Renewable Energy: Avoiding a National Security "Train Wreck"

Lenny Siegel Center for Public Environmental Oversight July, 2008

Slowly but surely, the United States is finally confronting the twin challenges of energy dependence and global climate change. Though largely unrecognized, the Defense Department is implementing numerous initiatives to promote energy efficiency and construct renewable energy generation capacity. However, environmental advocacy and private sector proponents of renewable energy, particularly wind and solar, are concerned that military objections to projects near military ranges and installations may delay or even prevent energy development. Looking down the figurative rail lines of energy planning, there is a potential train wreck on the horizon, but there is still time to negotiate win-win solutions.

The Department of Defense is the largest single consumer of energy in the United States. In 2006, it spent \$3.5 billion to purchase 3.8 billion kWh of electricity. Its 577,000 domestic buildings are spread across more than 5,300 sites. Combined with its annual purchase of 110 million barrels of petroleum fuel each year, and natural gas for heating its buildings and water heating, this makes the Department one of the largest—perhaps the largest—generators of greenhouse gases in the world.

But there is hope. People within the Defense Community are recognizing the need to reduce energy dependence, combat global warming, and increase electrical grid reliability. A landmark 2007 study by the CNA Corporation, *National Security and Climate Change*, found, "Projected climate change poses a serious threat to America's national security." Furthermore, a 2008 Defense Science Board study, "More Fight, Less Fuel," argued that it would be advantageous for the military, for its own reasons, to improve its energy policies. Many of its recommendations focused on deployed forces, but for domestic installations it called upon the Defense Department to "pursue the concept of 'islanding,' which would isolate critical loads, and selectively entire installations, from the grid and make them self-sufficient."

Thus far Pentagon "energy security" efforts are nascent and fragmented, but they are real. In 2007, Deputy Under Secretary of Defense (Installations and Environment) Phil Grone told Congress:

The Defense Department is one of the major leaders of the federal government in renewable energy. For example, DoD installations received over nine percent of their electricity from renewable sources in fiscal year 2006, which compares favorably to the national average of around six percent. In addition, the Deputy Under Secretary of Defense for Installations and Environment ... established a goal for the Department to procure or produce renewable energy equivalent to 25 percent of the total electricity demand by 2025, where life cycle cost effective, setting the pace for the rest of the federal government and industry.

While DoD does purchase some "green energy" locally, there are a number of base-level renewable projects that are very cost effective. For instance, the Navy facilitates the operation of a geothermal power plant at China Lake, California, and is developing an additional plant at Naval Air Station Fallon in Nevada. The geothermal plant at China Lake provides enough energy to operate the entire base. In addition, there are several wind facilities in Naval Base Coronado, San Clemente Island, California, FE Warren Air Force Base, Wyoming, Ascension Island, and eight additional projects are under consideration. DoD has multiple solar facilities and initiatives at several locations, including bases in California, Texas, and Arizona; and North America's largest solar array, being constructed at Nellis Air Force Base, Nevada, which will provide one third of the base's requirement by generating at least 14 megawatts of electricity.

Still, federal investments in renewable energy are dwarfed by the tens of billions of dollars that private companies are investing in wind turbines, solar thermal plants, photovoltaic arrays, and electricity transmission. Where private projects appear to interfere with the military's principal missions, the Defense Department is emerging as an opponent or potential opponent of otherwise viable investments. In this report, I review two such unfolding conflicts: land competition in California's Mojave Desert and concerns, across the country, that wind turbines degrade the performance of military and other radar systems.



The Western Mojave Gold Rush

Driving through the Western Mojave Desert, east of the Los Angeles Metropolitan Area, one sees a vast wasteland. It's difficult to imagine the region landpoor, but in reality there is sharp competition for the land and airspace among renewable energy companies, military facilities and ranges, endangered habitat, and off-road vehicle enthusiasts. Expanding the generation of solar and wind energy in the region will require balancing energy production and transmission against the other three uses. The West Mojave Desert area, as defined by the federal Bureau of Land Management (BLM), encompasses "9.3 million acres in Inyo, Kern, Los Angeles, and San Bernardino counties: 3.3 million acres of public lands administered by BLM, 3.0 million acres of private lands, 102,000 acres administered by the State of California, and the balance of military lands administered by the Department of Defense."

