

# Solar Tower



**Solar Power Tower Prototype**

## THE CONTEXT:

### WHAT IS A SOLAR TOWER?

A Solar Tower power plant is a Solar Thermal Power Plant that combines the use of a solar air collector (canopy) and a central updraft tower to generate a solar induced convective flow which drives pressure staged turbines to generate electricity.

### HOW IT WORKS:

The Technology is made up of three components.

#### 1) The Tower.

The Tower is the thermal engine of the Solar Tower technology. In it, heat is transformed into mechanical energy. The updraft inside the tower, produced by the rising lighter, hot air, is essential for this. The higher the Tower, the greater the velocity of the column of air is and the stronger the updraft. Therefore, a high-capacity power plant should have the highest Tower possible.



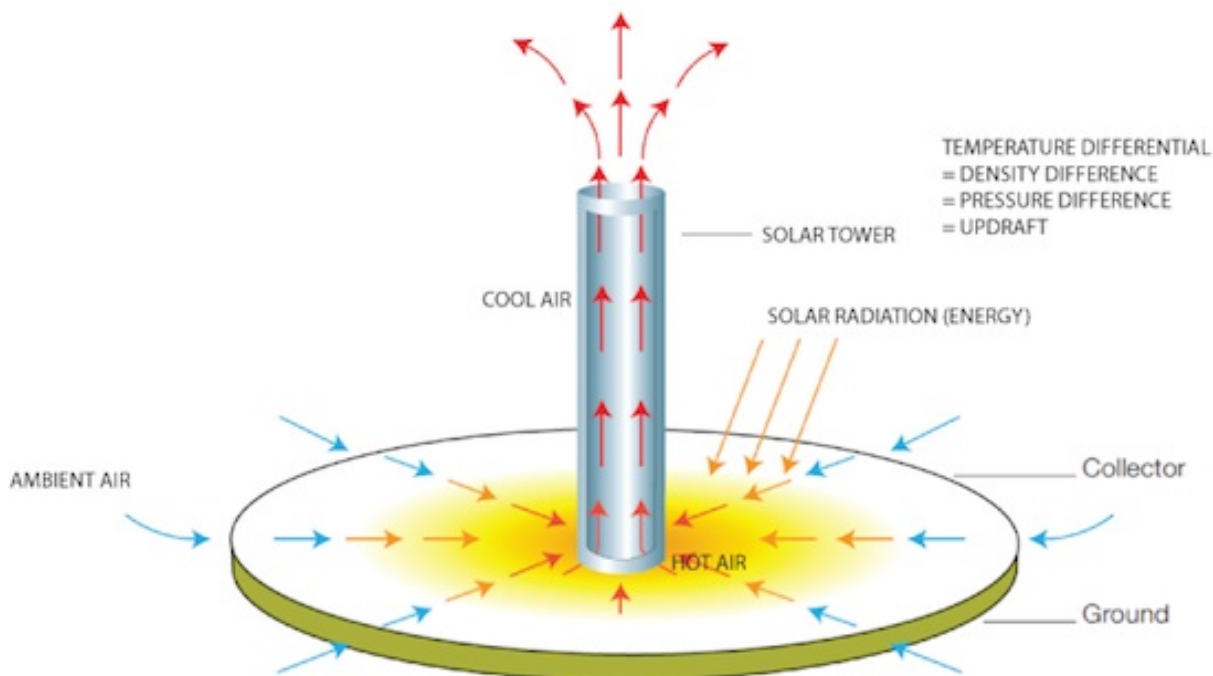
## The Canopy

The canopy converts a large percentage of the insolation into heat, which in turn, heats the air trapped under the canopy roof or is stored in the ground soil thermal storage system. One of the main objectives of the canopy is to lose as little heat as possible into the ambient.

## The Turbines

The Turbines transform the energy from the heat and pressure of the air into mechanical energy and the generator converts it into electricity. They work like the well known Kaplan Turbines used in hydro-electric power plants.

