



# LARGE-SCALE SOLAR AIR CONDITIONING PLANT OF CERDANYOLA

## CONCEPTUAL DESIGN AND SELECTION TECHNOLOGIES

Jesús López

POLYCITY PROJECT - CERDANYOLA DEL VALLÈS

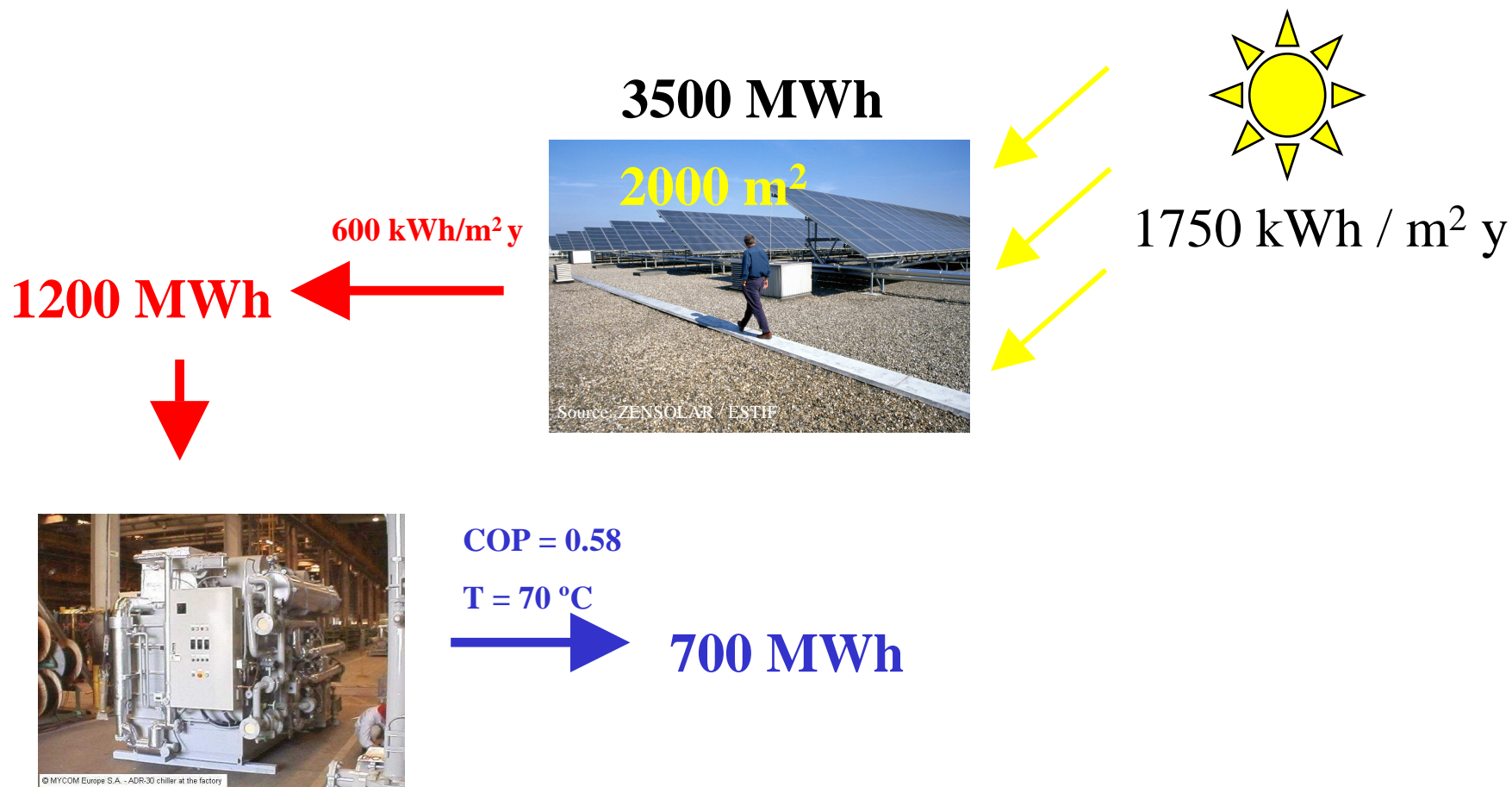


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- 3 – Solar thermal plant design considerations
- 4 – Absorption / adsorption comparison study
- 5 – Results

