Chapter 2
Concentrating Solar Thermal Technologies

Concentrating solar thermal technologies belong to an engineering field which can significantly contribute to the delivery of clean, sustainable energy worldwide. This chapter describes the technologies used in the production of solar thermal electricity and process heat divided into medium-concentration solar technology, high-concentration solar technology and the one devoted to solar fuels and industrial processes at high temperatures.

2.1 Introduction

Concentrating solar thermal (CST) technologies can produce electricity on demand when deployed with thermal energy storage, providing a dispatchable source of renewable energy. Therefore, solar thermal electricity (STE) can be provided by smoothing the variability of the energy resource and taking advantage of peak power prices (IEA 2014).

Furthermore, CST technologies can be applied in industrial processes to desalinise water, improve water electrolysis for hydrogen production, generate heat for combined heat and power applications, and support enhanced oil recovery operations. The use of these technologies in a wide range of applications encourages the improvement of their efficiency, which depends on the direct-beam irradiation.

Consequently, arid and semi-arid areas with clear skies are desirable locations where STE plants are installed. In these facilities, curved mirrors are used to concentrate solar radiation onto a receiver which is heated by the radiation. The heat absorbed is transferred to a fluid that passes through the receiver. In order to obtain concentrating solar thermal power, the heated fluid drives a turbine that converts solar heat into electricity (Roldán et al. 2015).

M.I. Roldán Serrano, *Concentrating Solar Thermal Technologies*,
Green Energy and Technology, DOI 10.1007/978-3-319-45883-0_2

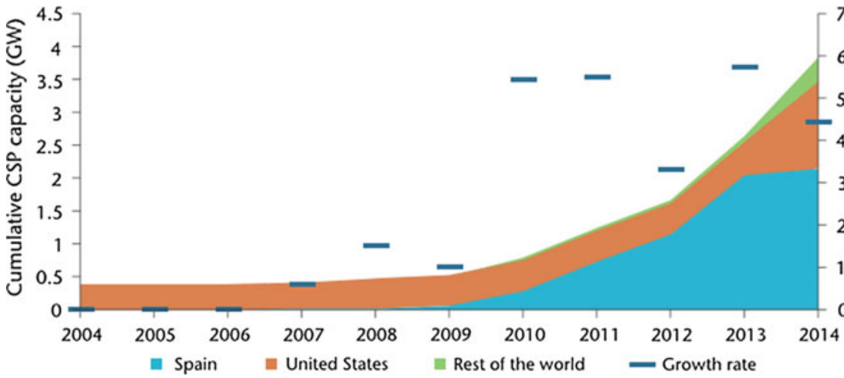

Fig. 2.1 Global cumulative growth of STE capacity (IEA 2014)

The STE industry has experienced robust growth since 2009 which has been most notable in Spain and the United States, and initiated in many other countries with an increasing energy demand (Fig. 2.1, IEA 2014). The largest plants considering the countries with initial STE development are located in United Arab Emirates and India, but others are under construction in Morocco and South Africa. Smaller solar fields, often integrated in larger fossil fuel plants, also can be found in Algeria, Australia, Egypt, Italy and Iran. Furthermore, market prices seem to be falling because new technologies have reached commercial maturity and new concepts have emerged.

2.2 Concentration of Solar Radiation

Solar energy is the most abundant energy resource on earth and the solar radiation reaching the earth's surface equals about 1 kilowatt per square metre (kW/m^2) under clear conditions when the sun is near the zenith. It is comprised of two components: direct or beam radiation, which comes directly from the sun's disk; and diffuse radiation, which reaches the earth after being scattered in all directions by the atmosphere. Hence, global solar radiation is the sum of both components (direct and diffuse radiation).

Many applications require energy at higher temperatures than those reached from incident solar radiation onto the earth's surface. With the aim of achieving high temperatures, solar energy is concentrated in collectors that capture and focus the solar radiation onto a smaller receiving surface.

The relevant measure for the sunlight concentration is the direct normal irradiance (DNI) that corresponds to the density of the available solar resource per unit area on surfaces perpendicular to the direct sunbeam. In humid equatorial places, the atmosphere scatters the sun's rays and DNI is much more affected by clouds and aerosols than global irradiance. The quality of DNI is important in STE plants because the thermal losses of the receiver and the parasitic consumption of the electric auxiliaries are almost constant, regardless of the incoming solar flux. Thus, below a certain level of daily DNI, the net output is null.

