



solarcombi+

Space cooling, space heating and domestic hot water preparation through solar energy

Identification of most promising markets and promotion of
standardised system configurations for the market entry of
small scale combined solar heating & cooling applications
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Intelligent Energy  **Europe**

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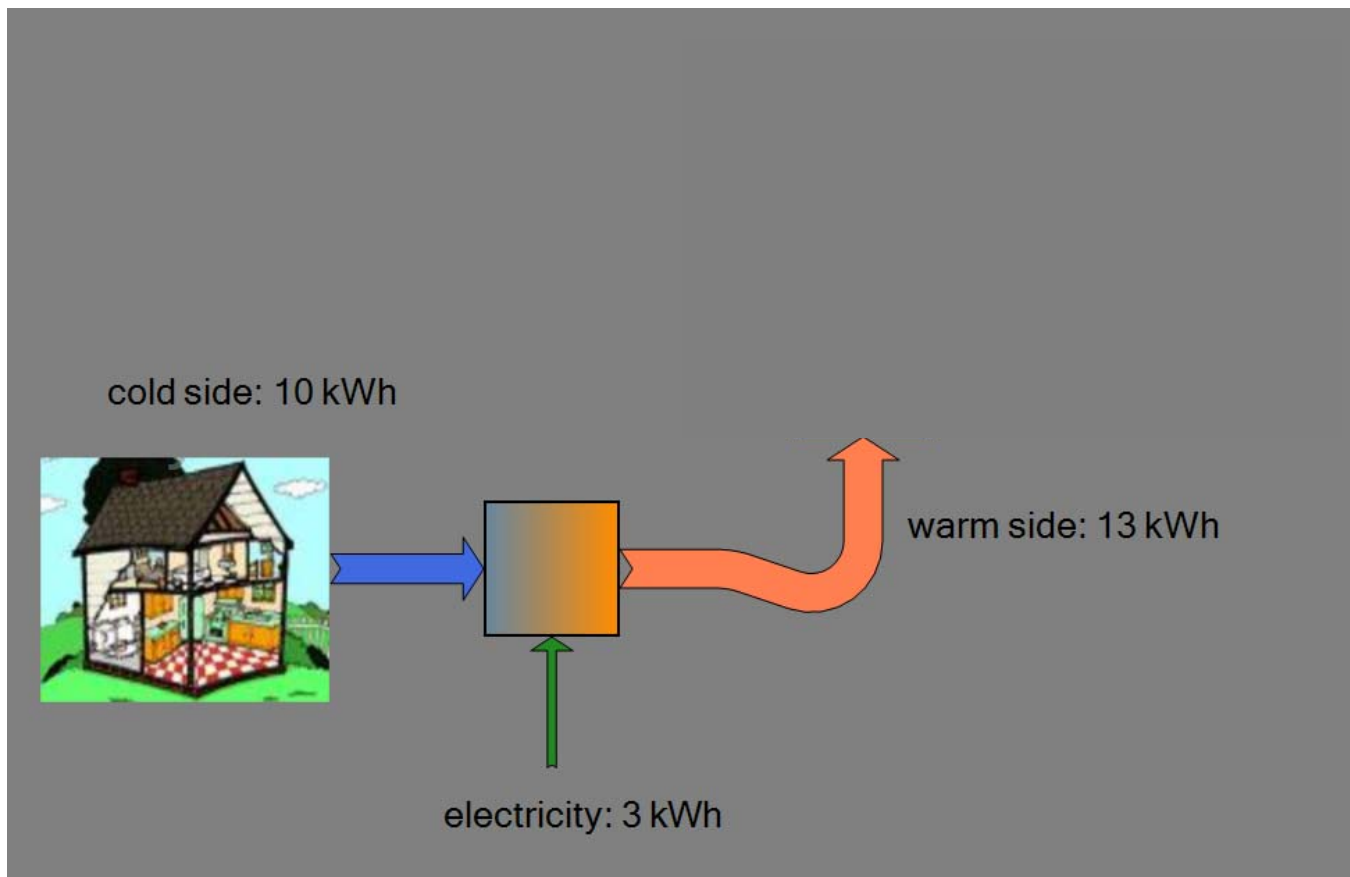


