

Atmospheric Vortex Engine Highlights

Louis Michaud, June 2020

Large quantities of clean energy could be produced by harnessing the tornado process.

The attached file provides more information including links to: drawings, photos, videos, thermodynamic basis, and sample process calculations.

The Atmospheric Vortex Engine (AVE) produces a controlled tornado-like vortex by admitting warm or humid air tangentially into a circular arena. Tangential entries cause the warm moist air to spin as it rises forming an anchored tornado.

A vortex engine could have a diameter of 200 m and generate 200 MW. The vortex could have a diameter of 40 m at the base and could extend to a height of 14 km. There could be 20 turbines around the base of the station each with a power output of 10 MW.

Current world electrical generation of 2 TW could be provided by 2000 1000 MW AVE's.

The vortex engine has the same basis as the proven solar chimney which is just a chimney surrounded by a greenhouse. The physical tube of the solar chimney is replaced with centrifugal force in the vortex.

The heat source can be solar energy or waste industrial heat. The solar heat can be warm sea water or warm humid air. There is no need for the greenhouse; the solar collector is the earth's surface in its unaltered state.

The atmosphere is heated from the bottom by solar radiation and cooled from above by infrared radiation to space. The heat stored in tropical ocean is enough to produce hurricane force wind.

There is no need for energy storage. The AVE can supply power on demand from low temperature thermal energy stored naturally in sea water or in the air at the bottom of the atmosphere.

Starting the vortex requires a temporary central heat source because the atmosphere is usually in a metastable state. The temporary heat source can be steam or fuel. The surface air may have to be raised several kilometers to become buoyant because the latent heat of its water vapor content is only released when it condenses. Like for starting a car, a syphon, or some thermo-syphons a starting impulse is required.

Supplying the energy needs of a city with conventional solar or wind energy requires an area 100 times that of the city. A vortex engine would have a footprint of under a square kilometer.

There is a potential for converting 10% of the heat carried upward by convection in the atmosphere to useful work. The energy produced in a large hurricane can exceed the energy produced by humans in a whole year. A tornado can produce as much energy as a large power plant.

The cost of AVE electrical energy would be less than half of the cost of the least expensive alternative and could be as low as \$0.03/kWh. There is no fuel cost; the capital cost of an AVE would be less than that of a fossil fuel plant of the same capacity.

The vortex engine would alleviate global warming by reducing the quantity of fuel required to produce electrical energy. In addition, the energy produced by AVE's could be used to sequester CO₂. The solubility of CO₂ in sea water increases with decreasing water temperature. An AVE using warm sea water for its heat source would produce cool water with high CO₂ concentration which could be made to sink to sequester CO₂ at depth.

A vortex engine using waste heat from a thermal power plant would increase its efficiency by reducing the cold sink temperature from the temperature at the bottom of the atmosphere (+15 °C) to the average temperature of the troposphere (-15 °C).

Prototypes of 1, 4 and 6 metre diameters have demonstrated the possibility of producing controlled vortices. Vortices 50 cm in diameter extending over 50 m in the free atmosphere have been produced.

The technology which has been described in issued patents needs scaling up. The scientific basis of the AVE has been described in 9 peer reviewed articles.

The AVE has a remarkably simple thermodynamic basis. There is a potential for producing work, called exergy, when warm or humid surface air is raised to its level of neutral buoyancy at an elevation of approximately 14 km at the top of the troposphere. Exergy equals reduction in enthalpy minus increase in potential energy. The exergy of saturated 26 °C air can be 5000 J/kg corresponding to a velocity of 100 m/s. Power output is exergy times flow. A 500 MW AVE could have an upward flow of 100,000 kg/s and a specific exergy of 5000 J/kg.

Process calculation can readily be carried out with chemical engineering process simulator such as PROII formerly from SimSci and now from Schneider Electric via AVEVE.

Commercializing the AVE requires in depth engineering capabilities such as is available at major energy companies. Financial resources alone are insufficient. Strong support from a proven engineering organization is essential. Numerous design options will require extensive testing; government support will be also be important. AVEtec Energy Corporation would welcome the participation of the oil and gas in the development of the AVE process.

Vortex engines would not be dangerous. The air flow and the intensity of the vortex are limited by the size of the air entries which can be closed. The heat source can be turned off. Cooling towers and warm oceans show that without spin and starting disturbance large heat sources are not a hazard.

Addition information can be found at:

Vortex Engine web site

<http://vortexengine.ca/>

<http://vortexengine.ca/BAMS/BAMS%20ALL.pdf>

http://vortexengine.ca/Cycle/Tcycle_SV.pdf

http://vortexengine.ca/Isabel/MAP_HES_Text_Fig.pdf

http://vortexengine.ca/VPS_ARTICLE.pdf

Twitter

<https://twitter.com/VortexEngine>

<https://twitter.com/VortexEngine/status/1201854304241553408>

<https://twitter.com/VortexEngine/status/1243236367360053250>

<https://twitter.com/VortexEngine/status/1184583199927820288>

YouTube pitch video

<https://www.youtube.com/watch?v=JTRWklR9yP4&t=3s>