Highest Wind LLC response to FAA docket 2011-1279 regarding Airborne Wind Energy Systems (AWES).

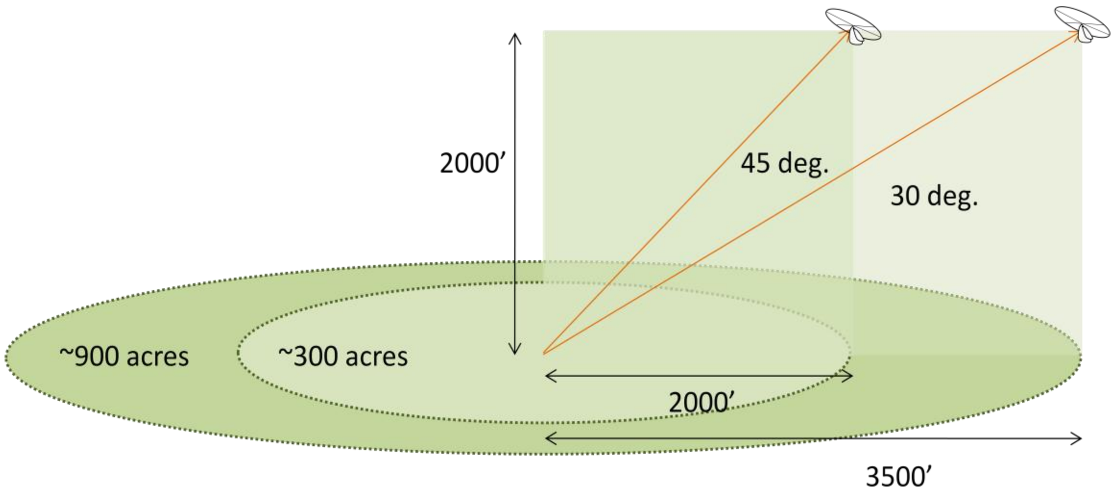
Dimitri Cherny
Founder, CEO
Highest Wind LLC

February 3rd, 2012

General comments on all AWES from Highest Wind LLC.

1. ***All American AWE system developers are years away from commercialization. We are all currently in the development and test phase and will likely remain here for the next three or four years before any of us have systems ready for purchase.***
2. ***Unlike other aircraft, development of AWE systems requires frequent, and eventually continuous flight testing, day and night in all weather conditions for weeks and months on end. Longevity, survivability, and extremely low maintenance requirements are the keys to the commercial feasibility of AWE systems. Only by keeping AWE systems in the air for months at a stretch will any developer be able to determine whether their system is ready for commercialization. We are all essentially designing flying vehicles that must be as reliable as wind turbines – more reliable than the best existing passenger aircraft.***
3. ***Testing of AWE systems must occur at all the altitudes at which they will eventually be allowed to fly commercially. Testing at lower altitudes will enable us to confirm flying vehicle designs but not entire system designs enough to confirm commercial feasibility.***
4. ***Cost-effective testing of these designs will require a minimum of restrictions on marking and lighting. Early test systems will all be considerably smaller than final commercially viable systems, meaning the additional weight, drag and electrical generation requirements imposed by lighting and marking devices on small test systems will adversely impact testing and development.***
5. ***Final commercially viable systems will generally be larger, better able to handle the additional weight, drag and electrical generation requirements of lighting and marking devices.***
6. ***Many AWE systems in development utilize "cross-wind motion", flying nearly perpendicular to the wind at high speeds. Such motion across the wind induces high levels of drag in the tether, a problem many developers are struggling to overcome. The addition of flags or lights on the tether would increase tether drag even further, compounding this problem to the point that many otherwise successful AWE designs might become completely infeasible.***
7. ***As a group, we AWE developers believe we can find a number of private land-owners around the country willing to host our flight testing. These private lands would each have hundreds of acres of uninhabited land adequate in size to contain our "flight cylinders", in windy and***

remote areas already located in Class-G airspace and experiencing virtually zero aircraft traffic below 3,000 AGL.



1. Diagram of AWES "Flight Cylinder" and size of footprint depending on flight angle.

8. ***If the FAA can designate a specific number of no-fly zones up to 2,000 feet AGL above these private lands, our testing and development could continue unhindered.***
9. ***In a few years, as AWE developers approach final designs ready for commercialization and have a better understanding of how the additional burdens of weight, drag and on-board electrical generation requirements will impact their systems, further clarification of the marking and lighting requirements should be made.***
10. ***What we are suggesting is a two-phase approach to the regulation of AWES. During the testing phase for the next few years, limit us to specific testing areas we find free of other aviation but reduce our burden of marking and lighting to an absolute minimum and allow us to fly in these areas up to 2,000'AGL. After our systems have reached commercial viability and we have a better understanding or what our systems can handle, let us all re-visit the issues of marking and lighting, location and permitting.***

Responses to the questions posed by the FAA regarding AWES.

•General information on a developer's specific AWES design concept and plans for operation.

o What type(s) of mechanical devices are you employing to keep the system aloft?