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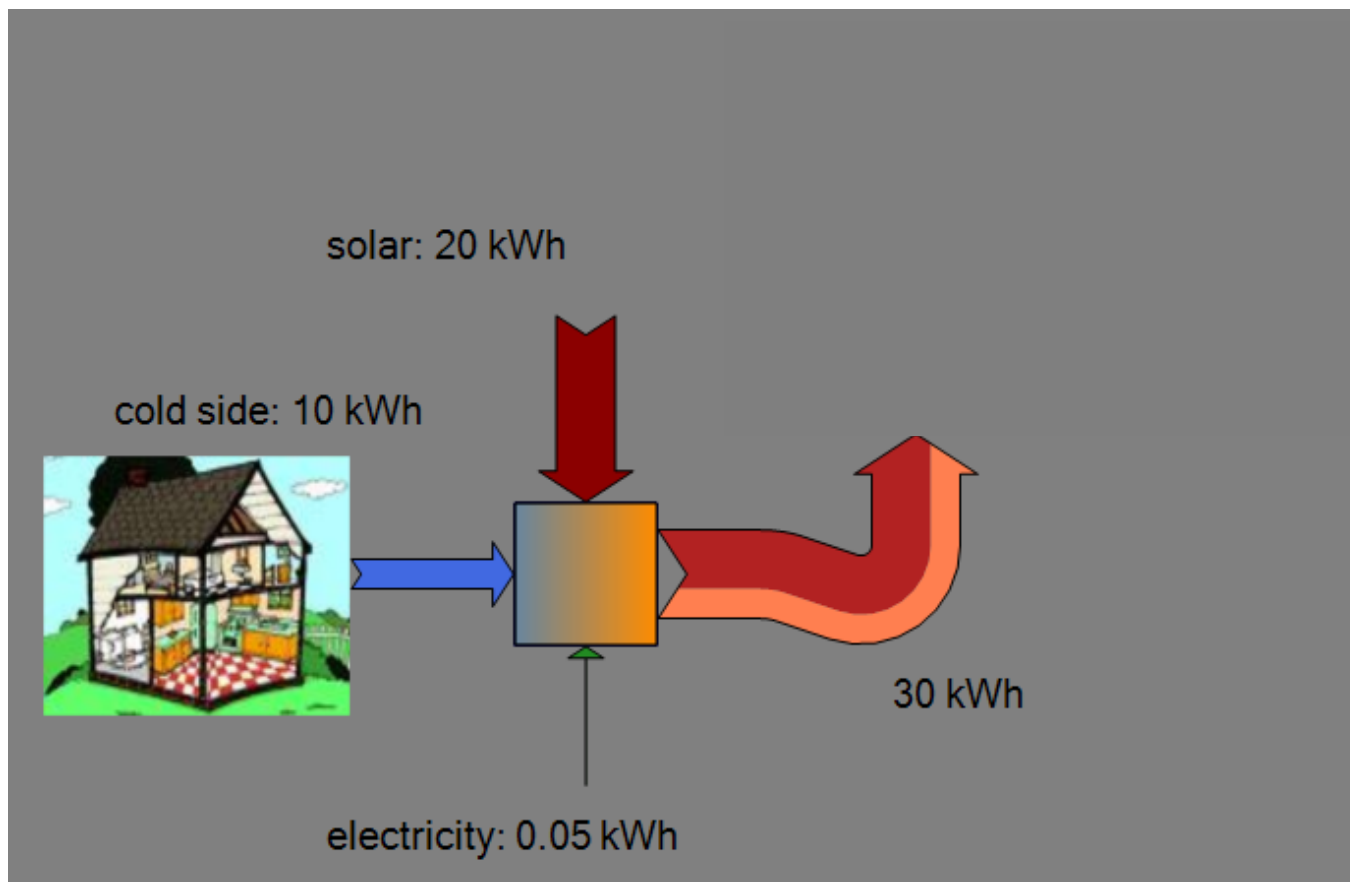
Summary

