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# The quest to find alternative sources of renewable energy is taking to the skies



Sky WindPower, based in northern California, aims to use helicopter-like turbines to harness high winds

Mike Harvey in San Francisco

Man's search for renewable power is about to take to the skies. Companies and inventors are casting their hopes — and millions of dollars — upwards as they seek to exploit the strong, steady winds circling the planet at higher altitudes.

High-altitude wind power — essentially putting wind turbines in the air — received a recent boost when half a dozen companies and other entrepreneurs met at a conference in northern California to discuss how to get their businesses off the ground.

Wind power is accepted as an important part of the planet's search to replace energy from fossil fuels. Recent research into high-altitude winds has shown that jet-stream winds can be far more powerful and reliable than winds closer to Earth's surface, providing an immense source of energy if companies can find a way to tap into it at a reasonable cost.

Analysts estimate that more than \$50 million (£30 million) in investment is being put into high-altitude wind power. A host of start-ups and established companies are jostling for position, each with unique proposals for capturing the force of the wind.

One proposed generator resembles a big floating ball that rolls in the wind, tethered by an electric cable 1,000ft off the ground. Another looks like a helicopter, with four huge rotors designed to fly nearly five miles into the sky. A third proposal involves a ladder of kites driving a generator, while a fourth project, backed by Google, turns the momentum of a huge kite at altitude into power.

A recent report by Cristina Archer, Assistant Professor of Energy, Meteorology and Environmental Science at California State University, Chico, found that high-altitude winds blow at speeds of more than 300mph and are spread across the globe.

Ken Caldeira, Professor of Global Ecology at the Carnegie Institution for Science, who co-authored the report in the journal *Energies*, has said that there is enough energy in the high-altitude winds to "power civilisation 100 times over".

Sky WindPower, a start-up based in Oroville, northern California, is still at the prototype stage with its Flying Electric Generator. It has the most ambitious target of sending its helicopter-like turbines high into the atmosphere, at heights of between 6,000ft and 24,000ft. The generator has four rotors at its tips to lift the device into the air. The rotors are designed to spin in the wind once the generator has reached its desired height. Each blade could be 10.7 metres (35ft) in diameter. A tether made of aluminium cable would carry power to the ground and help to keep the device in place.

Len Shepard, the company's chief executive, said that larger versions of the device could generate up to 20MW of power, compared with five megawatts produced by the biggest terrestrial wind turbines. A prototype with seven-metre blades was on track to be launched in 2011, he said.

Experiments so far showed that electricity could be produced, in the long term, at less cost than conventional electrical generation. "The technical challenge is keeping control of the craft at such great heights," Mr Shepard said, adding that

the tethering and turbine technology was already proven. Commercial production was five years away, he added.

The devices, which would barely be visible in the sky at such great heights, would need their own restricted airspace, but, he pointed out, airspace was already limited in some areas, mostly for military reasons. American authorities maintain a fleet of tethered balloons at 15,000ft as part of drug-traffic tracking operations along the US-Mexican border.

A company called Magenn, based in Canada and California, is likely to be the first to market in the next two years with its helium-filled balloon devices. The Magenn Air Rotor System is designed to float 1,000ft up. Blades on the surface of the blimp catch the wind, turning the device around a horizontal axis. On-board generators send electricity down the tether to a transformer and into the grid. Larger versions could generate as much as one megawatt in a steady wind — enough to power 750 homes, according to Magenn.

Makani, a Silicon Valley start-up, has attracted an estimated \$15 million in funding from Google.org, the online search group's charitable unit. The company is investigating how highaltitude kites could power generators.

High-altitude wind power groups acknowledge that they have to prove to utility suppliers that their prototypes can work. Ms Archer, who chaired the high-altitude wind power conference in Oroville, said: "A river of energy flows above us. It makes sense to tap into that free source."

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