Highest Wind has arrived at an autogyro design which we believe will eventually stay aloft in wind speeds as low as eight mph and as high as eighty mph. Our AWES is of the "ground-gen" type employing a relatively lightweight flying vehicle (the "glider") which ascends, pulling the tether, which spins a generator in the "Energy Trailer" on the ground. At the end of each ascent, the glider quickly descends while the tether is reeled in. At some minimum altitude the descent stops and the ascent cycle starts over again. Ascent/descent cycles will complete every minute or less, possibly ranging from 500'AGL up to 2,000'AGL depending on which altitudes have wind speeds of more than 20mph. On the eventual commercially viable system, each ascent of the glider will pull the tether with more

than a ton of force at a speed of no less than 20mph producing as much as 100kW of power during the ascent. Continuous energy output of the system will be some percent of that maximum – TBD – based on duty cycles, overall system efficiencies, and wind speeds aloft. We have found a continuous energy output of 30kWs to be the sweet-spot for our target market of US farmers.

o What are the physical dimensions of the device(s) with relation to the above?

Our eventual market-ready system will have a rotor diameter of less than 50 feet with a small body suspended beneath it no taller than 20 feet. We still have a few years of development and testing before final dimensions will be available. During those years our testing will be done on systems no smaller than about a ten foot diameter weighing about thirty pounds.

o What kind of materials will comprise this device?

At this point we are unsure if our system will use rotor blades made of aluminum or some sort of composite material. The internal structures of the body will be primarily composed of aluminum with some sort of plastic aero-shell around the body. For the next couple of years of testing our rotors will continue to be made of wood.

o What are the operational dimensions (requirement for airspace) for the system?

Our system will fly no lower than about a 30 degree angle above the horizon. At an elevation of 2,000 feet (our maximum preferred altitude), depending on wind direction, our flying vehicle could be anywhere (downwind) within a virtual flight cylinder (see diagram above) with a radius of 3500 feet (contained within a square space of 1,125 acres). At an elevation of only 1,200 feet (our minimum preferred), the flight cylinder reduces in size to be contained within a 405 acre square. We anticipate that further testing will determine that our angle above the horizon will be considerably higher than 30 degrees, further reducing the ground-space requirement.

o Is there a requirement to operation more than one device in the air?

Each of our systems will operate independently and will most likely eventually be purchased in quantities of one by our target buyers in the US - farmers.

o What are your long-term plans for this system?

We intend to bring this system to commercialization and sell it in the US, primarily to farmers in rural areas within Class G airspace.

•Marking and lighting.

o Can you comply with marking and lighting requirements?

If the marking and lighting requirements to be complied with are those described in FAA Advisory Circular 70/7460 – 1K, Chapter 11 "Moored Balloons and Kites", the answer is "no". Those marking

requirements are overly burdensome and the lighting requirements would make our system commercially and technically infeasible. See details below.

o Can you identify any impacts to your system when complying with current guidance for marking and lighting standards?

The current requirement for anti-collision lighting the same as for towers (L-864 and L-865) will require the development of new lights meeting those standards which have half the weight, size and energy requirements of those available today. However, that seems like it could be possible within the next few years.

The requirement for the same lights on the tether at 350 foot intervals would make our system commercially infeasible given the current or future technologies for those lights. We have no easy way to provide power to those lights along the tether and would face extreme difficulties with any system to attach or detach those lights as the tether is reeled in and out. Similarly, the current requirement for flags every fifty feet on the tether would be very difficult to achieve.

o What are your plans or how is your system designed to make the system conspicuous to the flying public?

We are planning to sell our system for use only where there is no flying public. My pilot training stressed remaining above 3,000 AGL at all times other than for landings and take-offs. Having toured agricultural areas in more than forty states, I know virtually zero aircraft other than the occasional crop duster fly below 2,000 AGL in class-G airspace more than five miles from any airport. That said, we plan to provide adequate anti-collision light on the flying vehicle to make it conspicuous to pilots in all weather conditions.

•Safety to other airspace users and persons and property on the ground.

o What safety mechanisms or devices have you designed into the system to ensure all aspects of aviation safety?

At this point, only anti-collision lights and an on-board alarm (described below) have been considered for aviation safety. Should the worst-case situation of a tether-break occur, as with any tethered flying vehicle, our vehicle will be unstable in un-tethered flight, settling quickly to the ground.

o What safety mechanisms or devices have you designed into the system to minimize or mitigate hazards to persons or property on the ground?

We intend to sell our system only to farmers and other single large land-holders with primarily uninhabited agricultural land large enough to contain the entire flight cylinder footprint. That said, in a worst-case situation of a flying vehicle crash, an on-board alarm will sound whenever the vehicle descends below some pre-designated altitude. However, long before an imminent crash, the system is designed to reel the flying vehicle in at a speed adequate to keep it aloft and under control to pull it to a safe landing upon its landing platform.

•Minimized impacts to NAS facilities.

o What are your plans or how is your system designed to reduce a large radar cross-section and become less conspicuous to surveillance systems?

Our eventual flying vehicle ready for commercialization will utilize a rotor no larger than that of a BlackHawk helicopter with a body below the rotor less than one quarter the size of the BlackHawk.

o What are your plans or how is your system designed to reduce impacts to any communication or navigation systems supporting the NAS?

We anticipate no impacts to communication or navigation systems from a vehicle no larger than a BlackHawk helicopter.