1. Sorption Chillers and Solar Cooling
2. Solar Combi+ Systems
3. Production
4. Costs
5. Conclusions

1.1 Compression chiller – Conventional Technology

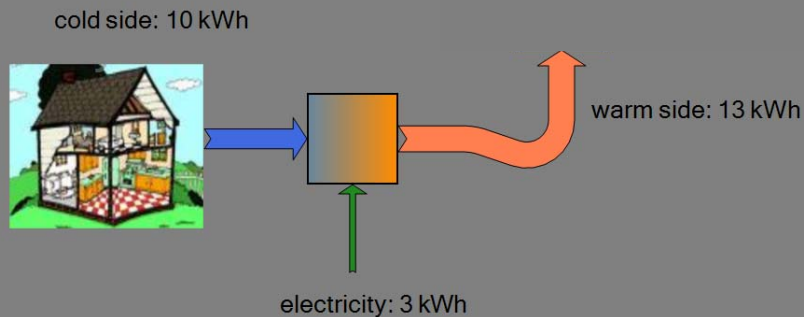


1.2 Sorption Chiller – New Technology

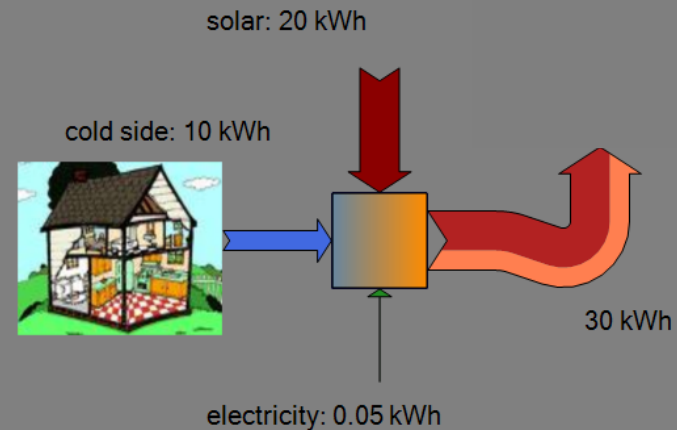


1.3 Comparison

Compression chiller

