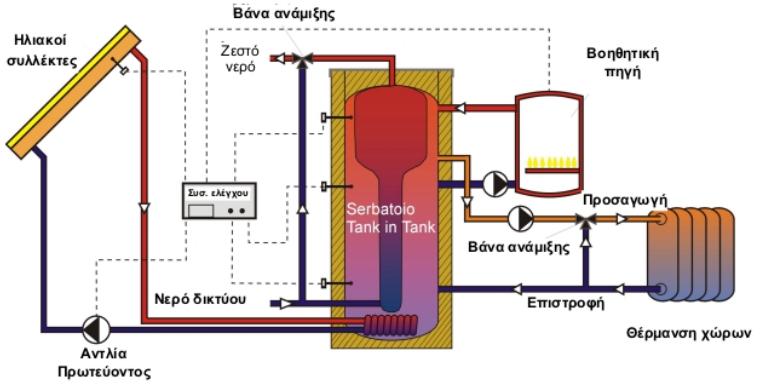


Solar Combi Systems

Trans-solar Workshop

Bulgaria, Sofia

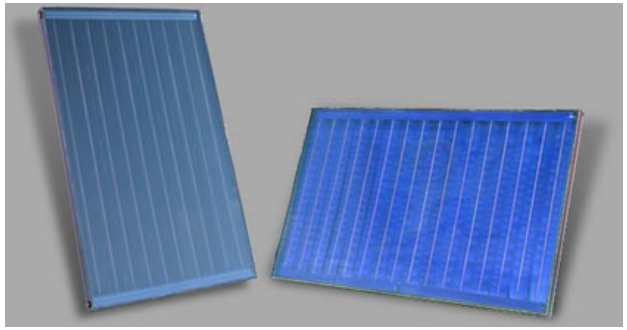
Ioannis Santzaklis
Mechanical Engineer &
Dimitrios Chasapis
R.E.S. Systems Technology Engineer
ΚΑΠΕ Τομέας Θερμικών Ηλιακών Συστημάτων