The Western Mojave's future is closely tied to its location, on the eastern edge of the Los Angeles Metropolitan Area. The California Department of Fish and Game reports:

Within the Mojave Desert region, the west Mojave has the greatest land area with the fewest protections for maintaining wildlife diversity. The western Mojave has experienced tremendous growth over the last 20 years, and that trend is expected to continue. Collectively, the 11 incorporated cities of the western Mojave grew by 25 percent in the last decade, about double the statewide growth rate, and the region's population is expected to grow from 733,000 in 2000 to 1.5 million in 2036. Existing local government General Plans provide for residential growth in the western Mojave to reach a population of 5 million.... In the western Mojave, sprawling development replaces and fragments desert habitat. Growing communities require additional rights-of-way for power lines, pipelines, and roads, further fragmenting habitat. This pattern and density of growth dramatically increases the severity of development's effects on wildlife.

The Western Mojave Desert is ideally suited for the development of renewable energy. It is near one of the nation's largest population centers; it is largely undeveloped; and it contains vast energy resources. The rugged ridgelines and mountain passes are ideal sites for wind turbines. The flatlands have some of the best insolation in the world—to those who know the numbers, 7.65 kWh/m²/day. Wind developers have submitted more than 43 applications, covering about 264,000 acres of Bureau of Land Management property in the Western Mojave, while solar developers have proposed 25 projects on 170,000 acres.¹

The Western Mojave is also home to five major military complexes: Edwards Air Force Base, China Lake Naval Air Weapons Station, its associated Mojave B Naval Range, Ft. Irwin National Training Center, and the Twenty-Nine Palms Marine Corps Air Ground Combat Center. Above and beyond the first four land installations is the 20,000-square-mile R-2508 Special Use Airspace. In addition to the 17.4% of the R-2508 shadow managed by the Defense Department (more than 2.2 million acres), large swaths are managed by the National Park Service (26.8%), Bureau of Land Management (24.6%), and the Forest Service (13.0%).

¹ Press reports give larger numbers, but they don't isolate the Western Mojave from other Southern California desert areas, and some of these proposals may exaggerate current plans for development. On the other hand, it is also likely that new proposals will be put forward.



Twenty Palms is outside R-2508. The largest Marine base in the world, it currently covers about 600,000 acres. Officially it is studying assuming control over an additional 200,000 acres of land, but Marine Corps insiders reportedly want more:

Marines must train as they fight. The Marine Corps must fulfill training requirements for a large-scale, Marine Air Ground Task Force (MAGTF). This requires more training land and airspace than is now available anywhere in the United States; the training area must at a minimum provide three maneuver corridors for a ground combat element comprised of three battalions that are simultaneously maneuvering for 48-72 hours with combined-arms live fire and the accompanying special-use airspace; a Center for Naval Analyses study shows that Twentynine Palms is the best location with sufficient land and airspace

potential to meet the training requirements... The Marine Corps will study various land acquisition options that could meet the requirement, including a No Action alternative. Many options have been looked at that involve lands contiguous to the current base range complex at Twentynine Palms. Options approved for study by the offices of the Secretary of the Navy and the Secretary of Defense (OSD) will be presented to stakeholders and analyzed in full compliance with the National Environmental Policy Act (NEPA).

Depending upon how much land the Marines seek, it is likely that expansion will impact habitat, recreational uses, and future energy production. In fact, once the Marines formerly request land from BLM, it's expected that all energy proposals in the potential footprint—including some rather large projects—will be frozen.



A short drive from population centers, the Western Mojave is also a Mecca for off-highway vehicles, including motorcycles, all-terrain vehicles, and four-wheel drive vehicles. BLM's seven off-road open areas in the Western Mojave cover over 350,000, and there are thousands of miles of additional authorized trails and access routes. The California Department of Fish and Game estimates, "In addition to resident recreationists, the Mojave Desert [as a whole] attracts 2 million off-road vehicle visitors annually." Those riders are passionate about their sport, and they express that passion effectively whenever others propose to restrict significantly their access to the desert.

