Solar Thermal Systems

Design and Applications in the UAE

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VIESMANN

Viessmann Werke

Founded:	1917
Headquarters:	Allendorf (Eder) GER
Products:	Comprehensive product range heating- and climate-technology
Employees:	8.600
Turn-over:	1,7 Bil. Euro
Export Share:	60 %

Third generation family-owned enterprise

Among the Top 3 of industry

www.viessmann.com

Viessmann Headquarter

Allendorf (Eder), Germany 130 km North of Frankfurt

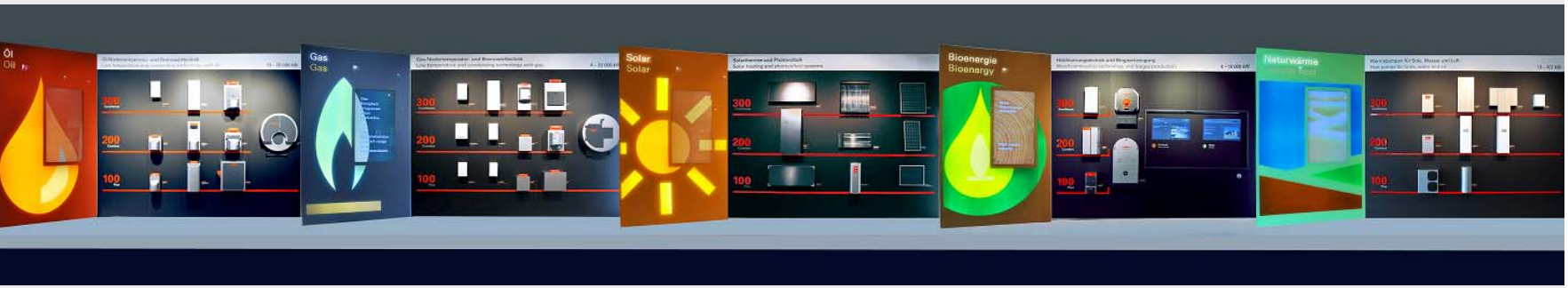
VIESMANN

Comprehensive product range

For all energy sources and all output ranges - 1.5 kW to 20 MW in three program levels

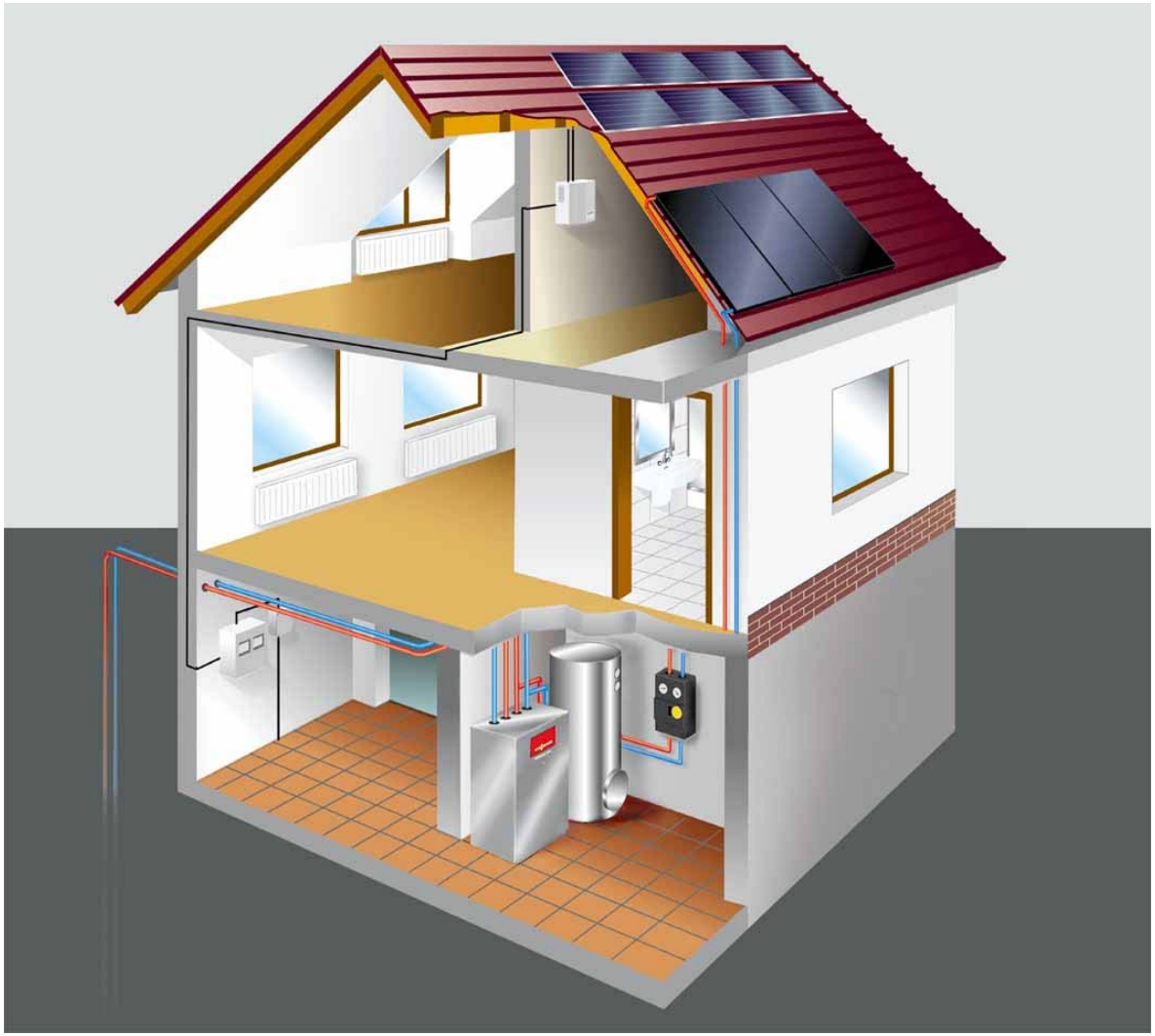
1,5 kW – 20.000 kW

Oil **Natural** **Solar** **Bio** **Natural**



Energy sources:	Oil, natural gas, solar, bio energy (wood, biogas), natural heat
Output range:	1,5 kW to 20.000 kW
Range categories:	100 Plus, 200 Comfort, 300 Excellence
System solutions:	Integrated system components

Viessmann has system solutions for heating, hot water, steam and solar energy applications in housing and commercial projects



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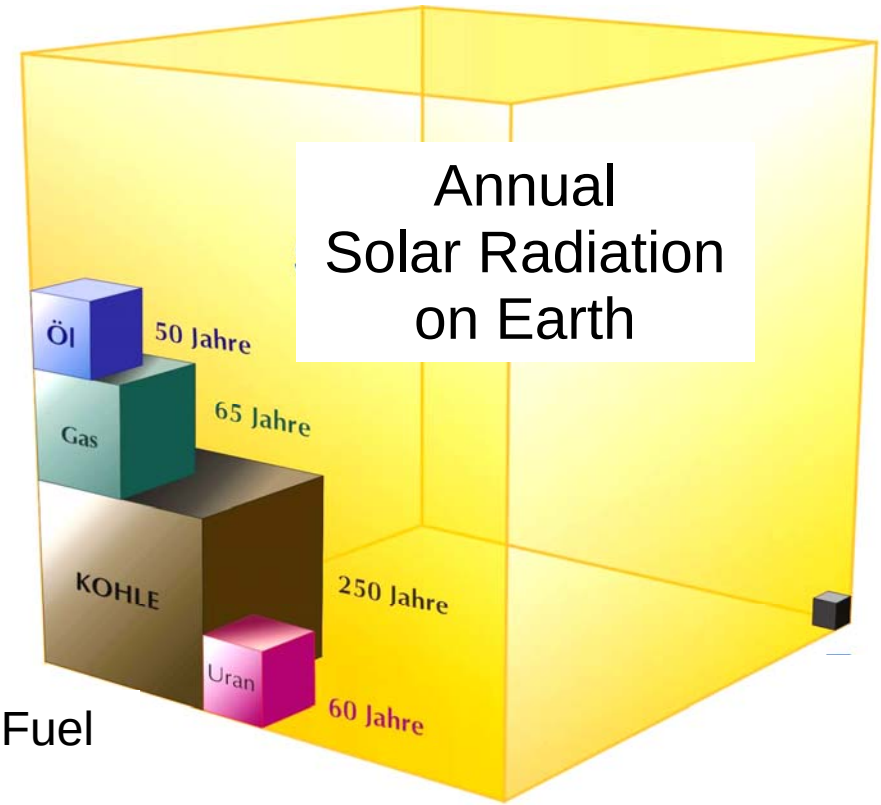
Solar Energy – The power source of the earth