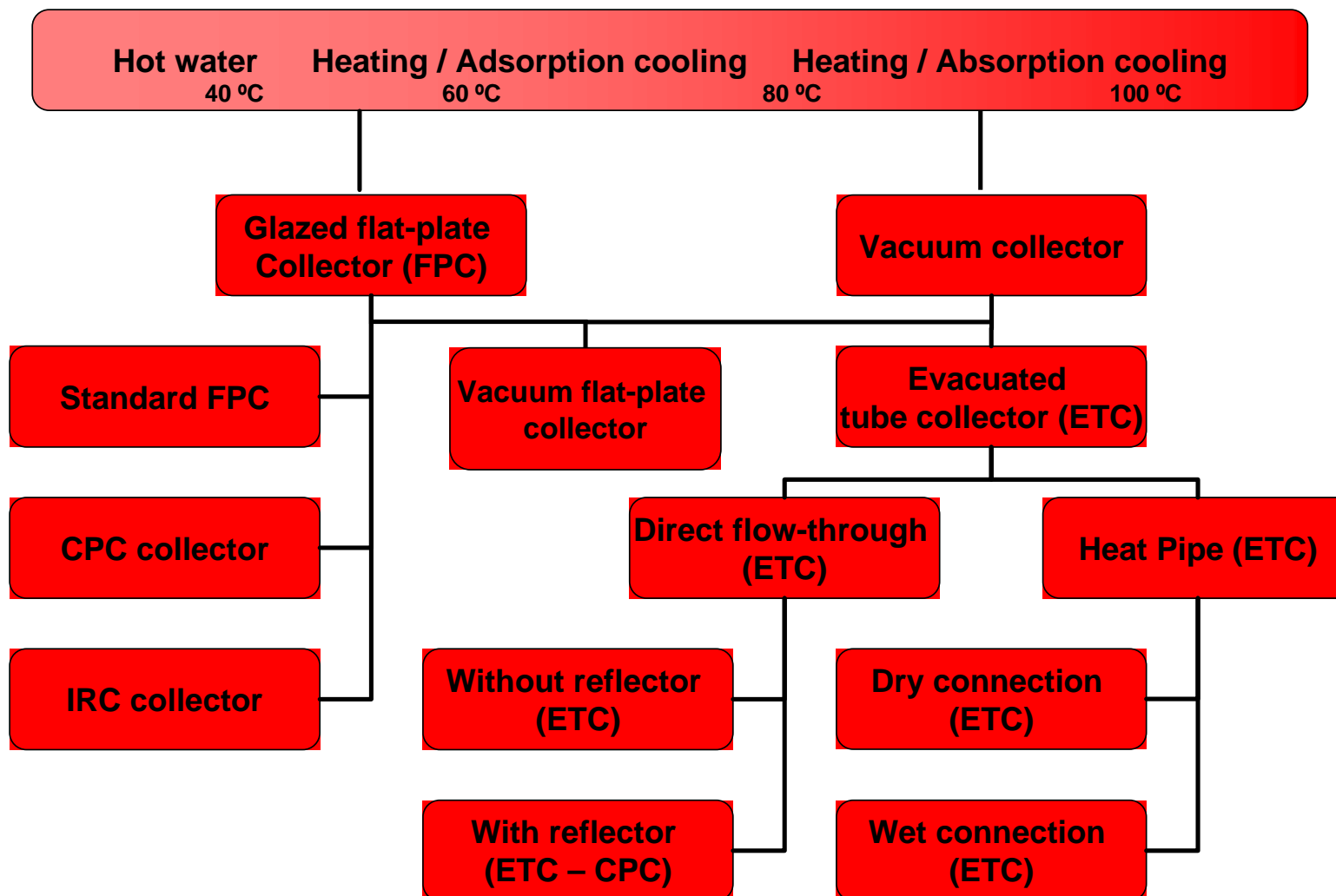


## SOLAR THERMAL PLANT – Problem definition



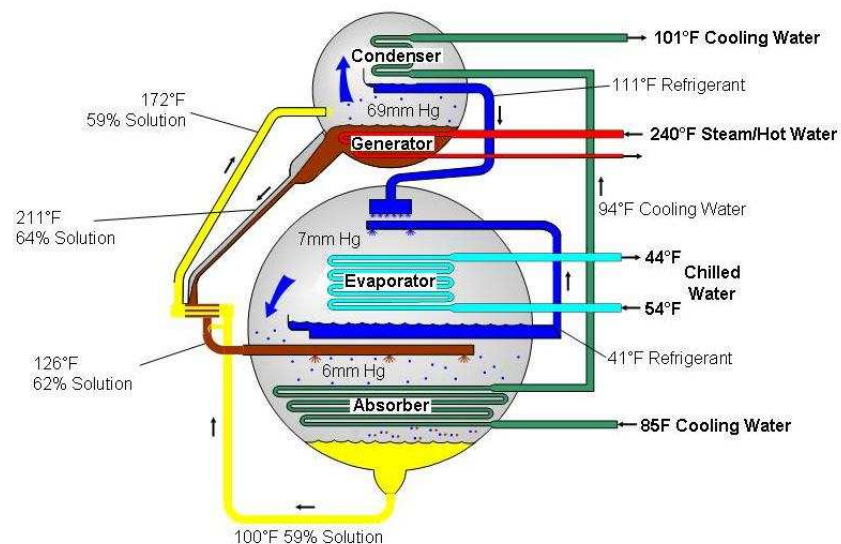


## SOLAR THERMAL PLANT – Solar thermal collector technologies

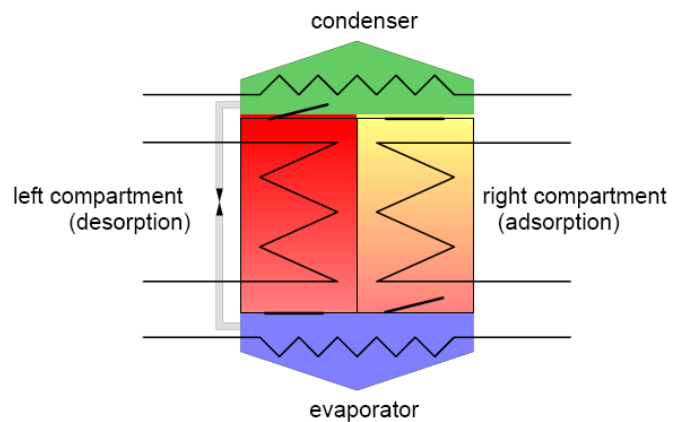




## SOLAR THERMAL PLANT – Cooling technologies



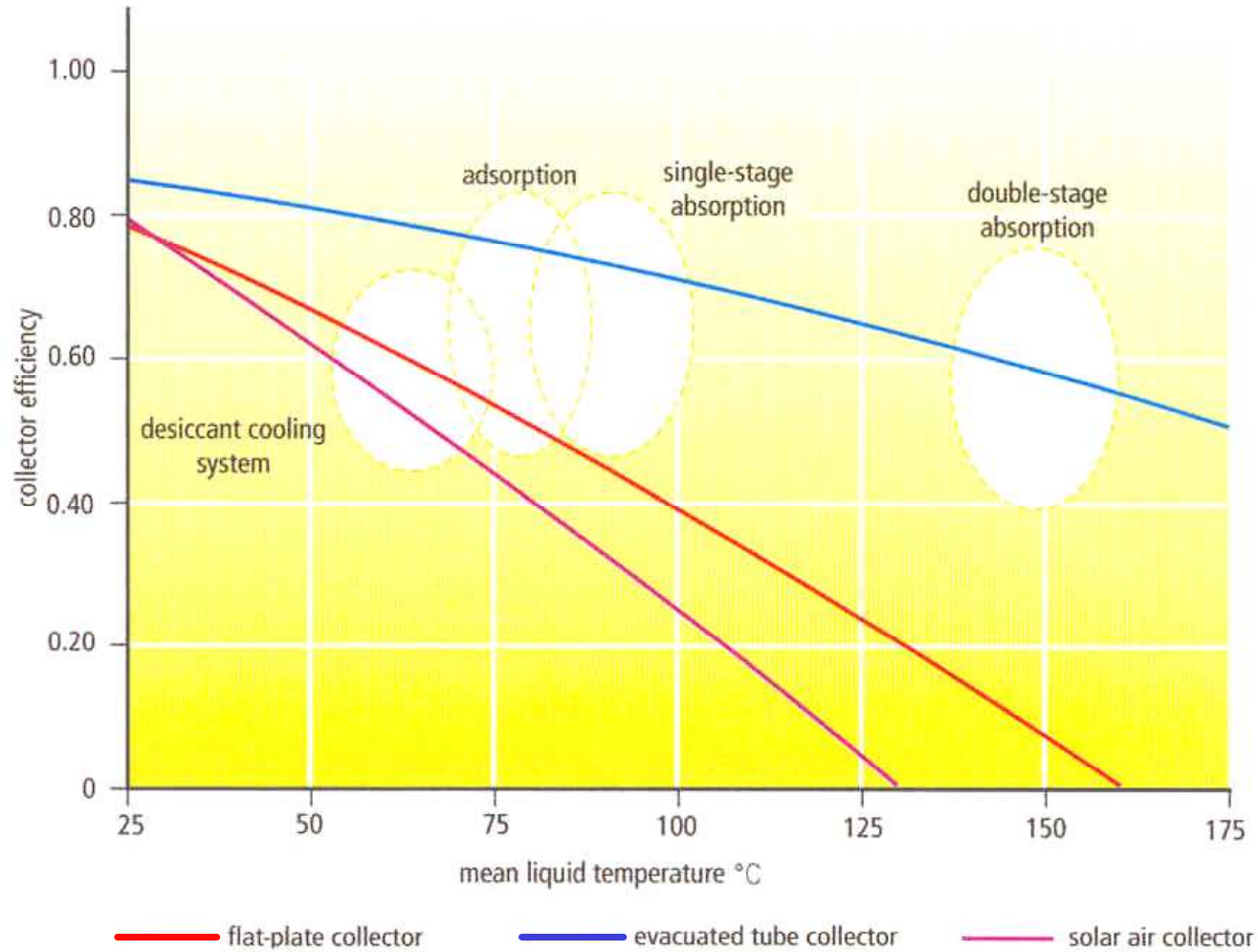
H<sub>2</sub>O – LiBr Single effect absorption chiller



Silica gel-water adsorption chiller

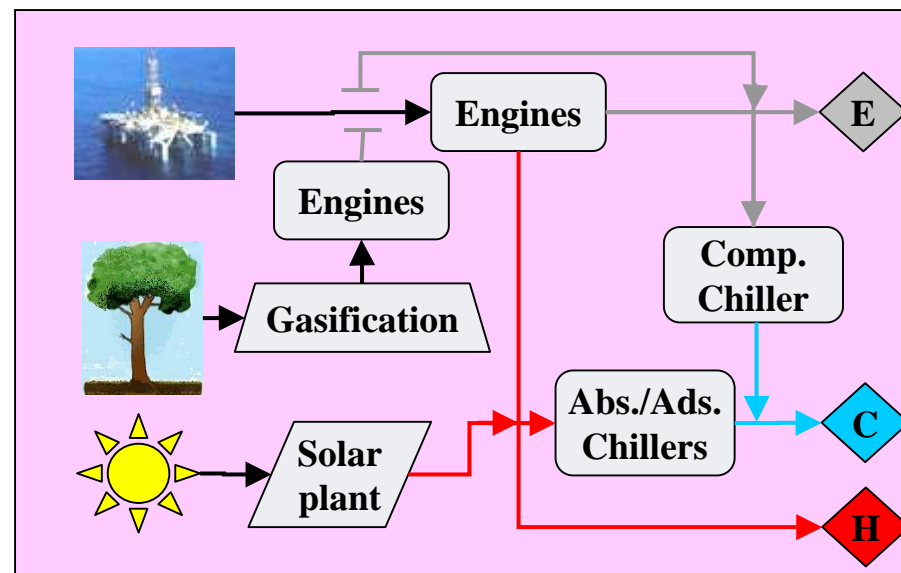
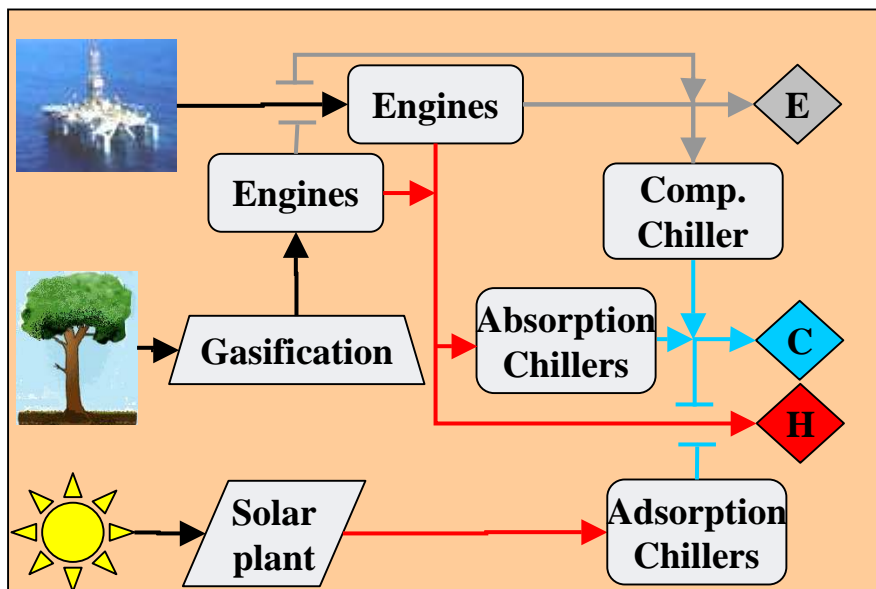


