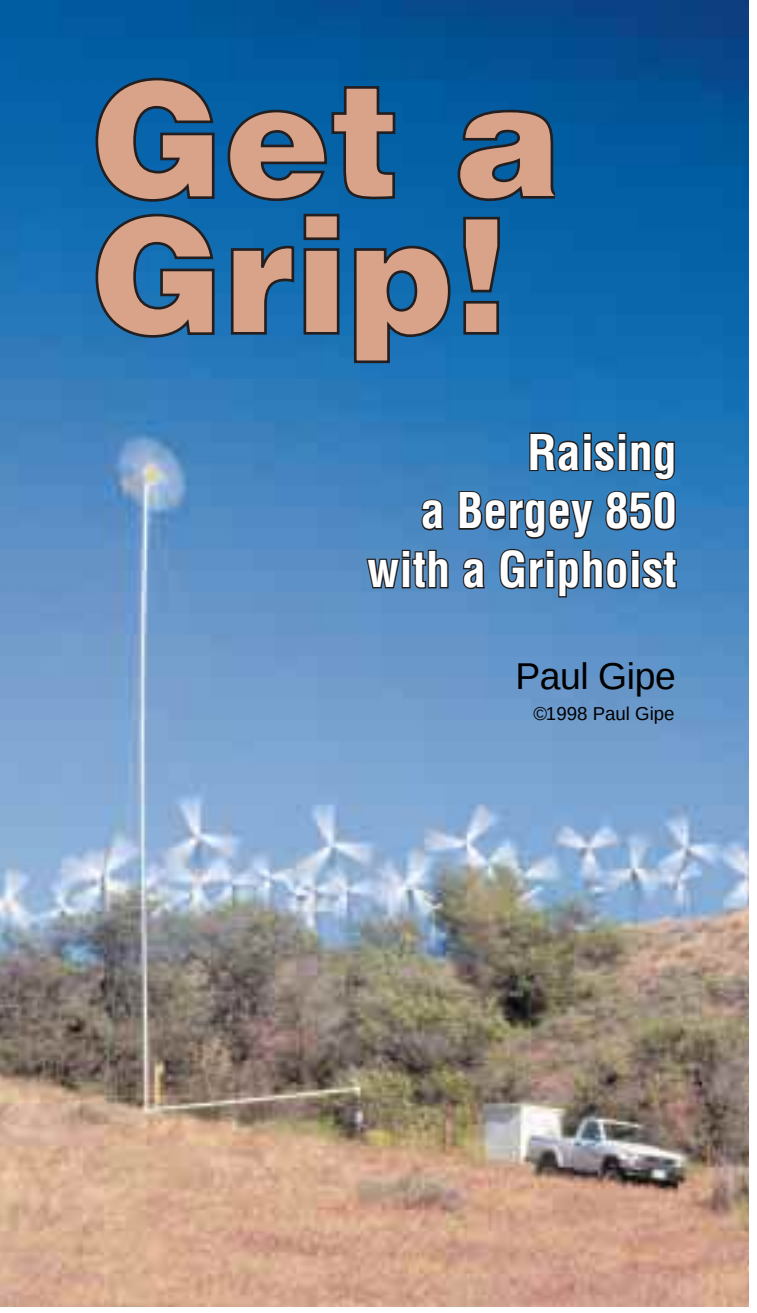
Get a Grip!

Raising a Bergey 850 with a Griphoist

Paul Gipe



Above: A Bergey 850 installed on a 64 foot NRG tower. One of the world's largest wind farms is right next door.

Many users of small wind turbines opt for guyed, tilt-up towers because of their simplicity and lower costs. And everyone who has chosen a guyed tower to support their small wind turbine has had to face a difficult question: How do I raise it? Next to servicing a wind turbine atop a tower, there is no more dangerous aspect of using wind energy than raising and lowering a wind turbine and its tower.

The most common technique here in the United States is to raise the tilt-up towers with a truck or tractor. I've never been a fan of this approach and I've long wondered if there is a better way. The griphoist, a simple hand winch, may be the answer. While no system is foolproof, using a griphoist can reduce the chance of accidents when raising and lowering a tower.