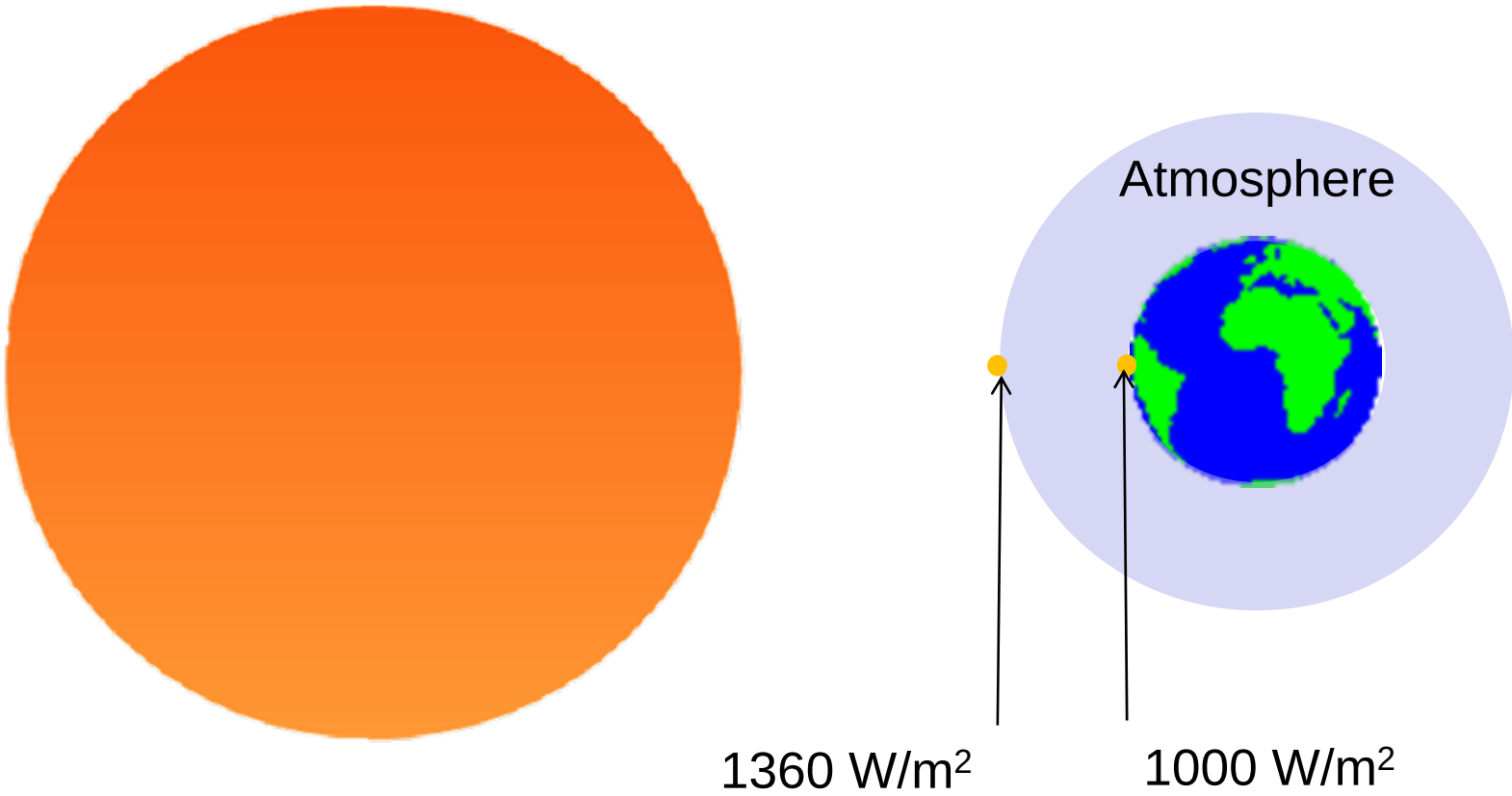
In **less than four hours** the sun radiates the **annual energy demand of the world's population** to the earth.



Estimated Fossil Fuel Sources

Annual Energy Consumption on Earth

Solar radiation on the Earth



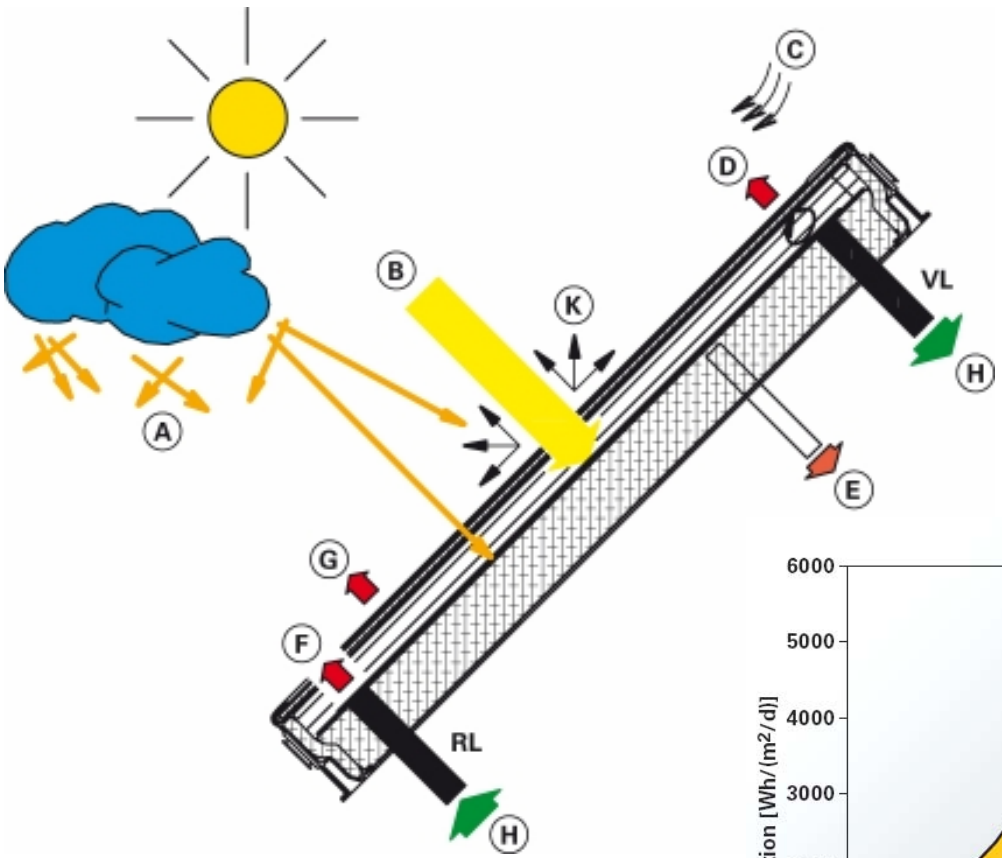
Solar energy

Annual energy amount (global radiation)

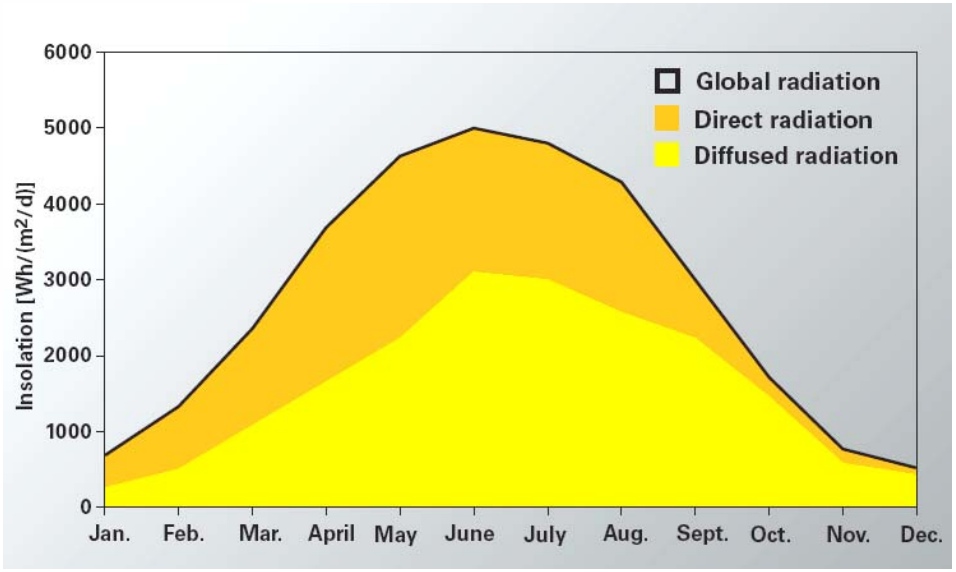
Country	City	Annual energy amount kWh / m² x year
UAE	Dubai	2027
Saudi Arabia	Riyadh	1873
Jordan	Amman	1870
Syria	Damascus	1862
Lebanon	Beirut	1734
Italy	Milano	1241
France	Paris	1127
Germany	Frankfurt	1087
UK	London	899