## SOLAR THERMAL PLANT – Technical Selection



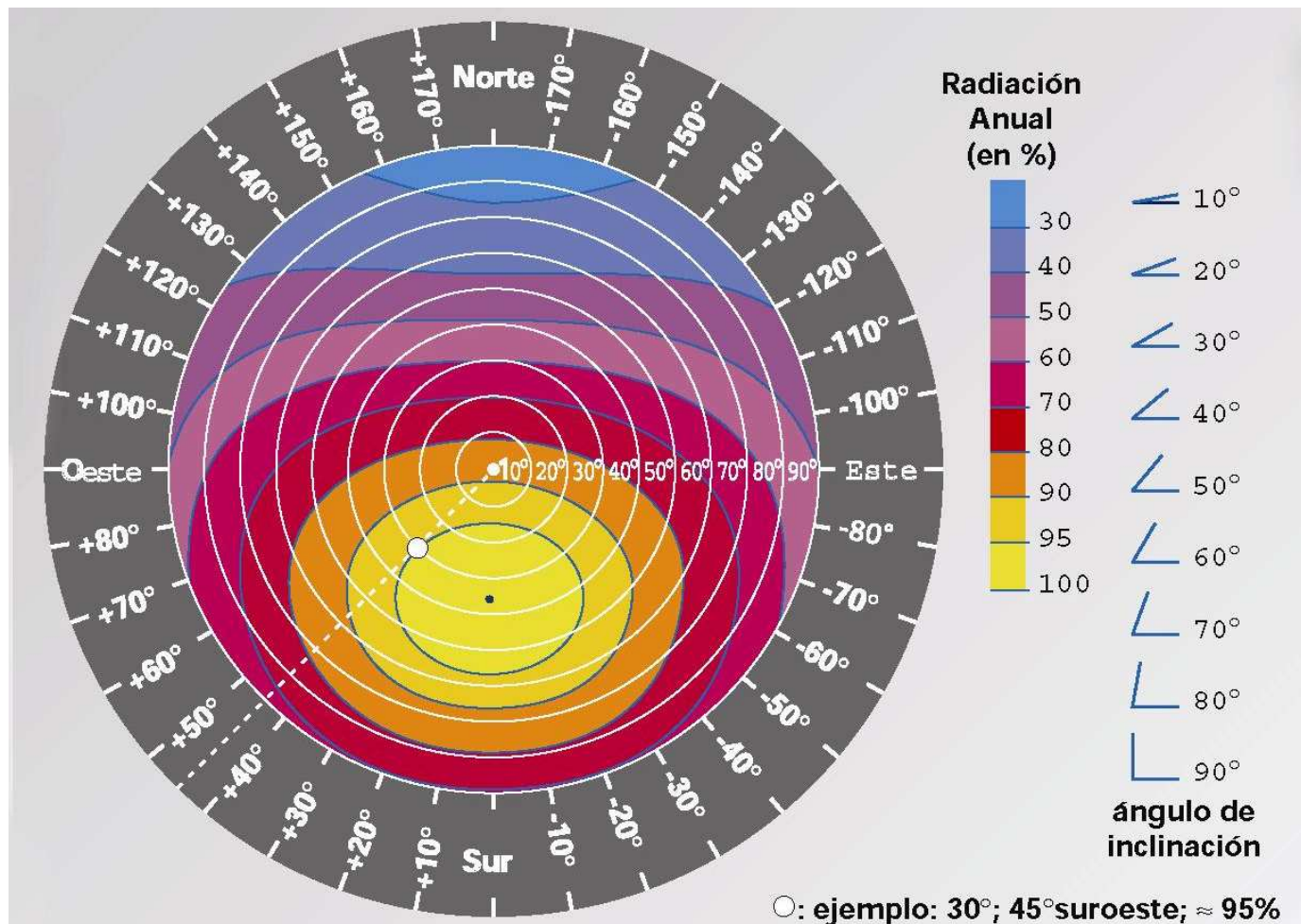


## SOLAR THERMAL PLANT – Design considerations



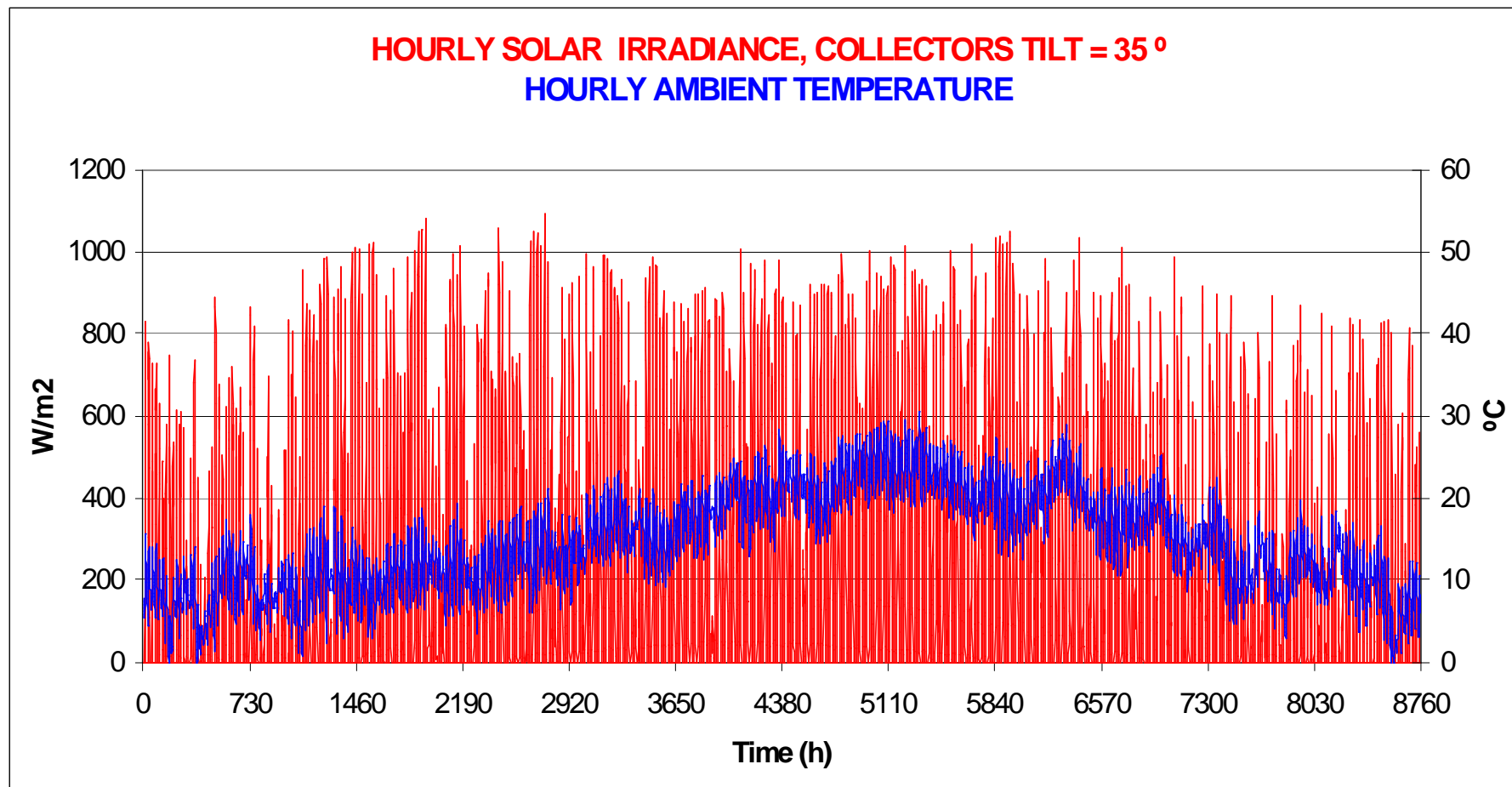


## SOLAR THERMAL PLANT – Design considerations



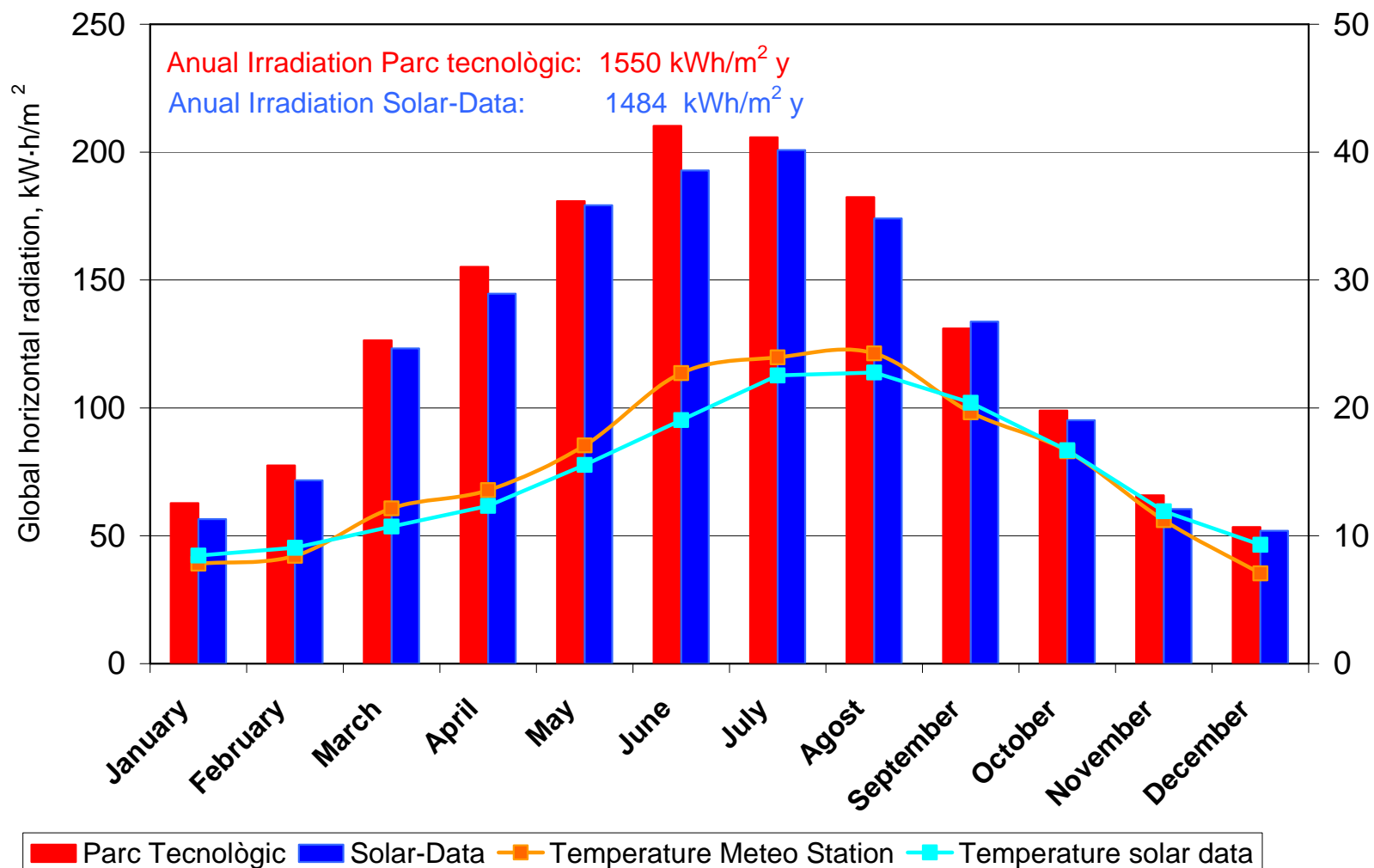


## SOLAR THERMAL PLANT – Design considerations



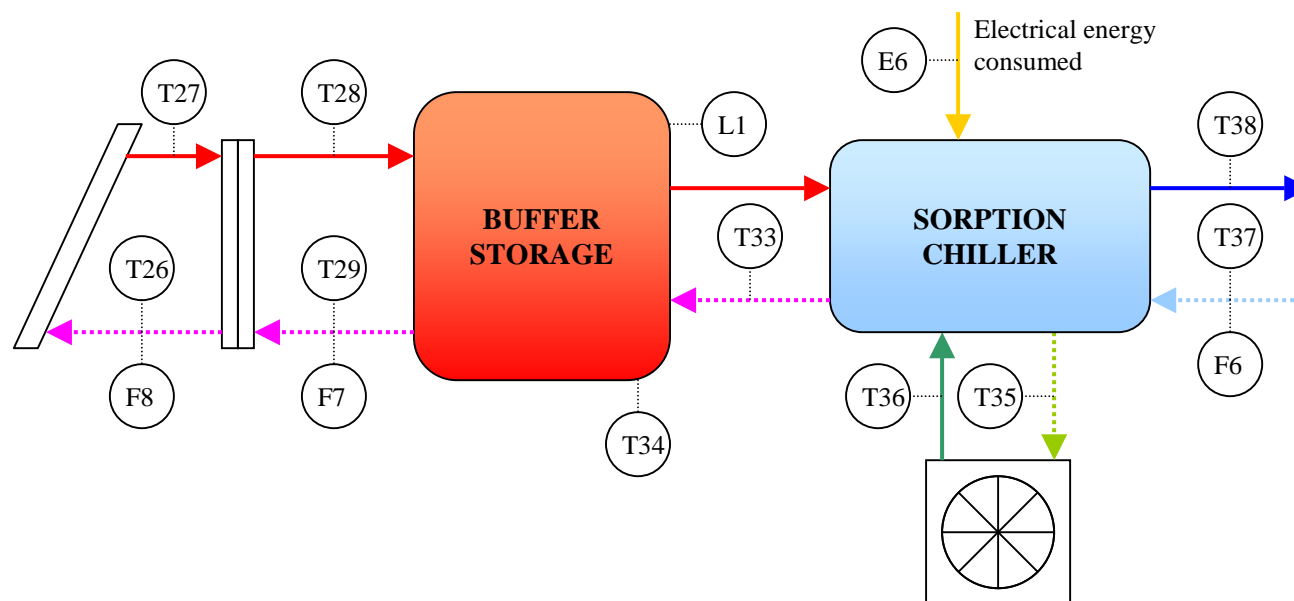


## SOLAR THERMAL PLANT – Design considerations





## SOLAR THERMAL PLANT – Abs / Ads comparison study





## SOLAR THERMAL PLANT – Abs / Ads comparison study

### Definitions

$$\text{Annual Heating Yield } (T_d) = \sum_1^{8760} \eta_{\text{collector}}(T_d + 5, T_a, I) \times I(t) \times \Delta t \quad (\text{kW}\cdot\text{h}_{\text{heat}}/\text{m}^2\text{y})$$

