

# Removal and Restoration Costs in California: Who Will Pay?

by Paul Gipe

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With signs that repowering may finally be getting underway, removal and restoration costs come to the fore. Who will pay the estimated \$100 million in unfunded liabilities that aging wind turbines represent in California?

New data from California indicates that it may be more expensive to remove wind turbines and restore their sites than previously thought. It was widely believed by California's wind plant operators that the resale value of used turbines or their value as scrap metal would offset the cost of turbine removal and site reclamation. This may not be the case new data suggests for several reasons. Removal costs may be higher than first expected and salvage values may be lower than once thought. Thus, the costs to remove the 1,200 MW of first generation turbines still standing in California could exceed \$100 million. WindStats looks at what it will cost, what is entailed, and who will pay.

## Removal and Restoration Costs

The cost of removing wind turbines, their towers, and other equipment varies considerably in California. This is partly due to different reclamation requirements between counties for turbines on private land and between the counties and the federal government for turbines on public land. For example, the U.S. Bureau of Land Management requires partial removal of the foundation. Kern County does not. Similarly, Alameda and Riverside counties and the BLM require removal of non-operating wind turbines. Again, Kern County does not. But all jurisdictions demand that if turbines and their components are removed, they must be disposed of properly. No on site burial, for example, is permitted with the exception that Kern County permits the burial of turbine foundations.

Finova Capital of Paramus New Jersey recently found that compliance with its conditional use permit in California's Alameda County will require it to restore its site in the Altamont Pass at a cost of \$150,000. Much of the cost is for treating the large foundations of Finova's 20 Wind Energy Group MS2 turbines to three feet (one meter) below grade. Fortunately for Finova, Alameda County does not require removal of the entire foundation or the costs would be significantly higher. Even so, restoration will cost Finova \$7500 per turbine or nearly \$30/kW of installed capacity, excluding the cost of removing the turbines. Finova is now looking for someone to buy the 250 kW turbines and pay for their removal.

The Central California Power Agency has announced that removal of its 132 MW Coldwater Creek geothermal plant and restoration of the site in northern California will cost \$10 to \$20 million, or \$75 to \$150/kW. If costs are similar in California's wind plants, and it appears that these costs are within this range, it could cost from \$5000 to \$10000 to remove a 65 kW turbine and restore its site.

In preparation for installing seven new Micon 600 kW turbines near Palm Springs, SeaWest removed 85 Enertech 40 kW machines from a site on public land just west of Indian Ave. Removal of the turbines and their foundations cost \$290,000 or \$85/kW. Of this 55% of the total was the cost to remove the turbines.

Interestingly, removal and disposal of the Enertech's concrete foundations was less costly than once feared. The BLM required SeaWest to remove the three pier foundations to three feet (1 meter) below the desert surface. SeaWest's contractor excavated the loose desert soil around each foundation and tipped the concrete pier over, then backfilled the hole.

Green Mountain Power's John Zimmerman reports that it cost \$15000 to \$20000 to remove the Vermont utility's two Kenetech 56-100s from Mt. Equinox. In this case removal costs alone were \$75 to \$100/kW of installed capacity. GMP left the pier foundations in place. At the high end is the estimated removal costs of Sandia's experimental 34 meter diameter Darrieus turbine at Bushland, Texas. The U.S. Department of Agriculture estimates that removal will cost \$120,000. Disassembly and site restoration will bring the total to \$325,000 or \$650/kW for the 500 kW turbine.

The USDA's costs are significantly higher than those in California for two reasons. First, they are removing only one turbine. There are no economies of scale and they have little experience removing turbines. Second, USDA has a higher reclamation standard than that typical in California. USDA's Ron Davis notes that this is just a rough estimate for restoring the site at the experiment station to agricultural use. Davis says USDA will entirely remove the concrete pad upon which the Darrieus turbine rests, but will remove only the top five feet (1.5 m) of the turbine's guy anchors.

Some claim they can do it for less--much less. One is Oak Creek's Hal Romanowitz. "It depends on the turbine," he says. "Bottle towers (old Danish 'rocket' towers) are the worst. We just cut them with a torch and fell them like a tree." In this way Oak Creek eliminates the cost of the crane needed to lower the tower. This may be the cheapest solution by far.

That's the same reasoning that led Pacific Gas & Electric years ago to fella its Mod-2 in Solano County in a dramatic televised end to the utility's experiment with wind energy. It could cost \$500,000 or more to remove Hawaii's giant Mod-5b, the last of its line, in the traditional manner.

Section 28 owners association's Peter Banner says site restoration can cost as little as \$600 to \$800 per turbine based on his experience with turbines in the San Geronio Pass. The total cost to remove a typical first generation machine and restore the site could be no more than \$1,500 to \$2,000 per turbine or only \$20 to \$40/kW.

Difko's removal of Difwind's Micon turbines on Section 28 near Palm Springs cost less than expected. Difko, now Foras, says that the total cost was less than budgeted in part because the large number of turbines involved, 132, permitted economies of scale. Difko's Micon turbines were located on public land and the BLM required partial removal of the foundation, once thought to be the most expensive aspect of site reclamation.

