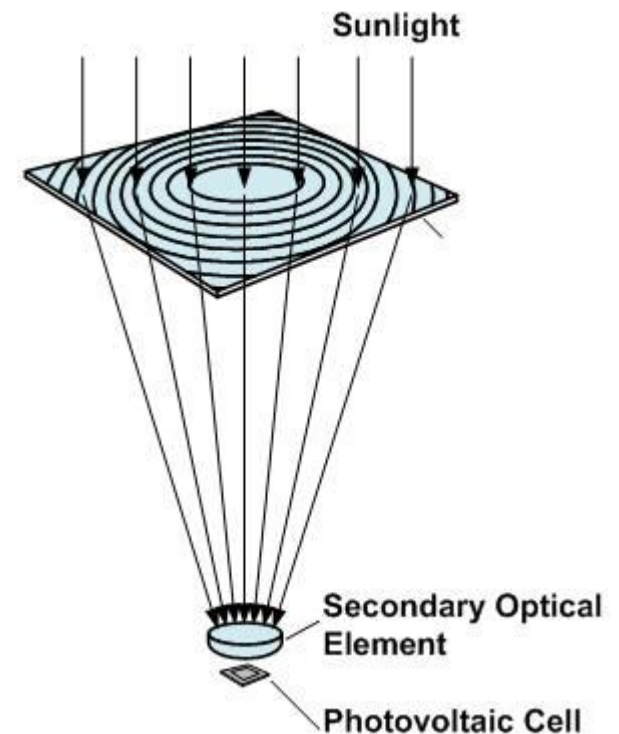

Solar Concentrating systems

Dr. Osama Ayadi

Introduction

- The temperature level that can be achieved with non-concentrating solar thermal collectors is limited. At the most a level of approximately 200° C (392° F) can be reached with high-end vacuum tube collectors.
- A further increase of temperatures beyond this level is technically hardly achievable. In addition, above 100° C (212° F) the collector efficiency decreases significantly.
- However, looking at the required temperature levels in the market segments of process heat or electricity generation by thermal processes, far higher temperatures are needed. Such temperatures can only be generated by the concentration of sunlight.
-

- Concentration of sunlight for large-scale applications is commonly done with reflecting concentrators;
 - lens systems cannot be used owing to their high price and limitations in size.
 - a parabolic-shaped reflector concentrates the solar radiation either on a focal line or on a focal point.



- The concentrator needs to track the sun, so that its incident rays are always perpendicular to the aperture area.
- In principle, the main choice is between one-axis and two-axis tracking systems.
 - Systems with one-axis tracking concentrate the sunlight onto an absorber tube in the focal line of the concentrator,
 - whereas two-axis tracked systems focus the rays of the sun onto a round-shaped absorber at the focal point.
- The theoretical upper value of concentration is 46,211; it is limited by the fact that the sun is not a point source of radiation.
- By concentrating solar radiation a maximum temperature of 5500° C (9932° F) – the temperature of the sun's surface – can be achieved.