[http://www.enviromission.com.au/EVM/content/media\\_education\\_factsheet.html](http://www.enviromission.com.au/EVM/content/media_education_factsheet.html)



# One project

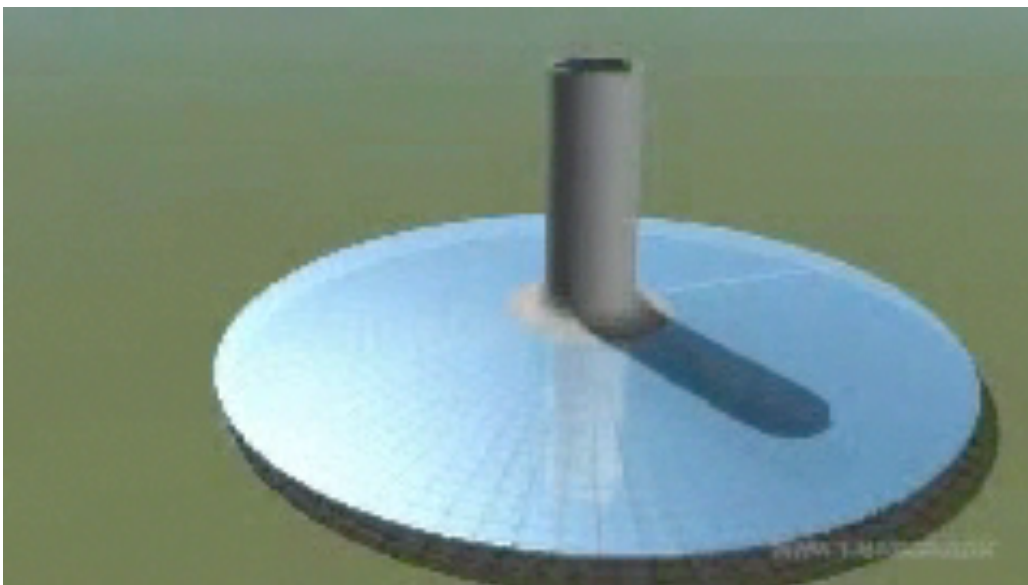
1 km high, 160 meters wide, one million tons of concrete, rug transparent 7 km in diameter, ... What is striking about this proposed "solar tower", a large hollow cylinder, it is first numbers. Pharaonic, oversized, large work beyond human scale. Probably, but it's not the most important.

The whole point of this tower is in principle extremely simple and reasonable: get electricity from currents of warm air upward, heated from the solar radiation collected on the ground. Enviromission to society, proponents of the project approved by the Australian Government, this gigantic tower would have a capacity of 200 MW.h . Something for a city of 200,000 inhabitants.

## WIND MILL

The concept of this tour is based on a combination of three renewable technologies, tested and implemented each for centuries: the greenhouse, the chimney and the windmill. The greenhouse, made of glass plates stretched a few feet above the ground, collecting the sun's heat and warms the air in it. Allowing it to reach a temperature of 30 ° greater than the outside air.

Then the oven warm air mass is converted into upward movement. A flow drawn at a speed of 15 m/s to the central tower, surrounded by cold air from the base to the top. A chimney effect causing a wind strong enough to result in the rise in the cylinder, the rotation of turbine 32. Propellers that will produce electricity. Released into the atmosphere, one kilometer high, warm air can then cool, before falling to the ground and repeat the cycle.