For some, such as Greg Jaunich of Northern Alternative Energy, there was never any question of removing the foundations when NAE repowered their Sibley, Iowa site. Total costs to lower and disassemble the site's five WindMatic turbines, and excavate the foundations were only \$19,000 or \$58/kW, including transport and disposal. "I don't understand how you could be in the renewables business and leave the site in anything but its natural state," says Jaunich. "Maybe it's a Midwestern attitude, but it would be a black mark against your reputation if a farmer found you'd left anything behind."

### **Site Restoration**

The BLM's Palm Springs office requires operators to remove the turbines and towers, pull all electrical cable from underground conduits, and remove foundations to 3 feet (1 meter) below grade. The latter, removing parts of the foundation, has appeared more daunting than it has proved to be.

The BLM's Claude Kirby says that when the Section 28 Owners Association were clearing their site of some 300 turbines they brought in a hydraulic chisel mounted on a back hoe. Called a "concrete breaker" in the trade, the device is used on highway reconstruction projects in the United States to break concrete roadbeds and it made quick work of chipping the foundations.

While this equipment made quick work of the deep pier foundations on the Whitewater Wash it may take more time to remove the floating pads used elsewhere in the San Geronio Pass. Some pads for tubular towers are only 5 feet (1.5 meters) deep but are 28 feet (8.5 meters) square.

Unlike the pier foundations, which may reach 20 feet (6 meters) deep, these floating pads, says Kirby, will have to be removed in their entirety.

The BLM's Ridgecrest office has yet to specify its restoration requirements. The agency has struggled vainly for several years to order removal of defunct Aeroman and Bouma turbines from the Windsource site alongside Hwy. 58, and Windmatic turbines on the Southern California Sunbelt's Mojave site, also near Hwy. 58, the major thoroughfare through the Tehachapi Pass. Ahmed Mohsen of BLM's Ridgecrest office says in his experience costs range from \$2000 per acre to \$10000 per acre (\$5000 to \$25000 per hectare) depending upon the level of earthwork and post removal monitoring needed. For comparison, the average coal mine in Maryland spends \$4,500 per acre (\$11,000 per hectare) for site reclamation.

There is no reclamation requirement in Kern County's wind energy ordinance. "Because there's such a variation in (Tehachapi Pass) sites and kinds of footings used," says the county's Larry Garratt, no specific action is dictated. Typically Kern County demands that operators sheer all bolts and anchors flush with the ground surface and cover foundations with 15 to 18 inches (about 1/3 meter) of soil. "We want it done in such a manner that it doesn't look like an Indian burial mound, but we don't require any concrete removal." The intent in litigious California, says Garratt, is to eliminate hazards to man and beast.

Garratt did say that all man-made materials must be removed from the site. The common Tehachapi practice of cutting blades into sections for use in rip rap to control erosion is prohibited. Fiberglass blades and all other materials except broken concrete must be removed from the sites and disposed of in "an approved manner." The concrete must be free of reinforcing bar or it too must be removed from the site.

The most complete restoration to date has been that on the Whitewater Wash near Palm Springs. Not only did the BLM require removal of the turbines, towers, transformers, cabling and accumulated debris, they also required operators to "knock down" berms alongside access roads and rake the sites. The berms are a feature common to wind plant service roads in Southern California that are not seen elsewhere. Repeated grading leaves a mound of displaced soil along both sides of access roads. The BLM stipulates that these be regraded onto the former road surface, and the packed road surface "ripped" to encourage revegetation with native desert plants.

Despite the reluctance of some operators to even consider foundation removal, the task may not be as difficult or as damaging to the surrounding terrain as once thought. Jerry Herling has found that it "takes longer to remove the turbines than to reclaim the sites." Herling

should know. He's removed more wind turbines in California, some 400 to 500 machines, than any other contractor. Herling took only 24 days to remove SeaWest's 85 Enertechs and, using a hydraulic chisel on his back hoe, to bury their foundations.

Sensitive that poor reclamation practices can do as much damage as initial construction, Herling says he "tries to stay on (existing) roads as much as we can and try to limit the disturbance to the site. We also try to use previously excavated earth for backfill."

While the BLM's reclamation practices are the most extensive in California, the former wind plant sites are clearly discernible for their lack of vegetation, especially desert shrubs. Still, the BLM sites on the Whitewater Wash stand in marked contrast to sites on private land across Interstate 10 that were repowered by Kenetech with their KVS 33 turbines. At the Kenetech site, unused foundations, trash, broken wind turbine parts, and an occasion old wind turbine such as an ESI 54, Vawtpower, or Storm Master lie scattered across the site.

Herling, whose firm Jerry Herling Construction restored both Difko's and SeaWest's sites on the Whitewater Wash to BLM's standards, says "We're proud of our work." Indeed, they could be the model for reclamation elsewhere in California.

### **Salvage Values Plummet**

Cannon's widely publicized problems peddling its used Micon turbines in India and a dearth of a market for wind equipment--new or used--in North America has caused the market for used turbines, if one ever existed, to collapse.