High DNI is found in hot and dry regions with reliably clear skies and low aerosol optical depths (subtropical latitudes from 15º to 40º north or south). Closer to the equator, the atmosphere is usually too cloudy. At higher elevations, DNI is also significantly greater, where absorption and scattering of sunlight due to aerosols can be much lower. Thus, the most favourable areas to site STE plants are North Africa, southern Africa, the Middle East, north-western India, south-western United States, northern Mexico, Peru, Chile, the western area of China, Australia, the extreme south of Europe, Turkey, central Asian countries, some places in Brazil, and Argentina (IEA 2014).

As mentioned, the incoming solar radiation can be concentrated in solar collectors whose concentration ratio is evaluated by

$$C = \frac{A_a}{A_r} \tag{2.1}$$

where A_a (m^2) is the aperture area of the concentrator and A_r (m^2) is the receiver area. When the second law of thermodynamics is applied to radiative heat exchange between the sun and the receiver, it is obtained the maximum concentration ratio. Considering a circular concentrator with area A_a, a receiver area A_r and viewing the sun of radius r at distance R, the half-angle subtended by the sun is θ_s. For a perfect concentrator, the radiation from the sun on the concentrator is the fraction of the solar radiation which is intercepted by its aperture. Assuming that the sun is a blackbody at T_s, the heat transferred to the receiver is expressed by the following equation

$$Q_{s \to r} = A_a \cdot \frac{r^2}{R^2} \cdot \sigma \cdot T_s^4 \tag{2.2}$$

where σ is Stephan-Boltzmann's constant (Duffie and Beckman 1980; Roldán et al. 2014).

Similarly, the heat transferred from a perfect receiver at T_r to the sun is given by

$$Q_{r \to s} = A_r \cdot \sigma \cdot T_r^4 \cdot E_{r-s} \tag{2.3}$$

where E_{r-s} is the fraction of radiated energy which reaches the sun. Thus, when $T_s = T_r$, the second law of thermodynamics implies $Q_{s \to r} = Q_{r \to s}$ and the concentration ratio can be evaluated by

$$\frac{A_a}{A_r} = \frac{R^2}{r^2} \cdot E_{r-s} \tag{2.4}$$

Since the maximum value of E_{r-s} is unity, the maximum concentration ratio for circular concentrator is

$$\left(\frac{A_a}{A_r}\right)_{circular,\max} = \frac{R^2}{r^2} = \frac{1}{\sin^2\theta_s} \tag{2.5}$$

The same procedure for linear concentrators leads to

$$\left(\frac{A_a}{A_r}\right)_{linear,\max} = \frac{1}{\sin\theta_s} \tag{2.6}$$

As a result, with $\theta_s = 0.27°$, the maximum possible concentration ratio for circular concentrators is 45,000, and the maximum for linear one is 212. Hence, the higher the temperature delivered, the higher the concentration ratio and the more precise the optics of both the concentrator and the orientation system (Duffie and Beckman 1980).

Concentrators are usually continuous or faceted parabolic reflectors, where the incoming solar beams, parallel to the optical axis, are focused on a point (focus). These reflectors require a solar-tracking mechanism, which can consider one or two axis. The continuous solar-tracking system along one or two axes with a solar concentration on one axis (focal line) reaches medium concentration (523–723 K). The solar-tracking system along two axes with focal point achieves high-concentration levels (temperatures greater than 723 K) (Cabrera et al. 2006).

The combination of different concentrators and receivers makes possible to develop several types of concentrating solar systems divided into: parabolic trough (PT), linear Fresnel reflector (LF), central receiver or solar tower (ST), parabolic dish (PD), and solar furnace as test facility.

2.3 Concentrating Solar Thermal (CST) Technologies

STE plants are gaining in popularity with advances in technology. There is a variety of concentrating solar thermal technologies available nowadays, being solar thermal collectors the major component of solar power systems. As previously stated, these collectors receive the incoming radiation and concentrate solar rays to heat a fluid, which then directly or indirectly drives a turbine and an electricity generator. The concentration of sunlight allows the fluid to reach working temperatures high enough to ensure affordable efficiency in turning the heat into electricity, while limiting heat losses in the receiver.