From Death Valley to the Joshua Tree National Park, the Mojave Desert is home to environmentally sensitive resources. Because vegetation is sparse and threatened species are spread out over wide areas, large swaths of land are needed to protect and preserve sensitive habitats. Home to endangered species such as the desert tortoise and the Mohave ground squirrel, it is overlain with a patchwork of official "critical habitat" and slightly larger Desert Wildlife Management Areas. Though there are a number of state and local Habitat Management Plans in place, the principal vehicle for protecting desert habitat is BLM's West Mojave Plan, the March 2006 amendment to the California Desert Conservation Area Plan. Among other tools, the Plan manages the use of federal desert lands by motorized vehicles, grazing cattle, and other commercial activities.



Compatibility Issues

Competition for land in the Western Mojave is driven by the limited compatibility of the major uses: habitat, military operations, energy production, and off-highway vehicles.

To learn to what degree renewable energy generation is compatible with desert habitat and military operations, in April 2008 I joined a tour of the Solar Energy Generating Systems (units III-VII) facility in Kramer Junction, California. This facility, rated at 150 Megawatts, is among the oldest, largest solar electrical generating systems in the world. Operated by FPL Energy in partnership with Southern California Edison, the facility consists of long rows of parabolic mirrors that rotate on a horizontal axes to follow the Sun each day. The mirrors focus the Sun's heat on tubes containing an oil, which in turn is used to heat water to drive a conventional turbine power plant. Like other thermal power plans, the SEGS facility has a control room that manages the (daily) startup and shutdown of each unit. Operators also clean the mirrors regularly, and each month they replace about 200 four-foot-square mirror panels broken by the powerful desert winds.



A quick look around SEGS showed that the solar thermal technology is *not* compatible with habitat preservation. To permit free mirror-trough rotation as well as

regular maintenance, the ground beneath was leveled and scraped. The operators use both physical and chemical methods to prevent vegetation from taking root. The facility was constructed before the U.S. Fish and Wildlife Service establish criticaled habitat zones for the desert tortoise, and in fact SEGS is prevented from expanding across Highway 395 by tortoise critical habitat. Assuming that new solar farms are similarly designed, they are for now likely to be confined to areas away from threatened species.

In April 2008 the Argonne National Laboratory projected the impact of likely environmental exclusions on potentially developable acreage for solar energy in BLM's California Desert District. In the two BLM areas that make up the Western Mojave, available land would drop from 2,089,000 acres to 923,000.

Wind energy is generally more compatible with land habitat and agriculture, but in some locations—such as central California's Altamont Pass—wind turbines are perilous to bats and birds. Thus far I not heard of any particular problems with flying creatures in the Western Mojave, but it's a potential problem that should be addressed. Nationally the Interior Department has created a Wind Turbine Guidelines Advisory Committee to recommend measures to avoid or mitigate wind farm impacts on wildlife, but I did not evaluate such measures in this study.

Furthermore, the establishment of wind farms requires the construction of roadways, which may cover as much as six percent of the property. The roads are necessary to bring in towers, blades, cement mixers (for laying foundations or pads), and cranes for assembly. Not only may such road networks directly impact habitat, but unless access is restricted they can essentially invite in additional habitat-damaging traffic.



Argonne Labs also estimated the likely impact of habitat restrictions on land with potentially developable wind resources. The total for the Western Mojave is reduced from 843,000 without exclusions to 459,000 with them.

My visit to SEGS also demonstrated that solar projects are often compatible with military operations—as long as those operations don't generate dust. Kramer Junction is not far from Edwards Air Force Base, and the control room looks out at the approach to the base. Our host told a story of how a schoolteacher, accompanying her class to the same control room, asked if sonic booms from the Air Force jets broke mirrors all over the facility. At least that's what her husband, an Air Force pilot had speculated. SEGS officials not only reported that the planes did no damage, but that operators enjoyed the informal air show provided by the Air Force and occasional space shuttle landings. Now Edwards, following the lead of Nevada's Nellis Air Force Base, is planning its own major solar generating project.



On the other hand, the high-speed, low-level flight operations by Air Force and Navy pilots in the area face physical compatibility issues with wind power—in fact, with any activity utilizing tall towers. (I address radar interference in a separate section below.) Planes fly as low as 200 feet above ground level. Wind turbines, usually built on mountaintops and ridgelines, often have tip elevations as high as 400 to 600 feet above ground level. To reduce hazards and avoid restrictions on military flight operations, the Navy and Air Force negotiated a zoning overlay ordinance with the wind industry. Adopted by Kern County to cover its unincorporated areas, the ordinance uses a zoning map with colors representing various allowable structure heights, Any tower proposed to exceed the zone height would need military approval for the County to approve the project.²

The Height Restriction Zoning provides the military with protection against a form of encroachment while providing wind energy firms with the predictability they need to plan projects. It also serves as a model for how parties with distinct but orthogonal—that is, not antithetical—interests can work together to find mutually acceptable solutions to difficult problems.