$$\eta_{\text{annual collector}}(T_d) = \frac{\text{Annual Heating Yield } (T_d) \quad (\text{kW}\cdot\text{h}/\text{m}^2\text{y})}{\text{Annual Global Irradiation } (\text{kW}\cdot\text{h}/\text{m}^2\text{y})}$$

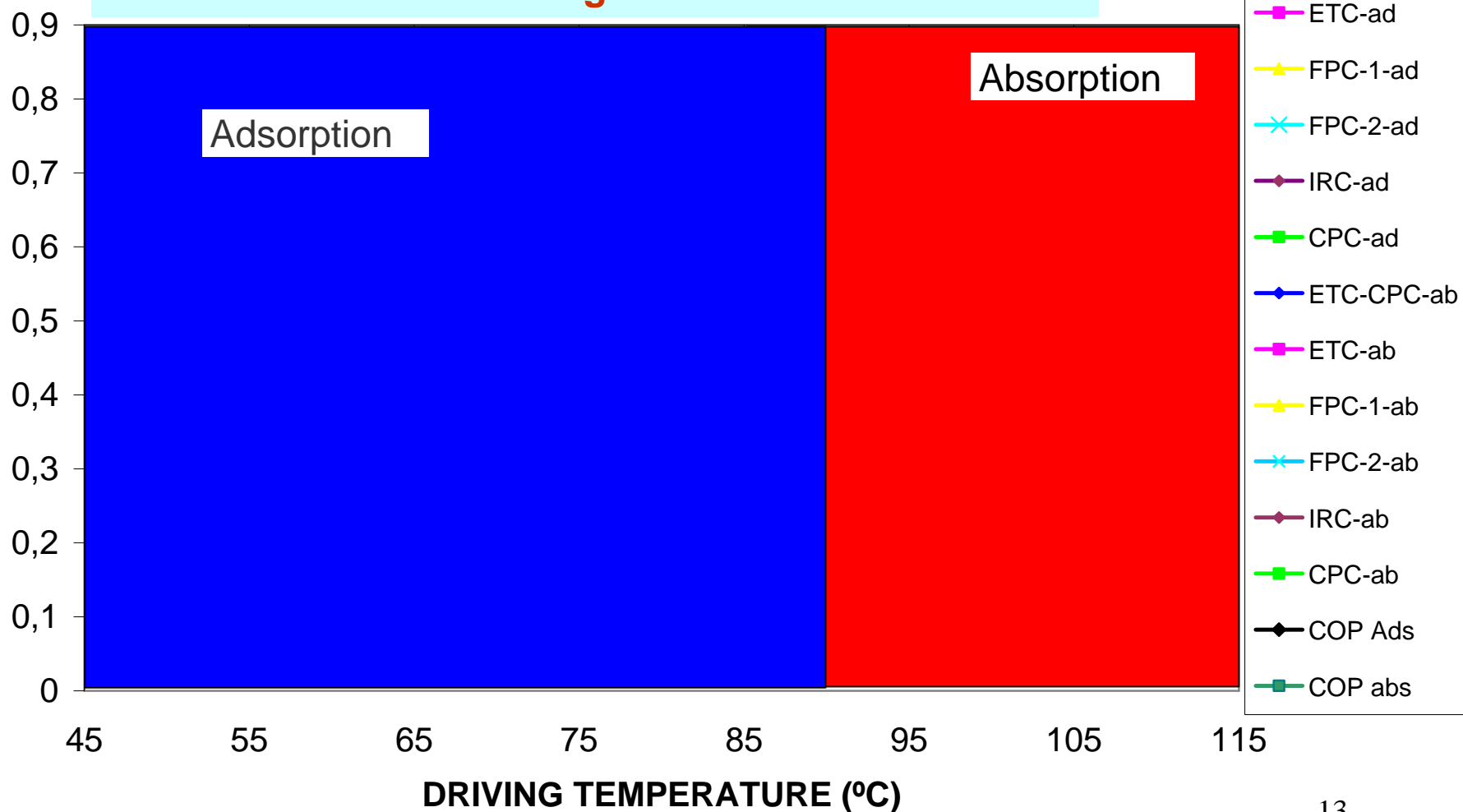
$$\text{Annual Cooling Yield } (T_d) = \text{Annual Heating Yield } (T_d) \times \text{COP}_{\text{cool}}(T_d) \quad (\text{kW}\cdot\text{h}_{\text{cool}}/\text{m}^2\text{y})$$

$$\text{COP}_{\text{Solar}}(T_d) = \eta_{\text{annual collectors}}(T_d) \times \text{COP}_{\text{cool}}(T_d)$$



## SOLAR THERMAL PLANT – Abs / Ads comparison study

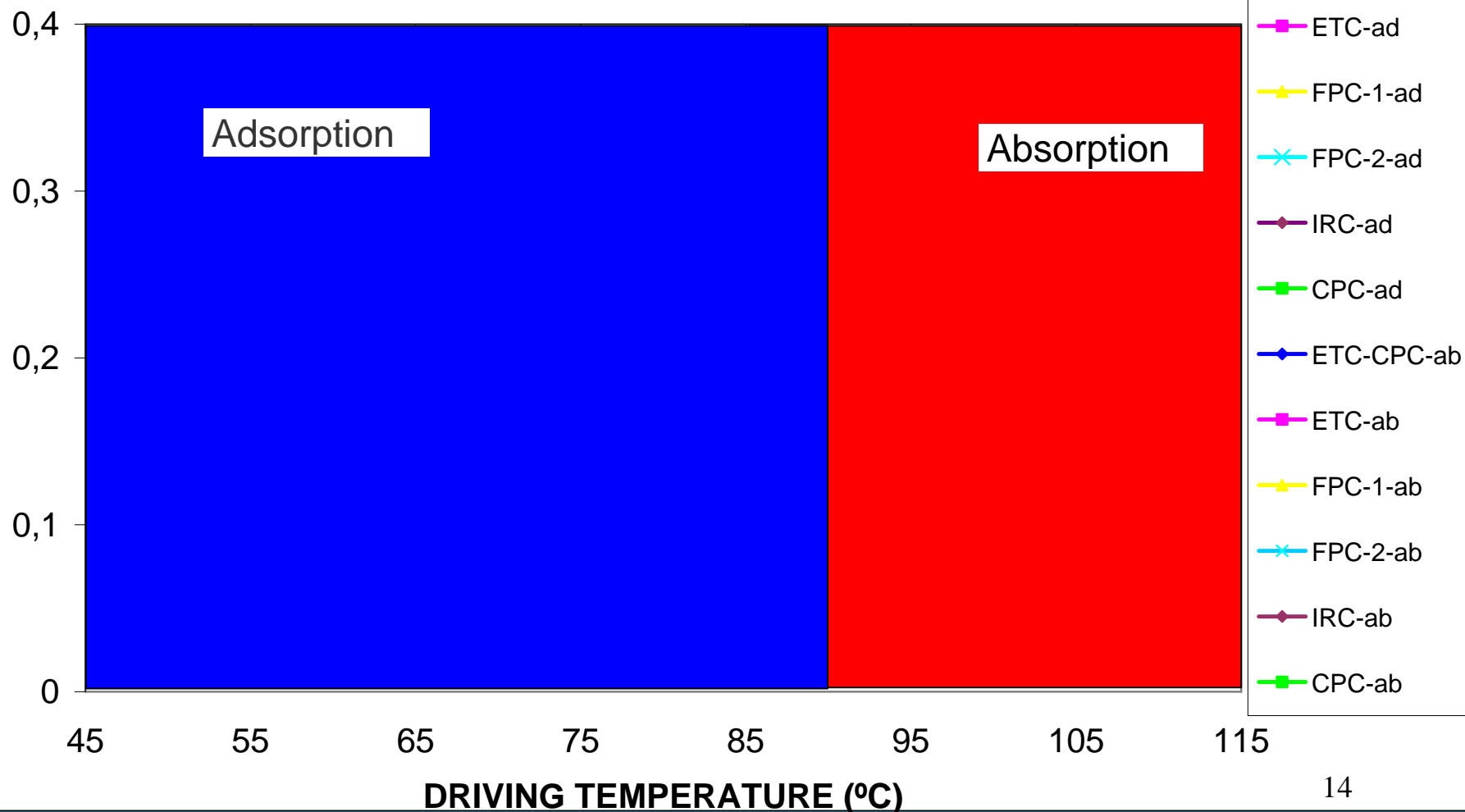
### Thermal Plant and Cooling Performance Coefficients