For me, this question came to a head when my wife Nancy Nies and I decided to install a Bergey 850 (BWC 850) on a nearly inaccessible site in southern California's Tehachapi Mountains. Ed Wulf, a local pioneer of off-grid living, provided the site so that we could experiment with small wind turbines.

Because of the difficult access and our desire not to bulldoze any roads, we chose NRG's lightweight, guyed, tilt-up tower system that uses thin-walled steel tubing. These lightweight towers are easily transportable and don't require concrete anchors. Today they are widely used in the wind industry as meteorological (met) masts. The BWC 850 was designed specifically for NRG's 4.5 inch (114 mm) diameter mast.

Considering our site and our inexperience, we chose the 64 foot (19.5 m) tower. We thought that NRG's 44 foot (13 m) tower probably was too short to clear nearby trees, and we felt that their 84 and 104 foot (26 and 32 m) towers were more than we wanted to handle in our first project.

The quest to find a griphoist suitable for raising the Bergey 850 on NRG's tilt-up tower began when I saw Niels Ansø use one to lower a Whisper 1500 at the Folkecenter for Renewable Energy in Denmark. It seemed like an ideal way to raise and lower small wind

Right: Author Paul Gipe begins to install one of the five screw anchors.

Above: The screw anchors can be driven by hand.

turbines on hinged towers. So when I began planning to install our own BWC 850, I naturally thought of using one myself.

"It's a good way to raise a windmill," says Scoraig Wind Electric's Hugh Piggott. It gives you "plenty of time to check things." Zephyr North's Jim Salmon agrees. Salmon, a Canadian meteorologist, uses a griphoist to raise 164 foot (50 m) NRG anemometer towers in Canada. "They are easier to control" than either electric winches or vehicles, he says, "and in some cases much safer."

Griphoists

A griphoist is a compact portable winch which passes the hoisting cable through the body of the device rather than wrapping the cable around a spool. The griphoist is operated manually by using one of two short levers protruding from the top of the hoist. One lever is used to pull cable through the hoist, the other to pay out cable in controlled increments. A griphoist also includes a detachable handle that fits over either one of the hoist levers. The length of the handle is governed by the rated load of the hoist, and special shear pins are built in to prevent overload.

With the help of Hugh Piggott, Niels Ansø, Jim Salmon, and NRG's Dave Blittersdorf, I was able to track down this hoisting tool that I'd seen used in Denmark. To Hugh this tool is a tirfor. To Niels it's a wire talje (hoist). Jim calls it a griphoist.

It's all of the above, and more. Tractel, the manufacturer, officially calls this hand winch a griphoist-tirfor-greifzug product. Griphoist

Above: NRG tower sections slip fit together and seat firmly when the tower is raised.

pretty much says it all in English. But the tool was originally sold as a tirfor, which in French says much the same thing. "Tir" comes from the French for pull, but it can also mean heave as in the maritime expression "heave ho." "For" is probably a shortened form of fort, French for strong or powerful. Greifzug is the German equivalent "greif" for taking hold or gripping, and "zug" for pulling.

This tool, whatever you call it, was patented by Simon Faure in 1945. Tractel began manufacturing them in 1948. Today, Tractel claims 70% of the griphoist market worldwide with plants in France, Luxembourg, Germany, Canada, and Brazil. Griphoists are used throughout the world for a variety of applications that include raising wind turbines and met masts. Griphoists are also used in the United States, mostly in industry. However, most folks here still raise tilt-up towers using a truck or tractor.

Risky Business

Using a vehicle for tower raising is just too risky for me. I've used a truck with block and tackle to salvage wind machines back in the 70s and I had one or two near misses that I've never forgotten. And I've installed Bergey 1000s on guyed towers in Pennsylvania using a truck and gin pole. It was always, shall we say, exciting. The NRG tower looks like a long strand of steel spaghetti. Raising it with the jerky motions common to a vehicle-driven lift seems like a recipe for disaster.