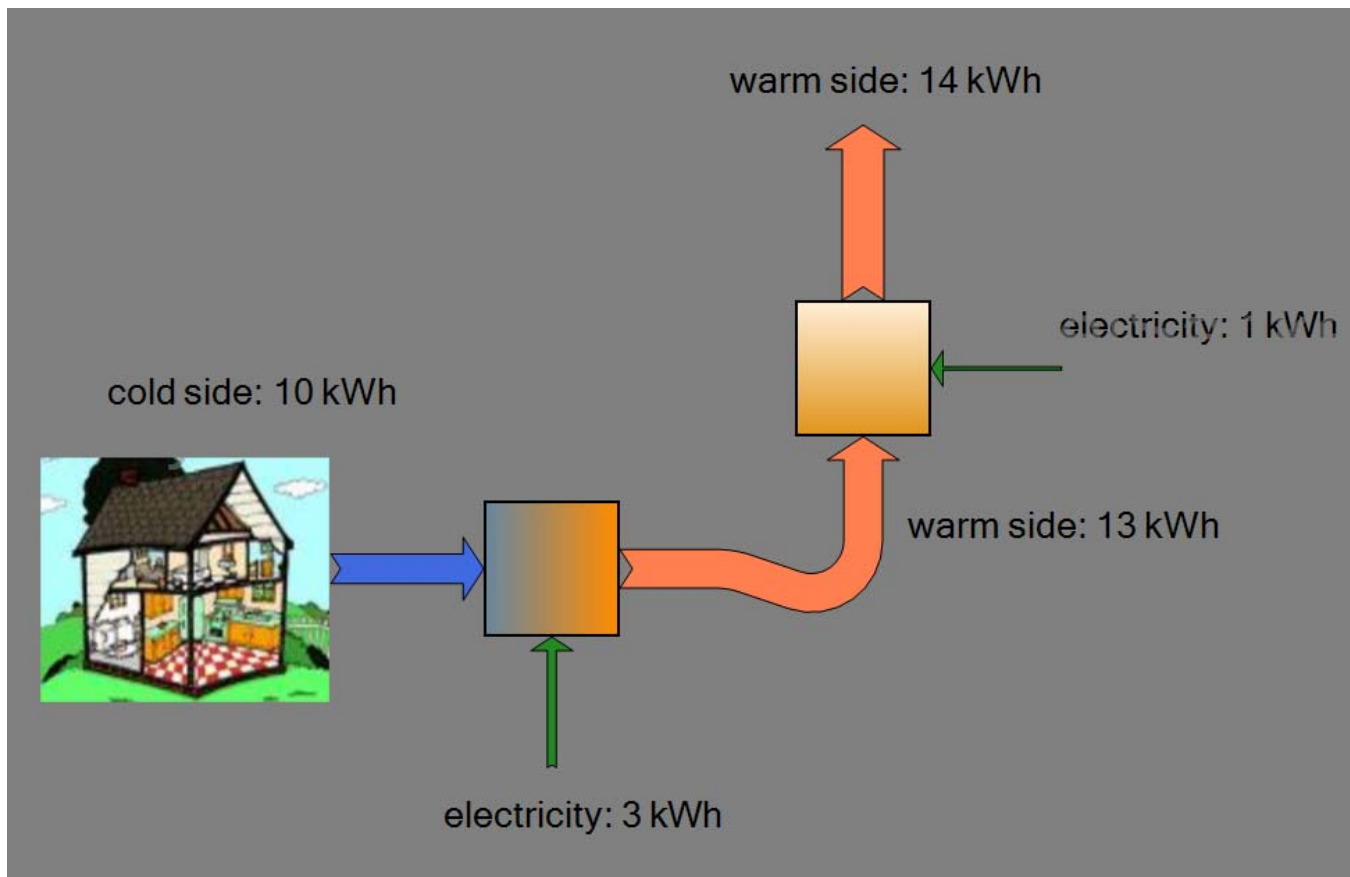


Sorption chiller

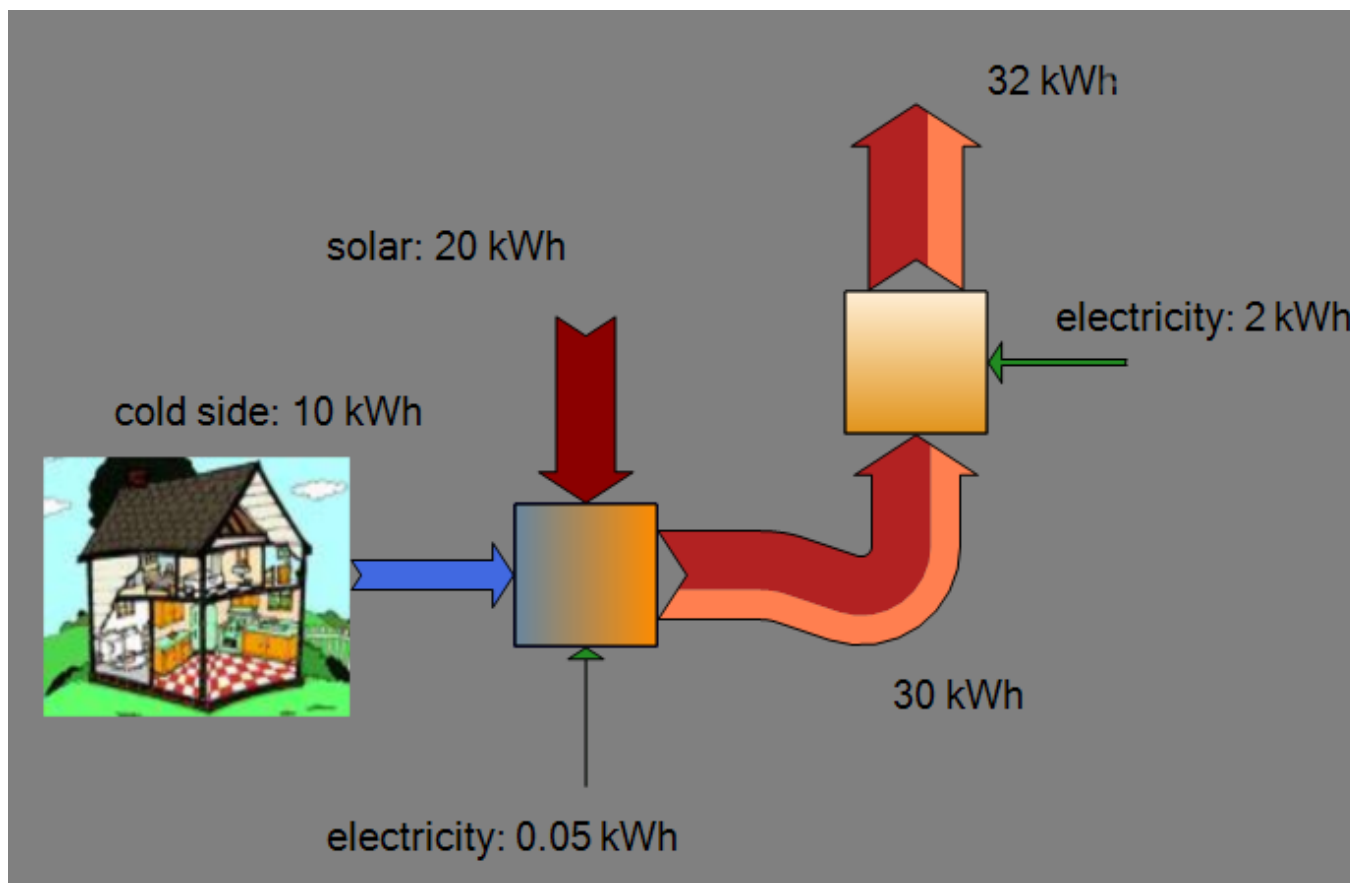


1. Huge reduction of electricity consumption (-98%)
2. Considerable heat flux needed in: it has to be cheap -> Solar energy
3. Considerable heat flux out: majority from the sun -> environmentally neutral