Solar radiation on the Earth

Utilisation of solar energy in the collectors Output / losses



A	diffused radiation
B	direct solar radiation
C	wind, rain, snow, convection
D	convection losses
E	thermal conduction losses
F	heat radiated by the absorber
G	heat radiated by the glass cover
H	useful collector output
K	reflection



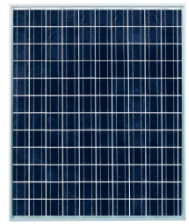
Daily energy values irradiated onto the horizontal plane over a 12 month period

-Diffuse radiation of UAE is more than 40 %

Solar Energy related to buildings

→ Heat

→
Electricity
(direct with PV)



→ Solar lighting

→
Concentrated
Solar Power

→ Bio Fuels

Solar energy related to buildings

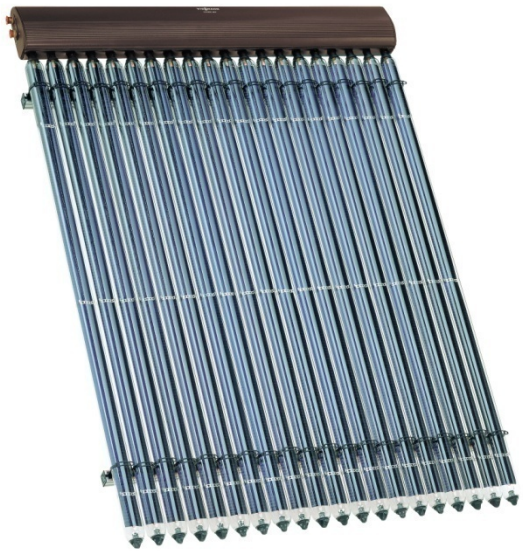
What can we do with the heat?

→ **Heat**

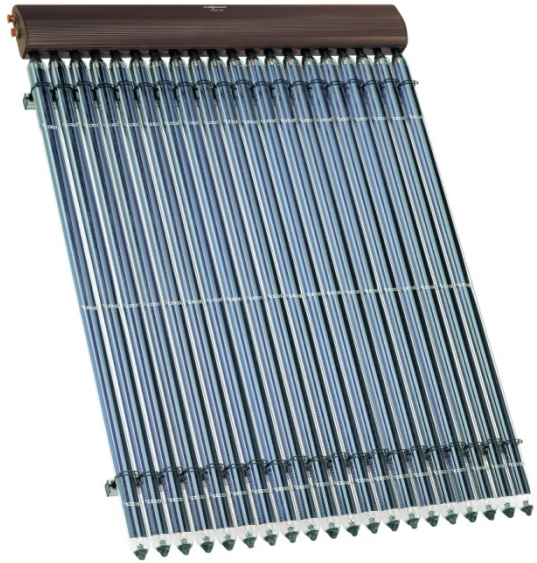
- Domestic hot water >80%
- Pool heating
- Heating support in cold climates
- Process heat
- Solar cooling with absorption chillers
- Solar desalination

Solar-thermal: Heat through sunshine

Vitosol 100/200-F
Flat



Vitosol 200-T
tube



Vitosol 300-T
tube-heat pipe

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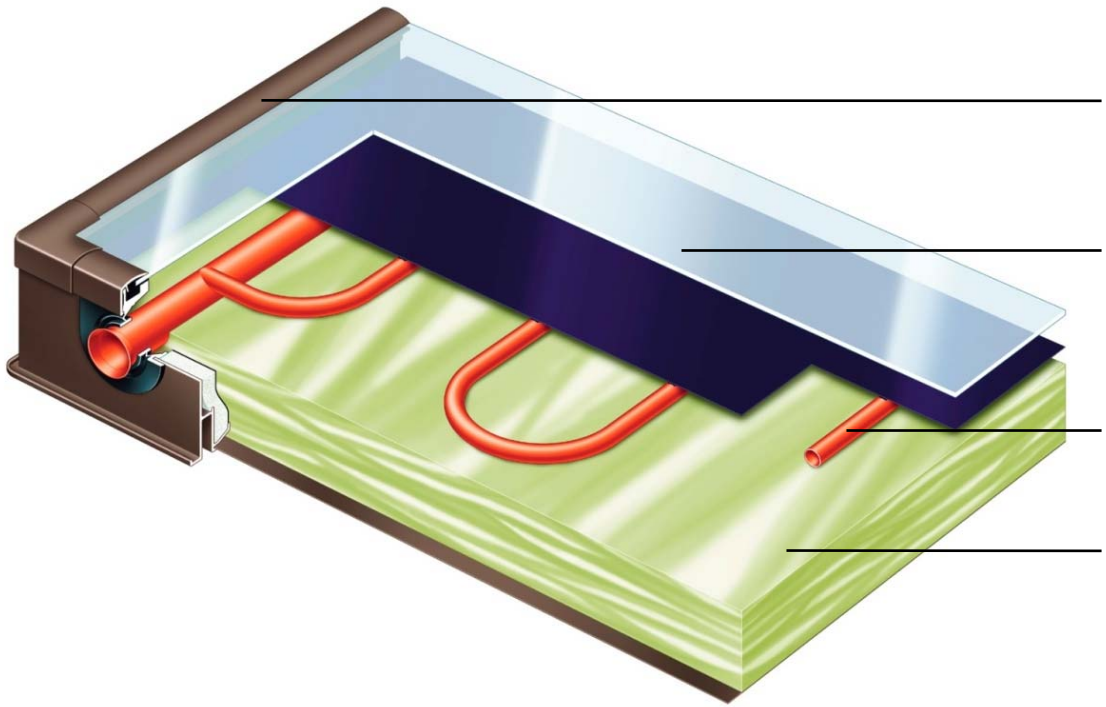
Vitosol 200-F

Flat collector



All round folded aluminium frame

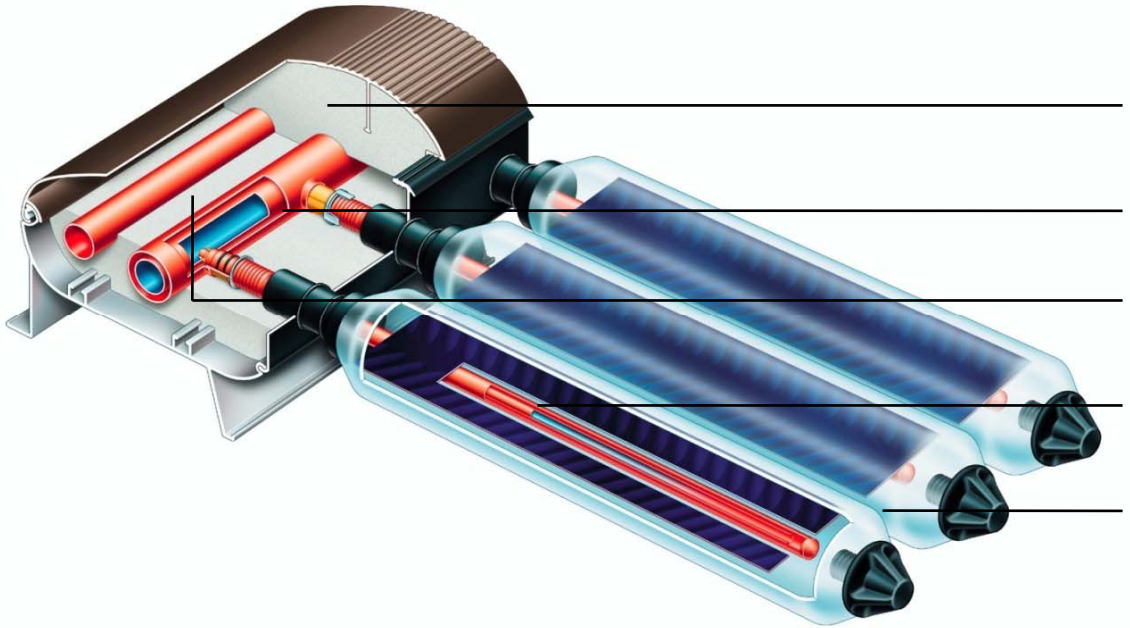
Stable, highly transparent cover made from special glass