Last year at this time industry consultants were fielding numerous calls from Indian entrepreneurs seeking used wind turbines. Though there was a flurry of activity, few transactions took place. Cannon's Micon turbines, probably some of the best used turbines California, were eventually installed in India but only after much difficulty.

Cannon's Micon turbines had been previously reconditioned by Difko and were probably good for another ten years of operation. If there's no market for Danish turbines recently reconditioned by a reputable operator, then who will buy the remaining thousands of Danish machines that are nearing the end of their useful lives in California? Scrap dealers?

Scrap value too is subject to the whims of the market. Some turbines are worth no more than the scrap value of the metal used to make them. Others contain marketable components such as generators and gearboxes. It all depends on the turbine, says Oak Creek's Romanowitz.

Mogul Energy sold the scrap tube towers from its recently repowered Liberty Wind farm for \$500 to \$600 each. FloWind is earning top dollar, about \$0.30/pound (\$0.66/kilogram) for the aluminum blades from its 17-meter Darrieus turbines while the torque tube is also highly valued at \$185/ton as straight pipe. Altogether, FloWind could be receiving as much as \$3000 per turbine in scrap value. FloWind refused to comment on what it was paid for the 17 meter Darrieus turbines it recently scrapped in Tehachapi, saying the information was proprietary.

Used Carter 25 towers are available at Oak Creek for \$600 as is. Because these are hinged towers that can be lowered to the ground with a winch, they have found application supporting the 7-meter diameter Bergey Excel. The Oak Creek site in the Tehachapi Pass is littered with several dozen of the remaining towers. The rotors and nacelles had previously been removed and shipped to Palm Springs as spare parts for the 60 Carter 25s still operating out of a fleet that one time numbered 350.

Scrap steel is selling for \$75/ton in California, Herling says. One 40 kW Storm Master and tower will weigh nearly 2.5 tons and earn about \$200 in scrap value, or \$5/kW. The much heavier Danish machines earn up to \$750 for the tower and \$1500 for the nacelle or \$30 to \$40/kW.

Currently there is also value in the generators and gearboxes on Danish machines. Because there are so many Danish machines still operating in California, there's a market for spare parts. Generators and gearboxes alone can be sold today for more than \$1000. But what will happen when thousands of first generation Danish machines enter the salvage market and there are fewer and fewer 65 kW and 100 kW Danish turbines needing spare parts?

Even at today's prices it appears that Danish wind turbines are worth little more than \$3000 in scrap value or about \$50/kW and that's well short of what it could cost to remove a 65 kW or 100 kW turbine and tower with a crane and properly restore the site, for example, to BLM standards.

## **Net Costs**

Wintec has had the lowest net removal costs yet. They were able to scrap the 177 Jacobs from their Riverview site at no cost. A scrap dealer lowered the turbines on their hinged towers, cut the towers into manageable lengths and loaded them onto trucks with an electromagnet. Wintec hasn't had to yet face restoration cost since Kenetech repowered the site with its KVS 33 turbines.

As seen earlier, removal and restoration costs range from less than \$50/kW to more than \$100/kW, and salvage values vary from \$5/kW to \$50/kW. Overall net costs could thus span from a simple break even to

nearly \$100/kW. No one knows for sure and no one is considering who will pay when the bill comes due.

## **Unfunded Liabilities**

In California, property owners are ultimately responsible for disposal of industrial facilities on their property. They are also liable for any hazardous materials left on site. Property owners include not only absentee landlords, real-estate speculators for the most part, long-time local residents, but also the American public in the case of sites under the jurisdiction of the Bureau of Land Management.

At the old Airtricity site in Tehachapi, landowners have had to hire a contractor to remove the remaining Windmatics and Storm Masters and to restore the site abandoned by the long-defunct wind company. In the Altamont Pass landowners will likely be stuck with removal costs of Storm Master turbines that have become a safety hazard to SeaWest employees servicing nearby Micon turbines.

There are some 50 MW of early first generation turbines, such as the Storm Masters, remaining in California. Very few of these are still operating or remain in service. Removal of these turbines and restoration of their sites represent, at a minimum, \$2.5 million in unfunded liabilities.

In 1988, consultant Bob Lynette estimated that 1,000 machines in California were so poorly designed or manufactured that they were unsalvageable. Lynette's estimate may have been far too conservative. More than 3,000 turbines comprising 230 MW of California wind capacity may be unsalvageable and best suited for the scrap yard.

Yet these early machines are just the tip of the iceberg. There are nearly 12,000 turbines of first generation designs. The gross cost to eventually remove these machines and restore their sites, if repowering does not proceed, is staggering: from \$60 to \$120 million.

Sales of scrap metal could cut the final bill substantially, but if wholesale removals begin in earnest, scrap values could fall sharply. Optimistically, if removal and restoration cost only \$50/kW and salvage earns \$30/kW, there are still \$20/kW in net costs. Even this modest sum could easily cost landowners and taxpayers \$23 million.