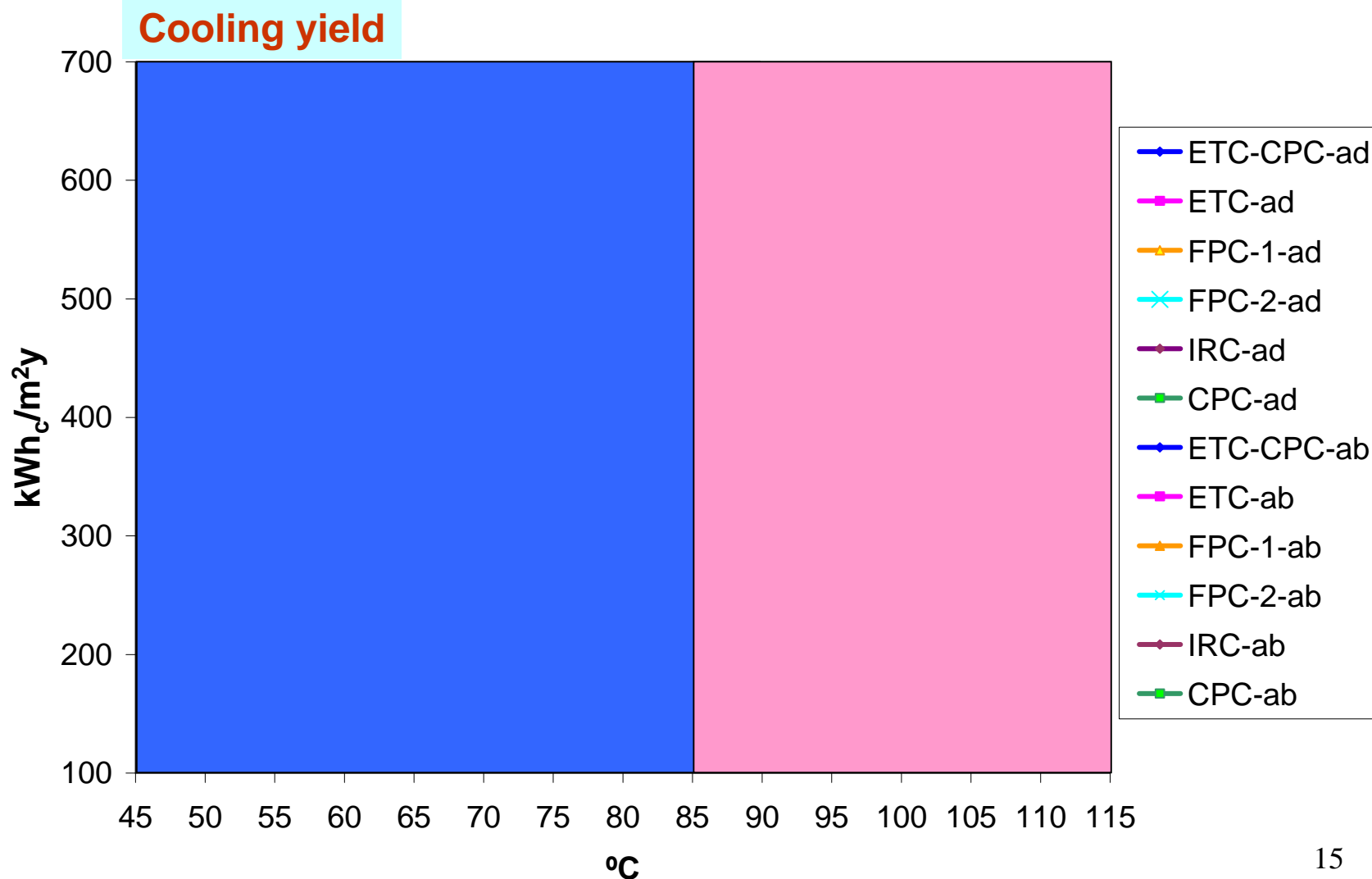
## SOLAR THERMAL PLANT – Abs / Ads comparison study

### COP SOLAR





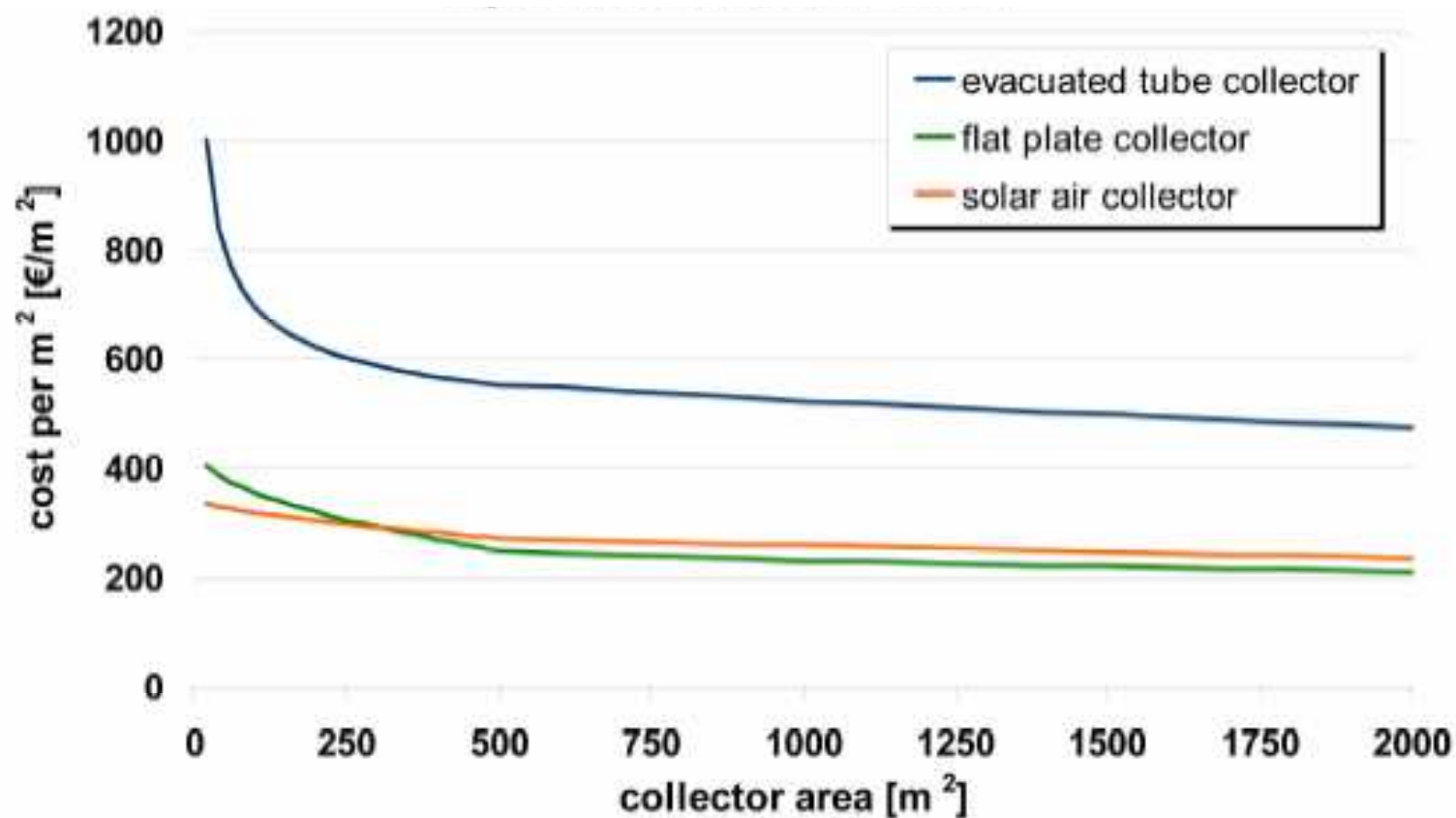
## SOLAR THERMAL PLANT – Abs / Ads comparison study