Solar energy appears to be incompatible with nearby off-highway vehicle use, because in the desert such vehicles, like tracked military vehicles, stir up dust than can quickly degrade performance. On the other hand, motorized recreation may in cases be compatible with wind farms. At a site proposed for wind development within BLM's Johnson Valley Off-Road Vehicle Area, FPL Energy proposes to allow off-roaders to ride up to and around the wind turbines themselves, while still fencing off the proposed electrical substation.

Private off-road vehicles simply are not allowed onto military bases in the region, but there is no apparent conflict with military overflights elsewhere in the special use airspace.

Off-road vehicles are particularly damaging to habitat. Fish and Game summarizes:

The 1980 California Desert Conservation Area Plan referred to off-road vehicles as the "most pervasive management issue in the area." Along with direct collisions with desert tortoises and other wildlife and the crushing of animal burrows, off-road vehicles compact soils, induce erosion, spread invasive plant species, and denude the landscape of vegetation. Off-road driving or riding has essentially a nonrestorable impact on some desert habitat; damaged soils and perennial vegetation are not likely to recover for several hundred years or more. Revegetation efforts on disturbed upland areas of the Mojave are expensive and have had little success.

The West Mojave plan addresses the motorized vehicle impacts by limiting access to the most sensitive areas, calling for increased enforcement, and education

Finally, some military operations threaten habitat while others protect it. Environmentalists opposed the annexation of 110,000 acres by Ft. Irwin because of anticipated harm to desert tortoises. The Army expanded the base anyhow, relocating 800 threatened tortoises. This backfired when coyotes ate 23 the transported tortoises. Now environmental groups are suing, arguing in addition that the tortoises were moved to inferior habitat containing diseased tortoises.

² Similarly, I recall the Marine Base at Camp Lejeune, North Carolina getting the adjacent town to move a cell-phone tower located in or near a Marine helicopter flight path.

More generally, Fish and Game found:

Military training activities utilize large areas of the Mojave landscape. Bases and training centers occupy 2.6 million acres, or 13 percent, of the land area. Some of the most degraded lands and some of the most pristine habitats are on lands managed by the Department of Defense. In areas of the U.S. Army's National Training Center at Fort Irwin and the Marine Corps Air Ground Combat Center at Twentynine Palms, where warfare is practiced with heavy tracked armored vehicles, significant tracts are nearly denuded of plants, and the soils are hard packed. However, in other areas of Fort Irwin, Edwards Air Force Base, and China Lake Naval Air Weapons Station (NAWS) there exist some of the best representative habitats of the desert region, protected from public access and destructive land uses.

In many parts of the country, from Ft. Bragg, North Carolina to the North Shore of Oahu, the military has overcome the challenges of on-post habitat protection by partnering with other agencies and non-profit conservation groups to create adjacent buffer zones, under what is now known as the Readiness and. Environmental Protection Initiative. Installations find such buffer zones essential to environmental compliance when they increase their intensity of use within their boundaries. Thus, development activities—including wind farms and solar projects—that do not directly encroach upon military operations may still affect them in the long run, if they reduce habitat or potential habitat that the military may someday want to satisfy its environmental obligations.

One Big Table

Government agencies have established a number of forums for resolving the competition for ownership and use of the Western Mojave's fragile landscape. Here I profile three of the most imporant.

First, the R-2508 Joint Land Use Study (JLUS), a collaborative planning effort among three military installations—China Lake, Edwards Air Force Base, and Fort Irwin surrounding counties and cities, and other affected agencies, addresses all lands beneath the R-2508 Complex or in the vicinity of the three bases. Funded by the Defense Department's Office of Economic Adjustment, the JLUS released a draft document in March 2008 recommending 61 distinct strategies for sustaining the military mission while promoting both the economic vitality of the region and protecting public health, public safety, and the natural environment.