1.4 Compression Chiller – Heat Rejection

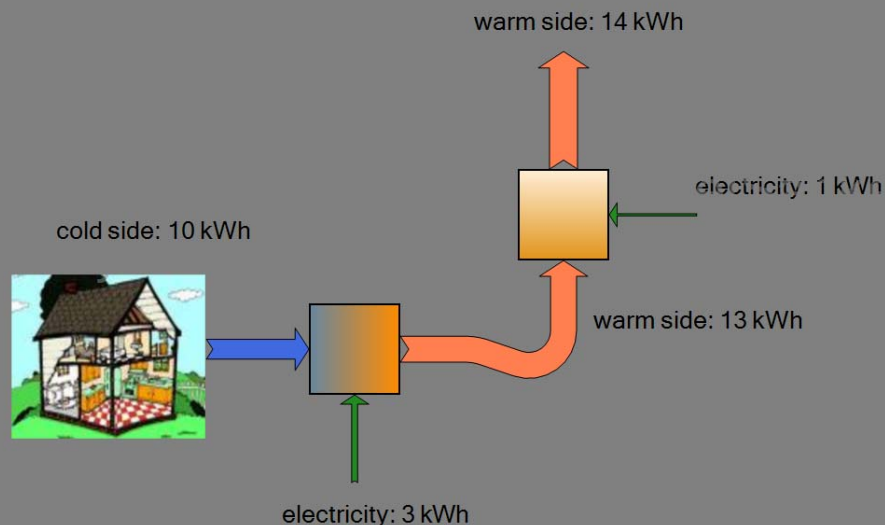


1.5 Sorption Chiller – Heat Rejection

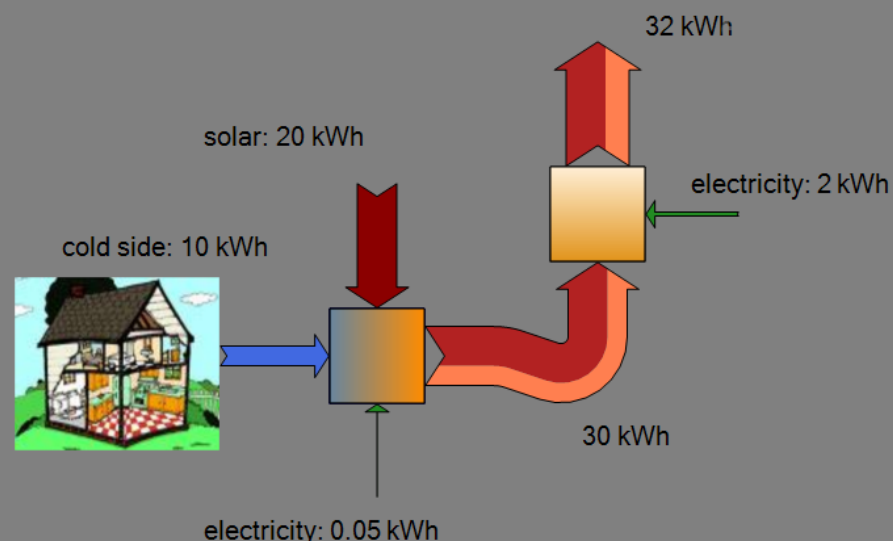


1.6 Comparison

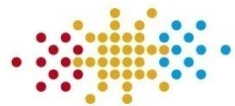
Compression chiller



Sorption chiller

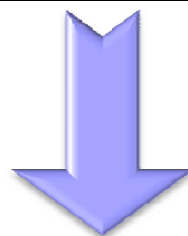


- If heat rejection is considered, the reduction of electricity consumption is not so large (-50%)
- The control of the system's components is of utmost worth to reduce electricity consumption



1.7 Comparison

Reduced electricity consumption in cooling mode	+
High investment costs	-
Domestic hot water with same system	++
Space heating with same system	+
Extremely reduced electricity consumption in heating, domestic hot water mode with respect to cooling mode	+++



Use Solar Combi+ systems for combined space heating, space cooling and domestic hot water preparation



solarcombi+

2.1 What is a Solar Combi+ system?

Solar thermal
domestic hot water
heating (DHW)