“S” patterned copper absorber

Highly effective thermal insulation

Vitosol 200-T

Evacuated tube collector with copper absorber, direct flow



Highly effective thermal insulation

Coaxial distributor pipe

Header

Direct flow Sol-titanium coated absorber

High grade, low ferrous glass

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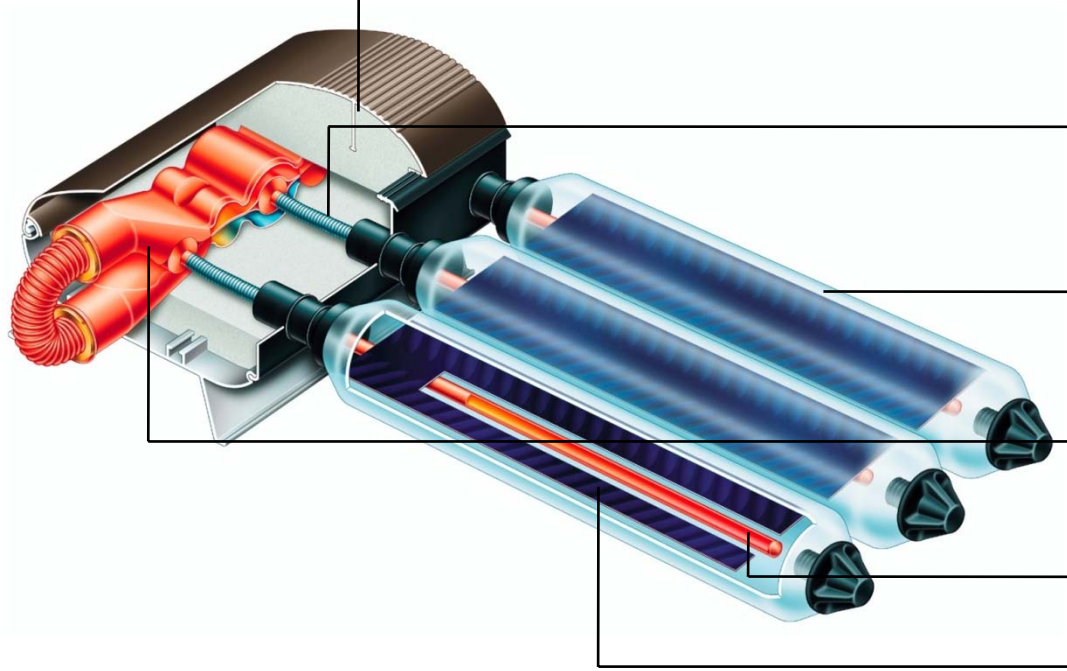
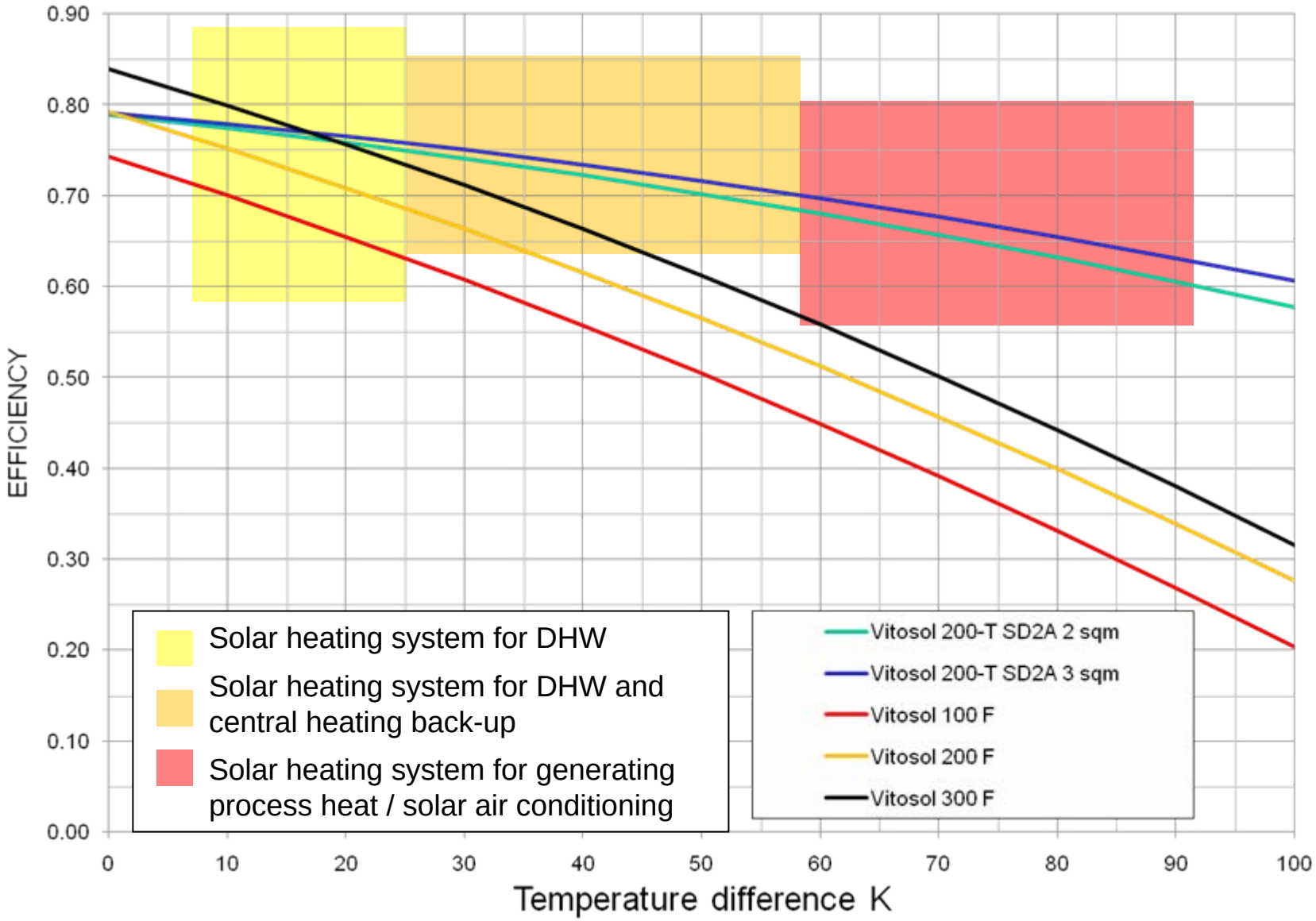
Vitosol 300-T

Evacuated tube collector with copper absorber, heat pipe technology



- Highly effective thermal insulation
- “Dry” connection, no direct contact between carrier and heat transfer medium
- High grade, low ferrous glass
- Duotec twin-pipe heat exchanger with integral overheating protection
- Heat pipe
- Sol-titanium coated absorber

Solar Thermal Collector efficiency



Life expectations of solar collectors

Life expactations of solar collectors

30 years

35 years

Certificates of solar collectors

Performance & Reliability Test reports according to EN 12975

Institut für Solarenergieforschung GmbH
Hameln / Emmerthal

Test Centre for Solar Thermal
Components and Systems

ISFH

Am Ohrberg 1 · 31860 Emmerthal · Germany

Report of Performance Test according to EN 12975-2 for a Glazed Solar Collector

DAP-PL-3662.00 DAP-PL-3662.00

Test Centre

Address	Institut für Solarenergieforschung GmbH, Hameln/Emmerthal Am Ohrberg 1 31860 Emmerthal, Germany
Contact person	Dipl.-Ing. C. Lampe Tel.: +49 (0)5151/ 999-522 Fax: -500 E-Mail: Pruefstelle@isfh.de