The four main commercial CST technologies are distinguished by the way they focus the sun's rays and the technology used to receive the solar energy (Fig. 2.2): parabolic-trough collector (PT), solar tower (ST), linear Fresnel (LF) and parabolic dish (PD). They can be classified according to the focus type (line focus or point

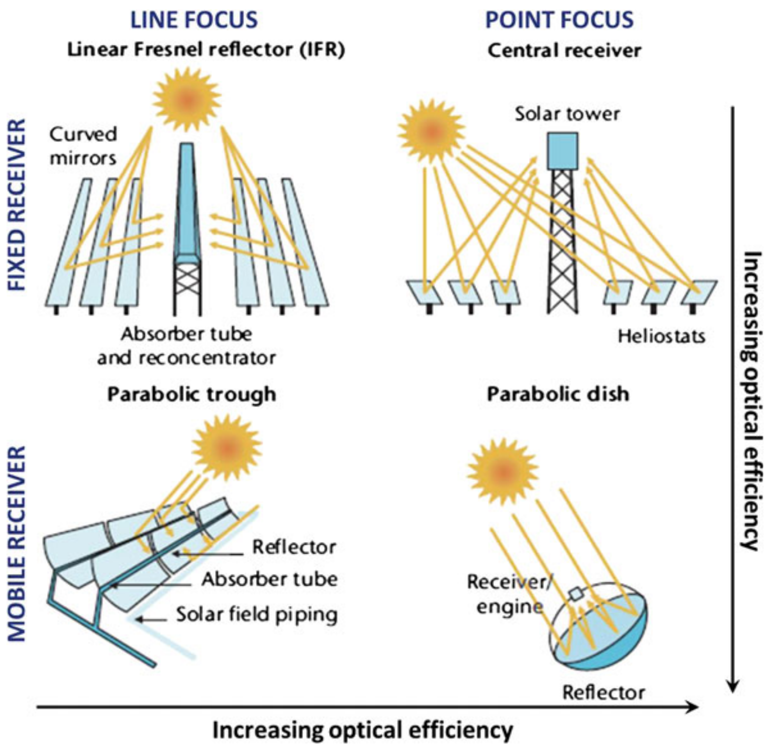

Fig. 2.2 STE technologies (IEA 2014)

one), depending on the receiver type (fixed or mobile) or considering the concentration level (medium or high concentration).

In solar tower and linear Fresnel, the receiver remains stationary and mechanically independent from the concentration system, which is common for all the mirrors. However, the receiver and concentration system move together in PT and PD technologies, enabling an optimal arrangement between concentrator and receiver (IEA 2014; Roldán et al. 2015).

The temperature reached on the receiver is related to the concentration ratio of the collector (Fig. 2.3). Thus, PT and LF reflect the solar rays on a focal line with concentration factors on the order of 60–80 (medium-concentration technologies) and maximum achievable temperatures of about 550 °C. In PD and ST plants, mirrors concentrate the sunlight on a single focal point with higher concentration factors and operating temperatures (high-concentration technologies). On one hand, central receivers achieve a concentration ratio of around 600 and temperatures of 800 °C, and, on the other hand, parabolic dishes reach concentration ratios greater than 1000 that lead to temperatures of 1600 °C. Furthermore, solar furnace is used as test facility able to concentrate around 10,000 times the sunlight reaching temperatures above 2000 °C.

