target that 25 per cent of its energy should come from renewable sources by 2025. What's more it aims to create machines and methods to help 'Main Street America' reach similar targets. By 2015, a portable solar and wind-power station at the Army's Fort Irwin in California could bring a quick return of electricity to hurricane-damaged coastal cities, said retired Colonel John Spiller. "These energy technologies may one day spread to households, as a by-product of a more efficient military," added Colonel Dave Belote, Commander of Nellis Air Force Base, Las Vegas, Nevada. The biggest solar power array in the US has been operating at Nellis in a public-private partnership.

Arguably, we in the US are following a lead already established by the Chinese in 2007. At the time, China's Commission of Science Technology and Industry for National Defense announced it was encouraging military industrial enterprises to accelerate the development of wind power. "China should fully exploit technological advantages in the military industry sector to upgrade its wind power sector and make wind power equipment a new economic growth point for the military industry," a statement said.

According to the statement, China plans to establish two to three wind power generator manufacturers by 2020 with an annual production capacity of 2,000 sets. Meanwhile, the country will establish eight to 10 key manufacturing enterprises by 2015, producing wind power equipment components with an annual production capacity worth 20bn yuan (US\$2.66bn). China boasts wind power sources of 3.2bn kw, of which one billion can be developed, according to previous reports.

Meanwhile at the US naval base at Guantanamo Bay in Cuba, four windmill towers and turbines rising from the crown of John Paul Jones Hill began powering the facility in 2005, saving an impressive \$1.5m in annual oil imports, reducing pollution and 'showing energy-starved communist neighbors what they are missing', as one source put it. The wind-generation project that provides 25 per cent to 30 per cent of the base's energy needs was described as 'a rare embrace of renewable resources for the US military, which can seldom justify the high start-up costs or efficiently extend new technologies to the small, scattered communities they serve'.

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At the Cuban base, where the population has grown fourfold since it began housing hundreds of suspected enemy combatants captured mostly in Afghanistan, favorable winds and Pentagon-mandated energy independence have converged to allow Guantanamo to boast the largest stand-alone hybrid wind and diesel power system in the world, according to its developers.

Guantanamo is unique in its need to remain separate from its communist-ruled host and neighbor, and the narrow hilltop where the four stanchions are planted cannot accommodate more. The pillars standing 185 feet above the hilltop are embedded 35 feet into the ground, each tethered below the surface with 22 'soil nails'. Other high land on the windward side of the base divided by Guantanamo Bay might be suitable, but the cost would be prohibitive compared with the benefit, a spokesman said.

More recently, the Massachusetts National Guard filed a site plan with the Federal Aviation Administration and Air Force Space Command for review of 17 possible wind turbine locations on the sprawling Massachusetts Military Reservation. The Army Guard said the project could possibly provide power

to the entire installation and help meet the state's alternative energy goals. The announcement came on the same day the Bourne Planning Board was advised of plans to locate 18 turbines north of the Cape Cod Canal on parcels in Bournedale, Governor Deval Patrick said MMR turbines would be 'a national model for clean energy development on military facilities, and at the same time it contributes to our state wind power goals'.

However, lest we be tempted to run away with the idea that the US military is in the vanguard of the move towards a greener future, it is worth bearing in mind that

there is a downside to its enthusiasm which can be summarised in one simple little word: radar.

A recent report to the Congressional Defense Committees by the US Department of Defense (DoD) Office of the Director of Defense Research and Engineering, called: The Effect of Windmill Farms on Military Readiness stated that, 'while DoD strongly supports wind energy, wind turbines located in a radar installation's line of sight might adversely impact the unit's ability to detect threats'. The study was requested by Congress under the National Defense Authorization Act (passed in 2005 and effective Jan 2006). The issue it raised subsequently held up a large number of wind farm projects, with the potential to impact adversely on the wind energy industry, which is a big consumer of composite materials as well as an economic engine for rural communities.

Fortunately, the US Federal Aviation Admin (FAA), which is responsible for impact mitigation on US Air Traffic Control radar facilities, recently approved a number of the delayed projects, including the \$630m (USD) Twin Groves farm in Illinois, after detailed review found that no problem existed. However, the potential for future delays and possible restrictions means that projects

could be shut down, threatening jobs, local economic revenue and renewable energy growth – an outcome which is both unproductive and inappropriate to the industry.

So what does the American Wind Energy Association (AWEA) make of all this? In a statement it said it 'recognizes and respects the paramount importance of national security concerns, while believing that rapid development of domestic energy sources is vital to national security as well.' The good news is that wind projects and radar systems already coexist in some locations, so we know there are solutions out there.

So what's the problem?