Test Basis

Test according to	EN 12975-2:2006 Section 6

Test Report

Number	03-06/D
Date	27.06.2006
Number of pages	20
Date of translation	25.10.2007

Customer

Address	Viessmann Werke GmbH & Co. KG Viessmannstraße 1 D- 35107 Allendorf Germany
Contact person	Mr. Sigurd Wenzler Tel.: +49 (0)6452/70-2862, Fax: -5862

Test Collector

Type	Vitosol 200-F
Manufacturer	Viessmann Werke GmbH & Co. KG
Serial- or Prototype	Serial type
Year of production	2006
Serial number	7188383613499109

Institut für Solarenergieforschung GmbH
Hameln / Emmerthal

Test Centre for Solar Thermal
Components and Systems

ISFH

Am Ohrberg 1 · 31860 Emmerthal · Germany

Report of Reliability Test according to EN 12975-2 for a Glazed Solar Collector

DAP-PL-3662.00 DAP-PL-3662.00

Test Centre

Address	Institut für Solarenergieforschung GmbH, Hameln/Emmerthal Am Ohrberg 1 31860 Emmerthal, Germany
Contact person	Dipl.-Ing. C. Lampe Tel.: +49 (0)5151/ 999-522; Fax: -500 E-Mail: Pruefstelle@isfh.de

Test Basis

Test according to	EN 12975-2:2006 Section 5

Test Report

Number	04-06/Q
Date	28.06.2006
Number of pages	18
Date of translation	31.10.2007

Customer

Address	Viessmann Werke GmbH & Co. KG Viessmannstraße 1 D- 35107 Allendorf Germany
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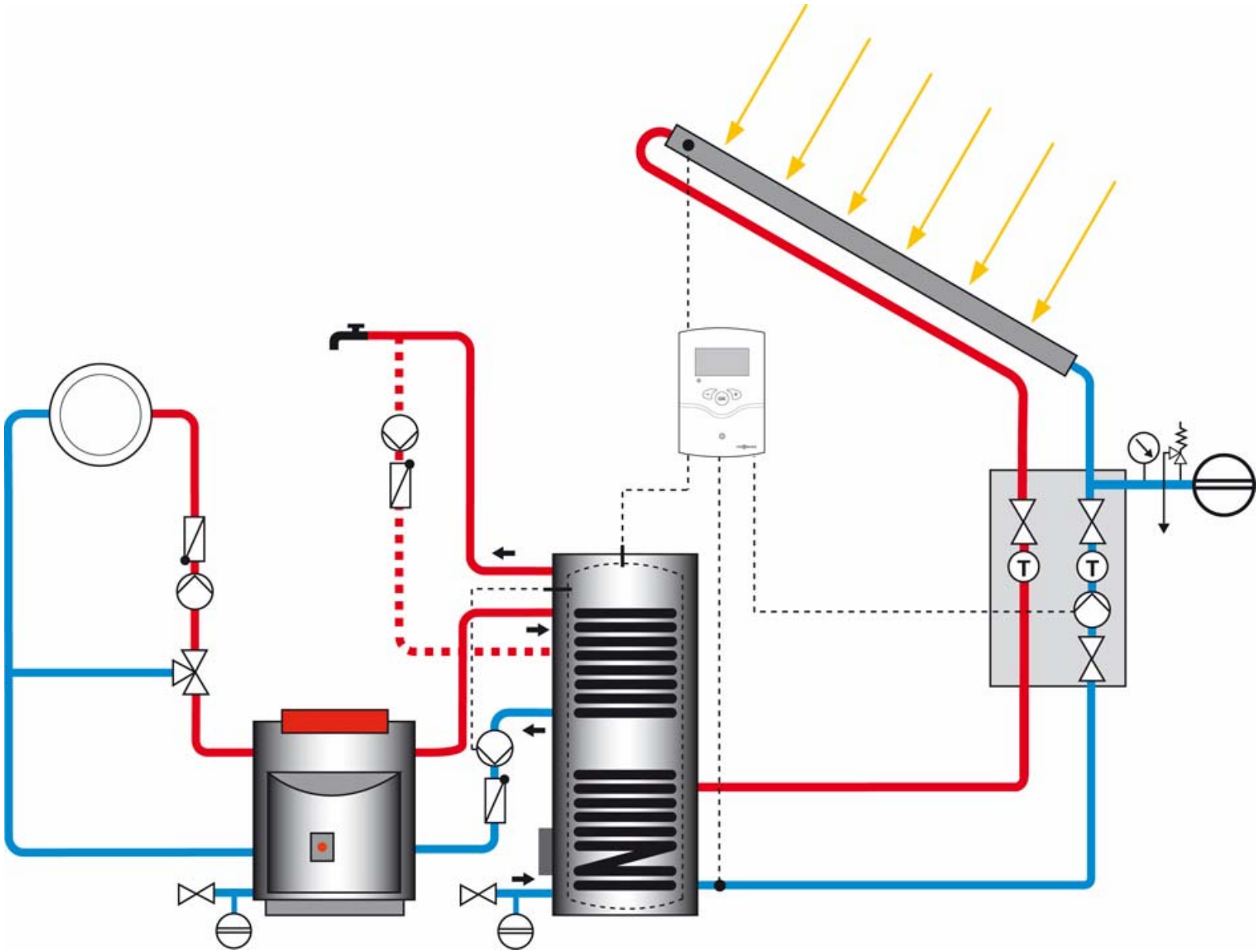
Test Collector

Type	Vitosol 200-F
Manufacturer	Viessmann Werke GmbH & Co. KG
Serial- or Prototype	Serial type
Year of production	2006
Serial number	7188383613498102

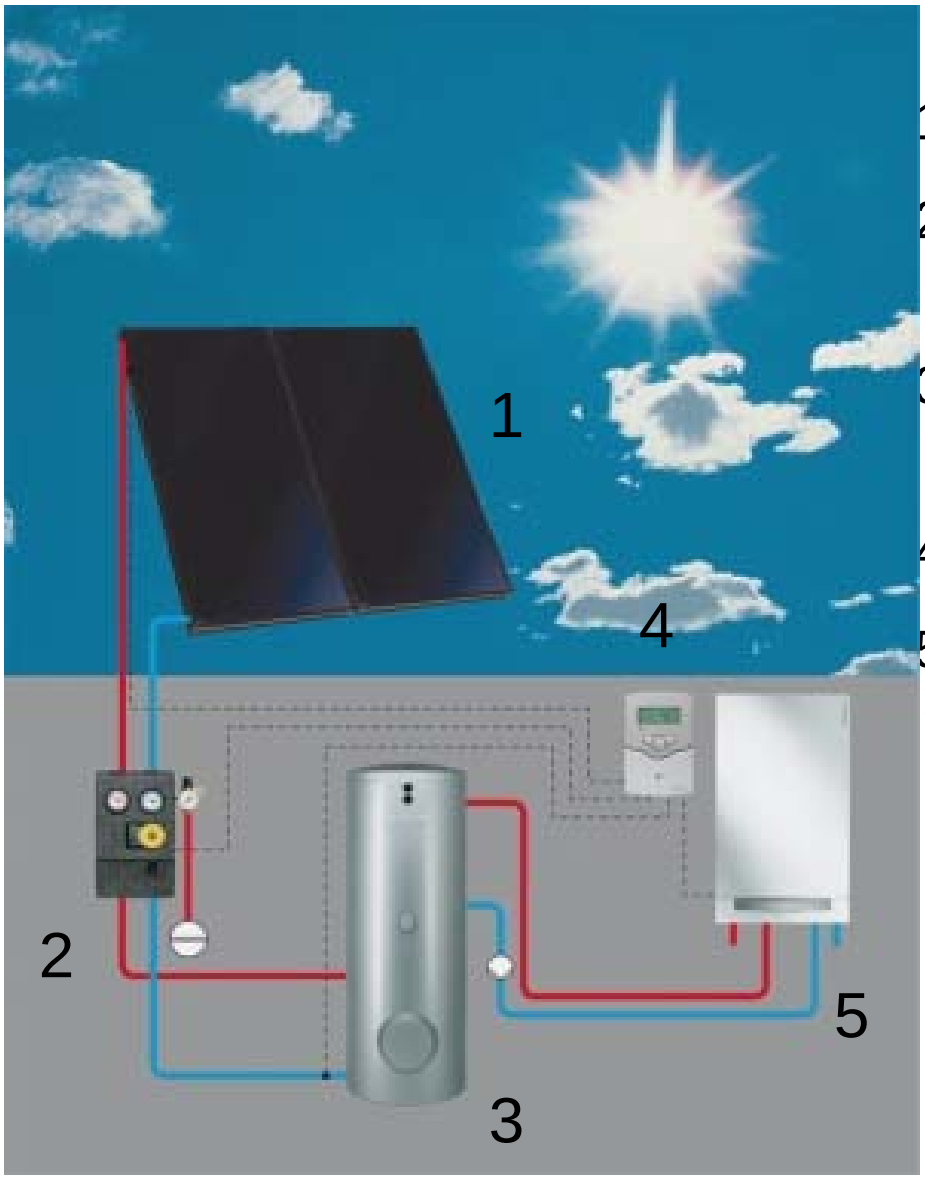
Solar Modernisation of a Hotel Project


MAGIC LIFE
Sarıgerme
Güneş Enerjisi
Sistemi
Viessmann' ın
katkılarıyla
MAGIC LIFE
MAGIC LIFE