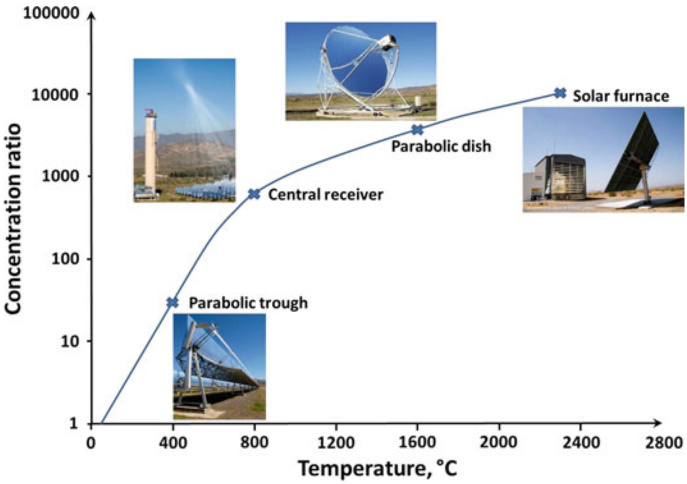

Fig. 2.3 Concentration ratio of the STE technologies

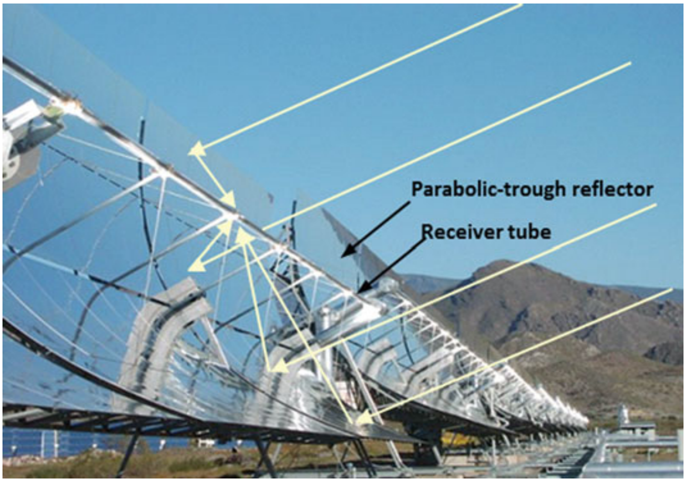

Fig. 2.4 Parabolic trough collector (Roldán et al. 2015)

2.3.1 Parabolic Trough Collectors

This is the most mature CST technology, accounting for more than 90 % of the currently installed STE capacity. As illustrated in Fig. 2.4, solar fields using trough systems utilise curved highly-reflective mirrors which focus sunlight onto a linear receiver attached to the focal axis of its parabola. The collectors are connected together in long lines of up to 100 m and track the sun's path throughout the day along a single axis (usually East to West).

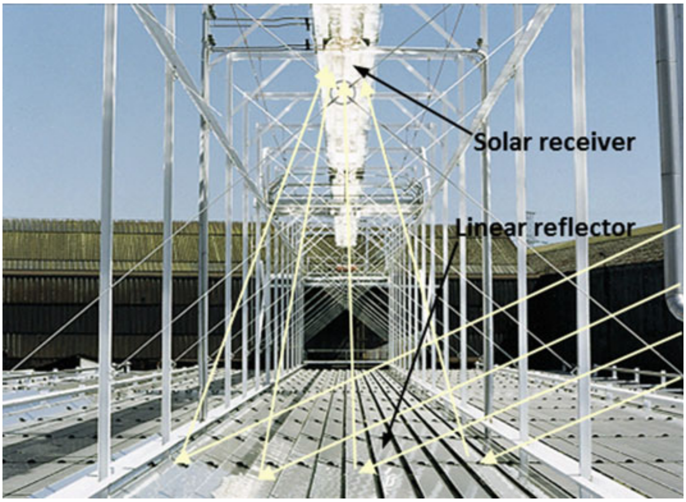

Fig. 2.5 Linear Fresnel (Roldán et al. 2015)

The parabolic mirrors are made by bending a sheet of reflective material (silvered low-iron float glass) into a parabolic shape and send the solar beam onto the receiver or absorber tube filled with a specific heat transfer fluid. These metal tubes or pipes have a special coating to maximise energy absorption and minimise infrared re-irradiation. In order to avoid convection heat losses, the tubes work in an evacuated glass envelope.

The thermal energy is removed by the heat transfer fluid (e.g. synthetic oil, molten salt) flowing in the heat-absorbing pipe and transferred to a steam generator to produce the super-heated steam that drives the turbine. Once the fluid transfers its heat (temperatures of up to 400 °C), it is recirculated into the system for reuse. The steam is also cooled, condensed and reused. Furthermore, the heated fluid in PT technology can also provide heat to thermal storage systems, which can be used to generate electricity at times when the sun is not shining.

Most PT plants currently in operation have capacities between 14 and 80 MW_e, efficiencies of around 14–16 % (i.e. the ratio of solar irradiance power to net electric output) and maximum operating temperatures of 390 °C, which is limited by the degradation of synthetic oil used for heat transfer. The use of molten salt at 550 °C for heat transfer purposes in PT plants is under investigation. High temperature molten salt may increase both plant efficiency (e.g. 15–17 %) and thermal storage capacity (Roldán et al. 2015).

2.3.2 Linear Fresnel

Linear Fresnel (LF) is similar to PT collector, with slight differences (Fig. 2.5). It uses a series of ground-based, flat or slightly curved mirrors placed at different angles to concentrate the sunlight onto a fixed receiver located several meters above the mirror field. Each line of mirrors is equipped with a single axis tracking system to concentrate the sunlight onto the receiver which consists of a long, selectively-coated tube. The facility usually uses water as heat transfer fluid, which passes through the receiver and it is converted into steam (DSG or Direct Steam Generation). Since the focal line in the LF plant can be distorted by astigmatism, a secondary mirror is placed above the receiver to refocus the sun's rays. Alternatively, multi-tube receivers can be used to capture sunlight with no secondary mirror (Roldán et al. 2015).