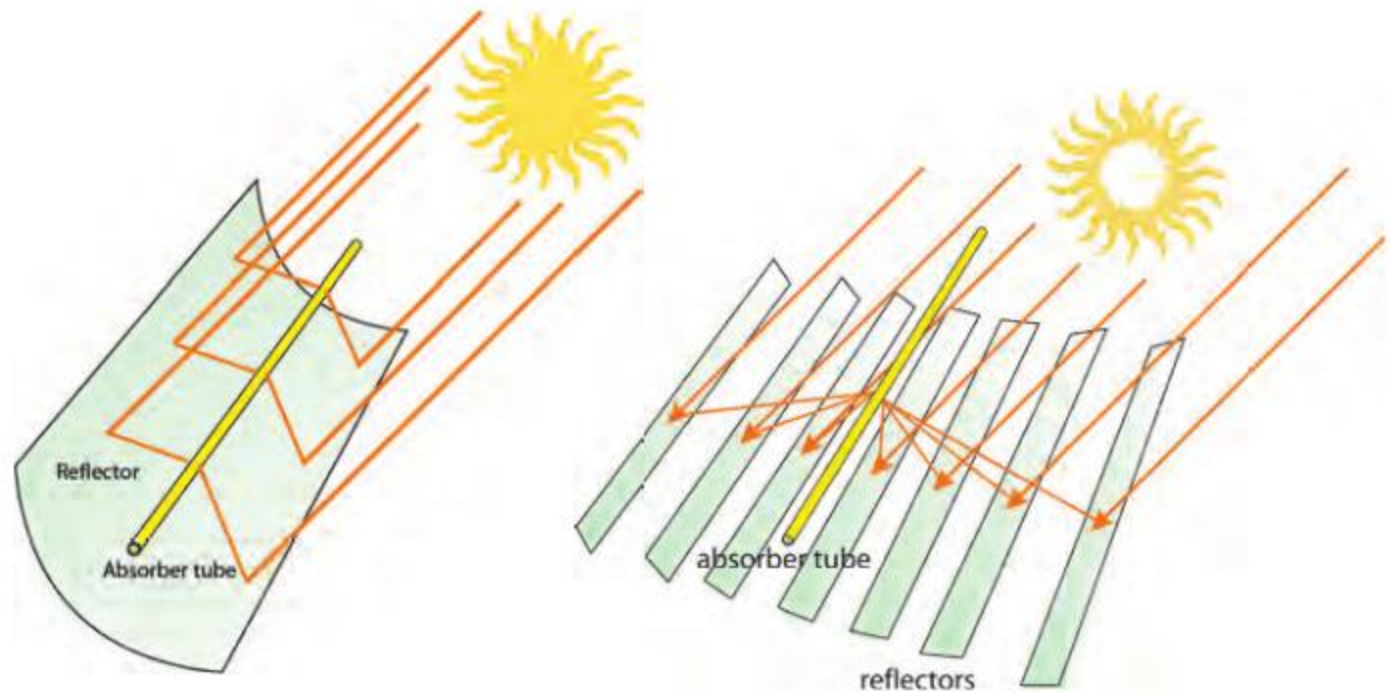
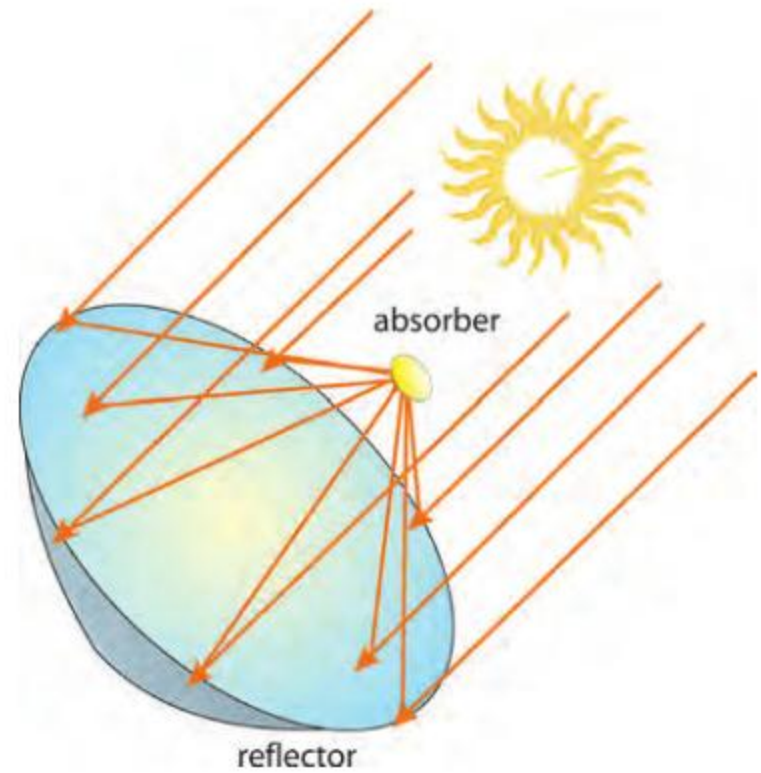
