

First Summer School

Part A: Line-focus Solar Thermal Technologies

September 20-24, 2021

Lecture 6:

- **Solar fields with parabolic trough collectors**
- **Thermal energy storage**
- **Solar field maintenance**
- **Parameters to evaluate the project profitability**

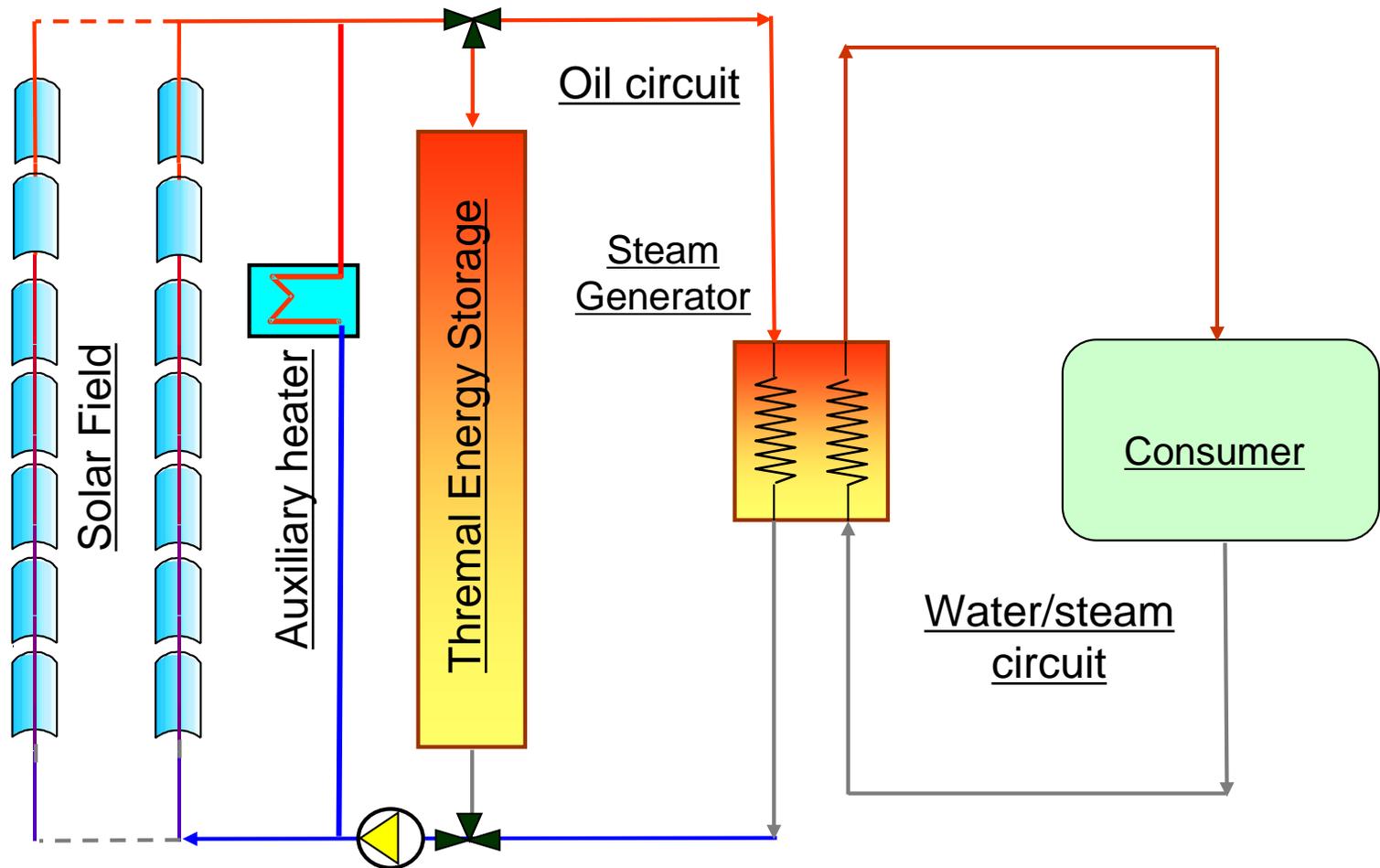
Lecturer: Eduardo Zarza Moya