The JLUS is a strong, positive program, but thus far it has not addressed the challenges posed by the rapid, impending energy gold rush in the R-2508 shadow.

Second, in May 2008 the Bureau of Land Management announced the scoping, in cooperation with the U.S. Department of Energy (DOE), of a programmatic environmental impact statement (PEIS) assessing "the environmental, social, and economic impacts associated with solar energy development on BLM-managed public land" in California, Nevada, Arizona, Colorado, New Mexico, and Utah. The legal and practical significance of the study was lost in the coverage of BLM's controversial, since-reversed moratorium on new solar project applications.



The BLM-DOE study is an essential step in managing the energy gold rush in the Western Mojave and elsewhere, but it is not designed to address military requirements in the region. Furthermore, as a document "owned" by government agencies, the PEIS development process is likely to be a "comment and response" dialogue, rather than a collaborative process or negotiation among equals.

Third, and most promising, is the Renewable Energy Transmission Initiative (RETI). Sponsored by California's energy agencies, its purpose is "to help identify the transmission projects needed to accommodate these renewable energy goals, support future energy policy, and facilitate transmission corridor designation and transmission and generation siting and permitting." RETI is a model multi-stakeholder dialogue: "an open and transparent collaborative process" with participation from state and federal agencies, public and investor-owned utilities, energy generators, and non-profit advocacy organizations.

Because the siting of transmission lines and energy generation projects are inextricably linked, RETI will propose competitive renewable energy zones (CREZ) for the Mojave Desert region. RETI's Environmental Working Group is defining a category of lands, including wilderness areas and state and national parks, off limits to energy development, as well as a second list, including land designated critical habitat, where development will be restricted.

The Defense Department sends a representative to RETI, but thus far the Initiative has not devoted substantial effort to the relationship between military activity and energy development. All major installations in the region are planning renewable energy projects, and at least one, Ft. Irwin, is planning to become a self-contained energy "island," but the bases will not be included in the CREZs developed by the Initiative.

Each of the existing forums for addressing military, energy, and habitat issues in the Western Mojave has its value, but I believe there is a need for an overarching discussion, in which all of the parties—including OHV representatives—are at the table, planning land use in the Mojave. RETI might be the basis for this, but since its program and process are well established, it might make sense to create a separate umbrella discussion group including many of the same interests.

Only by addressing all the bilateral tensions at a single table can lasting solutions be developed. The Western Mojave—particularly its BLM and Defense lands—should be viewed as a jigsaw puzzle, By addressing all four imperatives—energy, military, habitat, and recreation—at once, it may be possible to develop win-win solutions. For example, a military base might propose to open up a portion of its land, beyond what it needs for energy self-sufficiency, to commercial renewable power production, in exchange for banking off-site habitat protection. Balancing such complex concerns will not be easy, but in the absence of a single forum, it's likely that the various study groups will come up with competing solutions for the same Western Mojave land mass.

A Issue that Should Be on the Nation's Radar Screen

In late February the Kern County, California Planning Commission voted to approve the PdV 300-turbine wind farm near Rosamond, in the Western Mojave desert, over the objections of Northrop-Grumman. The giant Defense contractor warned that radar interference from the project, when built, would force it to close its nearby Tejon Test Facility. The company conducts classified research on radar-eluding stealth technology there, and it asserts that any interference would undermine its studies.

About the same time, the Air Force gave the green light to Shiloh II, a new wind project in the Montezuma Hills, in central California between the San Francisco Bay Area and Sacramento. The 700 existing turbines in the area were already showing up on air traffic control radar screens at nearby Travis Air Force Base, and more than a year earlier the installation had opposed approval of Shiloh II, with as many as 88 more.

Modern wind turbines, blades of quickly moving steel a few hundred feet above the ground, are exactly the types of objects that radar systems, whether for air defense, air traffic control, or target acquisition, are designed to detect. It should not be surprising, therefore, that wind power systems show up on military, homeland security, and Federal Aviation Administration radars as interference. The protection of such radar systems could undermine the growth of wind power in many parts of the country, but only a handful of people in government and the wind power industry are paying attention. If the U.S. is to move smoothly toward the official U.S. goal of 20% wind energy—as a share of the electricity supply—we will have to come up with the science, resources, and policy to overcome the growing conflict between radar and wind power.