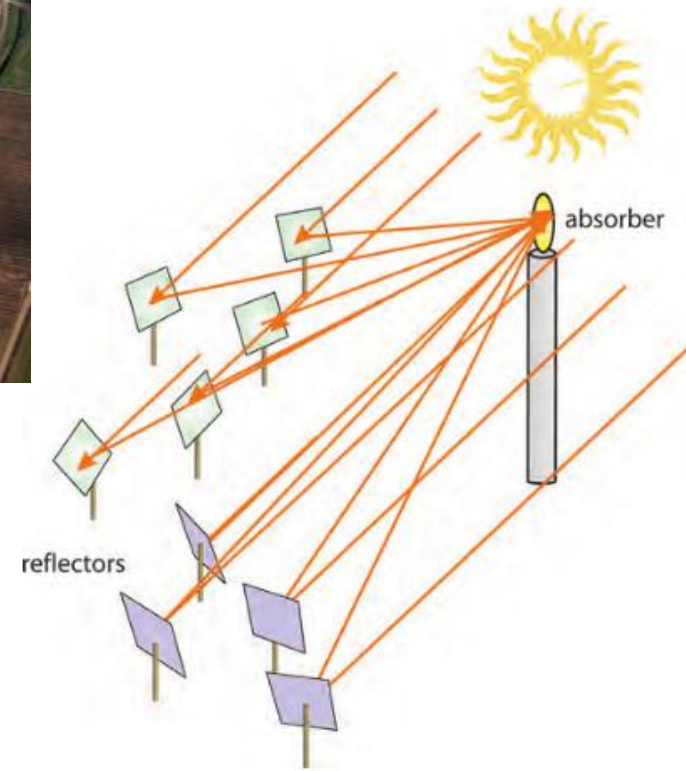


