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Harnessing the Wind When There Is No Wind

There is no doubt in my mind that we will continue to depend on fossil fuels to generate a large percentage of our electricity for the foreseeable future. The United States used fossil fuels to generate 67% of the electricity that was consumed in 2013 (www.eia.gov/tools/faqs/faq.cfm?id=427&t=3).

The important thing is that scientists, engineers, and technologists all recognize the need for us to shift to environmentally friendly alternatives as soon as possible. Until we can beam electricity down from Earth satellites, we need to find other environmentally friendly electricity-generating alternatives as soon as possible.

Altaeros Energies

Photo 1—The buoyant air-borne turbine (BAT) is a super-sized wind turbine that floats inside a monster-sized helium donut.

The problem with wind generation is that it doesn't work when the air is still. The two wind technologies that are described in this month's column can generate electricity even when the air is too still to properly spin a ground-based wind turbine.

When you don't have even enough of a breeze to ruffle leaves on the trees in your backyard, the air about 1,000 feet above your head is colder and often has very strong winds. Thinking outside of the box, a group of MIT graduates decided that a wind turbine floating 1,000' up in the air would be the perfect way to generate electricity in disaster zones or other locations not connected to a functioning electric grid. They formed the company Altaeros Energies, and after a great deal of testing the company is now set to install their floating wind turbine near Fairbanks, AK.

The BAT (buoyant air-borne turbine) is a super-sized wind turbine that floats inside a monster-sized helium donut. (See Photo 1.) Very strong tethers connect the BAT to the ground. Its automated control systems adjust its altitude to catch the best winds. These systems also turn the BAT so its turbine is always facing the proper direction to catch the maximum amount of wind. Since its ground station is built physically to fit on a trailer (Photo 2), the BAT can quickly be set up as soon as the trailer reaches the place where it is needed. The Alaska installation will supply off-the-grid electricity at 18 cents per kilowatt hour.

Valentin Angerer

Photo 2—Since its ground station is built physically to fit on a trailer, the BAT can quickly be set up as soon as the trailer reaches the location where it is needed.

The second new wind-based technology is a ground-based system that promises to deliver wind-generated electricity when natural winds don't exist. Solar Wind Energy Inc. has designed the Solar Wind Downdraft Tower shown in Photo 3. Their tower creates a very strong downdraft wind, which then turns all of the wind turbines that are located around its base.

The company says that their hybrid solar-wind tower system will generate electricity on windless days. The system requires heat from the sun to constantly keep the tower as hot as possible.

A water pump carries water to the top of the tower where it is continuously sprayed as a fine mist across the tower opening. Gravity causes this fine mist to fall through the hot tower. As it drops, the cold mist cools the hot air of the tower, which creates a downdraft with wind speeds as high as 50 mph. The flow-

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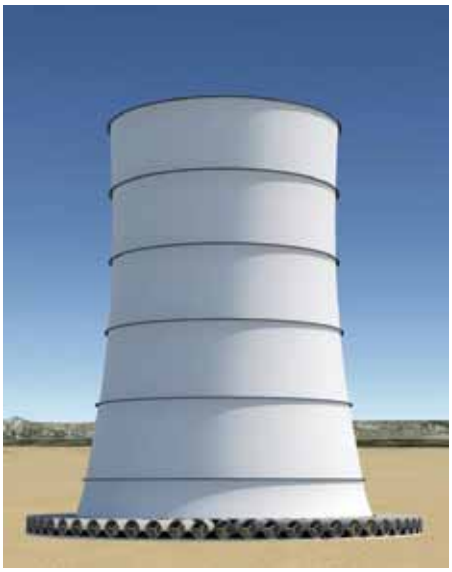

Solar Wind Energy Inc.

Photo 3—The Solar Wind Downdraft Tower creates its own downdraft wind and uses this wind to turn all of the wind turbines that are located around its base.

ing wind is then channeled into the different wind tunnels that surround the base of the tower. At the end of each tunnel, a wind turbine uses the artificial wind to generate electricity.

The height of the tower can vary depending on where it is built. The one that will soon be built in San Luis, AZ, will be 2,250' tall. This system uses electricity to pump water to the top of the tower and a hot solar-heated tower to create a wind downdraft to turn the wind turbines. The laws of thermodynamics cannot be violated, which means that the natural energy supplied by the sun, gravity, and falling mist must provide much more energy than it takes to pump the water around the system.

At this time, the operational feasibility of the tower has been established using computer simulations.

A Fox News broadcast that you can find on YouTube highlighted the plans to build the first Solar Wind Downdraft Tower in San Luis, Arizona (www.youtube.com/watch? v=EiFL4qsWaKE#t=50). In a May 2014 conference call, Ron Pickett, the CEO of Solar Wind Energy Inc., indicated that the construction of the San Luis tower will be completed in 2018. This plant will sell electric power to Arizona and California.

Recalling the Facts

1. How are these two technologies similar and how are they different?
2. The Solar Wind Downdraft Tower uses electricity and water to interact with natural forces to generate electricity. What happens to the output of the tower if these natural forces don't supply enough energy?
3. Can the operators of the system replace these natural forces by increasing the amount of electricity they feed into the system? Why?