The Solar Updraft Tower

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A solar updraft tower power plant – sometimes also called 'solar chimney' or just 'solar tower' – is a solar thermal power plant utilizing a combination of solar air collector and central updraft tube to generate a solar induced convective flow which drives pressure staged turbines to generate electricity.

The concept uses solar radiation to heat air beneath a large translucent collector to create a constant flow of heated air to drive electricity-generating turbines. The turbines are located at the base of a very tall tower in the center of the collector, and the movement of the heated air through these turbines is increased by the updraft effect created by the tower.

The generating ability of a solar updraft power plant depends primarily on two factors: the size of the collector area and chimney height. With a larger collector area, more volume of air is warmed up to flow up the chimney. With a larger chimney height, the pressure difference increases the stack effect.

Heat can be stored inside the collector area greenhouse, to be used to warm the air later on. Water, with its relatively high specific heat capacity, can be filled in tubes placed under the collector increasing the energy storage as needed [1].

A solar updraft tower power station would consume a significant area of land if it were designed to generate as much electricity as is produced by modern power stations using conventional technology. Construction would be most likely in hot areas with large amounts of very low-value land, such as deserts, or otherwise degraded land.

A small-scale solar updraft tower may be an attractive option for remote regions in developing countries [2]. The relatively low-tech approach could allow local resources and labor to be used for its construction and maintenance.

In 1982 a small-scale experimental model of a solar chimney power plant was built under the supervision of German engineer Jörg Schlaich in Manzanares, Ciudad Real, 150 km south of Madrid, Spain; the project was funded by the German government. As it was a test prototype, during its operation, optimization data was collected on a second-by-second basis with 180 sensors measuring inside and outside temperature, humidity and wind speed.

As a conclusion to the test and due to the development of science the chimney may be replaced by a vortex engine that will create a vortex of twisting air. Another adjustment to be mentioned is the usage of the tower's collector either as a greenhouse for obtaining different crops or as a space where photovoltaic panels can be installed.

According to model calculations, a simple updraft power plant with an output of 200 MW would need a collector 7 kilometers in diameter (total area of about 38 km²) and a 1000-metre-high chimney [1]. One 200MW power station will provide enough electricity for around 200,000 typical households and will abate over 900,000 tons of greenhouse producing gases annually since entering the environment.

By the present day there are more proposals to built such towers in Ciudad Real, Spain (est. 40MW), Buronga, Australia (est. 200MW, by EnviroMission), Namibia (est. 400MW).

A solar updraft power station would require a very large initial capital outlay, which may be offset by relatively low operating cost [1].

Bibliography:

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