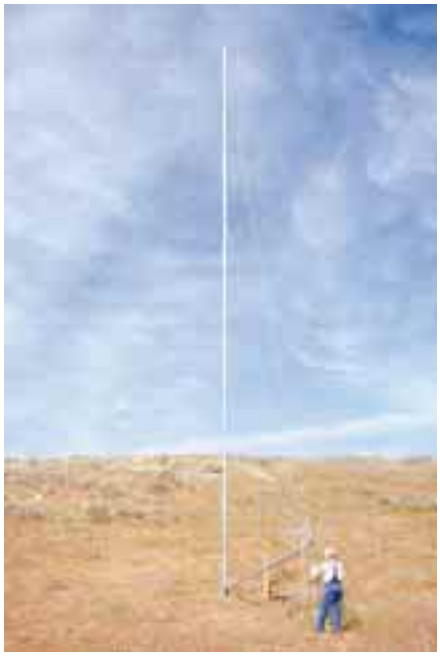
Below: Unreeling the guy cables. All attachments to the guy bracket are swaged, simplifying assembly.

Above:The gin pole bracket showing the hoisting cable (left), nylon rope for steadying, and three lifting guys to tower (right).

Properly using a vehicle for raising a tilt-up, guyed tower also demands a large crew. Altogether, I'd need half a dozen people. Mick Sagrillo recommends two on the truck and one for each anchor. Also, our site is remote. Crew members would have had to hike in or be trucked in. Once there, they'd be there all day. We'd have to feed and entertain them while I was readying everything. Then if there were any glitches, I'd be in the awkward position of either forging ahead and taking some chances I'd rather not take or asking everyone to come back another day.

As it turned out, my fears were justified. There was indeed a glitch. When we went to connect NRG's prefabricated lifting cables to the gin pole, one was too short. These measured lifting cables are one of the three key elements in NRG's tower system. The other two key features are the use of hand-driven screw anchors instead of concrete, and tower sections that slip together without bolts. Without the correct lifting cable, we had to postpone the tower raising one week while NRG air freighted a new set of top guy cables. Since there were just the two of us there that day, we were under no pressure to continue so we spent the rest of the day frolicking among the wildflowers.

Another facet of the communal approach to tower raising is often overlooked: you can quickly wear out your credit with friends and family. Communal tower raising is like Amish barn raising, bringing people together for a common purpose. But barns last indefinitely. You put it up and it stays up. Not so with a wind turbine. Whether we like it or not, small wind turbines do need repairs



Above: Raising the tower the first time, without the wind turbine, using the griphoist.

and we have to bring them down before we can haul them off to the local windmill doctor. Some turbines are up and down a lot. Gathering six people together every time you want to raise or lower your turbine would get old quickly. Since our purpose was experimentation, we wanted a system that would allow us to raise and lower the turbine as needed, with as few people as possible. A hand winch seemed like the best solution.

Now, I haven't raised a tower or installed a wind turbine in fifteen years. I am basically a paper pusher—keyboard pusher is more descriptive—and my tool skills are a bit rusty. I lost my spud wrench in the mud at the base of an 80 foot (24.5 m) Rohn SSV tower in 1983 and I haven't seen a spud wrench since. So, I wanted to take my time to ponder my next move. I didn't want a bunch of our friends standing around twiddling their thumbs and asking, "Hey, are we going to install this windmill or not?"

Electric winches are usually used here in the States to install the NRG towers for met masts. Installers typically power the winch with a truck battery. I didn't want our new truck in harm's way during my first attempt at raising an NRG tower. Of course, we could have lugged a battery up there to power the winch. But that didn't seem like a great idea either. Battery, winch motor, cables, connectors—seems like a lot of places for something to go wrong. With an 1100 pound (449 kg) load on the winch line, and a $2,000 BWC 850 at the end of a 64 foot

Below: Using the Super Pull-All to lower the tower. The cable passes through the body of the griphoist.

(19.5 m) fishing pole, I didn't want any surprises. By comparison, the hand operated griphoist seemed like such a simple, straightforward, and safe way to raise a tower.

Winches and Come-alongs

Before I got the terminology straight, I made the mistake of calling a griphoist a "come-along." This is a lightweight tool found in North American hardware stores that uses a small spool for coiling a short length of wire rope, often only ten feet long. Ranchers, for example, use come-alongs to tighten fencing, and for that they don't need much cable.