Solar thermal hot water generation



Design of a solar thermal system for DHW



1 – Solar collectors, **Vitosol**

2 – pumping station – **Divicon** and accessories

3 – Dual mode or multi mode **DHW cylinder**

4 – Control unit – **Vitosolic**

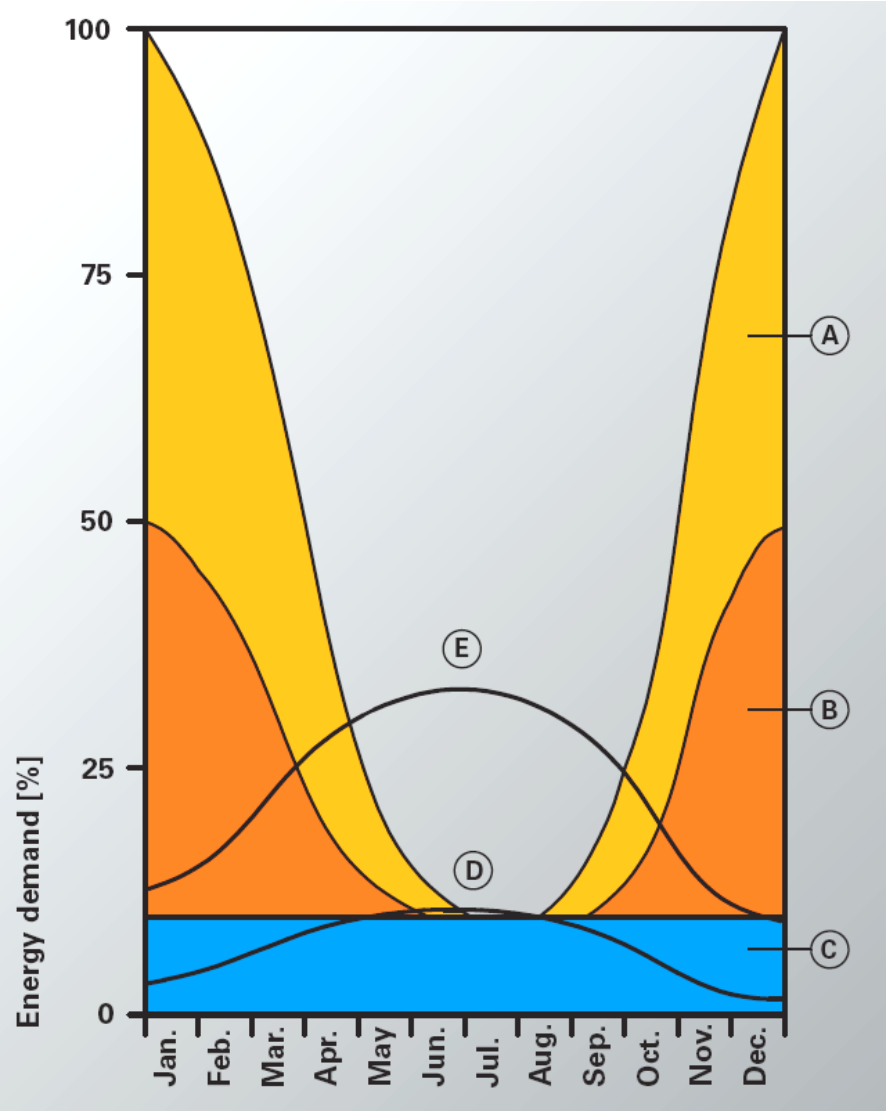
5 – **Back-up system** – oil/gas boiler, electrical or heat pump

Design of a solar thermal system for DHW

- Planning data
- Basic information
- DHW cylinder volume
- Absorber surface area
- Pipe sizing
- Circulation pump (Solar Divicon) sizing
- Expansion vessel sizing
- Vitosol control unit