The interference caused by wind turbines is real, but there appears to be very little data quantifying the problem. How many turbines, of what size and at what distance, does it take to prevent a radar system from doing its job? Do the functional consequences vary from region to region? Windmills cause clutter, but at numerous locations military radar and wind turbines operate compatibly.

While some offices at the Air Force have at least some of the data and expertise to evaluate the potential radar impact of proposed wind turbine projects, that expertise clearly is not found at the installation level. Furthermore, the catastrophic consequences of radar failure—a collision between aircraft or worse, a terrorist attack—means that decision-makers are inclined to object to proposals wherever there is uncertainty. In March 2006 the Defense and Homeland Security Departments enacted a policy that they would contest wind power projects proposed within line of sight of radar systems, effectively halting development at a number of Midwestern sites. Later that year federal agencies clarified that the line-of-sight criterion simply means that more careful evaluation is necessary.

Typically, wind projects need approval from both local and federal agencies. At Montezuma Hills and Rosamond, the Air Force and a government contractor expressed opposition at local planning hearings. At the former, local officials were reluctant to approve any action that might, down the road, lead to an economically costly base closure. In general, however, local officials are hesitant to block rewarding investments such as wind power due to issues, such as radar operations, that they know little about.

A more daunting obstacle is federal approval. The principal federal process for screening proposed wind projects is the Federal Aviation Administration's (FAA) Obstruction Evaluation. As its name implies, it is a process that was established for an entirely different purpose: preventing the construction of physical obstacles in airplane flight paths. The FAA acts as a clearinghouse for all other federal agencies, including the Department of Defense. In the past the FAA (at least sometimes) evaluated wind farms early in the development process, but today its web site reports:



Inside the tower of a high-tech 1.5 MW wind turbine

Due to resource limitations, the FAA can no longer support feasibility studies for proposed Wind Turbine projects. The FAA must have all Wind Turbine

configurations at the time of your filing to accurately evaluate the cumulative effect of the entire project as it pertains to the national airspace system.

Some wind project proponents have sought approval instead through the Department of Commerce's National Telecommunications and Information Administration, which coordinates with other federal agencies through the Interdepartment Radio Advisory Committee. This process also suffers from the fact that it was set up to address an entirely different question: radio transmission.

Hard-working federal officials have tried to make these processes work, and resources permitting, a long-range radar office in the Air Force has tried to supply answers to wind power companies in advance of their submissions to the FAA, letting them know whether specific development sites were likely to generate opposition further down the approval process. However, with the explosion of new wind projects across the country, the Air Force, like the FAA, doesn't have the resources to promptly conduct site-specific analysis.

Furthermore, while there are some sites where wind turbines promise no radar interference, and others where radar operators will always find them unacceptable, a large number of sites lie in a grey area. That is, wind farms can operate in these locations with proper mitigation. In January 2008 the Jason group, affiliated with the MITRE Corporation, explained:

There is no fundamental physical constraint that prohibits the accurate detection of aircraft and weather patterns around wind farms. On the other hand, the nation's aging long-range radar infrastructure significantly increases the challenge of distinguishing wind farm signatures from airplanes or weather.

Progress forward requires the development of mitigation measures, and quantitative evaluation tools and metrics to determine when a wind farm poses a sufficient threat to a radar installation for corrective action to be taken. Mitigation measures may include modifications to wind farms (such as methods to reduce radar cross section; and telemetry from wind farms to radar), as well as modifications to radar (such as improvements in processing; radar design modifications; radar replacement; and the use of gap fillers in radar coverage).

The wind-power industry is willing, perhaps anxious to build mitigation into its projects, but from the national security perspective it's imperative to build mitigation into radar technology, because U.S. forces operate throughout the globe, in and over areas where wind power operators might not be so willing to please. At Montezuma Hills, a key reasons that the Air Force agreed to wind farm expansion was that it was already planning to upgrade its radar from an analog to a digital system more capable of filtering out wind turbine clutter.