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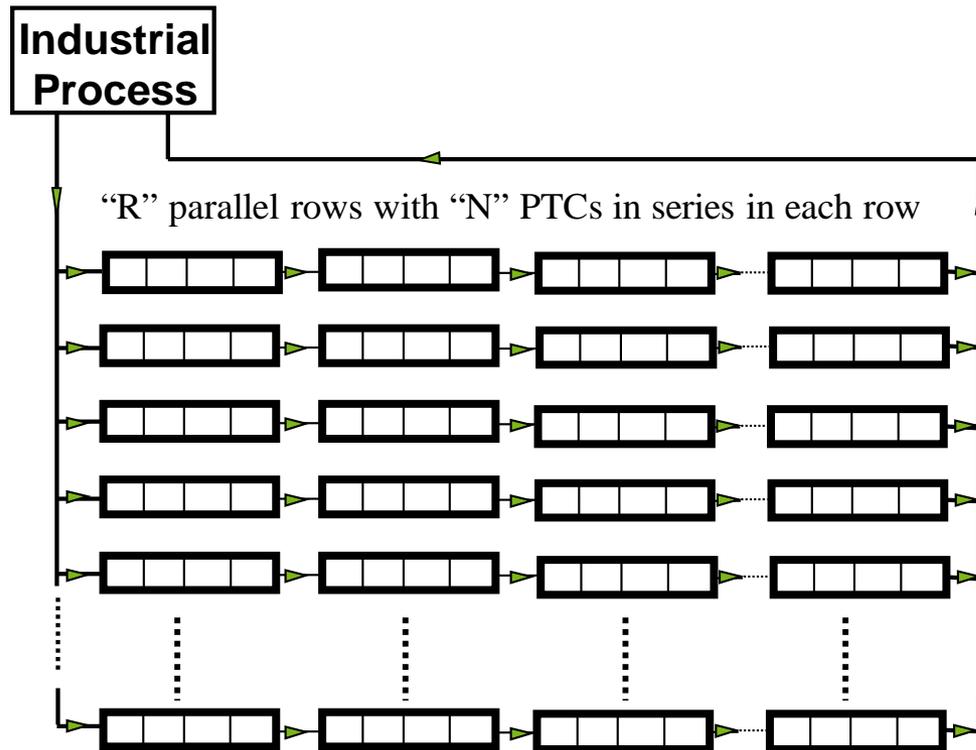
Solar Systems with PTCs

Main Components



Solar Systems with PTCs

Typical Solar Field with PTCs



View of a typical solar field

Simplified scheme of a solar field with PTCs

Solar Systems with PTCs

Aerial view of a complete solar field with PTCs

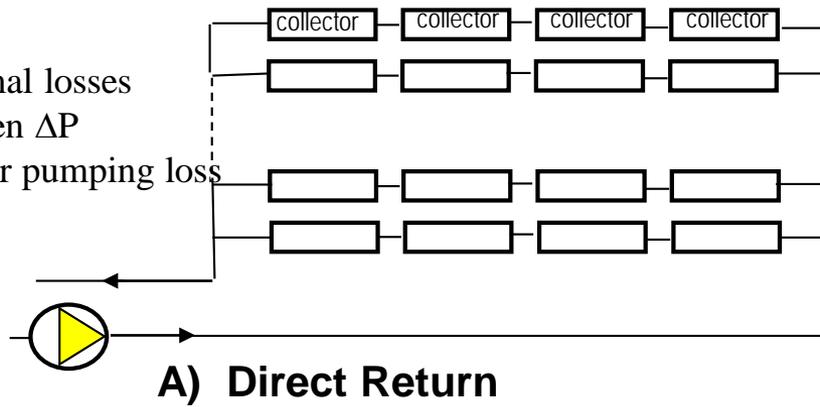


SEGS III - IV Plants (California, USA)