ΚΑΠΕ CRES

Intelligent Energy Europe

TranSolar

Solar Thermal Collectors



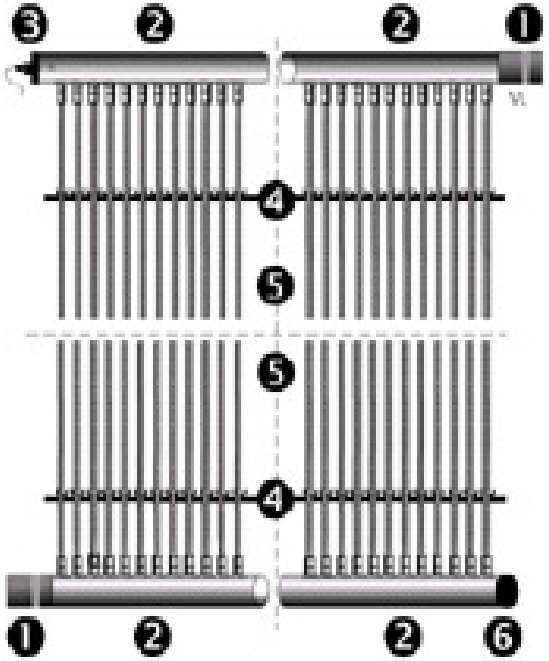
Flat Plate

Vacuum Tub

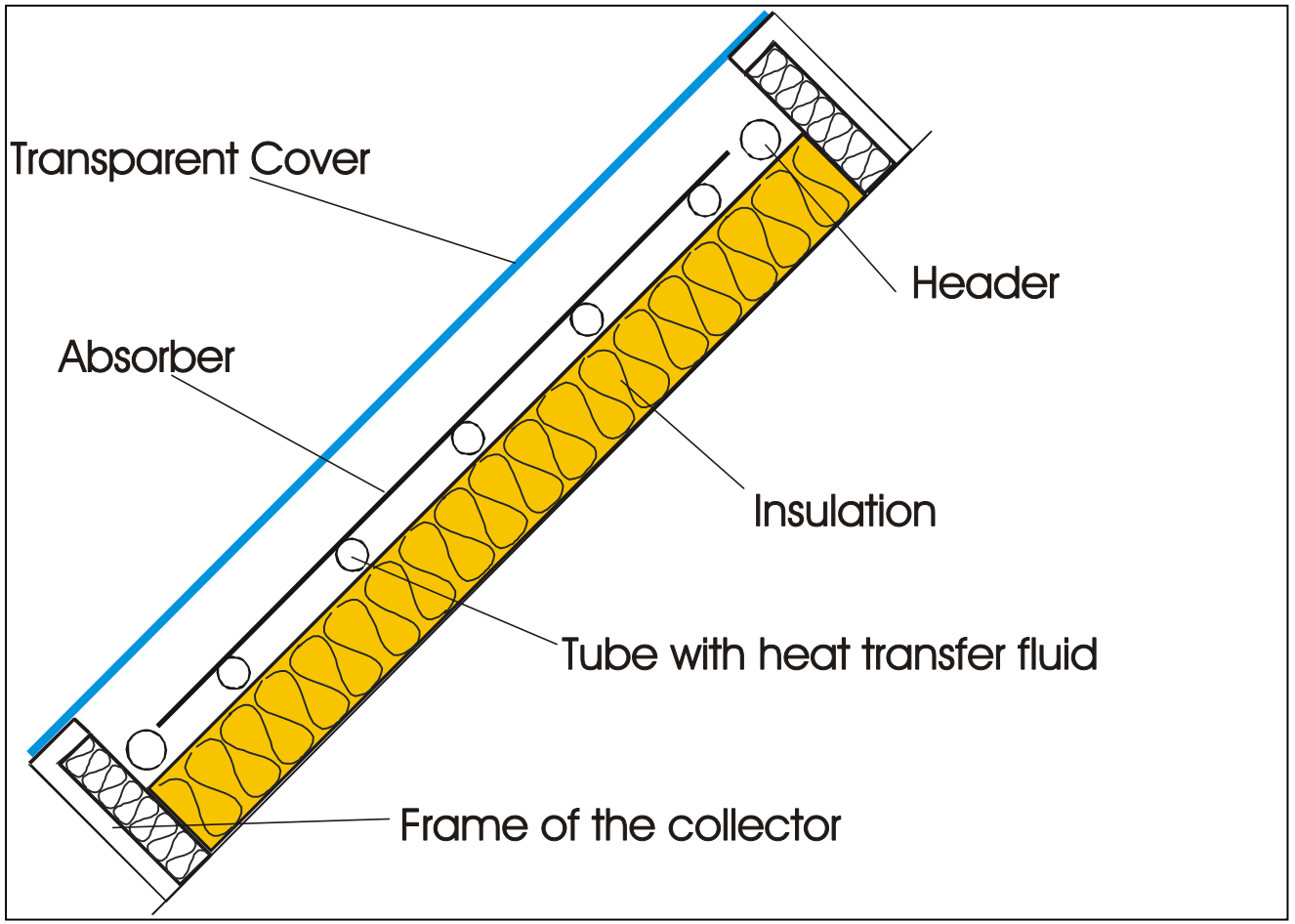
Unglazed

Plastic Absorber – Unglazed Collector

1. Inlet/Outlet
2. Header
3. Temperature sensor
4. Spacer
5. Absorber tube
6. Cap



Flat Plate Collector



Section of flat plate collector

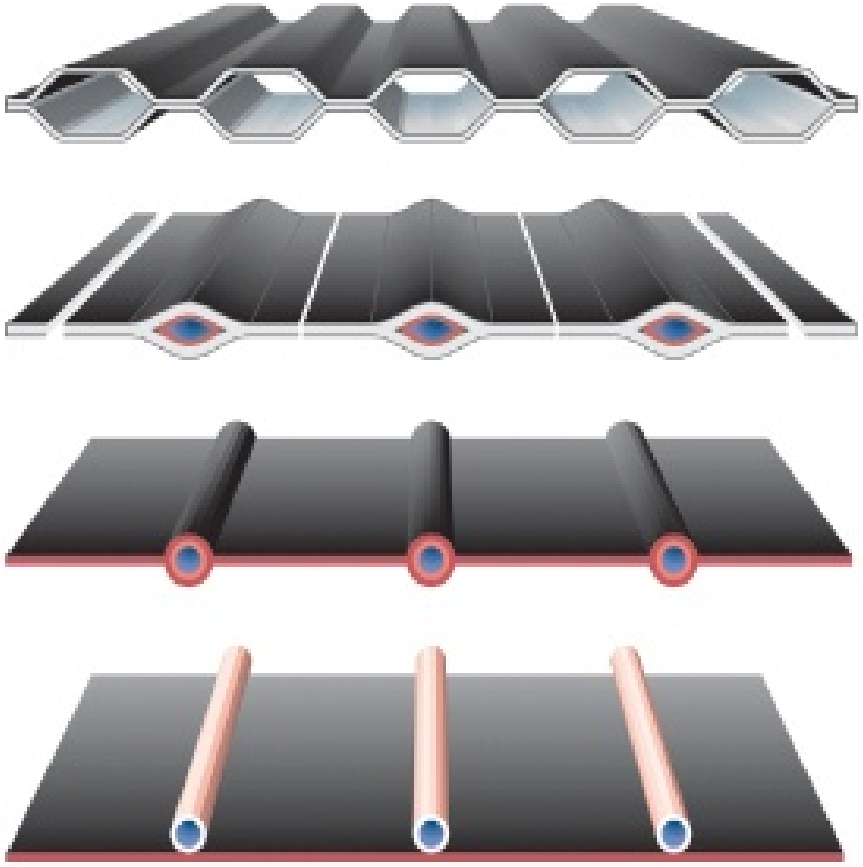
Flat Plate Collector

Aluminium Absorber

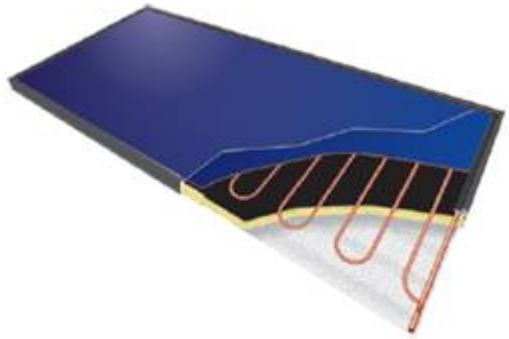
Aluminium absorber with pressed cooper tubes

Pressed tubes between 2 metal sheet

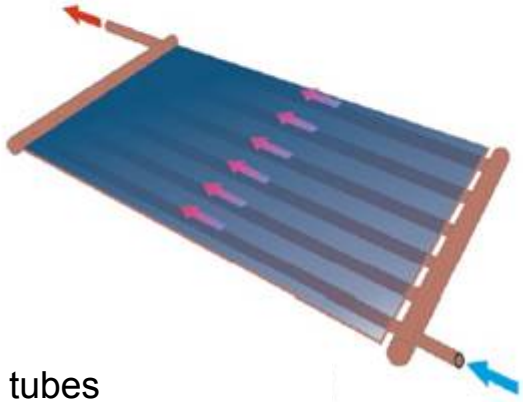
Tubes welded on metal sheet



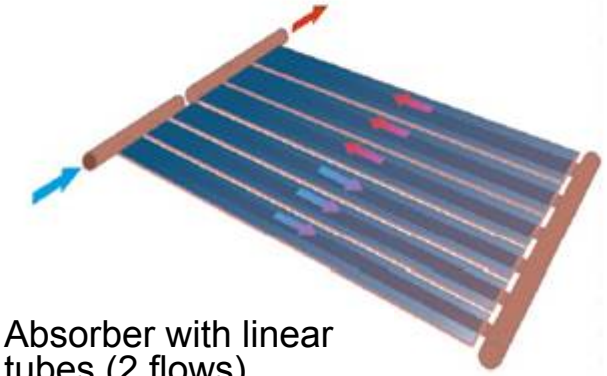
Flat Plate Collector



Absorber with serpentine tube (All surface cover)

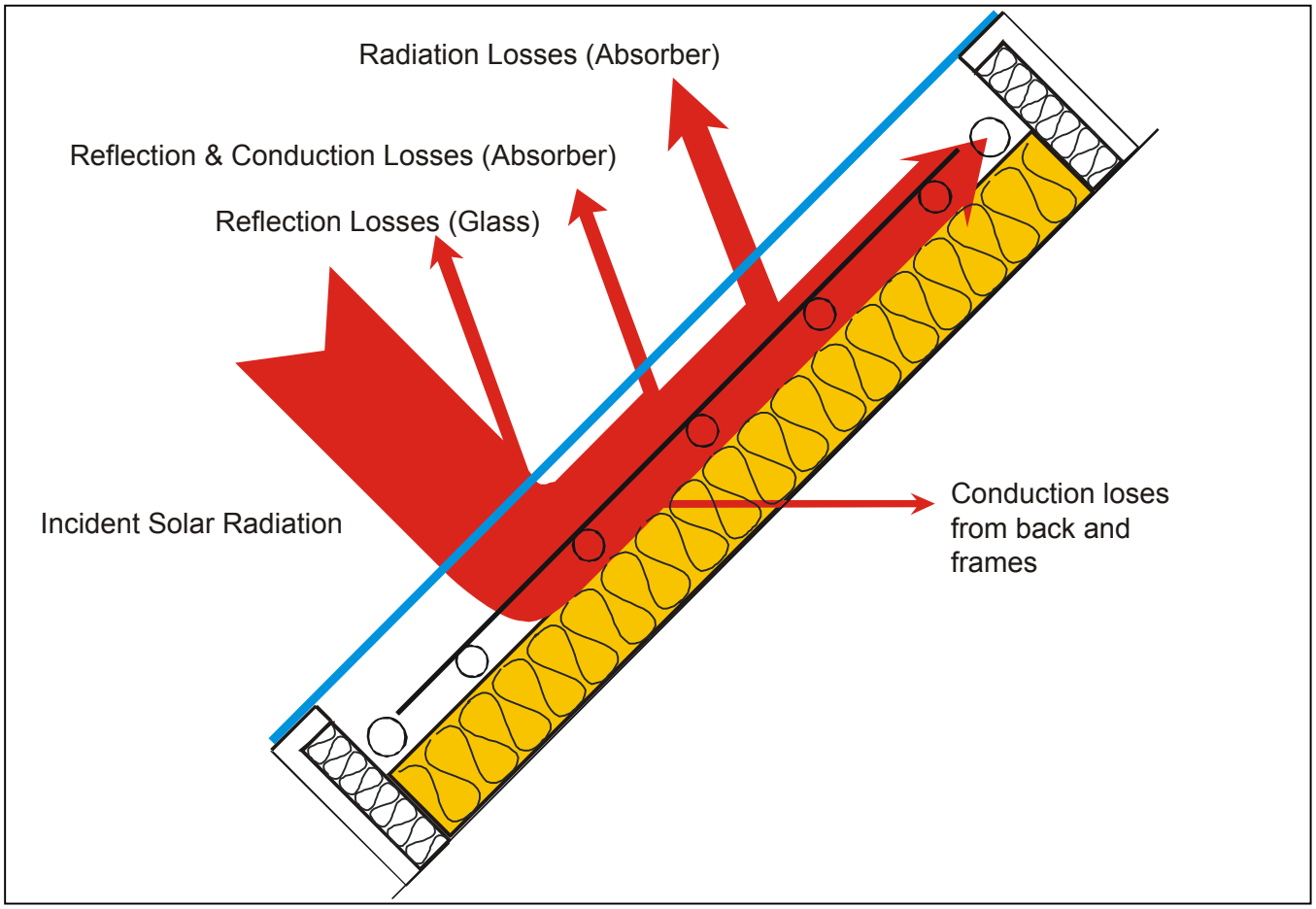


Absorber with linear tubes
(All surface cover)