Flat mirrors and shared receivers result in lower expenses, while at the same time, this technology benefits from the long-term success. Furthermore, similar to the PT system, linear Fresnel does not need two-axis tracking since the sun will be focused on a part of the system throughout the year.

The main advantages of LF compared to PT systems are the lower cost of ground-based mirrors and solar collectors (including structural supports and assembly). While the optical efficiency of the LF system is lower than that of the PT systems (i.e. higher optical losses), the relative simplicity of the plant translates into lower manufacturing and installation costs compared to PT plants.

Thus, the mirror aperture can be augmented more easily than with troughs, and secondary reflection makes possible higher concentration factors, decreasing thermal losses. However, LF has greater optical losses than troughs when the sun is low in the sky. This reduces power generation in early morning and late afternoons, and also in winter, but can be overcome in part by the use of higher operating temperatures than PT plants (IEA 2014).

Therefore, it is not clear whether LF electricity is cheaper than the one from PT plants. Furthermore, as LF systems use direct steam generation, thermal energy storage is likely to be more challenging and expensive. Thus, LF is the most recent CST technology with only a few plants in operation. The largest solar thermal plant using LF technology is Puerto Errado in Spain with a capacity of 30 MW_e (Kassem et al. 2016).

2.3.3 Solar Tower

In the ST plants (Fig. 2.6), also called central receiver systems (CRS) or power tower, a large number of computer-assisted mirrors (heliostats) track the sun individually over two axes. Heliostats are less expensive than trough mirrors because they utilise standard flare glass, instead of glass that is manufactured at specific curves. They concentrate the solar radiation onto a single receiver at the top of a central tower where the solar heat drives a thermodynamic cycle and generates electricity. ST plants can achieve higher temperatures than PT and LF systems because they have higher concentration factors (Fig. 2.3). The CRS can use water-steam (DSG), synthetic oil or molten salt as the primary heat transfer fluid.

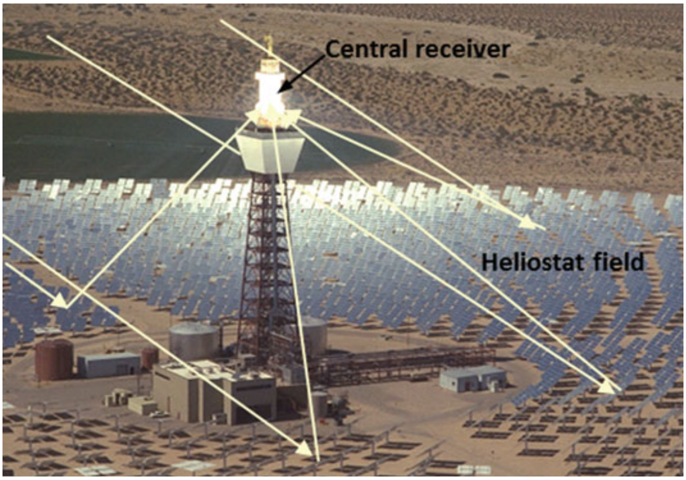

Fig. 2.6 Solar tower (Roldán et al. 2015)

The use of high-temperature gas is also being considered (e.g. atmospheric air in volumetric receivers).

In a direct steam ST, water is pumped up the tower to the receiver, where concentrated thermal energy heats it to around 550 °C. The hot steam then powers a conventional steam turbine. When DSG is used as heat transfer fluid, it is not required a heat exchanger between the primary transfer fluid and the steam cycle, but the thermal storage is more difficult.

Depending on the primary heat transfer fluid and the receiver design, maximum operating temperatures may range from 250 to 300 °C (using water-saturated steam) to 390 °C (using synthetic oil) and up to 565 °C (using molten salt and water-superheated steam). Temperatures above 800 °C can be obtained using gases (e.g. atmospheric air). Thus, the temperature level of the primary heat transfer fluid determines the operating conditions (i.e. subcritical, supercritical or ultra-supercritical) of the steam cycle in the conventional part of the power plant.