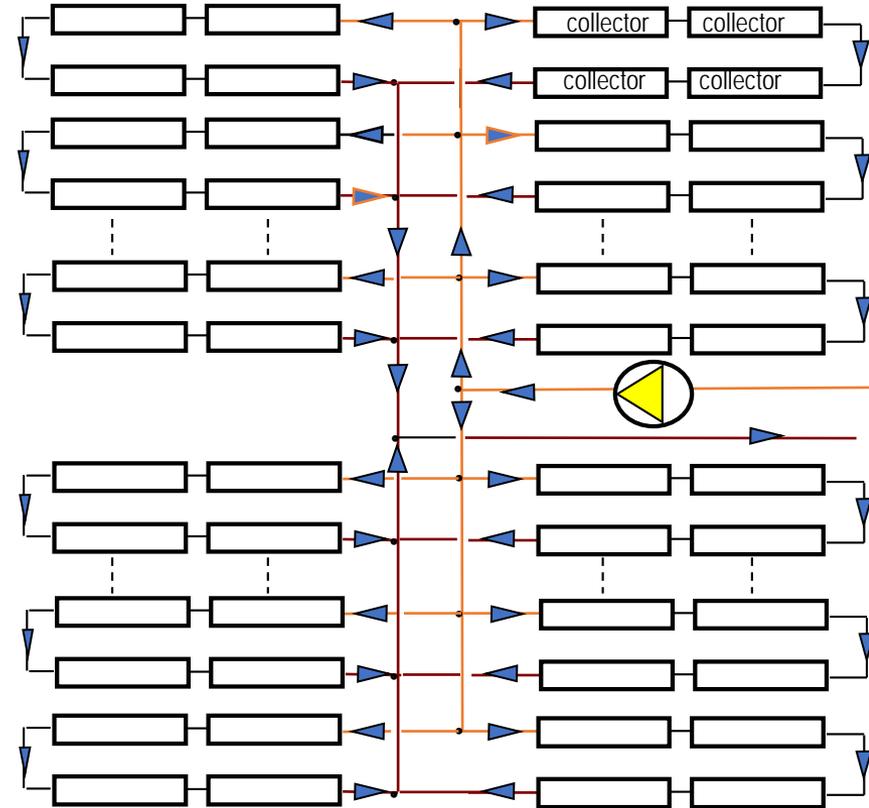
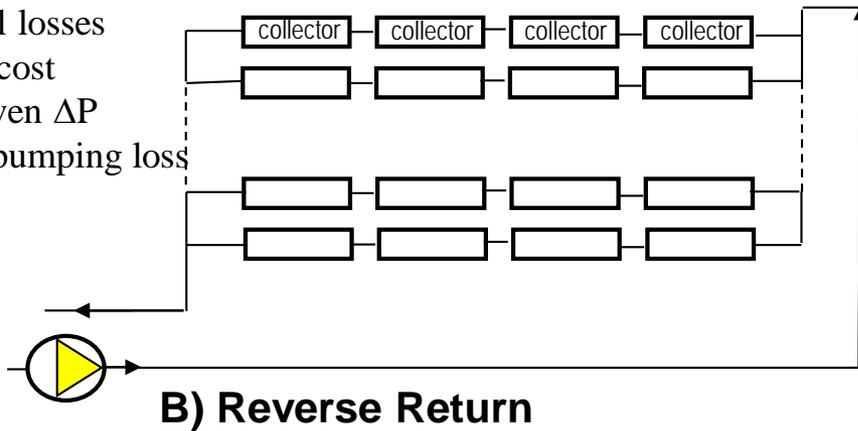