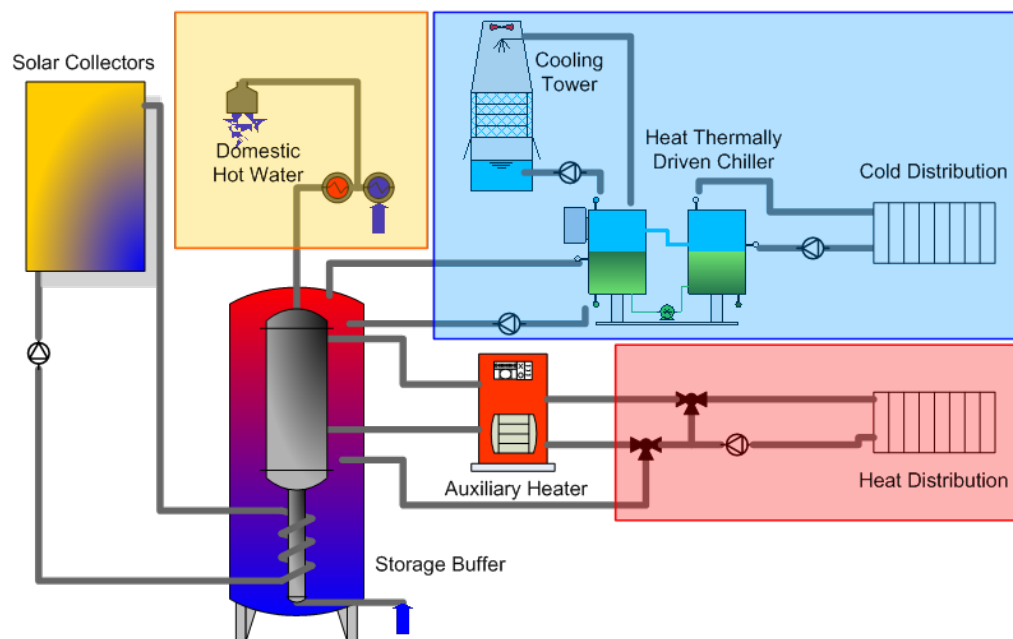
DHW

& space heating

Solar Combi

& space cooling

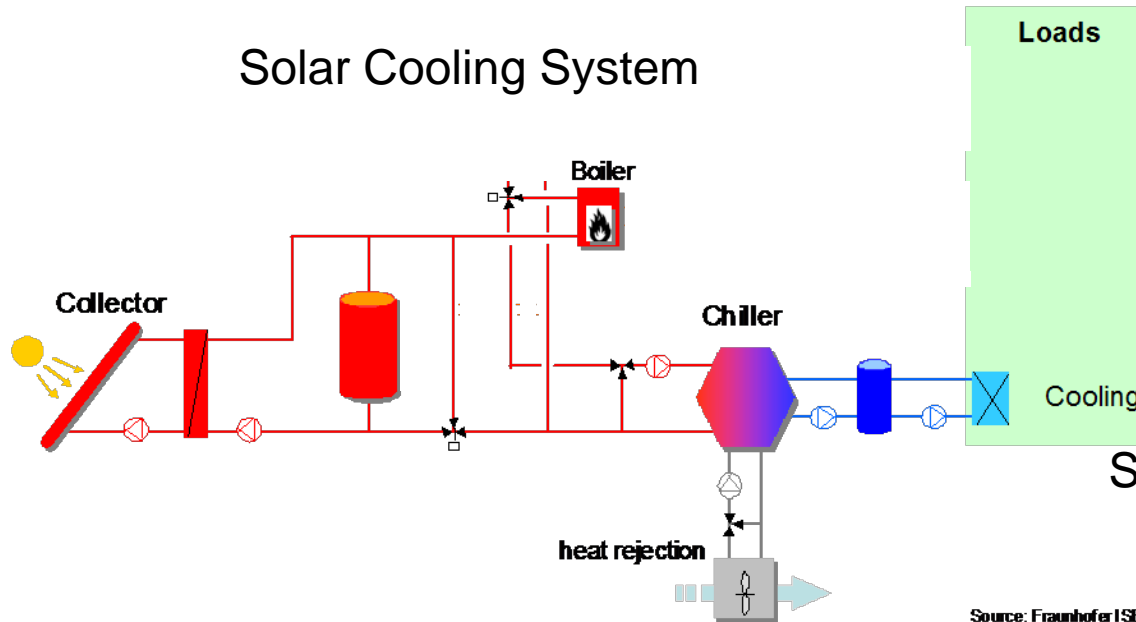
Solar Combi+



Source: EURAC

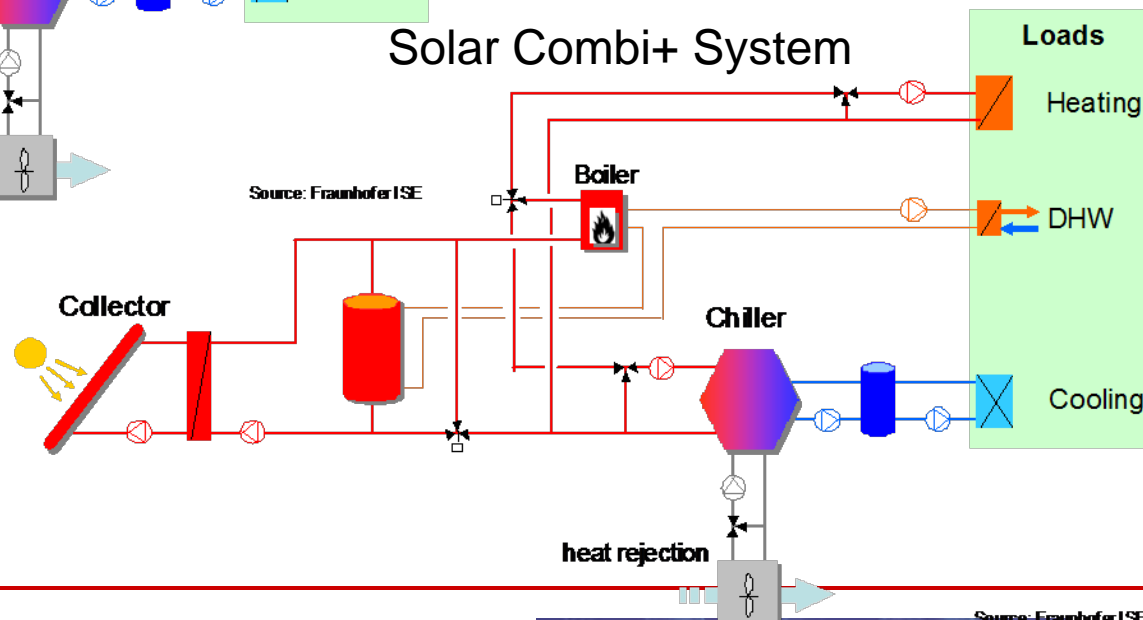
2.2 What is a Solar Combi+ system?