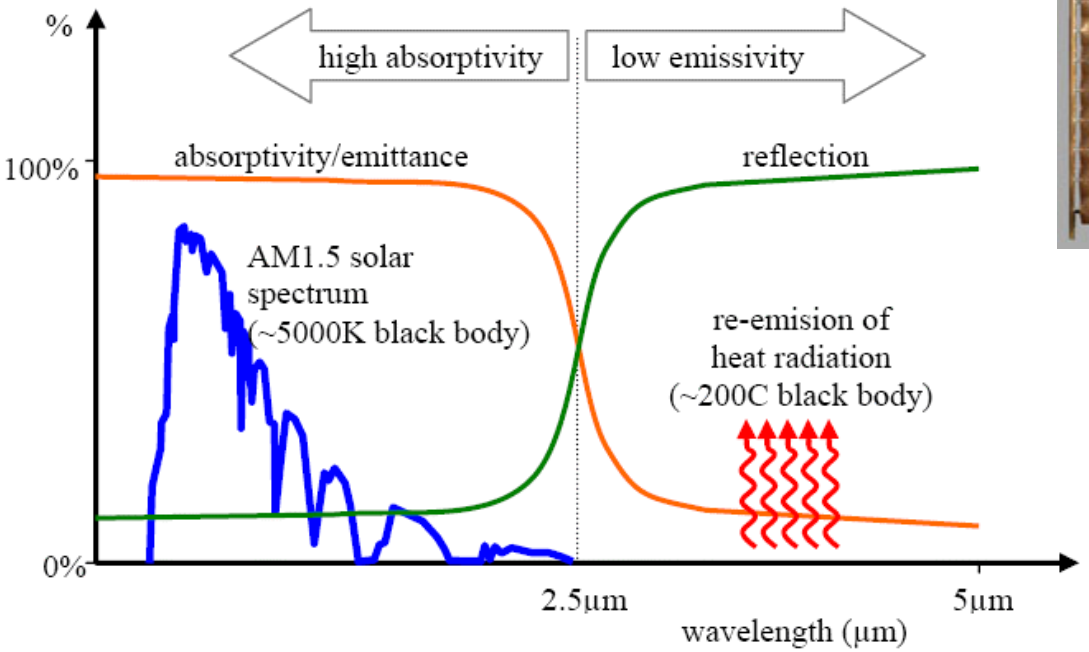
Absorber with linear
tubes (2 flows)