Solar field Lay-outs

- 👍 Thermal losses
- 👎 Uneven ΔP
- 👎 Higher pumping loss

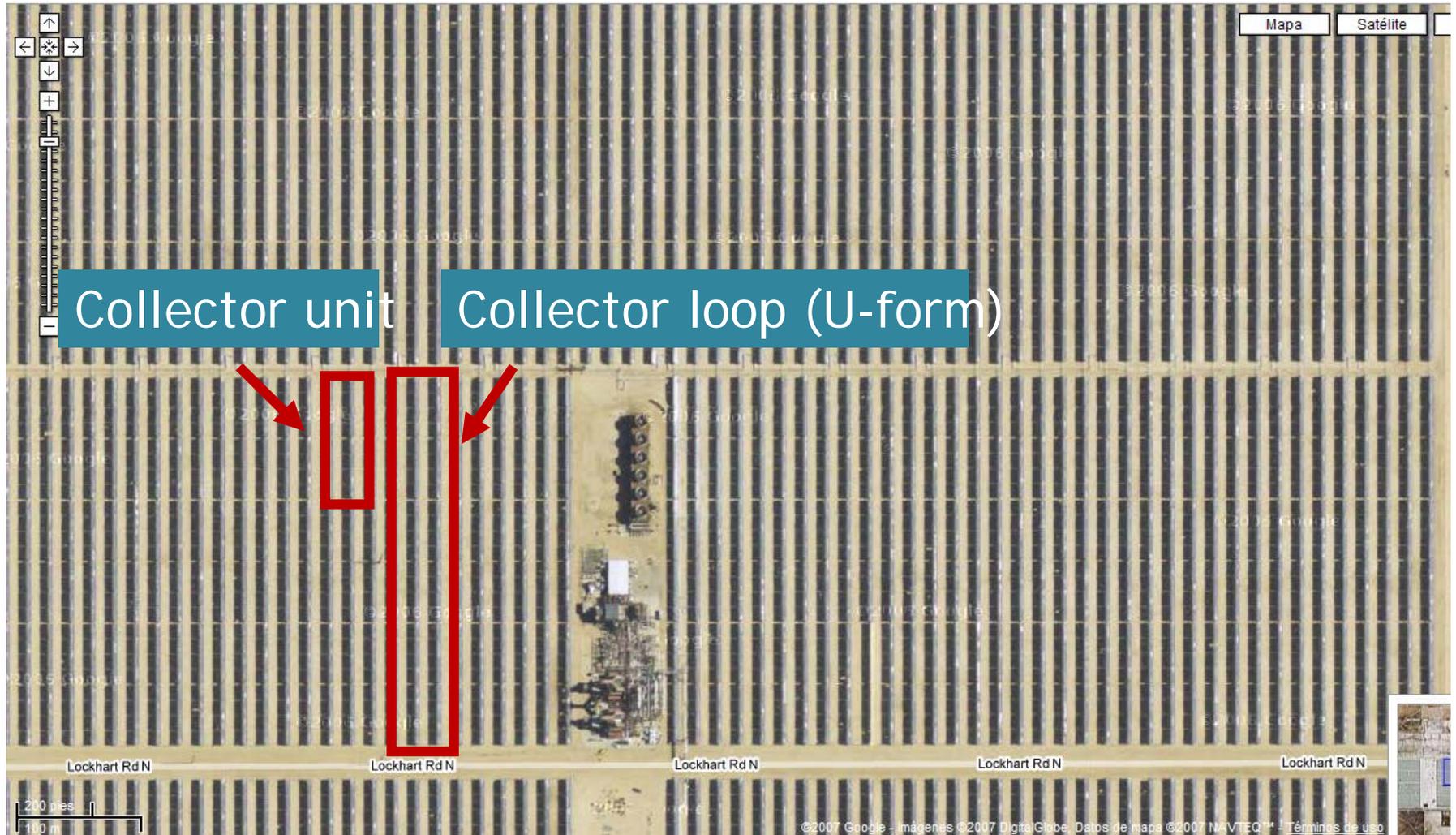


- 👎 Thermal losses
- 👎 Higher cost
- 👍 More even ΔP
- 👍 Lower pumping loss



- 👍 Shortest piping length
- 👍 Better access to the collectors
- 👎 Uneven ΔP

Solar field configuration with PTC



Source: Google Maps, SEGS VIII&IX