A radar system consists of a transmitter which emits radio frequency waves, an antenna, a receiver and a processor. An object in this radar beam – typically referred to as the target – will then reflect some of this energy back to the receiver. Processing the radar reflection from a target of interest depends upon the strength and variability of the signal at the receiver, relative to other sources. Variables include the power of the transmitter itself, the distance to the target, atmospheric effects – rain for instance – the target's radar cross-section, intervening physical objects and antenna geometry. The radar may receive reflected radiation from buildings and other objects, as well as natural and manmade radio waves from mobile phone towers and the like.

While fiberglass blades on large, utility-scale wind turbines are nearly transparent to radar frequencies – after all, most radar antennae and military aircraft radomes are made from fiberglass – they are not completely radar-transparent. Wind blades also contain several metallic components, like lightning strike ground wires and pitch-control devices, which can reflect radiation. Also, blades that contain carbon fiber in the central structural spar are certainly much less radar-transparent. The metallic towers and generators also contribute – when they rotate, utility-scale turbine blades can appear to be a radar target like an airplane because of their height, great length, aero-dynamic shape and tip speeds.

Mitigation strategies are already available, including radar software upgrades; turbine site adjustment to

accommodate the radar's line of sight; and blade design and construction modifications to reduce the amount of carbon and metal components, although the latter would have an admittedly negative impact on carbon fiber suppliers. What's more, the Department of Energy (DoE) and the National Renewable Energy Laboratory (NREL) are ready and able to undertake testing to explore mitigation strategies for a variety of wind blade designs.

Most importantly perhaps, from our point of view, decades of experience tell us that wind turbines and radar can co-exist. The busy Logan International Airport in Boston, Massachusetts, for example, has no difficulty with nearby turbines. But arguably, more telling is the fact that the US Air Force is the largest non-utility purchaser of 'green power' in the US and several active military installations have working wind turbines which provide electrical power. These include F.E. Warren Air Force Base in Wyoming and the US Navy installation at Guantanamo Bay, Cuba. Since radar and wind farms co-exist at these locations, AWEA is confident that acceptable solutions can be found in almost every case. The key is to keep an open mind and to continue the case-by-case review of projects and consultation that has led to these mutually beneficial solutions. Clearly, the wind energy industry would rather provide a solution to the problem, rather than being perceived as the originator of it.

Our cousins across the pond in Britain faced a similar quandary when their own military expressed concerns about the compatibility of wind farms and radar. The UK's ambitious plans to meet up to a third of its energy needs from offshore wind farms were placed in jeopardy because the Ministry of Defence (MoD) objected that the turbines interfere with its radar. The MoD lodged objections to at least four onshore wind farms in the line of sight of its stations on the country's east coast because they 'made it impossible to spot aircraft'. Giving evidence to a planning inquiry in October 2008, a senior MoD expert said that the turbines 'create a hole in radar coverage so that aircraft flying overhead are not detectable'.

In written evidence, Squadron Leader Chris Breedon said: "This obscuration occurs regardless of the height of the aircraft, of the radar and of the turbine."

He described the discovery as 'alarming'. The findings were the result of trials carried out in 2004 and 2005 but Britain's MoD seems to have toughened its stance more recently and it now tends to object to almost all wind farms in the line of sight of its radar stations.

Not surprisingly, the change of policy prompted fury among developers, who had previously been told that there were no defence implications for their plans. The MoD said that Air Chief Marshal Sir Jock Stirrup, the Chief of the Defence Staff, had given a firm direction that radar surveillance capability must not be degraded. It denied that it would make automatic objections, saying: "All wind farm applications are assessed on a site-by-site basis. The MoD is committed to government targets for renewable energy and whenever possible we seek to work with wind farm developers to find a mutually acceptable solution."

It did, however, add: "We look at whether turbines will be in line of sight, ie, if the radar can see the turbine. If it can, we know there will be an effect as we have evidence from trials. We decide whether line-of-site effect is manageable or not." Squadron Leader Breedon said that not only did the turbines create a radar hole directly over a wind farm but there was also a shadow beyond them which prevented low-flying aircraft being detected. He said: "The MoD trial results were alarming as they confirmed a greater impact than that previously thought. This in turn required a more robust approach to wind turbine assessments."

The British Wind Energy Association remained conciliatory. In a statement it said: "This is a very real issue for us, but we are now working with government. We are hopeful of seeing progress on this soon so that we can reach the ambitious 2020 targets for renewable power in the UK."

The Department for Business Enterprise and Regulatory Reform has described the MoD's protests as holding objections. It has created an Aviation Working Group bringing together the wind energy industry, MoD and Civil Aviation Authority to agree guidelines to solve conflicts. So it seems, like us in the US, Britain sees the value of working towards a compromise solution to the problems. Arguably the cost in lost energy output, for us all, is too high not to do so. ▀