Figure 6.1a.
Concentration of solar radiation:
reflectors with one-axis tracking

*Figure 6.1b.
Concentration of solar radiation: single
reflector with two-axis tracking*

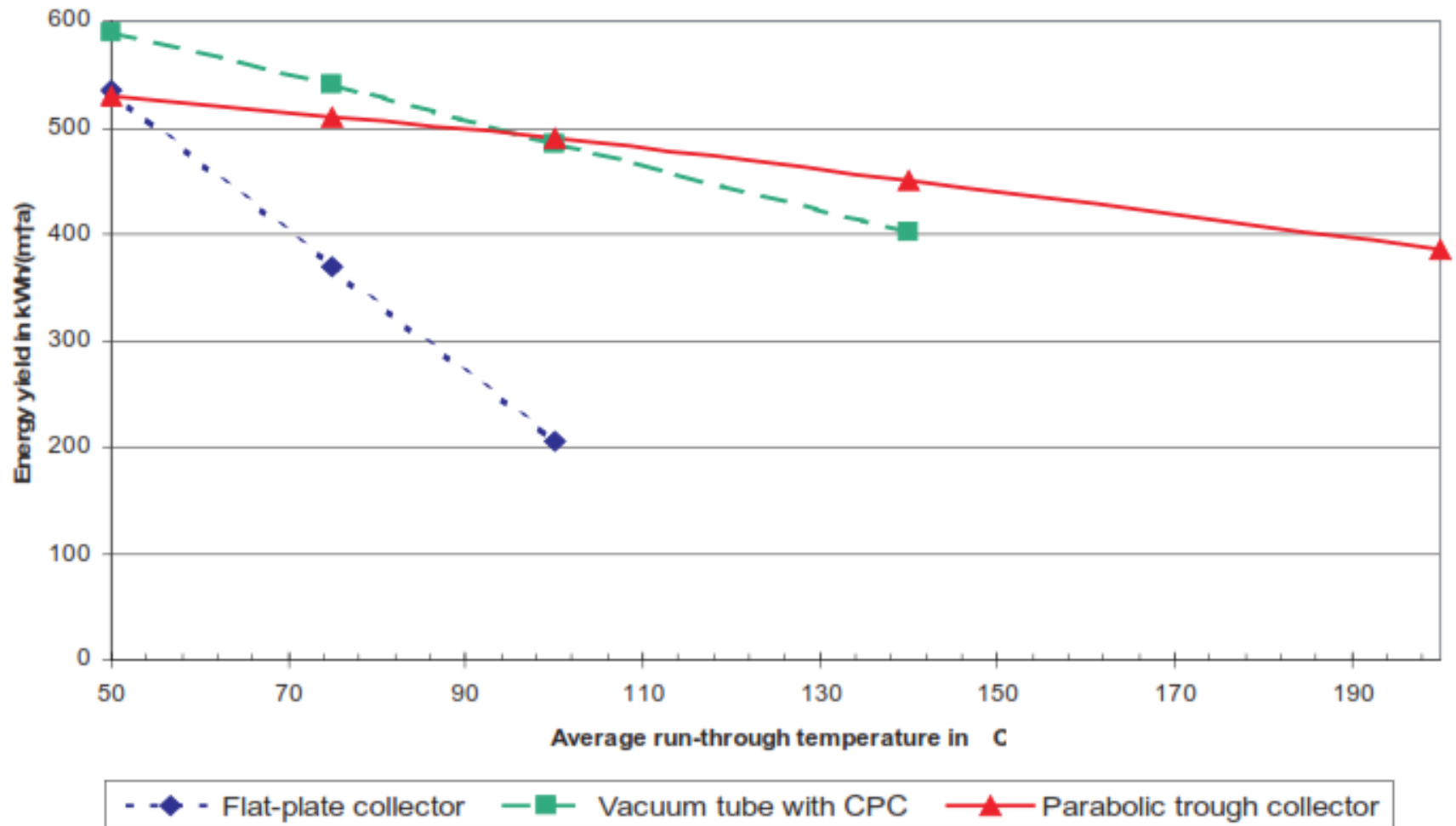




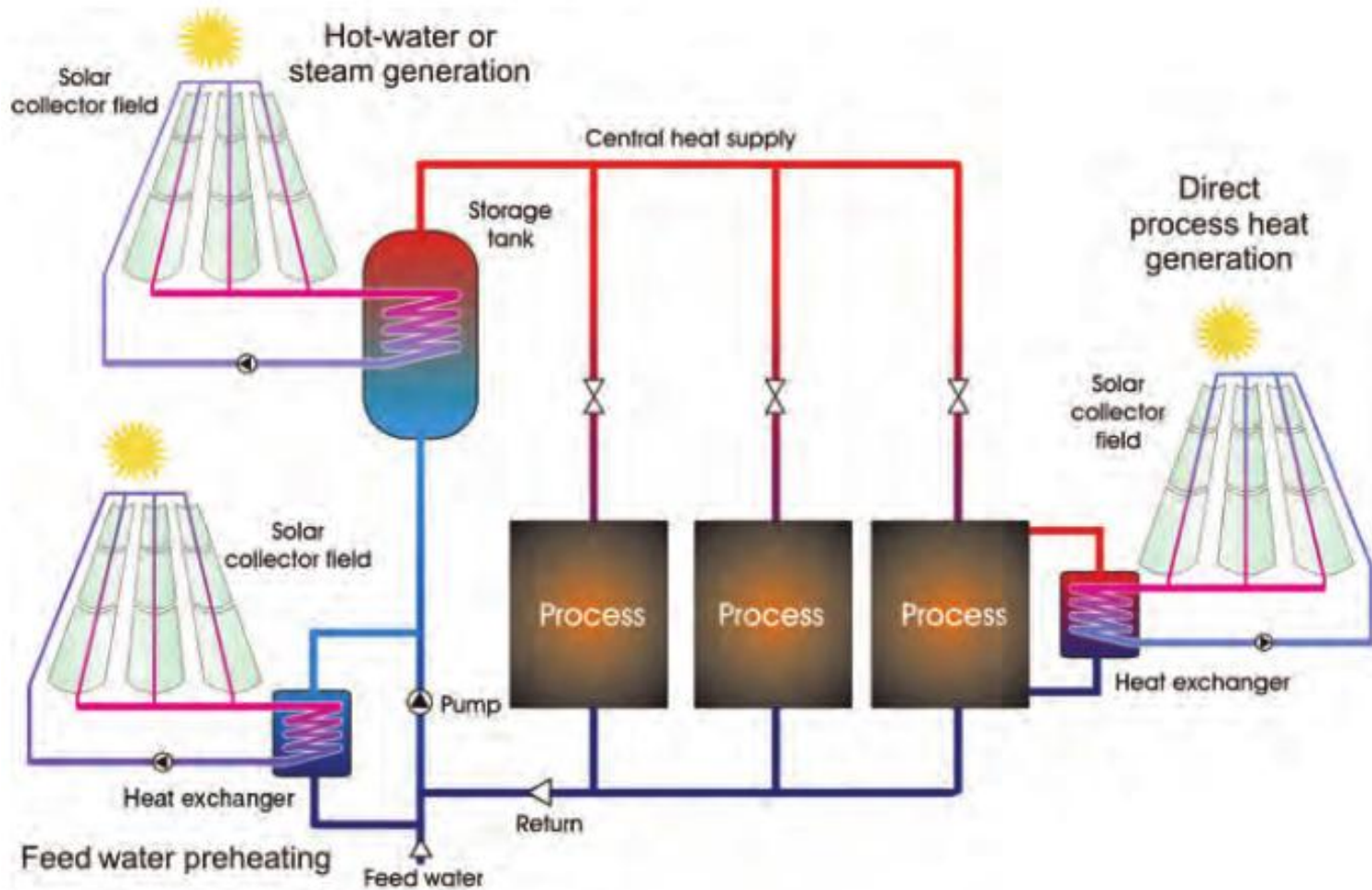
- The generation of energy- and cost-efficient heat at temperature levels above 150° C is possible only with solar systems that make use of concentrating collectors, in contrast to non-concentrating systems or collectors with low concentration ratios