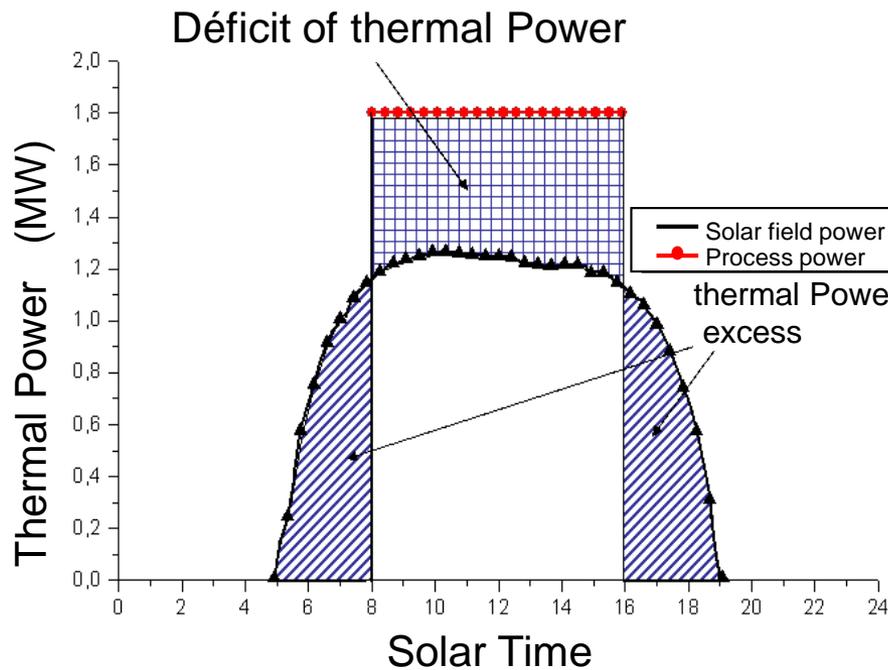
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Thermal Energy Storage Systems for PTCs

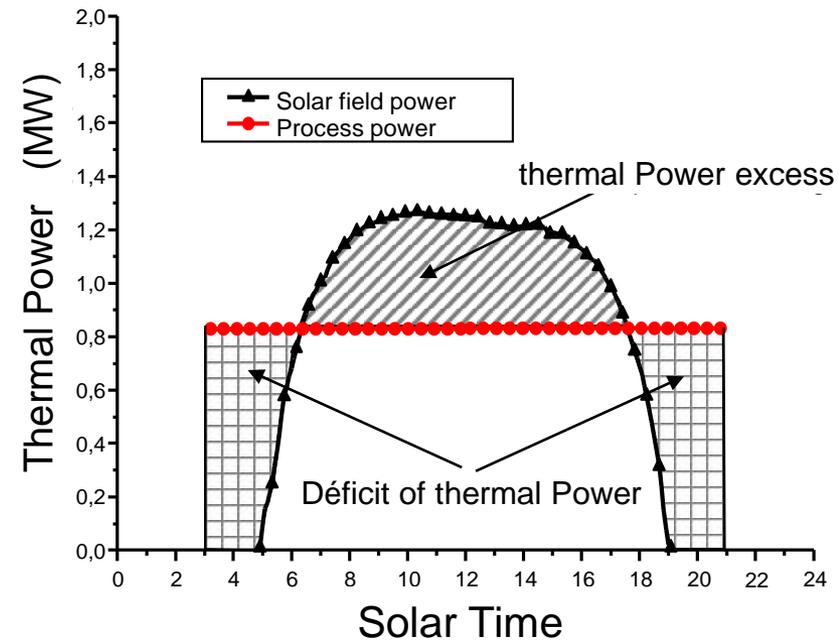
- **Advantages** {
- It increases the number of operating hours
 - It enhances solar field controllability
 - Delivery of thermal power at constant rate in spite of variable DNI