Flat plate Collector– Losses



Thermal losses from flat plate collector

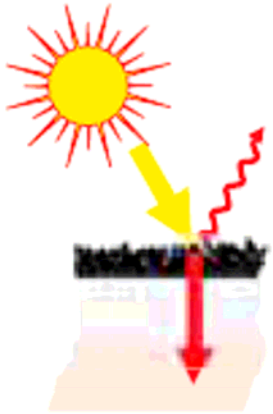
Selective surface



Selective surface

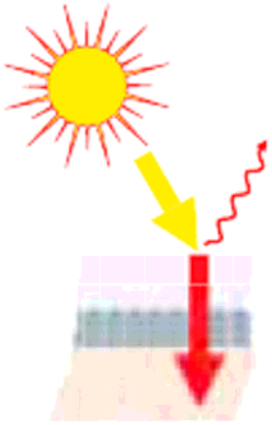
Black laquer

α = 95 %
ε > 80 %



Black chrome

α = 95 %
ε = 12 %



TINOX

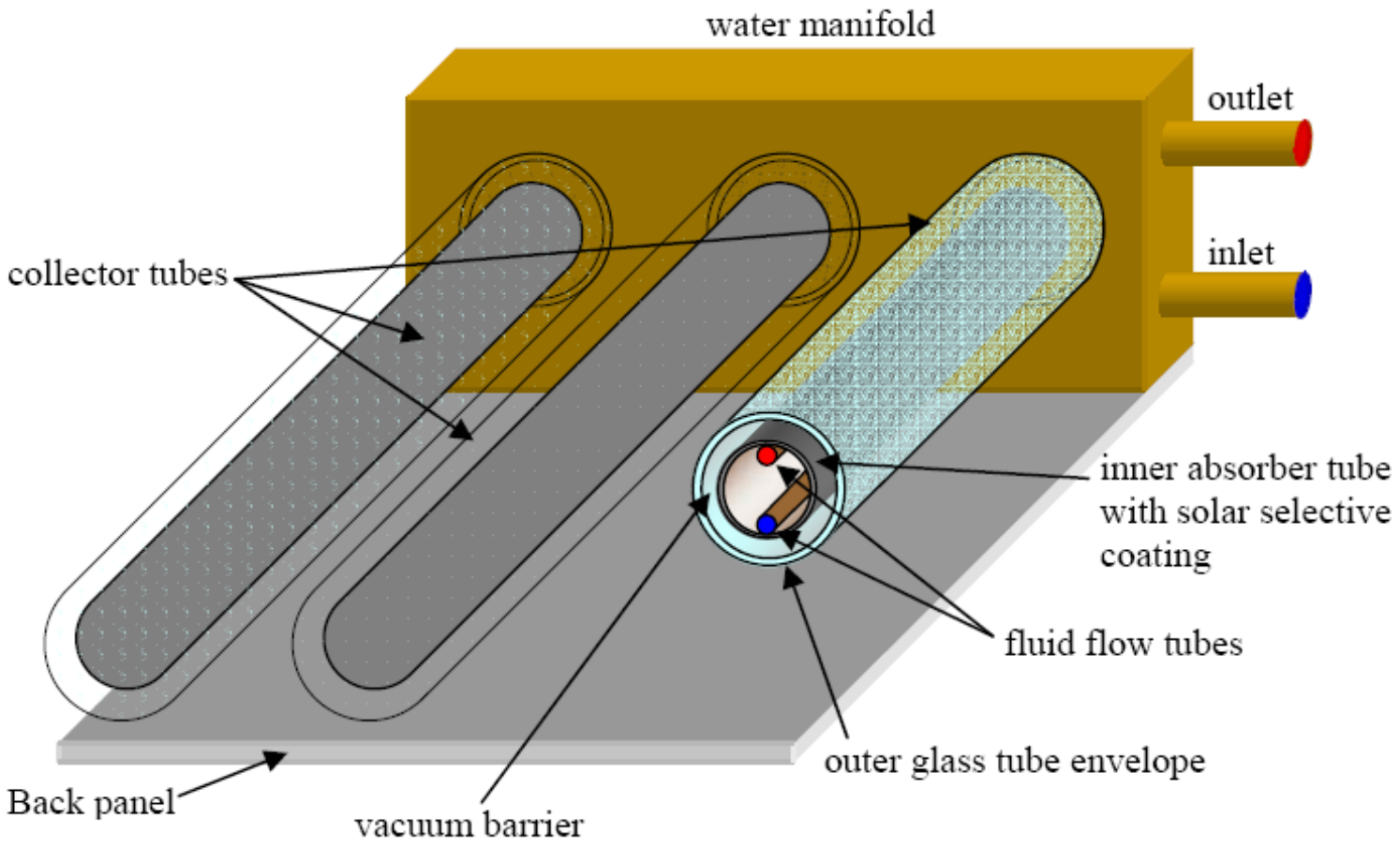
α = 95 %
ε = 5 %

Selective coating

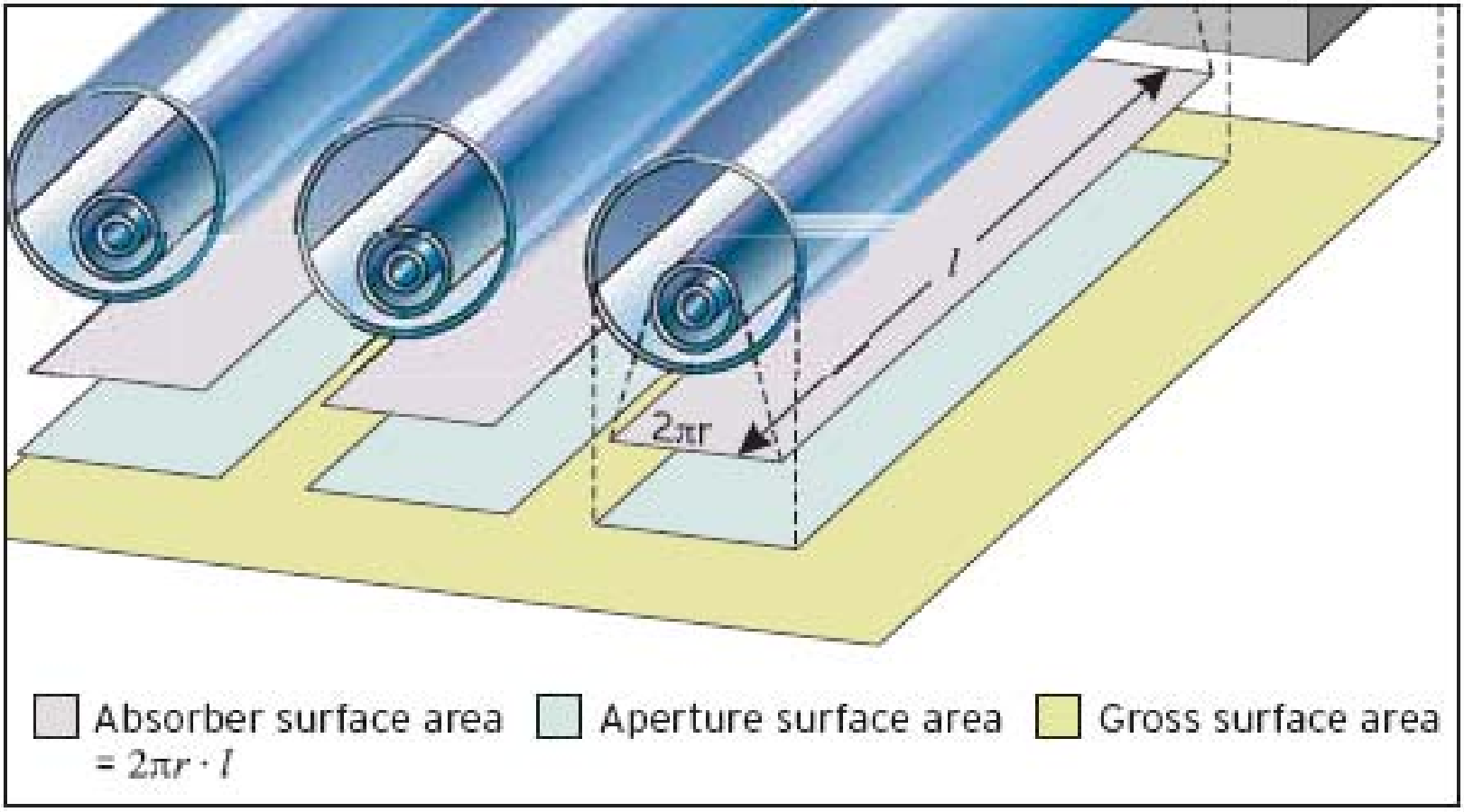
α = 95 %
ε = 5 %

Source:Vaillant

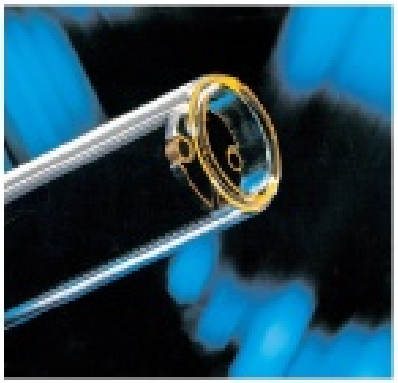
Vacuum tube collector

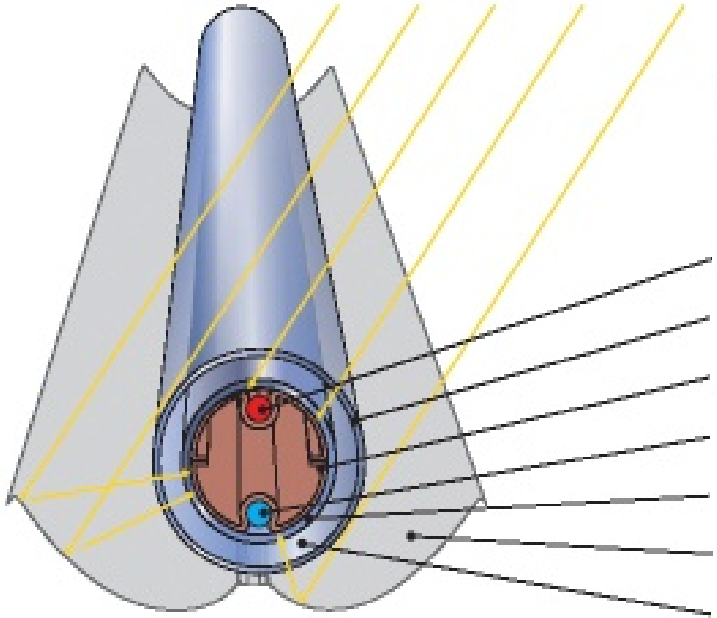


Vacuum tube collectors



Concentrated Parabolic Collector - CPC





Inlet

External glass tube

Heat transfer sheet

Outlet

Internal glass with absorber

Reflector

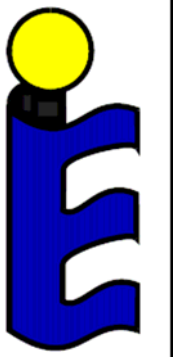
Vacuum chamber

Solar collector characteristics

Collector Type	Price	Performance (kWh/m²/year)	Typical use
Unglazed	Low	300	Pool heating
Flat plate (Black paint)	Mid	650	Pool heating, DHW
Flat plate (Selective absorber)	Mid	700	DHW, Space heating, Air conditioning
Vacuum tubes collector	Hi	850	Space heating, Air conditioning

Solar Key Mark

Way to guarantee the collector efficiency



-Randomly choose of the collector (Produce line or stored)

-Pass all the tests according to EN 12975/12976

-ISO certified production line

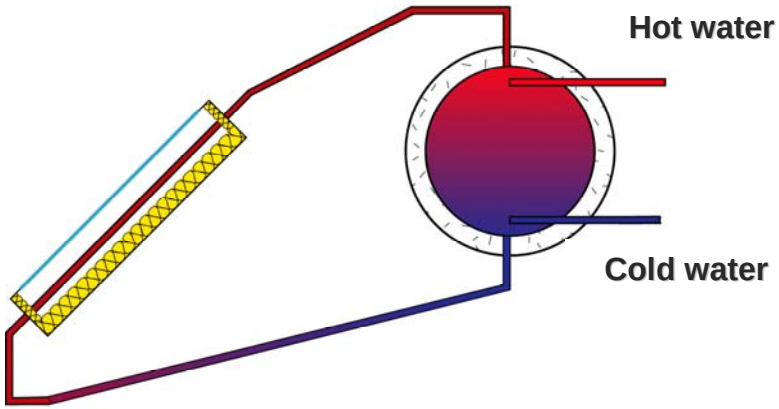
-Yearly inspection of the production line.

-Reinspection of the product every 2 years.