Solar Cooling System



Same
Investment
Cost

Solar Combi+ System





2.3 What is a Solar Combi+ system?

System performance depend on:

- *Integrated control of system's components*
- *Sizing of the components*
 - *with respect to the building*
 - *each component with regard to the other*

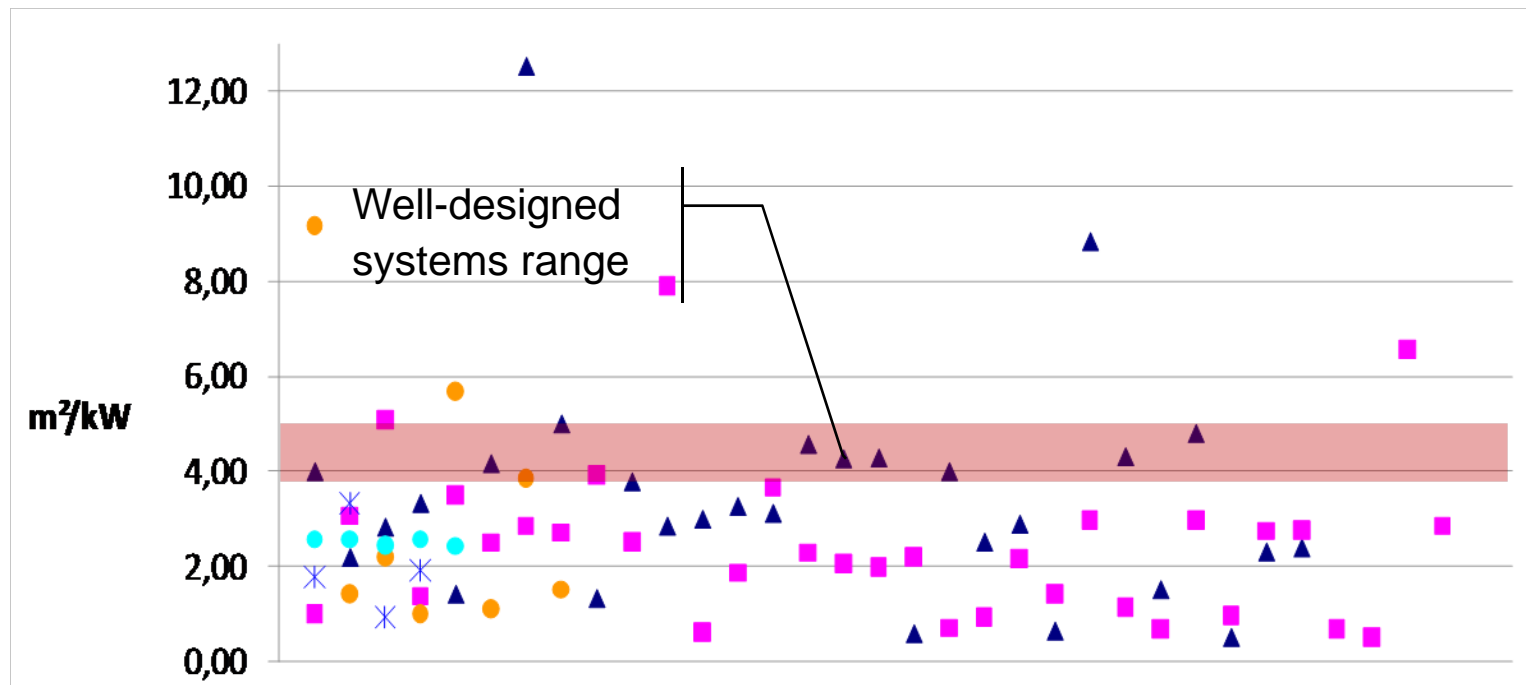
In particular the following ratios have to be respected:

a) Collectors' area/Chiller rated power

b) Storage tank volume/Collectors' area

2.4 Solar Combi+ systems state of the Art

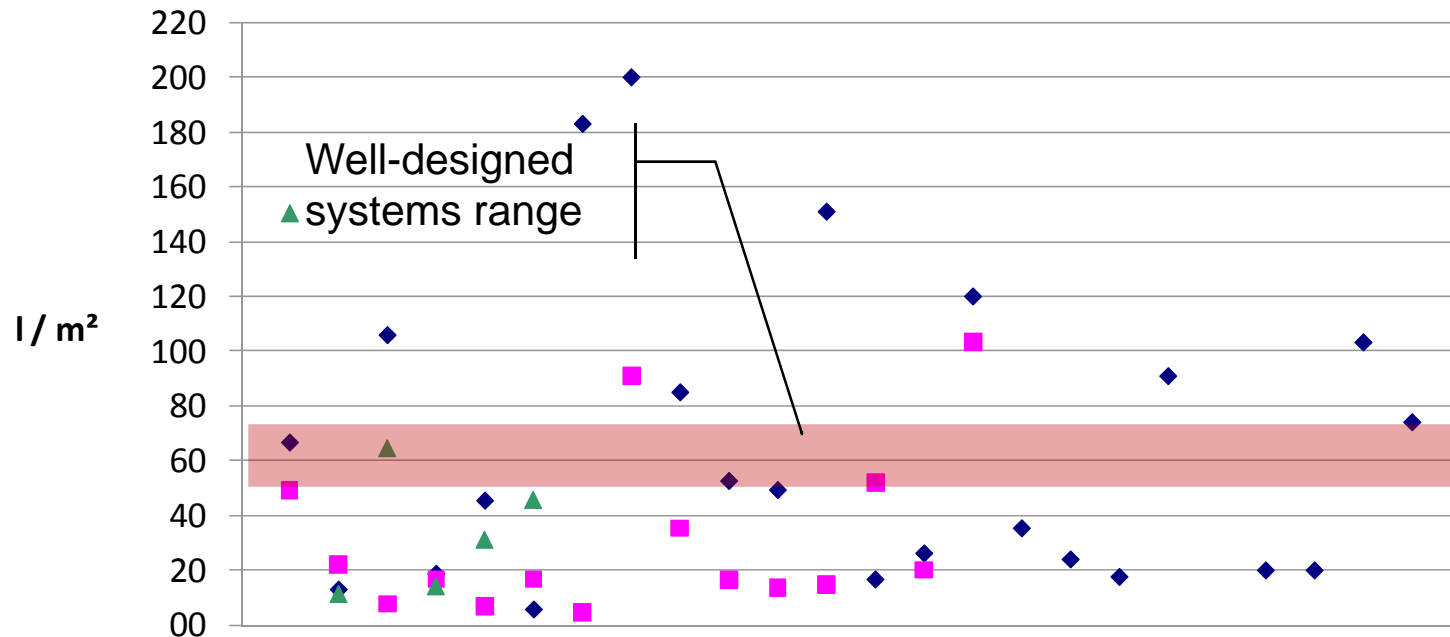
a) Collectors' area/Chiller rated power for 60 solar combi+ systems installed worldwide



Source IEA-Task 38

2.5 Solar Combi+ systems state of the Art

b) Storage tank volume/Collectors' area for 60 solar combi+ systems installed worldwide



Source IEA-Task 38



3 Production

A system with:

- ***Synergic control of all components***
- For **$1 \text{ kW}_{\text{cold}}$** chiller requires **$4\text{-}5 \text{ m}^2$** collectors' area
- For **1 m^2** collectors' area requires **$50\text{-}75 \text{ liters}$** storage tank

It harvest on an average of all collector technologies and European sites around **400 kWh/year** of solar energy ***per unit collectors' area (solar yield)***. Of those around **250 kWh/year** reach the building as ***heating, domestic hot water or cooling (solar fraction)***.

For example, a small system with :

32 m^2 collectors' area (**$4 \text{ m}^2/\text{kW}_{\text{cold}}$**)

2000 l storage tank (**60 l/m^2**)

8 kW sorption chiller

Collects **$8'000\text{-}9'000 \text{ kWh/year}$** to the building



4.1 Costs

The investment cost is around **4000-5000 euro/kW_{cold}**,
1000-1300 euro/m² collectors' area.

For example, a small system with:

32 m² collectors' area (**4 m²/kW_{cold}**)

2000 l storage tank (**60 l/m²**)

8 kW sorption chiller

Costs around **40'000 euros** (1/3 chiller, 1/3 collectors, 1/3 ...)

A reference system with:

Gas boiler

8 kW compression chiller

Costs around **15'000 euros**



4.2 Pay Back Time

Extra cost = 40'000 – 15'000 euros = **25'000** euros (4.1)

Cost saving = a) 8'000 kWh/year x 0.10 euros = **800 euros/year**

b) 9'000 kWh/year x 0.12 euros = **1'100 euros/year**

Simple Payback Time (no maintenance/energy cost increase/inflation)

1. **Without incentives:**

a) **> 30 years**

b) **> 20 years**

2. **With 50% incentives** on investment cost (average European level):

a) **approx. 10 years**

b) **< 10 years**



5 Conclusions - SWOT

Strengths

- Three systems in one
- Reduced electricity consumption
- *High energy saving*

Opportunities

- *Integration in buildings*
- *Incentive schemes*
- *Increasing energy prices*
- *Decreasing investment cost*

Weaknesses

- *No standardization yet*
- *No industrial production*
- *High investment cost*
- *Lack of local retailers*

Threats

- *Competing technologies' capability of covering peak demand*
- *Lack of awareness for the wider public*