Solar Systems with PTCs

The use of thermal storage systems to provide constant power



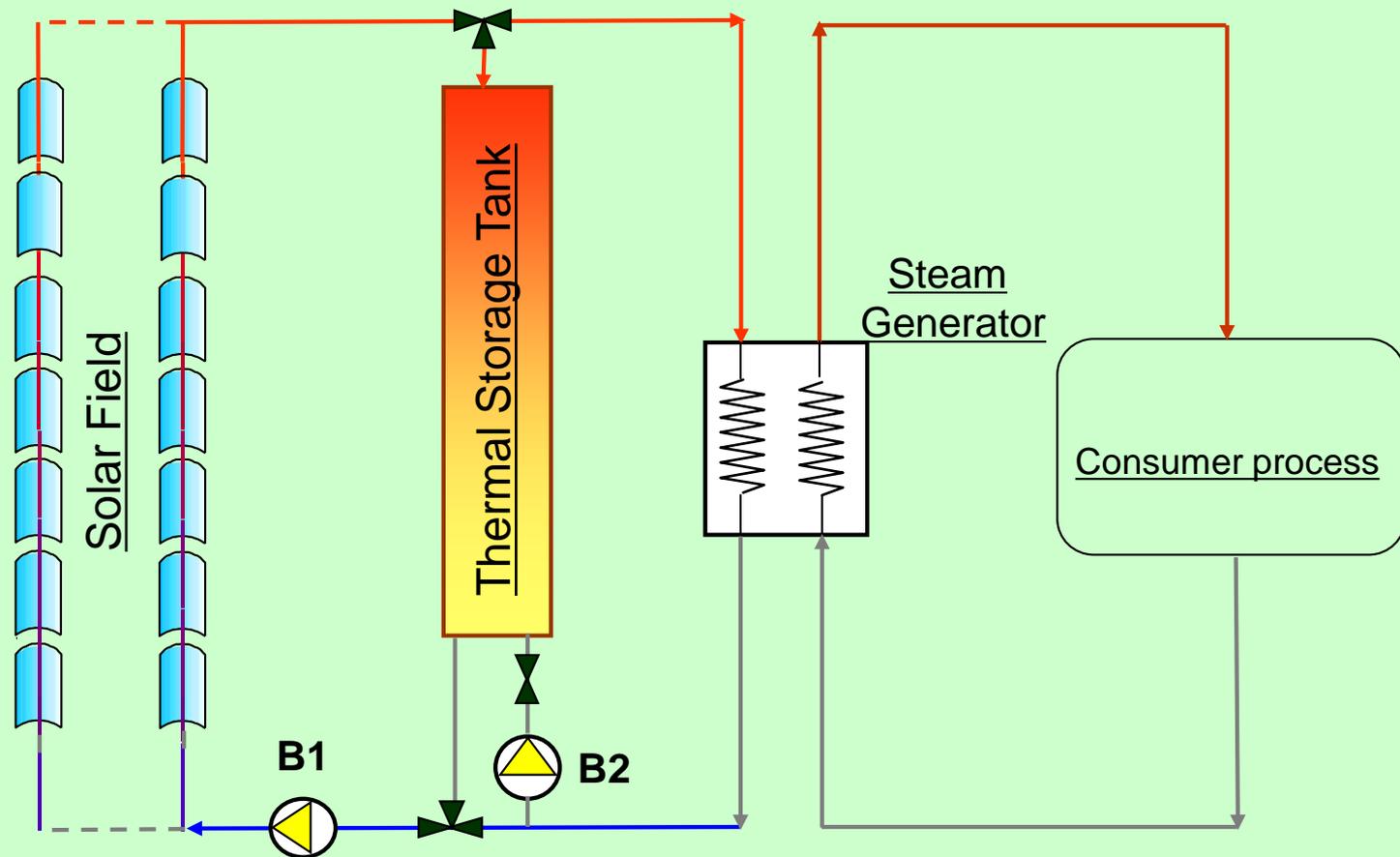
Case a)



Case b)