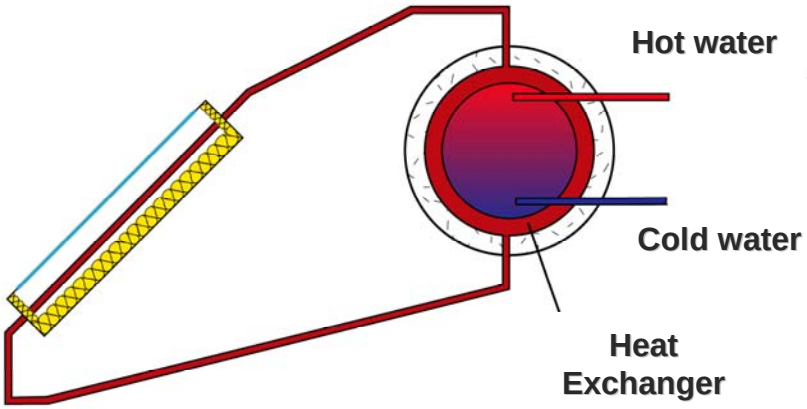
Domestic hot water heating

DHW heating system

Thermal solar systems
Thermosifonic



OPEN CIRCUIT

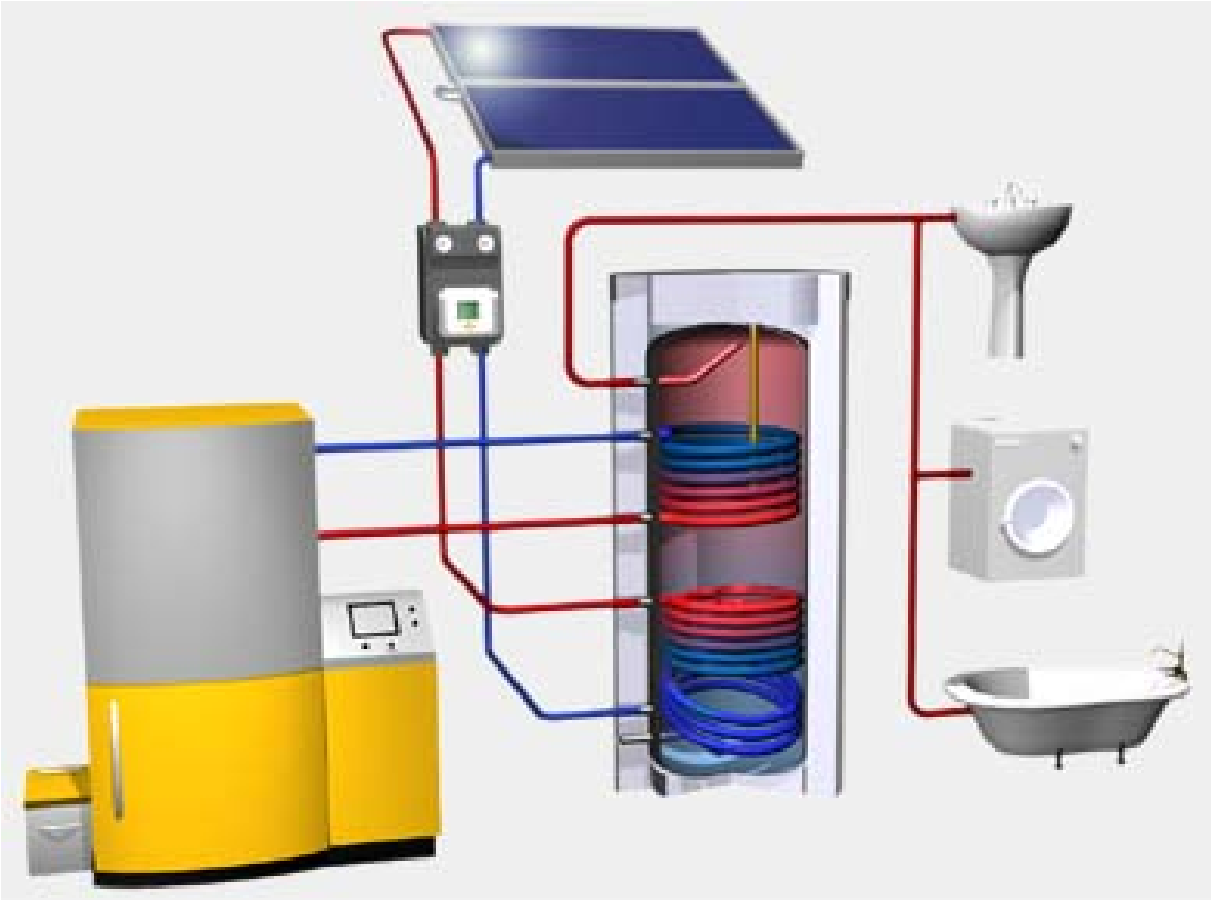


CLOSED CIRCUIT

Source:Target/DGS

Thermal Soar Systems

Forced circulation



Source:IfaS

Combi Systems

– *Operational ways, characteristics and examples.*

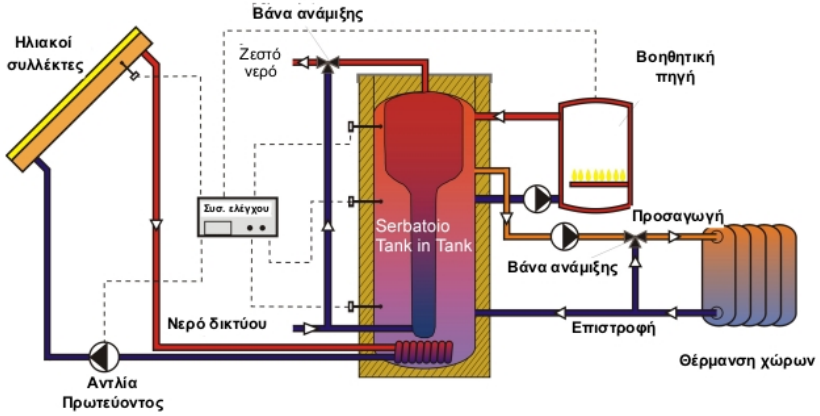
"Combi" Systems

General description

"Solar combisystems" or "combi": Solar thermal systems used for DHW and space heating.

10 basic variations (International Energy Agency –IEA, Solar Combisystems, Solar Heating & Cooling Programme, Task 26).