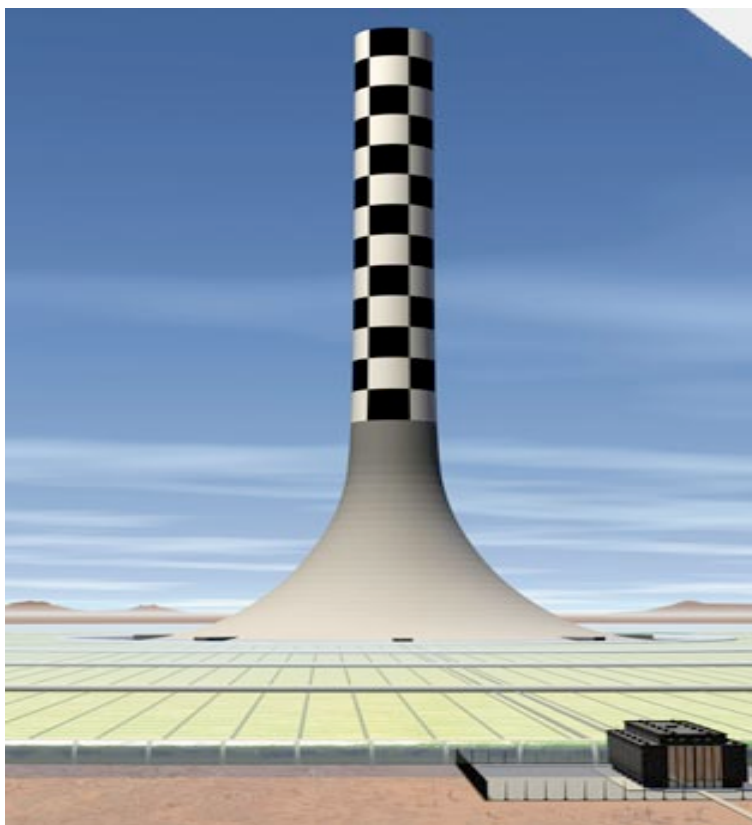
Known as much solar tower, solar chimney or tower collector, the proposal is not unprecedented. The idea has already been tested in Manzanares, Spain, over 80 years. A prototype demonstration made by the German engineer and inventor of the system, Jorg Schlaich, included a tower 200 meters high and a collecting area of 45,000 m<sup>2</sup>. On its operating time between 1982 and 1989, when it closed. These results demonstrated the value of the system. And feasibility to see more, and especially above. Because changing the size of the system, it becomes even more profitable. Energetically and financially.

### EXPONENTIAL LAW OF RETURN?

The efficiency of a solar chimney is the ratio between its height towards the sky and the ground surface. Denis Bonnell provides a quick estimate. "If we double the surface of the collector, you double the power. And if, then we double the height of the tower is still double the power. And in total, what will we do? We will just nearly multiplied by the cost of installation by 2, and the power produced by 4, so we will have halved the price per kWh produced! "

At this rate, the author, a senior official and former physics professor, says these calculations. According to him, a circle of diameter 950 km (700 000 km<sup>2</sup>) would supply Europe. "For the United States, about one million km<sup>2</sup> would find (...). In total, the world is the equivalent of a circle of 2000 km in diameter would be required . "

Calculations in the extreme, but shows promise of the revolution potential of such a device. Power plants, autonomous, situated in the desert, bringing clean energy to developing countries. Themselves or exporting electricity to the country large consumers.



Why the desert? Because the land is almost worthless, and recalls Denis Bonnelle, "this is the level of sunlight is the most abundant and more regular." The investment is there optimized. For economic rationality retain his rights. And such a renewable source of energy for it to be revolutionary, must bear comparison with fossil fuels or nuclear.

#### WHOM THE TOUR?

Hence the importance of reducing the price per kWh! Plus it will be attractive and the concept of solar chimneys may be warranted. A price close to the usual wind, but still twice that of nuclear power for example.

And tips are available. If the cost is as low Australia is for example by providing added ground water pockets. Transparent on the top, but jet black at the bottom. Such ways that the thermal pockets, after the day of the stored heat, released during the night. Allowing the fire to operate continuously, 24 hours. Even in the absence of collected light.

It is also possible to consider stacks higher and higher, with a collector or even wider. But what is possible in theory, in practice, faces constraints such as wind pressure, the resistance of the structure to its own weight. And provide a tour over 2 km high requires a lot of adjustments, including materials and structures used. Not to mention the psychological effect or disruption.

## THE PROBLEM:

A project of tower can produce electricity from the hot dry air of the desert. According to calculations, the tower would be 800 meters high. An updraft of hot air produced by a greenhouse (5 km<sup>2</sup> around the tower) go to the 28 turbines (of 4.5 MW each) to produce electricity.

1°) How many tower would be necessary to have the same power as a 1100 MW nuclear power plant?

2°) What is the solar cell area needed to have the equivalent of an electric power tower? The solar energy received on Earth is 270 W/m<sup>2</sup> in Europe, and the solar cell efficiency is 14%