ST plants can be equipped with thermal storage systems whose operating temperatures also depend on the primary heat transfer fluid. Today's best performance is obtained using molten salt at 565 °C for both heat transfer and storage purposes. This enables efficient and cheap heat storage and the use of efficient supercritical steam cycles (Roldán et al. 2015).

High-temperature ST plants offer potential advantages over other CST technologies in terms of efficiency, heat storage, performance, capacity factors and costs. In the long run, they could provide the cheapest STE, but more commercial experience is needed to confirm these expectations. However, a large ST plant can require thousands of computer-controlled heliostats, that move to maintain point focus with the central tower from dawn to dusk, and they typically constitute about 50 % of the plant's cost.

The largest solar thermal plant operating through power towers is the Ivanpah Solar Power Facility in the USA, with a capacity of 392 MW_e. The plant gathers three distinct towers, each with its own turbine, based on DSG technology and no storage. There are two more facilities in Spain, each with approximately 20 MW_e of capacity, and several other facilities with lower capacities in Turkey, India, and other countries (Kassem et al. 2016).

Larger ST plants have expansive solar fields with a high number of heliostats and a greater distance between them and the central receiver. This results in more optical losses, atmospheric absorption and angular deviation due to mirror and sun-tracking imperfections. Therefore, ST still has room for improvement of its technology.

2.3.4 Parabolic Dish

Parabolic dish (PD) systems (Fig. 2.7) consist of a concave dish shaped concentrator that reflects sunlight into a receiver placed at the focal point of the dish. The receiver may be a Stirling engine or a micro-turbine. PD requires two-axis sun tracking system to follow the sun from east to west during the day, and from north to south throughout the year. This technology offers very high concentration factors and operating temperatures (Fig. 2.3).

To date, there are no large utilities using PD technology, due to several difficulties. The design of reliable engines for large plants is still under development. In addition, the initial cost of such systems is high in comparison with the CST

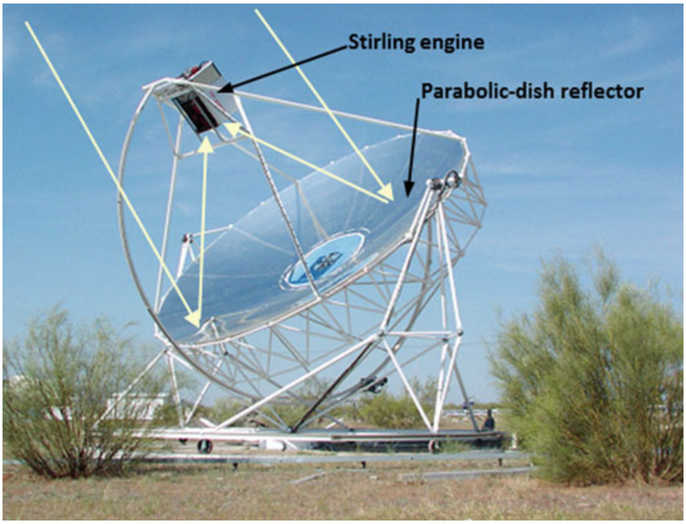

Fig. 2.7 Parabolic dish (Roldán et al. 2015)

technologies previously described, and there are also challenges related to the storage capability. Nevertheless, the Stirling dish system has the highest efficiency in the conversion from heat to electricity, with a net average annual yield rate that is 18–23 % higher than any other solar energy system.

Therefore, the main advantages of PD systems include high efficiency (i.e. up to 30 %) and modularity (i.e. 3–50 kW), which is suitable for distributed generation. Unlike other STE options, PD systems do not need cooling systems for the exhaust heat. This makes PD suitable for use in water-constrained regions, though at relatively high electricity generation costs compared to other CST technologies.

PD technology is currently considered a potential technology for STE generation and many pilot projects have been launched in the USA and Spain. However, the PD system is still under demonstration and investment costs are still high. Thus, with more research and development, it could be a potential alternative candidate technology for STE plants (Roldán et al. 2015; Kassem et al. 2016).

2.3.5 Solar Furnace

Solar furnaces reach the highest energy levels in concentrating solar systems (over 10,000 kW/m^2, see Fig. 2.3). Therefore, they are used as a test setup for high-temperature processes and other applications, such as material treatment, development and investigation of new solar receivers, and simulation of thermal effects from highly concentrated heat flux, among others.