"Combi" Systems
Properties

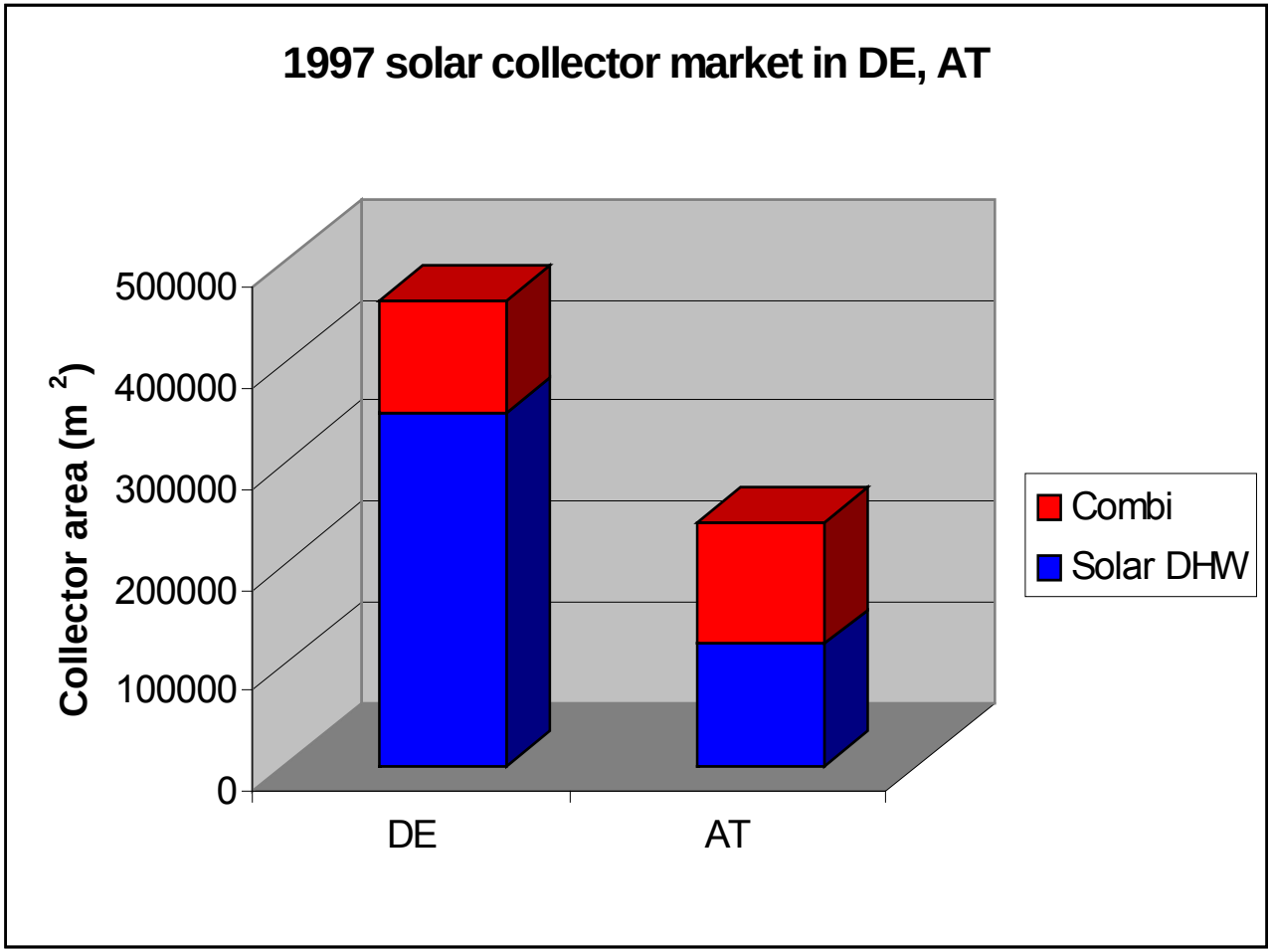


- High energy savings:
  - Introduction Solar technology in space heating
- Cost comparable with central solar systems.
- Possibility to combine with solar air condition units.

"Combi" systems
Advantages

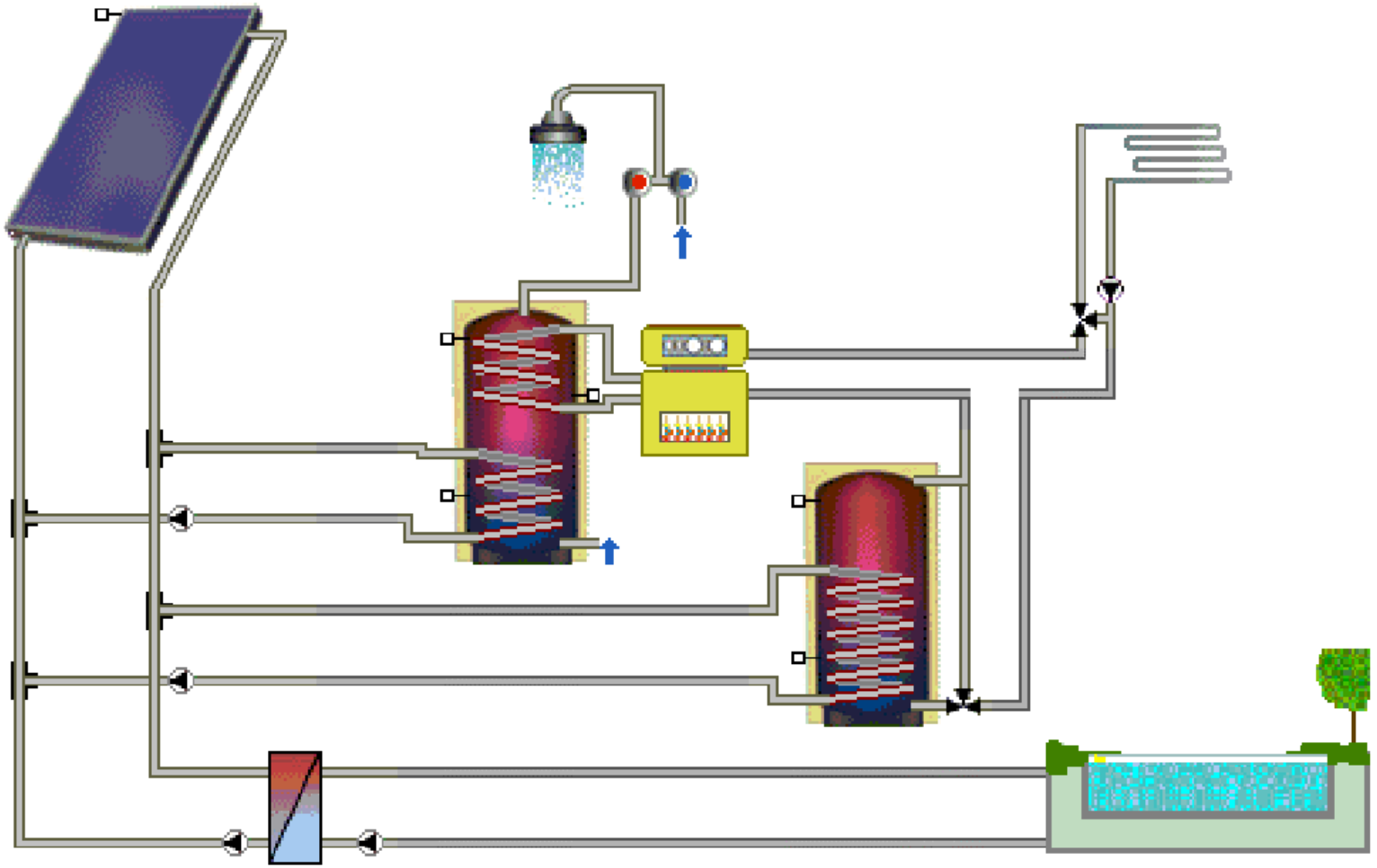
- Use at:
  - Homes
  - Hotels, Hospitals e.t.c.
  - Industry
- Already penetrated in European market
- Ability to cover high thermal load:
  - 30-50% only from sun
  - 100% (Combine with biomass)

Advanced market "Combi"