## SOLAR THERMAL PLANT – Abs / Ads comparison study

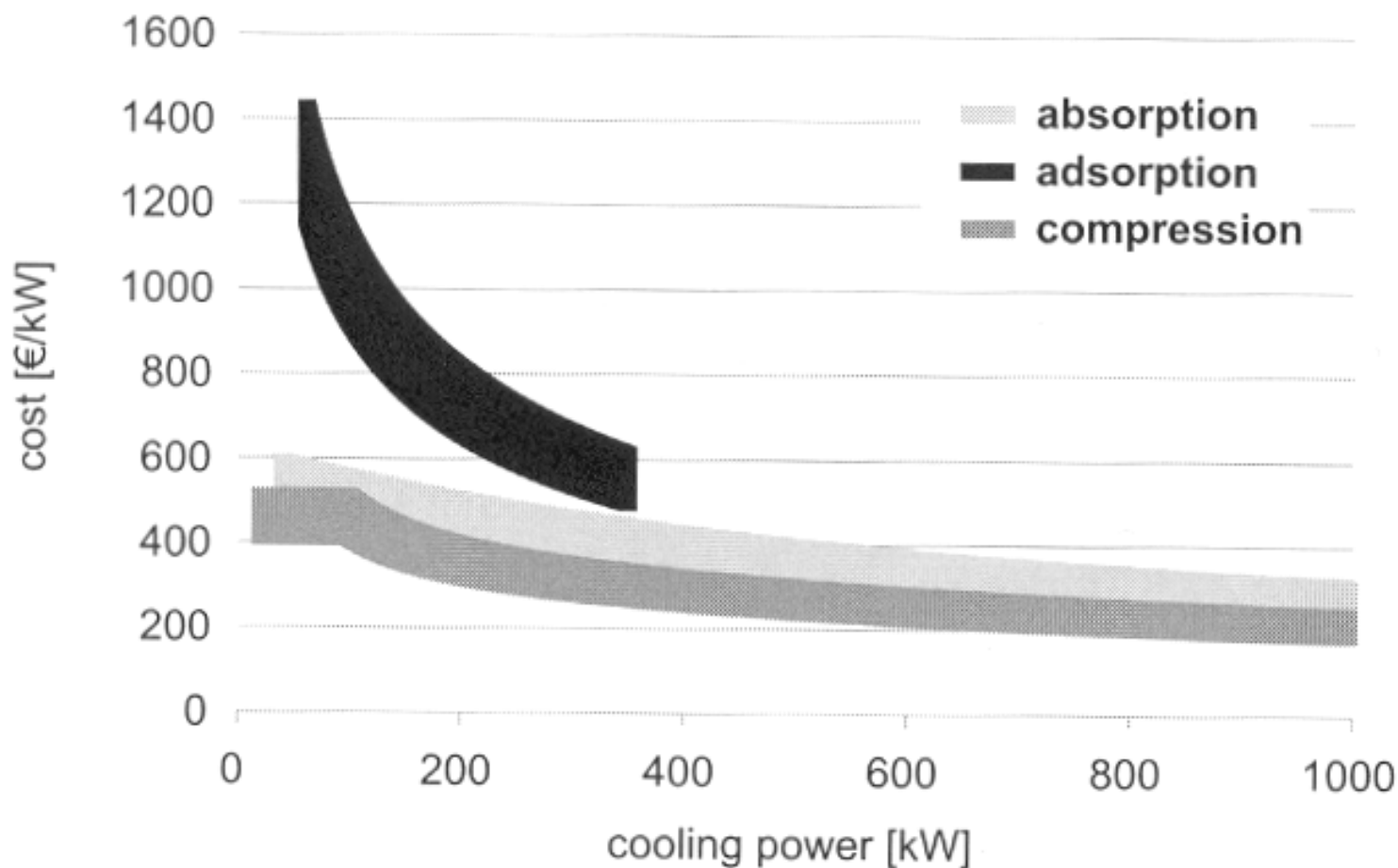
### Economic cost





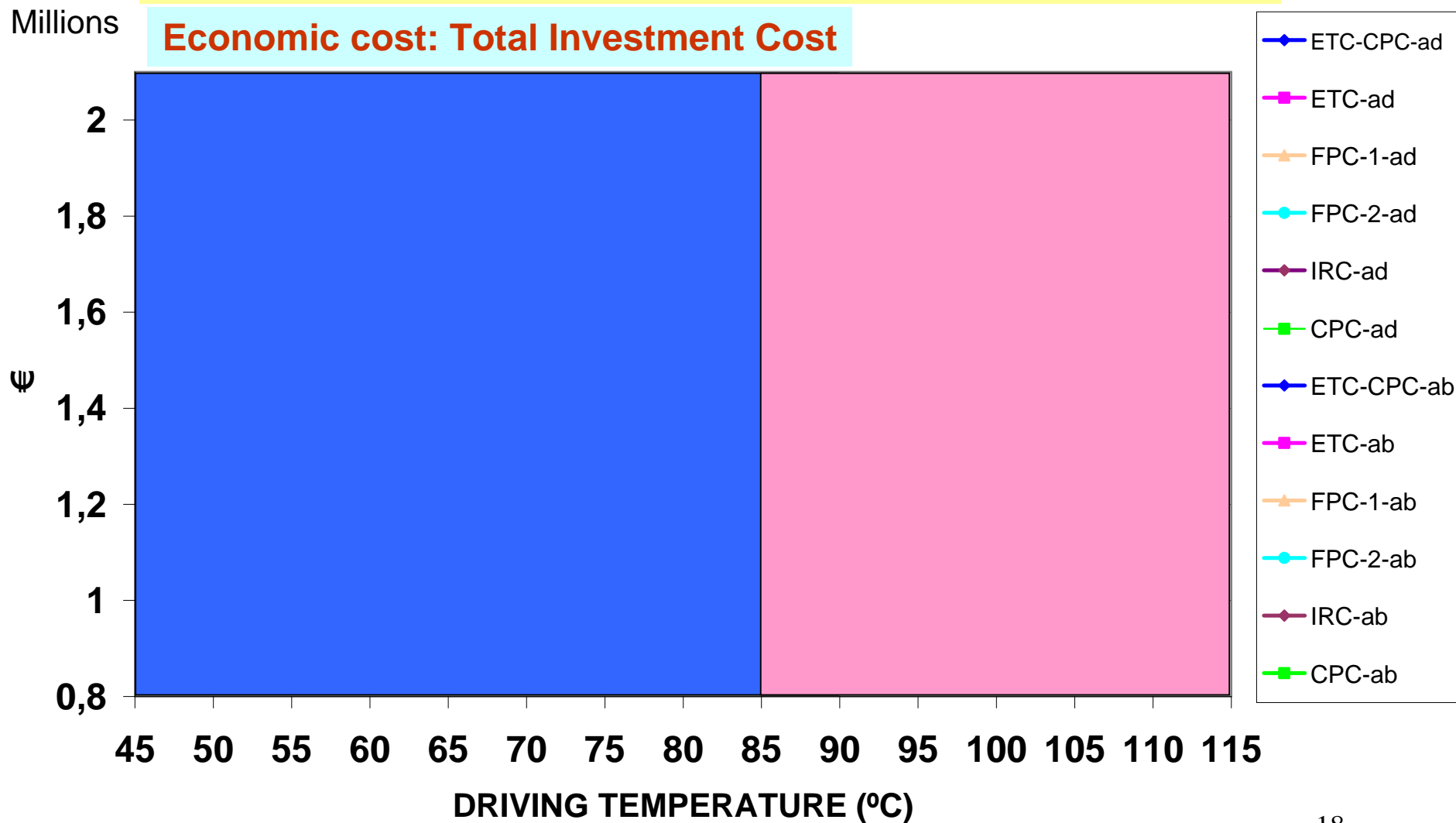
## SOLAR THERMAL PLANT – Abs / Ads comparison study

### Economic cost





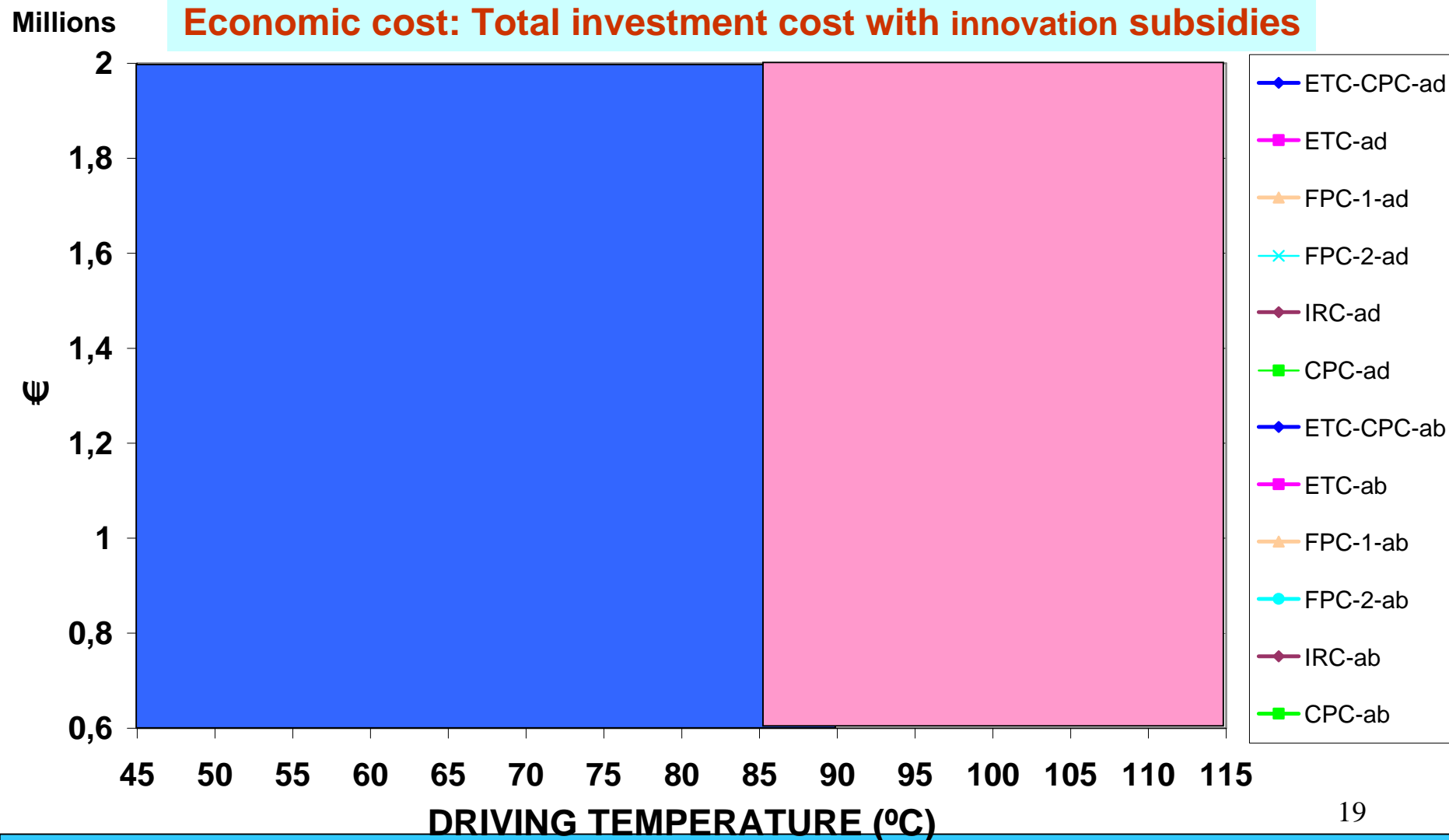
## SOLAR THERMAL PLANT – Abs / Ads comparison study