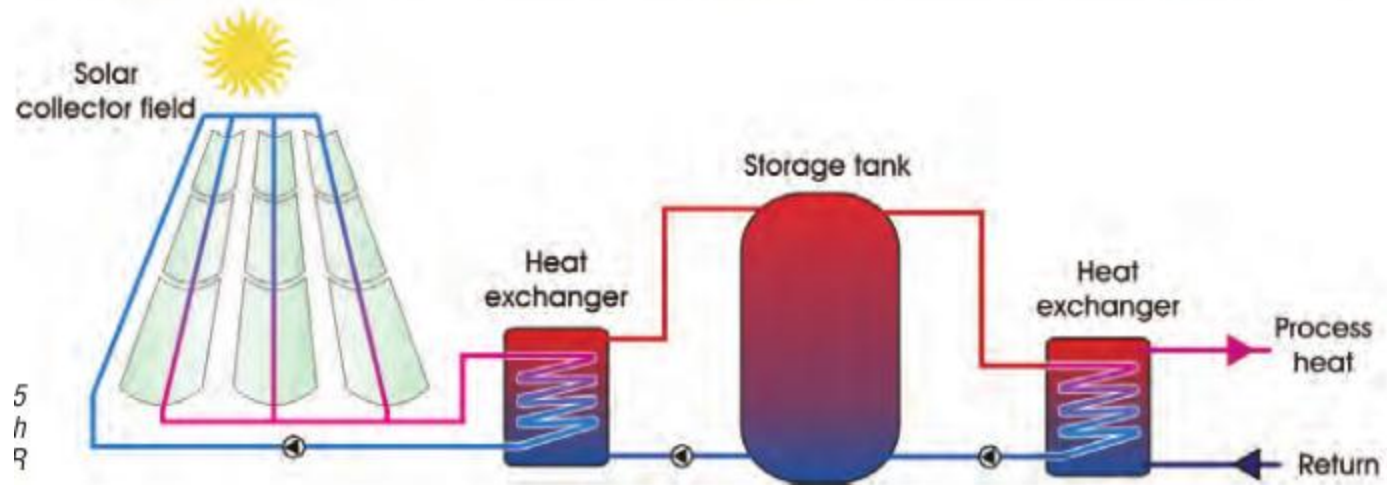
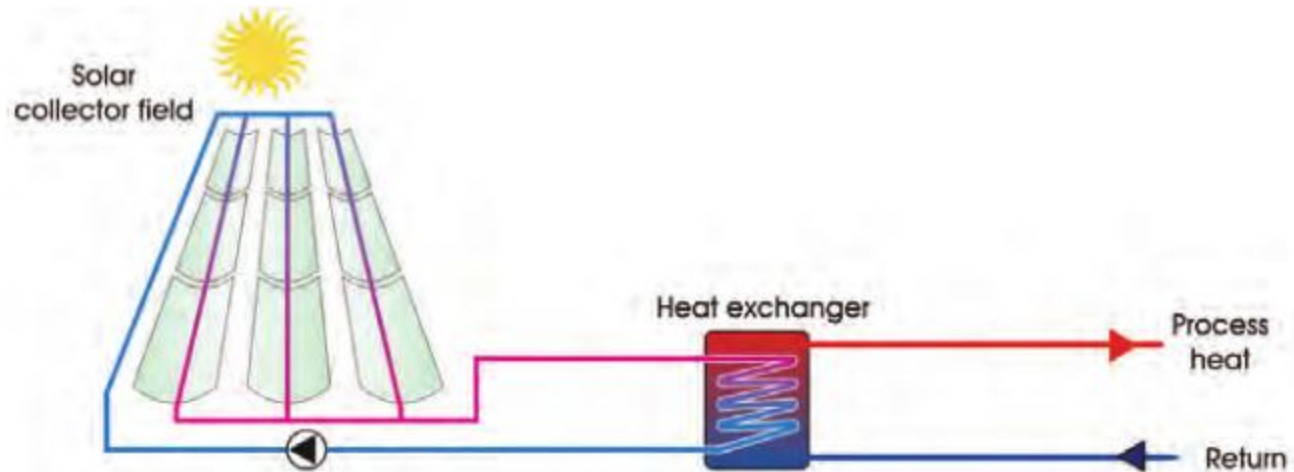
Collector type/system	Concentration ratio	Operating temperature (°C)	Theoretical temperature limit (°C)
Parabolic trough collector LS-3 and EuroTrough	82	~400	910
Solar tower plant with REFOS-pressurised receiver	~500	~1100	1590
EuroDish (dish/Stirling) system	2500	650	2510





- The energy yield of a collector system depends not only on the construction of the collector but also on the annual amount of direct irradiation..





Collector type	Costs (€/m²)
Flat-plate collector	250–300
Compound parabolic concentrator (CPC)	300–350
Parabolic trough collector	300–400
Evacuated flat-plate collector	400–600
Evacuated tube collector	400–600
Evacuated tube collector with CPC	400–600

- The maintenance costs (cleaning etc.) for conventional collectors are of the order of R2.5/m² a; for parabolic trough collectors they amount to approximately R5/m²a.