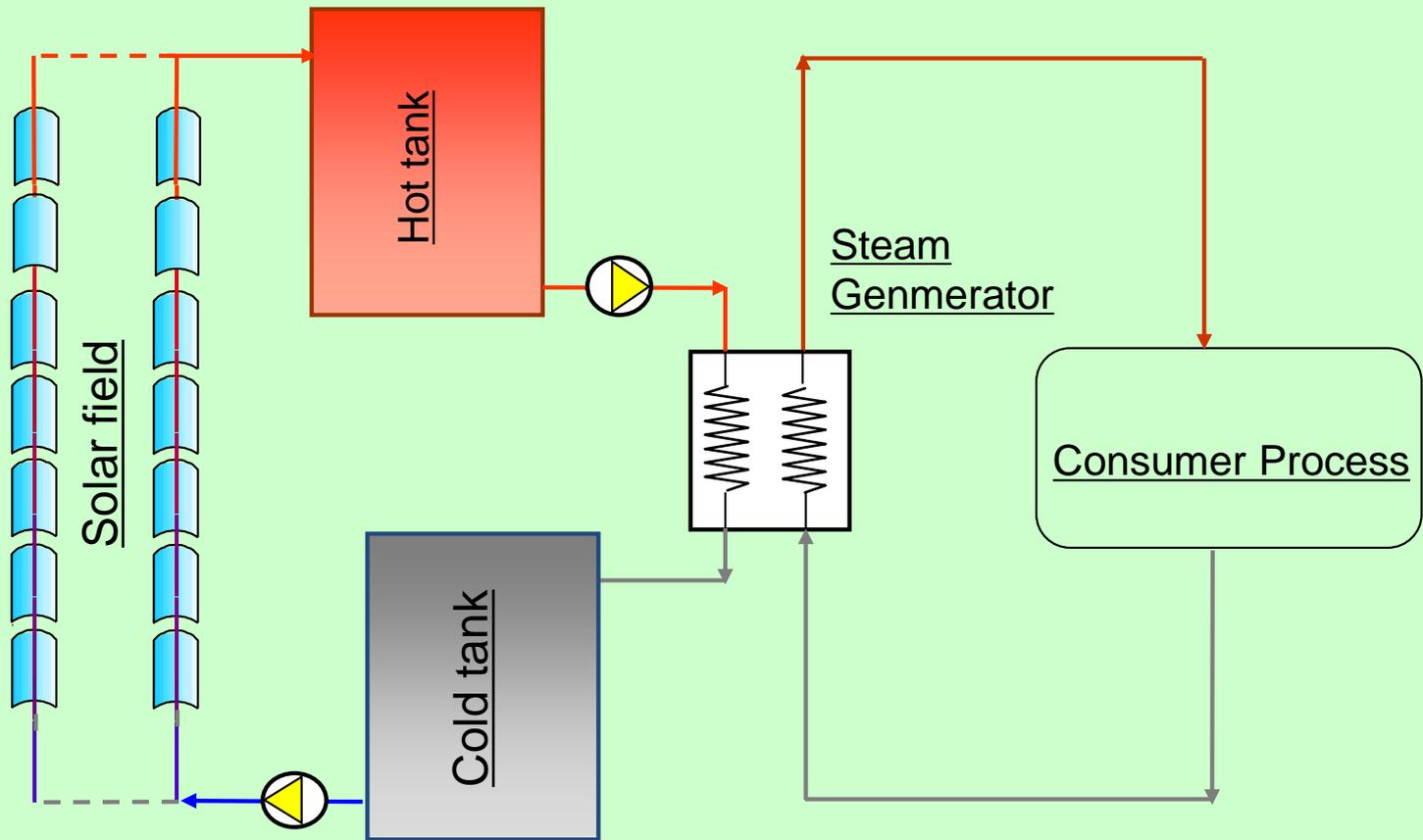
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Thermocline Storage tank (single-tank system)