## SOLAR THERMAL PLANT – Abs / Ads comparison study

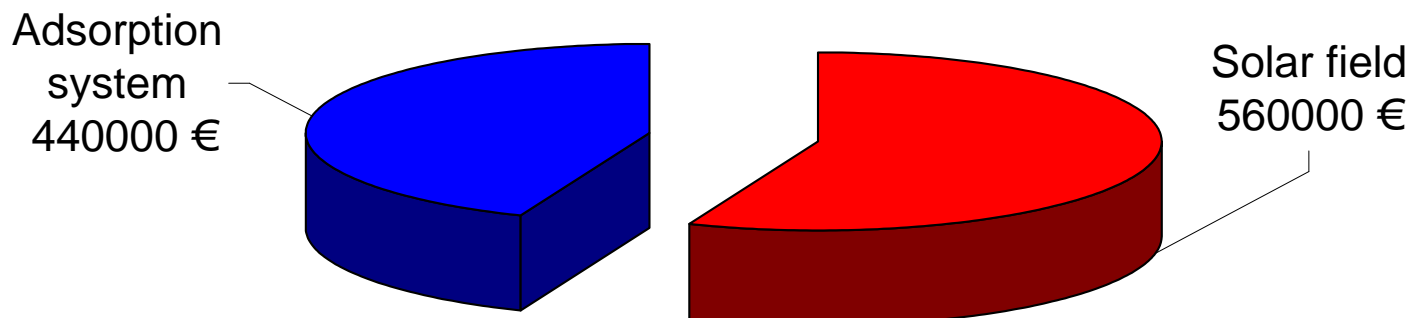
Economic cost: Total investment cost with innovation subsidies