It's the spool or drum that sets come-alongs as well as winches in general apart from griphoists. Technically, griphoists are not winches. Winches use a drum to spool the hoisting cable, like the large drum on a crane. Griphoists, in contrast, pull the hoisting cable directly through the body of the hoist, without rolling it up on a drum. Tractel likens the locking cams inside the griphoist to the way we take in a rope "hand over hand." To use a griphoist, you move a lever forward and back. This pulls the cable through the tool. The hoisting cable for a griphoist can be any length since there is no need to spool the cable on a drum. Capstan winches can also use cables of any length, but they pass the cable over a drum.

Like come-alongs, griphoists can "float" between the load and the anchor for the hoist. Electric winches and hand-cranked mechanical winches are all intended to be mounted to something solid, like a boat deck or the frame of a sport-utility vehicle. Griphoists are also portable. You can lug them into places you wouldn't want to haul an electric winch and battery or where you can't drive your 4x4. All in all, the griphoist sounded good, but then I'd never actually used one before. After consulting with Dave Blittersdorf at NRG about the hoisting loads, I ordered Tractel's Pull-All.

Below: The tower almost down. The forward lever on the griphoist is used to pay out cable.

Above: Adjusting cable tension. The NRG tower system doesn't use turnbuckles which allows for quick adjustments under less than ideal site conditions.

Tractel's Pull-All

You could call the Pull-All an entry-level griphoist. It was inexpensive and it would have done the job except for one serious drawback: neither the hook on the hoisting cable nor the hook on the body of the griphoist had safety keepers. You can never predict what may happen when you're raising a load; often there are some jerky movements despite your best efforts. Safety keepers or latches keep the hooks engaged when there's unintended slack in the cable. NRG's Blittersdorf as well as our local Tractel reps offered to replace the stamped metal hooks with hooks using keepers, but I wanted to test the griphoist right out of the box, so we sent it back.

Above: Tightening wire rope clips. Remember, "Never saddle a dead horse."

Next we ordered the Super Pull-All, the Pull-All's bigger brother. It's a real tool. At 8.3 pounds (3.8 kg), the Super Pull-All weighs twice as much as the Pull-All. It has twice the working load (1,500 pounds / 680 kg), and it comes with safety keepers on both forged hooks. At $390, The Super Pull-All isn't cheap, but good tools never are. It's shipped with 10 meters (32.8 ft) of 1/4 inch (6 mm) wire rope and two wire rope slings. You can order a longer cable if you need it.

Tractel also makes three other sizes. For example the T-508 griphoist is suitable for raising the BWC 850 on NRG's 84 foot (26 m) tower, and the T-516 is suitable for raising the BWC 850 on NRG's 104 foot (32 m) tower. If it included safety keepers, the inexpensive Pull-All would be ideal for raising the BWC 850 on NRG's 44 foot (13 m) tower.

Using the Griphoist

To use NRG's tower system, the

Above: Raising the tower again, this time with the Bergey 850, takes some effort. Going slow allows time for double checking.

hoist or the hoisting tackle must be anchored directly below the gin pole when the tower is fully upright. The twenty foot long gin pole is comprised of two ten-foot sections. If the hoisting anchor is farther than the length of the gin pole from the tower base, the sections could come apart, endangering the lift. NRG provides a safety cable to prevent this from happening, but no one wants to tempt fate.

The 44 foot (13 m) tower, which uses a 20 foot (6 m) guy radius, uses the forward guy anchor to secure the hoisting tackle or winch. Because the guy radius is larger on NRG's taller towers, they require a separate lifting anchor. So our 64 foot (20 m) tower, with its 35 foot (11 m) guy radius, uses a separate lifting anchor 20 feet (6 m) from the base of the tower. There are five anchors altogether, one for each of four guy cables, and one gin pole or lifting anchor. We attached the griphoist to the lifting anchor with one of the wire rope slings.

When raising a tower with a gin pole, one of the first challenges is raising the gin pole itself. We attached the hoisting cable to the top of the gin pole with a shackle. With the sling, the hoisting cable was just long enough to thread through the griphoist while the gin pole was still horizontal. Nylon ropes from the top of the gin pole to the side anchors kept it from tipping either way. We first used the griphoist to raise the gin pole upright. That was a piece of cake. Then we slowly raised the tower, inch by inch. While I operated the griphoist, Nancy kept tension in the rear guy cable with a tag line, standing well clear of the fall zone.