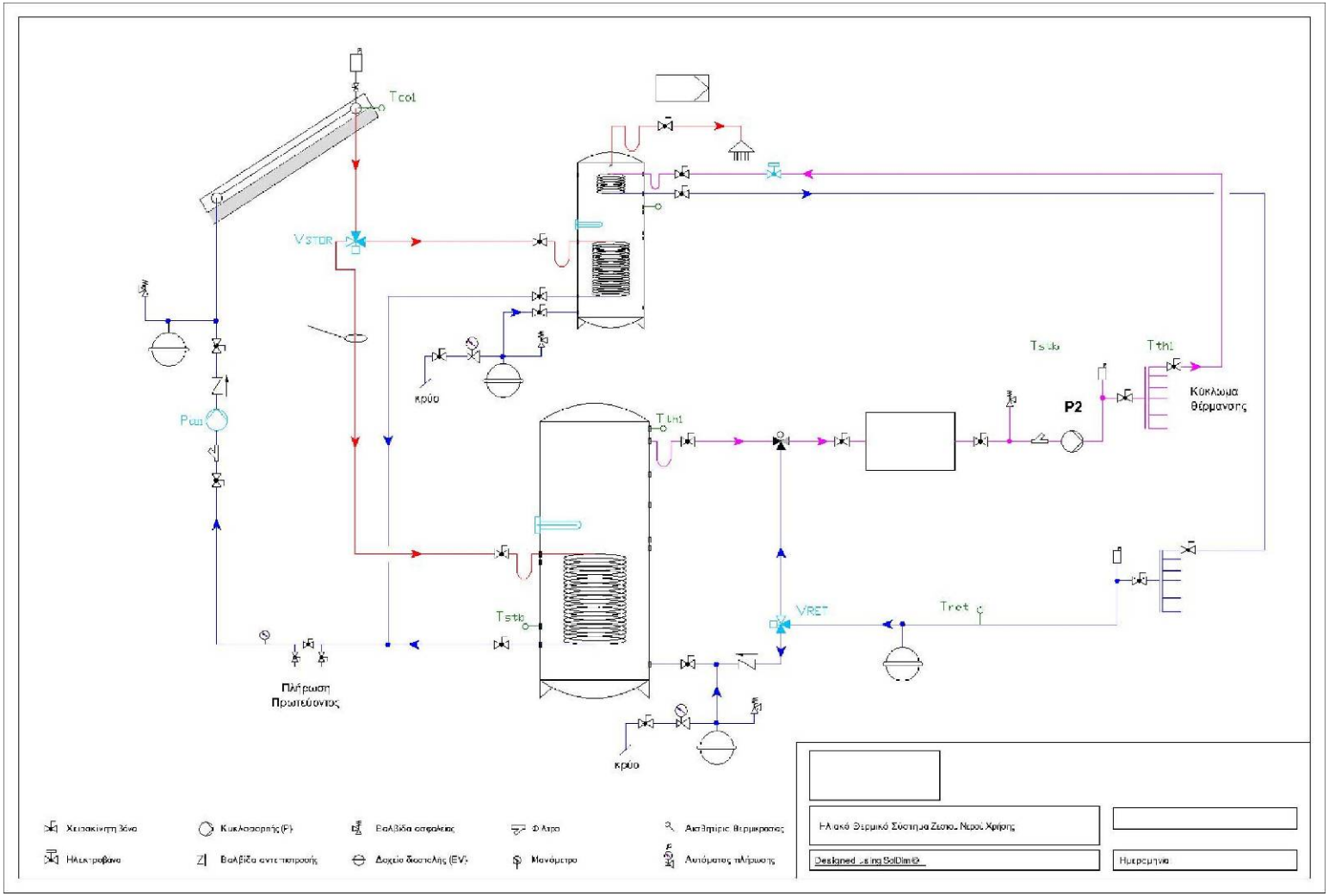
Combi Systems

Schematic diagram of a combi system for space heating, DHW and pool heating.

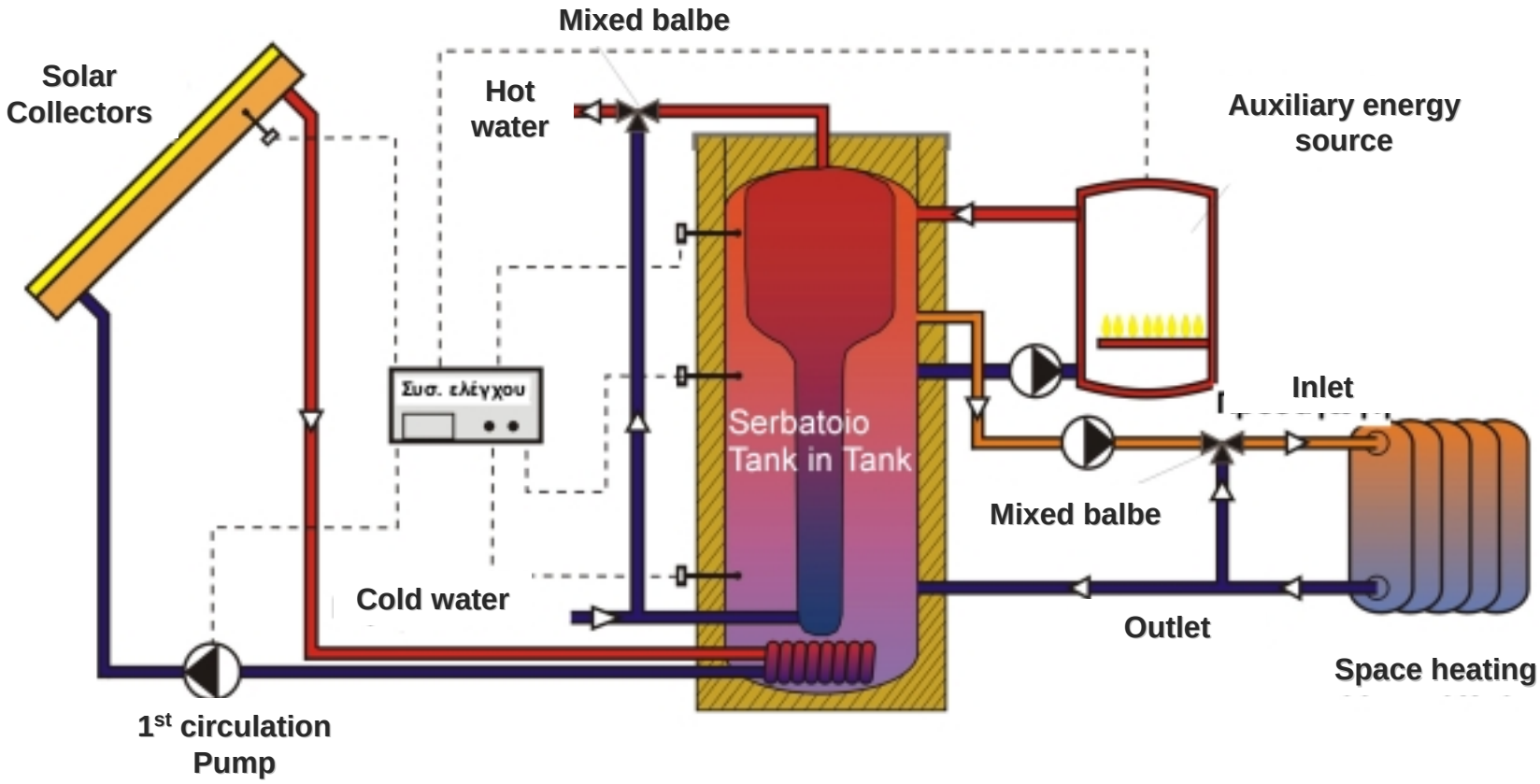


Combi System

Schematic diagram of a combi system for DHW and space heating



Combi Systems – tank in tank



"Combi" systems
Dimensioning

- Domestic Consumption (at 45°C):
  - Low Consumption: 20 - 30 l /person/day
  - Mid Consumption: 30 - 50 l /person/day
  - High Consumption : 50 - 70 l /person/day
  - Washing Machine: 20-40 l / washing
  - Dishwasher: 20 l / washing
  - Example house with 4 persons total

    4*40 = 160 l /day
- Storage tank for DHW = 0,7 - 1,5 x water requirement

  120-240lt storage tank
- Daily energetic load:
  - E = m x cp x (ΔT) =>
  - E = 160 l x 1,16 Wh/ (l K) x (45-15)K =>
  - E = 5.6 kWh
- Add energy required for space heating (about 70kWh/100m²)* coverage factor
  - E=70*0.4+5.6=33.6kWh
- Collector output: 1kWh/m² so 33.6/1=33.6m² collector area
- Space Heating Storage 40lt/m² collector = 1350lt