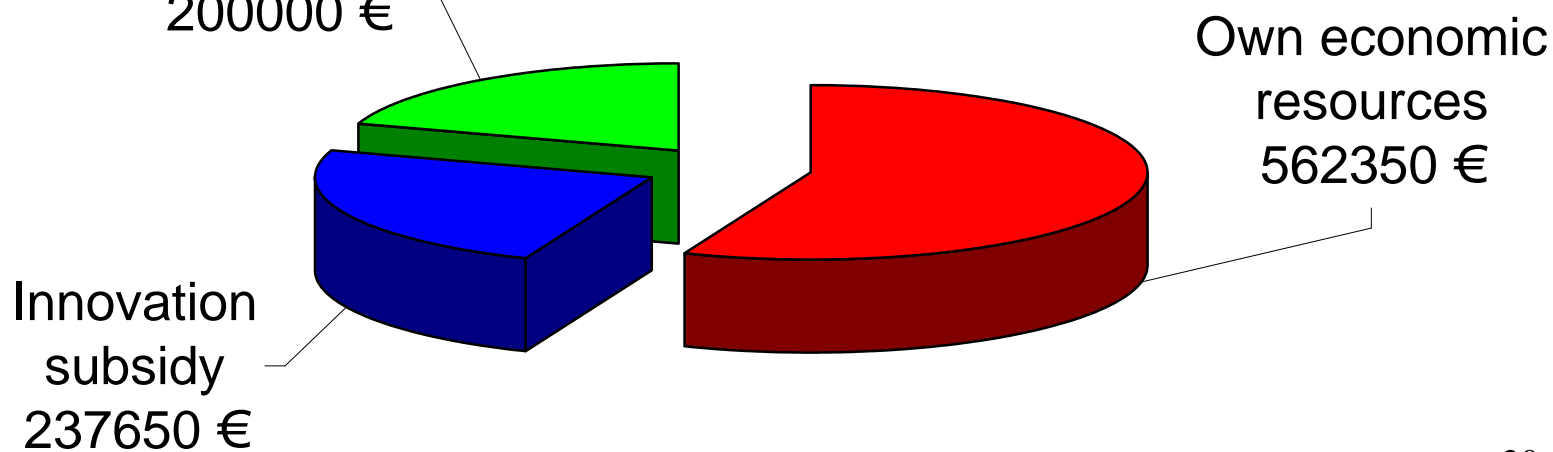
## SOLAR THERMAL PLANT – Results

### TOTAL INVESTMENT COST



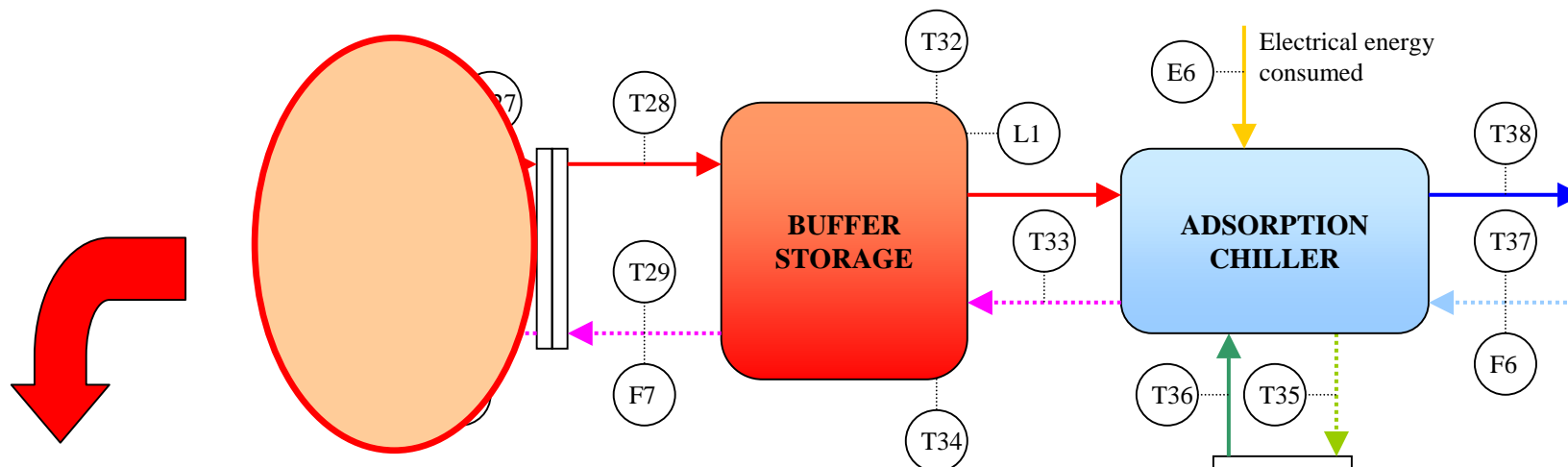
I.D.A.E.  
subsidy  
200000 €

### FINANCING





## SOLAR THERMAL PLANT – Results



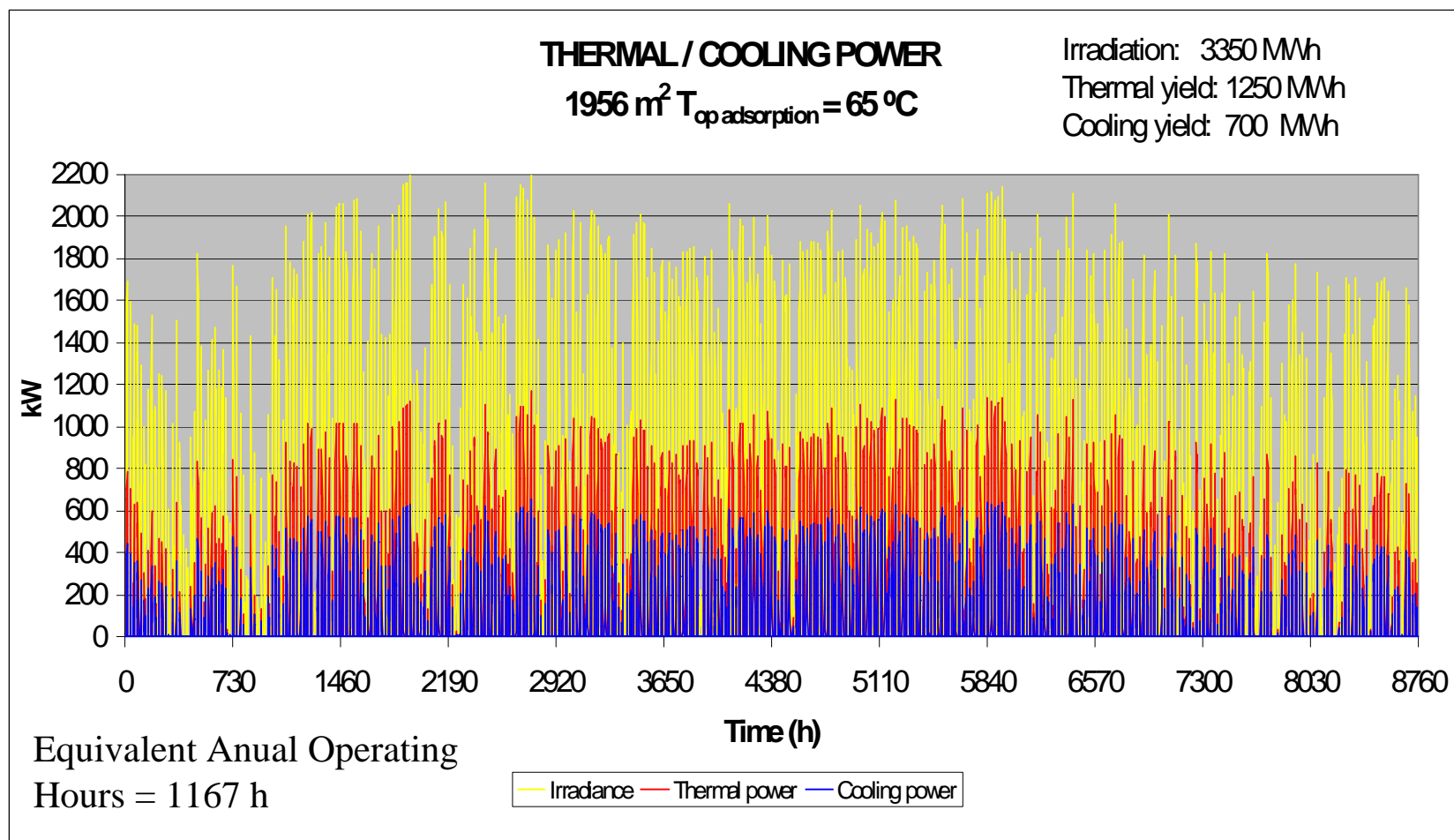
**1956 m<sup>2</sup>**

**1.37 MW**

Parameter	Unit	Value
Gross collector area	m <sup>2</sup>	1956
Number of flat plate collectors	-	762
Collector Type	-	Selective flat plate collector
Collector gross area	m <sup>2</sup>	2.567
Optical efficiency coefficient (c0)		0.69
Linear loss coefficient (c1)	W/ m <sup>2</sup> K	2.61
Quadratic loss coefficient (c2)	W/ m <sup>2</sup> K <sup>2</sup>	0.0098
Tilt angle	°	35
Operation temperature solar collector	°C	70
Specific cost (incl. 20% installation cost)	€/ m <sup>2</sup>	281

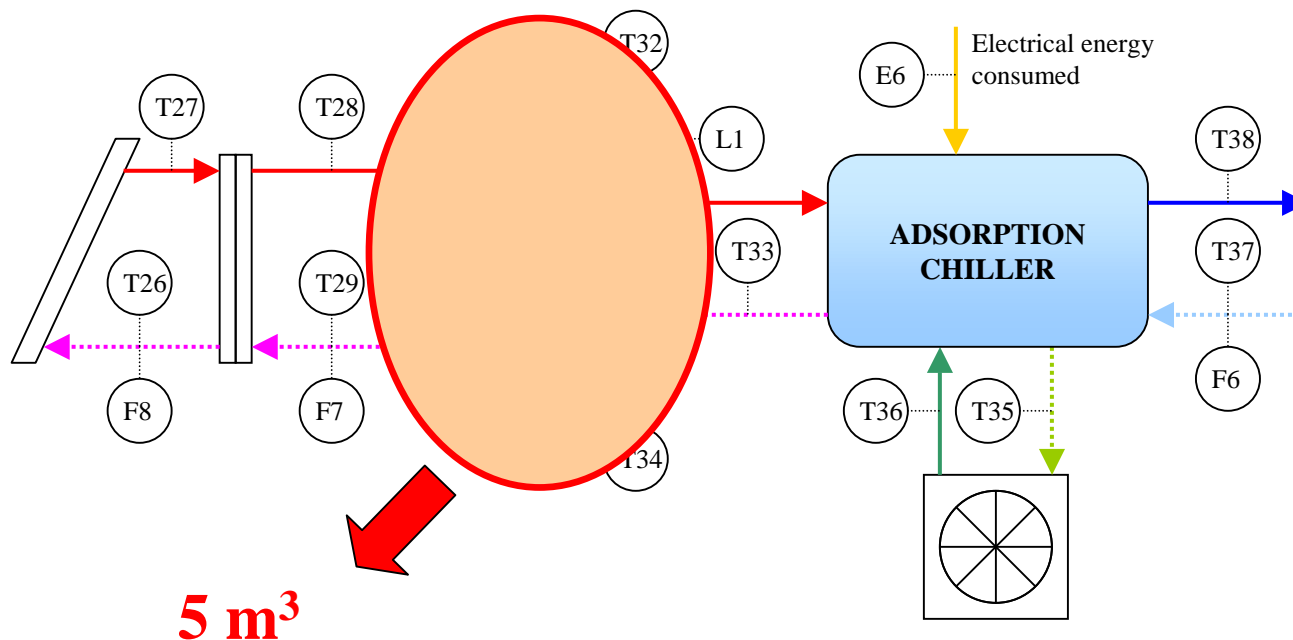


## SOLAR THERMAL PLANT – Results





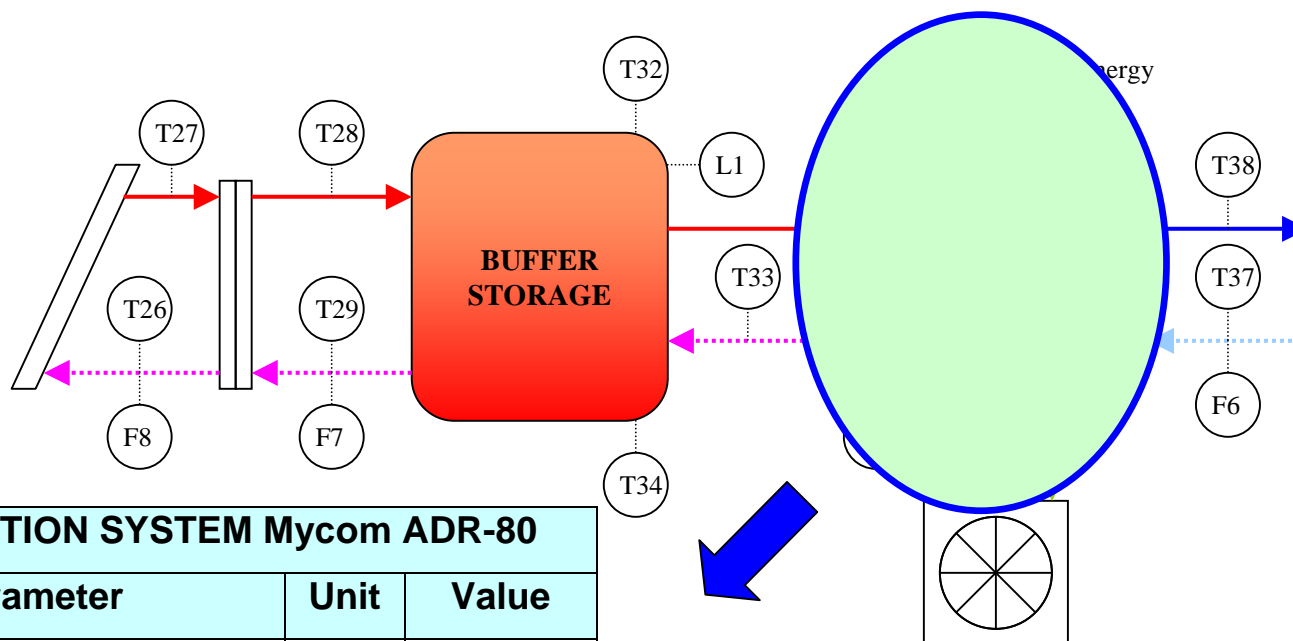
## SOLAR THERMAL PLANT – Results



Parameter	Unit	Value
Volume	m <sup>3</sup>	5
Maximum storage temperature	°C	100
Material	-	Cast Iron
Specific cost	€/ m <sup>3</sup>	500



## SOLAR THERMAL PLANT – Results



ADSORPTION SYSTEM Mycom ADR-80		
Parameter	Unit	Value
Nominal thermal capacity	kW	468
Maximum thermal capacity	kW	658
COP	-	0.60
Nominal chilling capacity	kW	281
Maximum chilling capacity	kW	395
Number of Units	-	2

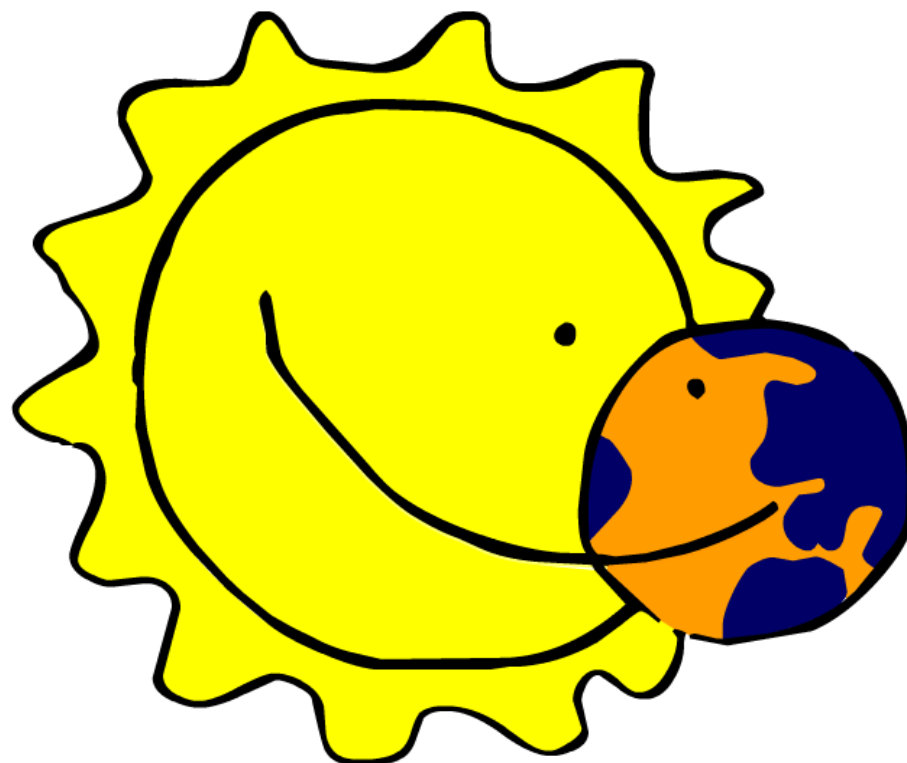
**936 kWt**

**562 kWc**



## SOLAR THERMAL PLANT – Future tasks

- Simulation of the whole solar cooling system (solar collectors, adsorption chiller, cooling tower).
- Selection of the hydraulic scheme and control strategy.
- Coupling with the district heating and district cooling networks.



**Thank you for your attention.**