Solar Systems with PTCs

2-tank thermal energy storage system



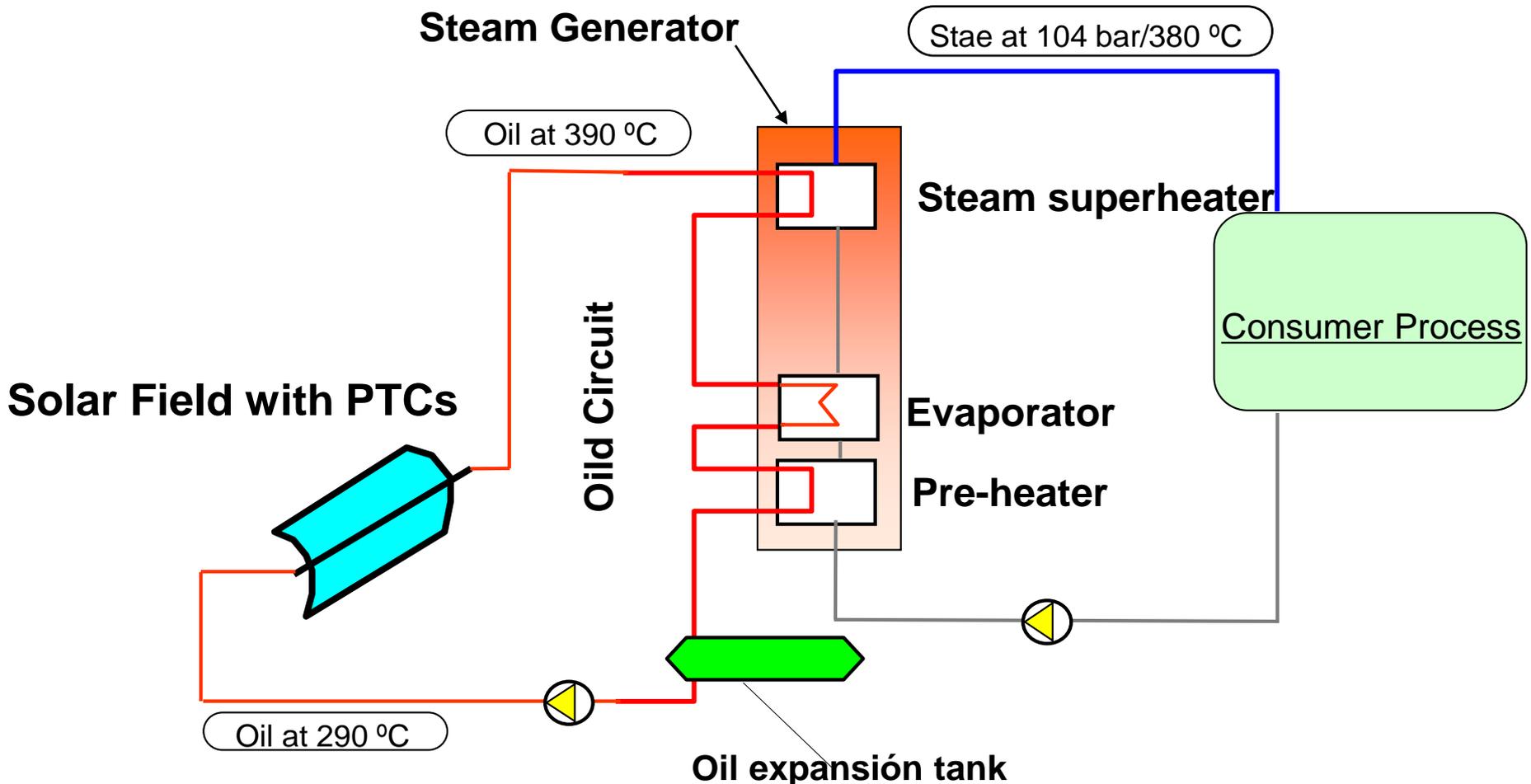
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Thermocline storage tank at PSA

Solar Systems with PTCs

Interface between the solar system and the Process





Solar Systems with PTCs

Main maintenance tasks in PTC solar fields

- Periodic measurement of mirrors reflectivity (every two or three days)
- Replacement of broken mirrors or damaged receiver tubes
- Checking of the solar collector and receiver tubes alignment (quarterly)
- Refilling of the graphite packing of the ball joints (once every 3 years)
- Checking of the Sun-tracking systems

The inertization of the oil circuit is extremely important !!

Solar Systems with PTCs

Parameters affecting the profitability of commercial projects

Environmental parameters

- High direct solar radiation (very critical, $>1800 \text{ kWh/m}^2 \cdot \text{year}$)
- High ambient temperatures (not very critical)
- Low level of environmental pollution

Process parameters

- Suitable process temperature (medium range temperature)
- Continuous operation (ideally: 7 days/week)
- Peak energy demand around solar noon in Summer time

Financial parameters

- High cost of fossil fuels
- Uncertain fossil fuels supply
- Cheap land available
- Money available for investment
- Tax exceptions or public subsidies available

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- Thank you very much for your attention

- Questions?

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