The facility (Fig. 2.8) consists of an optical system with one or more heliostats, which reflect the solar radiation onto a concentrator. This reflector can be composed by a parabolic mirror or a group of spherical mirrors. The furnace power can be

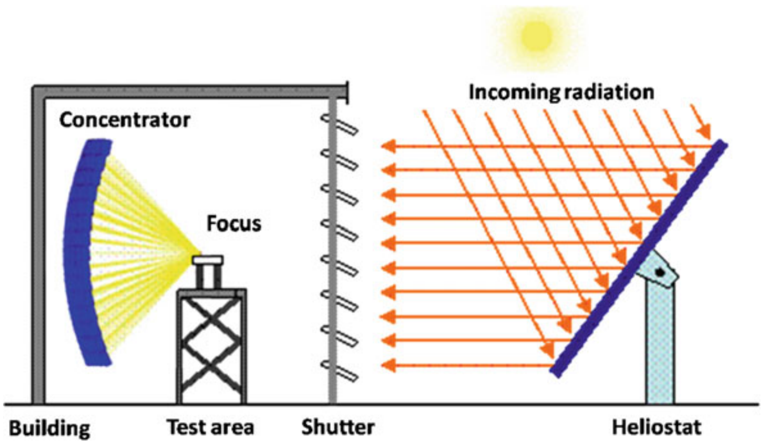

Fig. 2.8 Solar furnace (Roldán et al. 2014)

attenuated by a shutter, which control the amount of solar radiation received onto the concentrator. The concentrated radiation reaches the test area, which is located at the concentrator focus.

2.4 Status of CST Technologies

2.4.1 Medium-Concentration Solar Technology

Medium-concentration solar power plants use the line focusing parabolic solar collector at a temperature of about 400 °C. Significant advances have been made in parabolic collector technology together with organic Rankine cycle technology to improve the performance of parabolic trough STE plant. Furthermore, the traditional sun-tracking unit with sensors that detect the position of the sun has been replaced by a system based on the calculation of the sun position using a mathematical algorithm.

The Solar Energy Generating System in the USA is the largest parabolic trough power plant complex in the world, with a capacity of 354 MW_e. A recent development in cost effective concentrators is the design of Euro Trough, a new parabolic trough concentrator, in which an advanced lightweight structure is used to achieve cost efficient solar power generation. Parabolic trough STE plants can collect up to 70 % of the incident solar radiation and achieve a peak electrical conversion efficiency of 20–25 % (Siva Reddy et al. 2013) whose improvement is the main challenge for this technology.

Linear Fresnel facility is similar to a PT with the advantages of low costs for structural support and reflectors, fixed fluid joints, a receiver separated from the reflector system, and long focal lengths that allow the use of flat mirrors. While in 2010 only a couple of prototypes using LF reflectors were operating, a 30 MW_e LF plant built in Calasparra (Spain) started up in early 2012, and a 125 MW_e commercial located in India began operating in 2014. All LF plants currently use DSG and they do not have thermal storage, which is a challenging development issue for this technology.

2.4.2 High-Concentration Solar Technology

The parabolic dish-Stirling engine and the central tower receiver are primarily tried for high-temperature solar thermal power plants. Stirling-dish STE plants developed for commercial applications generate power for its supply in isolated communities and villages of rural areas. Furthermore, parabolic dish has a complete two axes tracking of the concentrator aperture that would increase the amount of the incoming radiation by avoiding the cosine effect. At the focal point, the Stirling receiver absorbs solar radiation and transfers the thermal energy to the engine. The

Table 2.1 Performance data for examples of solar tower plants with different working fluid

Parameter	Solar 100 plant	PS-10 plant
Working fluid	Molten salt	Air
Plant rating	100	10
Annual solar insolation (kWh/m^2)	2700	2063
Field area (m^2)	1,466,000	89,271
Receiver thermal rating (MW)	796	55
Thermal storage size (MWh)	3820	–
Steam generator rating (MW)	254	5.34
Annual net energy production (MWh)	613,000	19,200
Peak net efficiency	0.22	0.17
Annual net efficiency	0.16	0.12

Source Siva Reddy et al. (2013)

main Stirling absorbers are typically direct irradiated receivers, heat pipe receivers, and volumetric ones.

The heat pipe absorbers vaporise a liquid metal such as sodium on the absorber surface and the gas condenses on the Stirling engine heater tubes to transfer the energy to the working fluid. Heat pipe receivers reach more uniform temperature distribution on the tubes, resulting in longer life for both the absorber and engine heater head in comparison with the direct irradiated absorber. Volumetric receivers are potentially more cost effective and reliable than the heat pipe receivers, but the design of reliable engines for large PD plants is still under development.