Below: Not quite up yet. Using the griphoist allows for taking in or paying out cable as needed.

Above: Checking the tower for plumb. The turbine will only yaw properly on a plumb tower.

The griphoist pulls a few inches of cable on each stroke of the rear hoist lever, both on the back stroke and on the forward stroke. Because it's a simple mechanical device, you can actually feel the tension in the cable. This gives the operator a tactile sense of the load. When the loads are high, the lever is harder to move than when the loads are light. The loads in tower raising are greatest when the tower is just off the ground and least as the tower nears the vertical. Operating the griphoist takes the most effort when the tower first begins leaving the ground.

Griphoist ratings

Griphoist Model	*Capacity lbs (kg)*	*Cable Dia. in (mm)*	*Weight lbs (kg)*	*Cable Length ft (m)*	*Price $*
Pull All	700 (318)	3/16 (4.75)	3.9 (1.8)	32.8 (10)	115
Super Pull All	1500 (680)	1/4 (6.3)	8.3 (3.8)	32.8 (10)	390
T-508	2000 (907)	5/16 (8.3)	14.5 (6.6)	32.8 (10)	495
T-516	4000 (1814)	7/16 (11.5)	30 (13.5)	32.8 (10)	679
T-532	8000 (3629)	5/8 (16.3)	51 (24)	32.8 (10)	1170

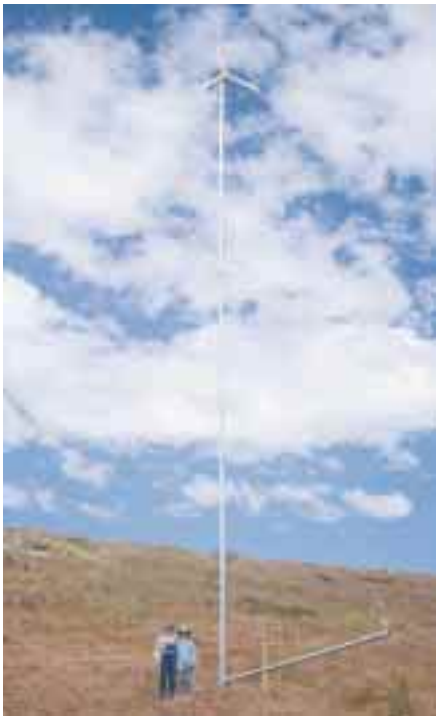
We spent a whole day on the initial tower raising. It took a lot of time because our site is far from ideal. In fact, it's on the side of a hill! I've never tightened and loosened wire rope clips so many times in my life. After we practiced plumbing the tower, we lowered it. It was easy to use the griphoist to let the tower down. The griphoist has two levers, one for pulling in cable, and one for letting it out. You simply use the forward lever to operate the hoist in reverse to pay out cable.

On the next visit, we mounted the turbine on the tower and repeated the raising sequence. The eighty pound turbine increased the weight of the lift by 60 percent, and I could clearly feel it in the griphoist. It took a lot more muscle than raising the tower alone. Rather than grumbling about the frequent adjustments to the guy cables, I found myself using the adjustments as an opportunity for a short breather. "Ah, I think those cables need adjusting," I found myself saying.

We raised the tower in less than one hour. It took another hour to plumb the tower and tighten the guy cables in a stiff wind. Though it wasn't a stroll in the park, physically operating the griphoist during the early part of the lift wasn't very difficult. It became much easier once the tower reached about 45 degrees. After the tower was upright and the Bergey began whirring, Nancy said, "I thought there was going to be a lot more to it than that. It was a lot simpler than I thought." That was the whole idea.

Adjusting Cable Tension

Unlike traditional towers with anchors at exact positions relative to the tower, the NRG system was designed for quick installation under field conditions. The guy cables are tensioned by hand. As the tower is raised and lowered, the guy cables may need adjusting. This system can't use pre-formed wire grips or turnbuckles unless the anchors and tower are all perfectly aligned. Because of the frequent and sometimes large adjustment necessary in guy cable tension, we used wire rope clips. Pre-formed wire grips require so much unwrapping and rewrapping that they lose their effectiveness in this sort of application.



