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In the previous section, we have talked a bit about solar concentrators and their applications for high temperature solar water heating systems.

But this is not its only application.

High temperature fluids can be used in steam turbines to produce electricity.

That is what happens in the so-called solar thermal power plants, like the one shown here.

Solar thermal power refers to the conversion of solar to mechanical and electrical energy.

Much of the early attention of these systems was in small-scale applications, mainly for water pumping.

However, since 1985, there have been several large-scale power systems of up to 80 MW.

This technology is especially interesting when located in desert regions, where radiation is optimum and the otherwise unused land is utilized.

These systems consist basically of a collector, where the solar energy is absorbed, a storage system, usually water or phase-change storage, a boiler that acts as a heat exchanger between the operational fluids of the collector and the heat engine, and the heat engine itself, which converts the thermal energy to mechanical energy.

This mechanical energy can be further used in an electrical generator.

Usually collectors include concentrator systems, to be able to reach the high temperatures that heat engines need to operate at.

I am going to explain the basic concept of solar thermal power using the example of a solar power tower, but we will see later that this is only one possible configuration of solar concentrator systems.

The direct light strikes the mirrors or collectors, which are equipped with a tracking system that follows the sun.

The parabolic shape of the mirrors is able to focus the light on a central tower, where a fluid is heated.

This fluid raises its temperature to values between 100 and 500 ºC due to the concentrated sunlight.

The fluid is then used to move a turbine in a heat engine and produce electricity.

A problem of these systems is that the efficiency of the collector diminishes as its operating temperature rises, while the efficiency of the engine increases as the temperature rises, so a compromise between the two has to be found when choosing the operating temperature.

Let's now focus on the concentrator system.

Solar concentration systems have been known and explored for a long time now, from the first concept developed by Archimedes to the concentrators designed by Leonardo da Vinci.

A more recent example is the Walkie-Talkie building in London, which by virtue of its shape is able to concentrate the light that strikes on it in a small area.

In this area on the streets of London, temperatures of more than 90ºC have been reached, and it has even burned some objects in the neighboring shops.

Different types of concentrators produce different peak temperatures, and correspondingly varying thermodynamic efficiencies, due to the different ways of tracking the sun and focusing light.

Innovations in this field are leading to more and more energy-efficient and cost-effective systems.

The first system that we will discuss is the parabolic trough.

A parabolic trough consists of a linear parabolic reflector that concentrates the light onto an absorber tube located in the middle of the parabolic mirror, in which the working fluid is located.

The fluid is heated to 150 to 350 degrees Celsius, and then used in a heat engine.

This is a developed technology, whose most known examples are the Nevada Solar One and the Plataforma Solar de Almeria.

Fresnel reflectors are similar, but using thin flat mirrors instead, in order to concentrate sunlight onto the tubes in which the fluid is pumped.

Flat mirrors allow more reflection in the same amount of space as parabolic, reflect more sunlight, and are much cheaper.

Other important concentrator systems is the dish stirling.

A dish stirling or dish engine system consists of a parabolic reflector that concentrates light to the reflector's focal point, where the working fluid absorbs the energy, heating up to 500 degrees Celsius, and is able to operate a heat engine.

These systems provide an overall efficiency of 31%, which is rather high.

Several projects have been developed using this technology, such as the Big Dish in Canberra, Australia, or the NSTTF in Phoenix.

Finally, we will finish the list with the solar power tower plants.

They consist of an array of dual axis tracking reflectors, commonly named heliostats, which concentrate the sunlight on a central receiver, which contains the working fluid.

The fluid can be heated to 500 up to 1000 degrees Celsius, and then used in a power generator or energy storage system.

They are very efficient systems and have easier storage.

The Solar Two in California and the Plataforma Solar de Almeria are good examples of this technology.

So this was a brief overview concerning solar thermal energy.

In the next block, we will discuss about other unconventional ways to use solar energy, like solar fuels, so: see you in the next block!