The installation of "SOLLET" project at C.R.E.S

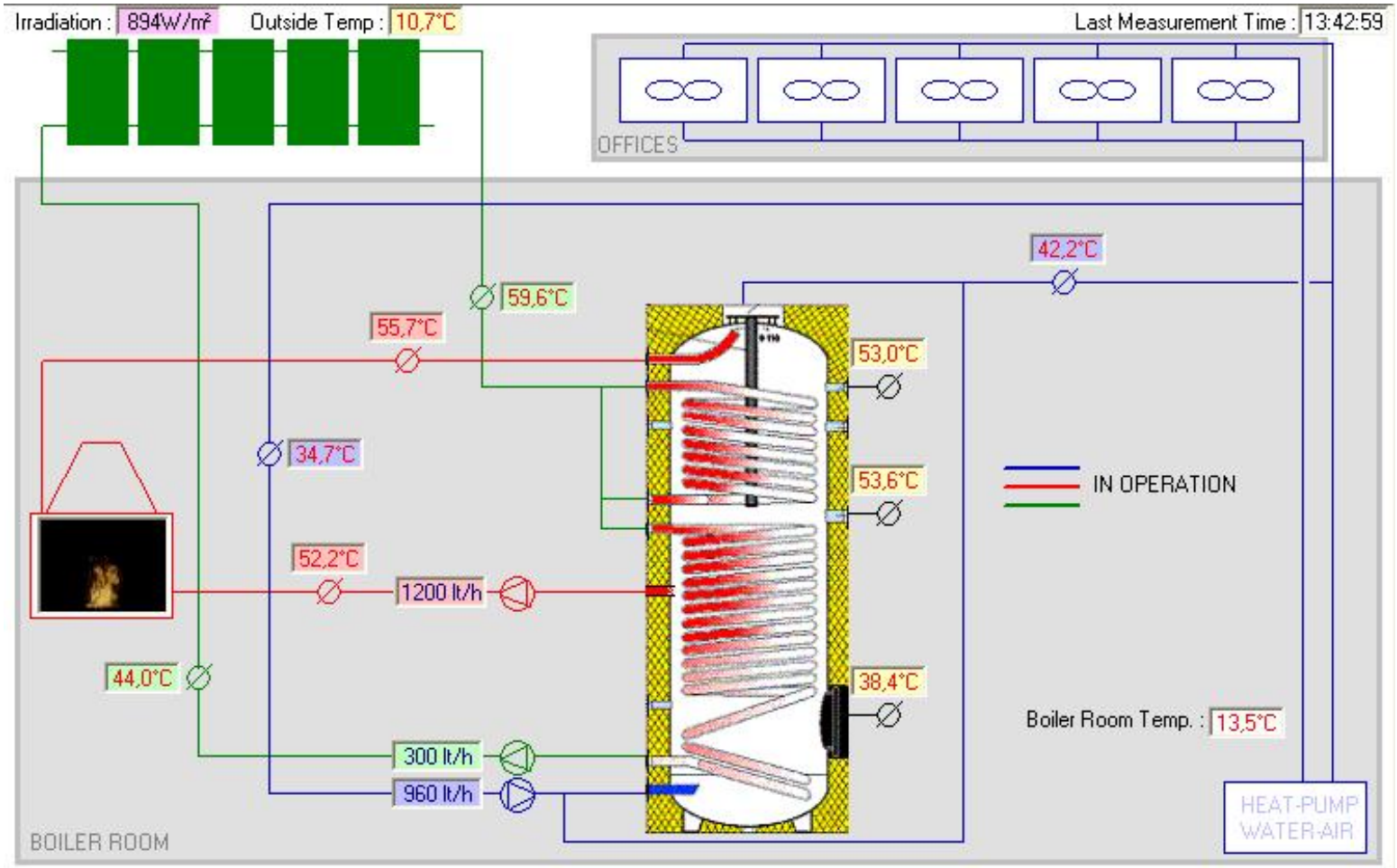
Heated Offices, 60m^2

Collector area, 13.5m^2

Storage tank, 500lt

Biomass burner, 35kW

Schematic diagram of the project



European project SOLLET (2):
Germany, House, Dormagen

Solar Collectors

- ***Heating area 400m²***
- ***Pellets burner 10 KW with heat exchanger air/water***
- ***Fire place 10 KW with air/water heat exchanger***
- ***105 m² collector area.***
- ***Water tank 3000 l***
- ***Auxiliary heating system with natural gas.***

Backup fire place

European project SOLLET (3):
Germany, House, Cologne

- ***Heating area 140m²***
- ***Pellets burner 10 KW with heat exchanger air/water***
- ***28 m² collector area***
- ***Water tank 1000 l***

Solar collectors

Pellet Burner

Combi : Home (FR)

Source: IEA Task 26

Combi : Apartments (AT)

Source: GSWB

Combi : Apartments – Solar village (GR)

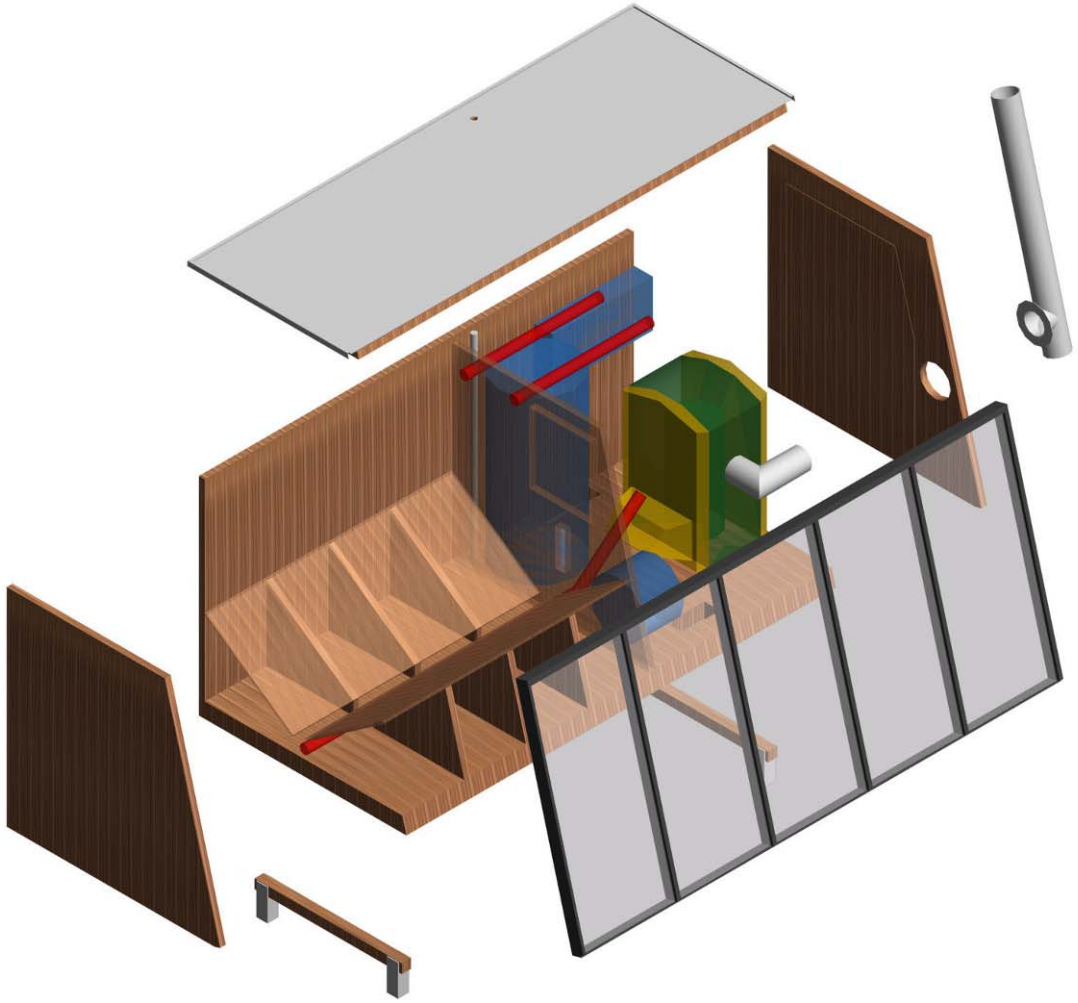
Ready Made Systems

Καυστήρας Pellet

Source: Buderus

Compact Systems:
Plug n' play

Compact systems:
Plug n’ play



General Observations

- Solar heating systems can be combined with conventional space heating systems – Integration with already installed systems.
- Combination with solar chillers to cover cooling loads (Use of excess energy).
- Cost: ≈400€/m²
- Collector area: 28% of the heated area for 40% load coverage (ex. 28m² flat plate collectors for 100m² house).
- Hot water Storage Volume: 10x heated area
  (1000lt tank for 100m² house)
- Must give emphasis at planning.
  ex. Dimensioning of expansion tank of solar circuit. (stagnation temperatures).