In central receiver systems, there are different receiver types depending on their configuration and the heat transfer medium. The configuration can be either external or cavity type. In a cavity receiver, the radiation reflected from the heliostats passes through the aperture into a box-like structure before impinging on the heat transfer surface. External receivers can be designed with a flat-plate or cylindrically shaped tubular panels.

The performance data on ST plants for two different receivers and heat transfer media (molten salt and air) are collected in Table 2.1.

2.4.3 Performance of CST Technologies

More than 90 % of the installed STE capacity in 2014 consisted of PT plants; ST plants total about 170 MW and LF plants of around 40 MW. A comparison of CST technology performance is shown in Table 2.2.

According to the previous data, the facility performance could be improved by considering an optimised receiver design and operating conditions, defining the best operation strategy for each facility and studying alternative working fluids which drive the turbine in more efficient power blocks. These should be the main issues addressed in future developments of CST technologies.

Table 2.2 Performance of CST technologies

	PT	PT	PT	ST	ST	ST	LF	PD
Storage	No	Yes	Yes	No/yes	No/yes	Yes	No	No
Status	Comm	Comm	Demo	Demo	Comm	Demo	Demo	Demo
Capacity (MW)	15–80	50–280	5	10–20	50–370	20	5–30	0.025
HTF	Oil	Oil	Salt	Steam	Steam	Salt	Sat.st	Na
HTF temperature (°C)	390	390	550	250	565	565	250	750
Storage fluid	No	Salt	Salt	Steam	Na	Salt	No	No
Storage time (h)	0	7	6–8	0.5–1	Na	15	0	0
Storage temperature (°C)	Na	380	550	250	Na	550	Na	Na
Efficiency (%)	14	14	14/16	14	16	15/19	11/13	25/30
Cap. Factor (%)	25–28	29–43	29–43	25–28	25–28	55–70	22–24	25–28
Optical efficiency	H	H	H	M	M	H	L	VH
Concentration	70–80	70–80	70–80	1000	1000	1000	60–70	>1300
Land (ha/MW)	2	3	2	2	2	2	2	Na
Cycle	Sh.st	Sh.st	Sh.st	Sat.st	Sh.st	Sh.st	Sat.st	Na
Cycle temperature (°C)	380	380	540	250	540	540	250	Na
Grid	On	On	On	On	On	On	On	On/off

HFT heat transfer fluid; *Sat.st* satured steam; *Sh.st* superheated steam; *L* low; *M* middle; *H* high; *VH* very high; *Na* not applicable
Source Roldán et al. (2015)

References

Cabrera JA, Cuesta MJ, Pérez M (2006) Concentrating solar power: current state and sector actors. CIEMAT Tech Report

Duffie JA, Beckman WA (1980) Solar engineering of thermal processes. Wiley, New York

International Energy Agency (2014) Technology roadmap: solar thermal electricity. https://www.iea.org/publications/freepublications/publication/technologyroadmapsolarthermalelectricity_2014edition.pdf. Accessed 20 May 2016

Kassem A, Al-Haddad K, Komljenovic D, Schiffauerova A (2016) A value tree for identification of evaluation criteria for solar thermal power technologies in developing countries. Sustain Energ Technol Assessment 16:18–32. doi:10.1016/j.seta.2016.02.003

Roldán MI, Valenzuela L, Fernández J (2014) Computational fluid dynamics in concentrating solar technologies. In: Al-Baghdadi MARS (ed) Computational fluid dynamics applications in green design, 1st edn. International Energy and Environment Foundation, Iraq

Roldán MI, Fernández J, Valenzuela L, Vidal A, Zarza E (2015) CFD Modelling in solar thermal engineering. In: Al-Baghdadi MARS (ed) Engineering applications of computational fluid dynamics: volume 3, 1st edn. International Energy and Environment Foundation, Iraq

Siva Reddy V, Kaushik SC, Ranjan KR, Tyagi SK (2013) State-of-the-art of solar thermal power plants—A review. Renew Sust Energ Rev 27:258–273. doi:10.1016/j.rser.2013.06.037

Springer

http://www.springer.com/978-3-319-45882-3

Concentrating Solar Thermal Technologies
Analysis and Optimisation by CFD Modelling
Roldán Serrano, M.I.
2017, IX, 88 p. 25 illus., Hardcover
ISBN: 978-3-319-45882-3