Since wind turbine towers are stationary, and the movement of the blades is repetitive, it should be relatively simple, from a technical point of view, to use digital signal processing to reduce or even eliminate interference. With digital systems, this may only require a software upgrade. However, on a national scale, upgrading both land-based and mobile radar systems could take time and large sums of money. The cash-strapped armed services are unwilling to accept new obligations, particularly in response to a new, externally imposed requirement. In other words, why should the military and Department of Homeland Security be forced to undertake a wholesale revamping of their radar systems just because someone else plans to make money installing and operating windmills? At Montezuma Hills, the wind developer—who faced money-losing delays from the Air Force after making a substantial investment—at one point reportedly offered to donate \$1 million toward the solution. In general the wind industry is willing—and able—to pay its share, but at this point there is no legal or regulatory framework for determining what a fair share from industry might be.

As far as I know, our legal system has no ground rules for judging radar interference. Does a wind developer have a right to build wind turbines if they meet the rules already established for land use and energy transmission, or does the operator of a radar system have a right to scan the skies without interference from distant structures? In the absence of a framework for weighing such conflicting requirements, one can expect continuing fights over the establishment of new wind farms.

Finally, a solution is not on the horizon because there is no one at the Defense Department "in charge" of resolving the problem. Travis Air Force Base withdrew its opposition to the Montezuma Hills expansion only after a four-star general, the commander of the Air Mobility Command, approved it. The Deputy Under Secretary of Defense (Installations and Environment) recently established a point of contact in the Environmental Readiness and Safety Office. A career civilian official at the Department of Defense, he is doing an excellent job of reaching out to the wind industry, but he lacks the resources to develop solutions and the clout to approve projects on behalf of the various operating commands.

Steps toward Solutions

The first step in resolving the contradiction between wind energy and military radar operations is to place a high-level official in charge, with the resources in hand to develop technical solutions and the authority to prioritize implementation of mitigation techniques. The Defense Department, in cooperation with an obviously willing wind industry, needs to collect more data so it can better predict, avoid, and even ignore interference from wind turbine facilities. They need to develop reliable mitigation technologies as well as a plan to implement them where they are needed most. This will take real money, but in the context of the overall size of the military budget or even current wind energy investment levels, it's a price the nation can afford, particularly if implemented in phases.

The second step is to reverse the federal approval process. That is, instead of having project developers bring in complete project proposals for screening, an umbrella body with participation from every agency and office responsible for operating radar should create radar-safe wind energy zones, similar to (perhaps overlaid on) the CREZ being developed by RETI and similar organizations in other states. I've heard that Texas created such zones for wind power, but without Defense or Homeland Security participation. Like RETI, the wind-power "zoning" body should include participation from generating companies and utilities; state, tribal, and local governments; and non-governmental organizations. The new process would differ from the existing approaches in two critical ways: First, it would be one-stop shopping. All entities with a potential reason for excluding property from wind-power development must sit at the same table. Second, it would eliminate blind-alley investments. That is, wind developers would not have to do detailed technical planning or make large speculative investments to find out whether a proposed project would pass the radar interference test, nor would they have to disclose privileged information to competitors.

Like the Kern County height ordinance, the national wind zone map could describe not just radar-free and wind-free zones, but a large middle ground, in which the density and size of proposed projects is matched with the proper level of mitigation. At this time, there is enough land in the U.S. suitable for wind energy development significant growth, based upon today's science. As we fine tune the technology and gradually upgrade existing radar systems, more land will become available.

Even if all parties agree on a common approach, it will take a few years to fully implement it. However, there is no reason for wind power development to grind to a halt. Rather, the goal should be to negotiate win-win solutions before the collision between wind and radar—the proverbial train wreck—is unavoidable. Congress and the executive branch must recognize how destructive such a train wreck would be, and take action now. The nation needs wind energy, and we still have enough time to work toward the 20% goal without sacrificing the national security and air traffic control functions with which it might collide.

Understanding the Whole Picture

National security, environmental protection, and economic vitality are all important objectives of the federal government and our nation as a whole. Because the other two goals sometimes conflict with the Defense Department's principal missions, the Department has for the past several years developed and refined analytical tools for understanding "encroachment," the conflict between Defense training or operations and external activities. Now renewable energy development is emerging as a national goal with momentum of its own. Currently subsumed in those tools for analyzing encroachment, under the categories of economic growth or environment, the role of energy should be upgraded. Wind, solar, and other renewable energy sectors are good for the economy and good for the environment—of the entire planet—and they are growing at remarkable rates. The Defense Department, if it acts quickly, can ensure that renewable energy development strengthens, rather than threatens, the Department's national security objectives.