Above: The new American Gothic. The griphoist allowed us to slowly and safely raise our BWC 850 on a difficult hillside site.

In our case, the anchor eyes were at different elevations and slightly out of perfect alignment. This was due to the slope of our site and because I screwed some anchors down closer to the ground than others. These misalignments cause tension in the cables to vary during the lift. The thin-walled tubing used on the NRG towers easily buckles. So it's necessary to adjust cable tension as the tower is being raised and lowered. If everything was perfect this wouldn't be necessary. But our site was far from perfect.

Tower Height

Since I've been such a stickler about adequate tower height in my books, I was concerned that the 64 foot tower wouldn't clear nearby obstructions. But I didn't want to work with a taller tower either, at least until I gained some experience with the NRG tower system. Fortunately, the 64 foot tower was sufficiently tall and gives us about twenty to thirty feet of clearance above some nearby willows—our only trees. It also gave us sufficient clearance from the hilltops overlooking the site.

Turbine Thrust

After the installation, we returned to the site to check on the turbine, which is a good idea. One of the wire rope clips had slipped and the tower was no longer vertical. A stiff wind was blowing and the tower was pulling against the top cable that had slackened.

In the NRG system, the guy cables are tightened by hand. Let's just say that I wouldn't want to try this with a BWC 1500 in a strong wind. Nor would you ever want to make the mistake of not using the friction of pulling through the guy anchor eye to help hold the cable after loosening the wire rope clips. While it was never in danger of getting away from me, I was immediately conscious that I had to really lean into tensioning the cable and not make any mistakes. As it was, the thrust on the turbine was too great for me to get the tower top back to vertical. I got it to where I was comfortable with it and we left well enough alone as we were planning to lower the tower a few days later.

Lowering the BWC 850 with the Griphoist

Because we would be traveling for an extended period, we didn't want to leave the turbine unattended and thought it best to lower the tower. Though we've raised and lowered the tower only twice, we are quickly

becoming proficient. The lowering went smoothly. As I developed a sense of how the tower behaves, I found it necessary to adjust the guy cables much less often. The down side is that there were fewer breaks from operating the griphoist lever. The cable moves only a few inches with each stroke of the lever. So, to lower the tower you need to operate the lever quite a few strokes. As an office type, I am not accustomed to all that activity and my shoulder muscles were sore for a few days afterward. But lowering the tower was uneventful, which is the way we like it.

Griphoists for the Rest of Us

While little has been written about griphoists, it's surprising the number of people who have used or are now using them. Bergey Windpower, for example, has been using griphoists for remote installations since 1993, when they used one to raise a 10 KW Excel on an offshore platform. Though you won't find any mention of griphoists in Bergey's installation manual for the 850, they recommend griphoists to their overseas clients, says Pieter Huebner, Bergey's field technician. When a heavy-duty drum winch isn't available, Huebner prefers the griphoist to raising a turbine with a vehicle. The griphoist "is much safer and gives much better control," he says. It "eliminates the possibility of miscommunication" between the vehicle driver and the tower crew.

The experience of Scoraig Wind Electric's Hugh Piggott mirrors that of Huebner. A griphoist is "hard to beat for erecting tilt-up towers, because it is slow and fail-safe," says Piggott. "Unlike using a truck or other vehicle to raise a tower, the operator of the winch has full control of the operation, and there's no dependence on hand signals or risk of missed cues." If you have to buy any tool for your off-grid wind system, Piggott recommends buying a griphoist. After using one myself, I agree.

Paul Gipe is the author of *Wind Power for Home & Business* (Chelsea Green Publishing, 1993), and *Wind Energy Comes of Age* (John Wiley & Sons, 1995). Gipe introduces griphoists in his new book *Wind Energy Basics: A Guide to Small and Micro Wind Systems* scheduled for release in early 1999 by Chelsea Green Publishing.

Disclaimer: I paid for all the components mentioned in this article and I have no affiliation with the manufacturers. In the mid 1980s I did some work for NRG. In the early 1980s I was a Bergey dealer. —Paul Gipe

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Access

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