Design of a solar thermal system for DHW

Basic information for a single house 120 m²



Consumption

A – Room heating requirement of a building

B – Room heating requirement of a low-energy house

C – Hot water required

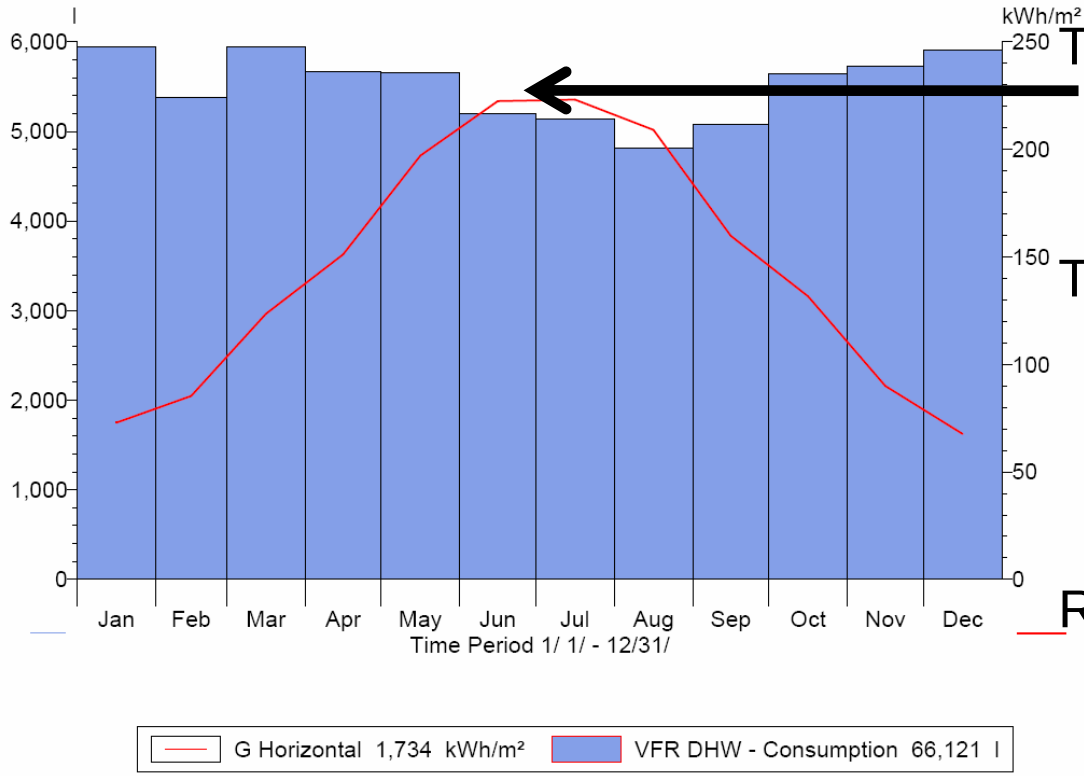
Gain

D – Solar energy yield with 5 m² of absorber surface area

E – Solar energy yield with 15 m² of absorber surface area

Design of a solar thermal system for DHW

Basic information



The solar system has to be selected for the maximum energy level

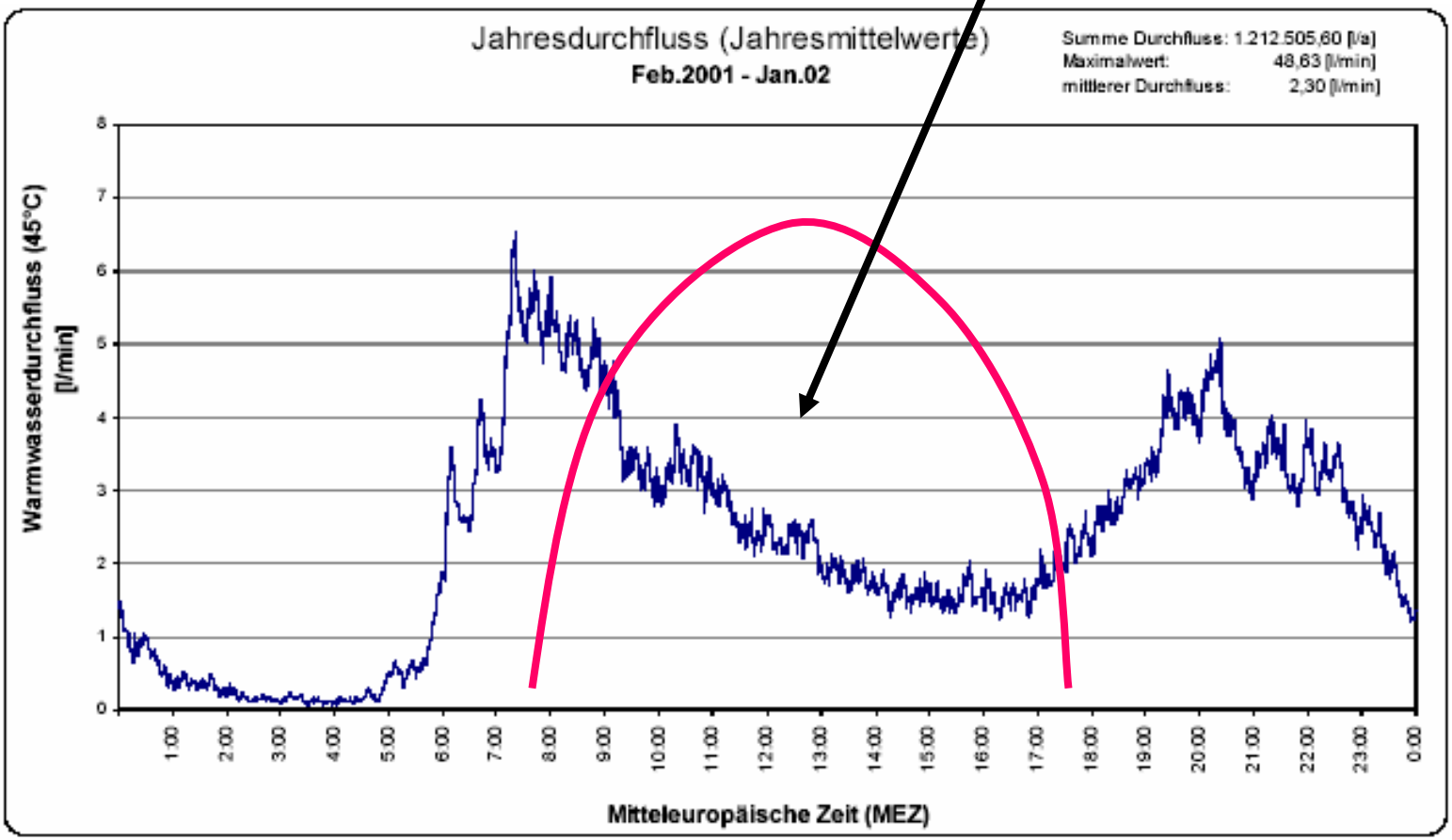
The solar system cannot cover 100% of the consumption

Realistic value is 60-70 % of annual energy demand

Design of a solar thermal system for DHW

Sample: Buffer tank for solar thermal system – 10000 l/pers/day

Energy needs to be stored => Daily buffer



Design of a solar thermal system for DHW

Hot water demand calculation

	DHW consumption V_P in l/(d·person) at a DHW temperature	
	45 °C	60 °C
In domestic homes		
High demand	50 to 80	35 to 56
Average demand	30 to 50	21 to 35
Low demand	15 to 30	11 to 21

Max 50 l/pers/day at 60°C

or

70 l/pers/day at 45°C

Sample:

4 pers x 50 l/pers/day = 200 l/day at 60°C or 280 l/day at 45°C

Design of a solar thermal system for DHW

Absorber surface area

Solar radiation ~1000 W/m2

If sun is shinning for 6 – 7 hours/day =>

Daily maximum gain 6 – 7 kWh/m2

The DHW temperature 60°C/10°C

The DHW flow: 6/50 = 0.12 m3/(h x m2)

100 l of DHW at 60°C per m^2 of collector

In our case:

400 l/day / 100 l/m^2 = 4 m^2 => 2 collectors Vitosol 200F

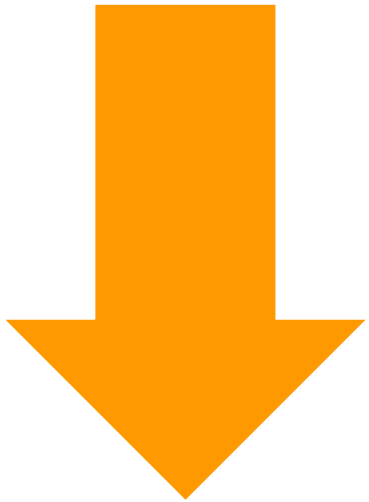
Thumb rules

DHW demand: 50 l/pers/day at 60°C

Collector area: 1 m^2 at 100 l of DHW at 60°C

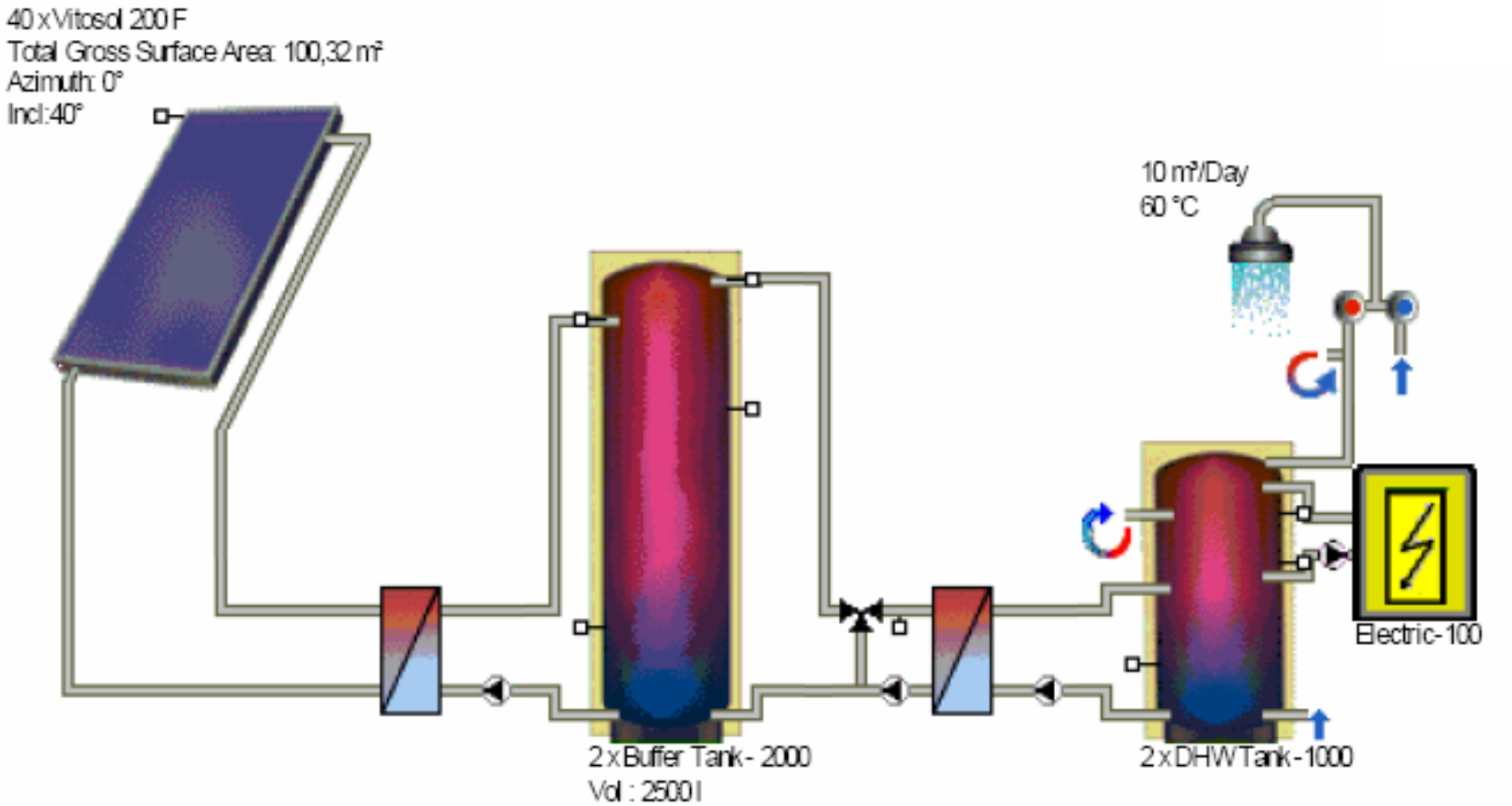
Buffer tank: 50 l/m^2 of absorber area

Solar simulation



Solar simulation software

Large scale solar thermal, Example for a 10000 liter/day hot water system



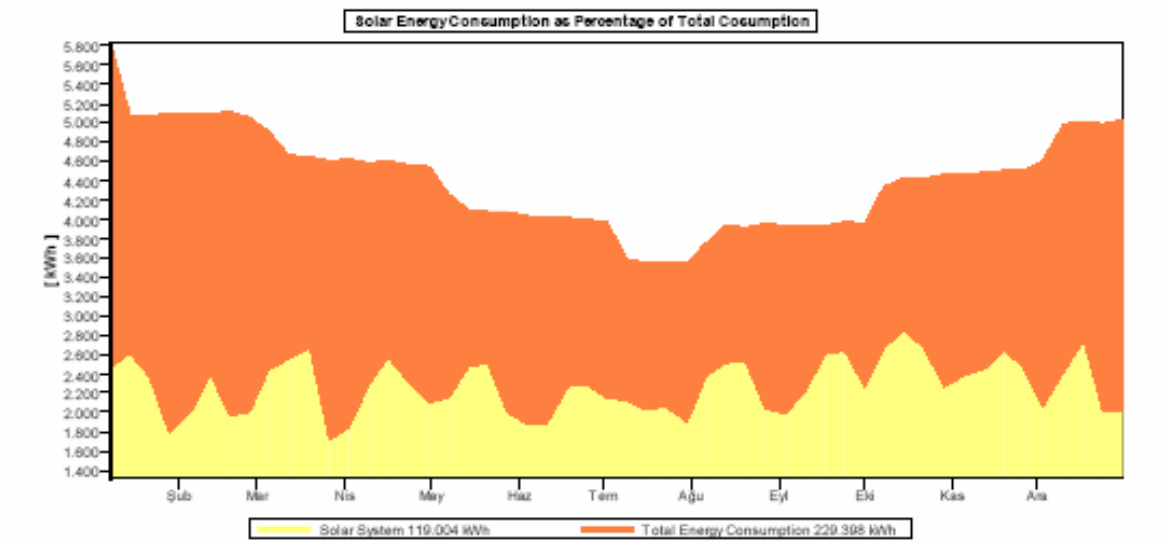
Large scale solar thermal, Example for a 10000 liter/day hot water system

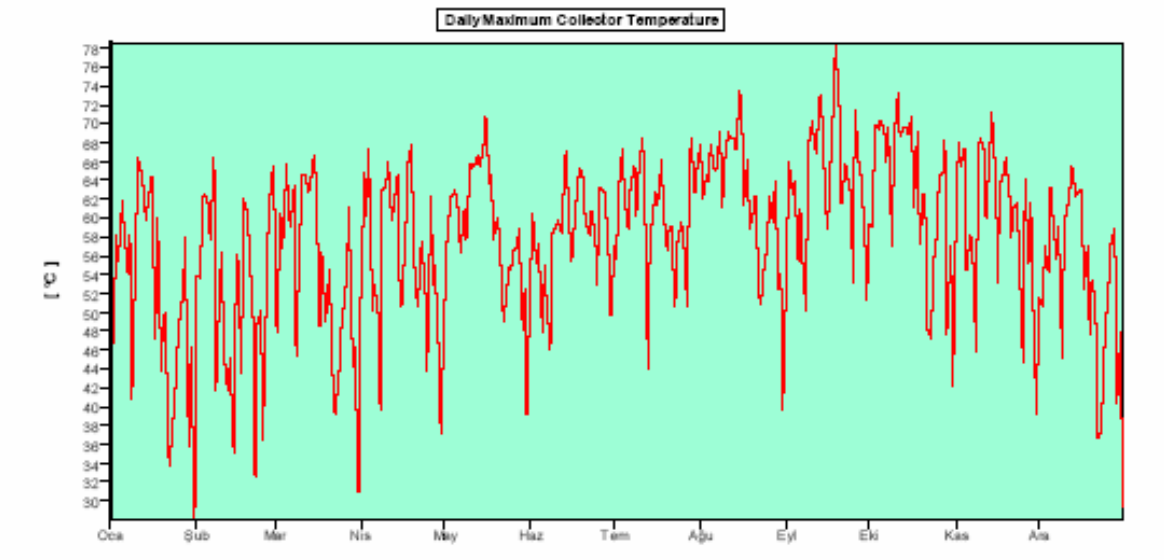
Results of Annual Simulation

Installed Collector Power:	70,22 kW	
Collector Surface Area Irradiation:	193,60 MWh	2.079,88 kWh/m²
Energy Produced by Collectors:	124,05 MWh	1.332,75 kWh/m²
Energy Produced by Collector Loop:	121,10 MWh	1.301,07 kWh/m²
DHW Heating Energy Supply:	212,38 MWh	
Solar Contribution to DHW:	119 MWh	
Energy from Auxiliary Heating:	110,39 MWh	

Electricity Savings:	**140,0 MWh**
CO2 Emissions Avoided:	**93.243,48 kg**
DHW Solar Fraction:	**51,9 %**
Fractional Energy Savings (prEN 12976):	**48,9 %**
System Efficiency:	**61,5 %**

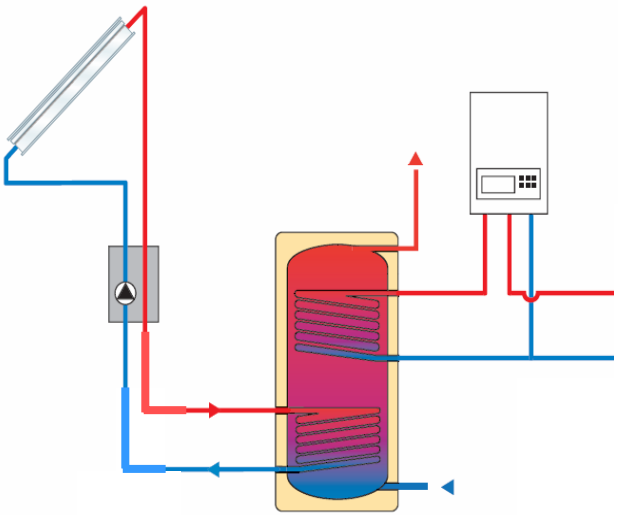
Large scale solar thermal, Example for a 10000 liter/day hot water system



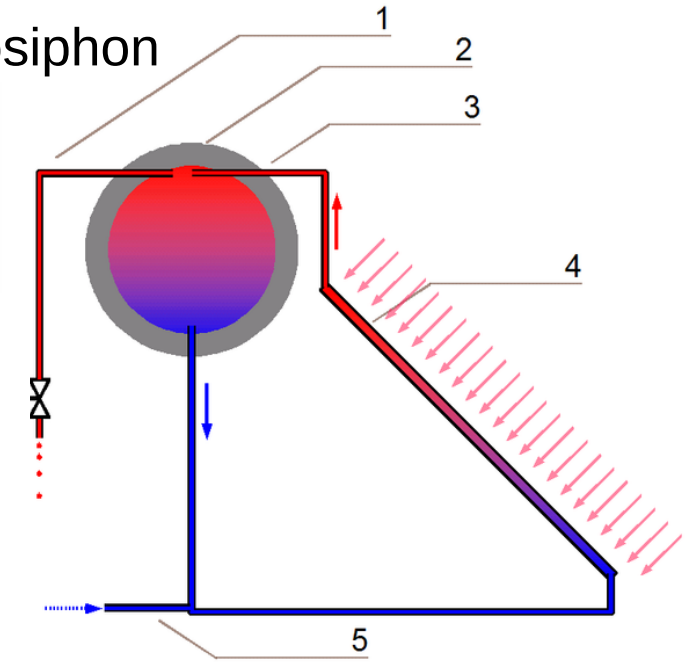


Solar hot water generation
closed loop- open loop differences

Closed loop



Thermosiphon



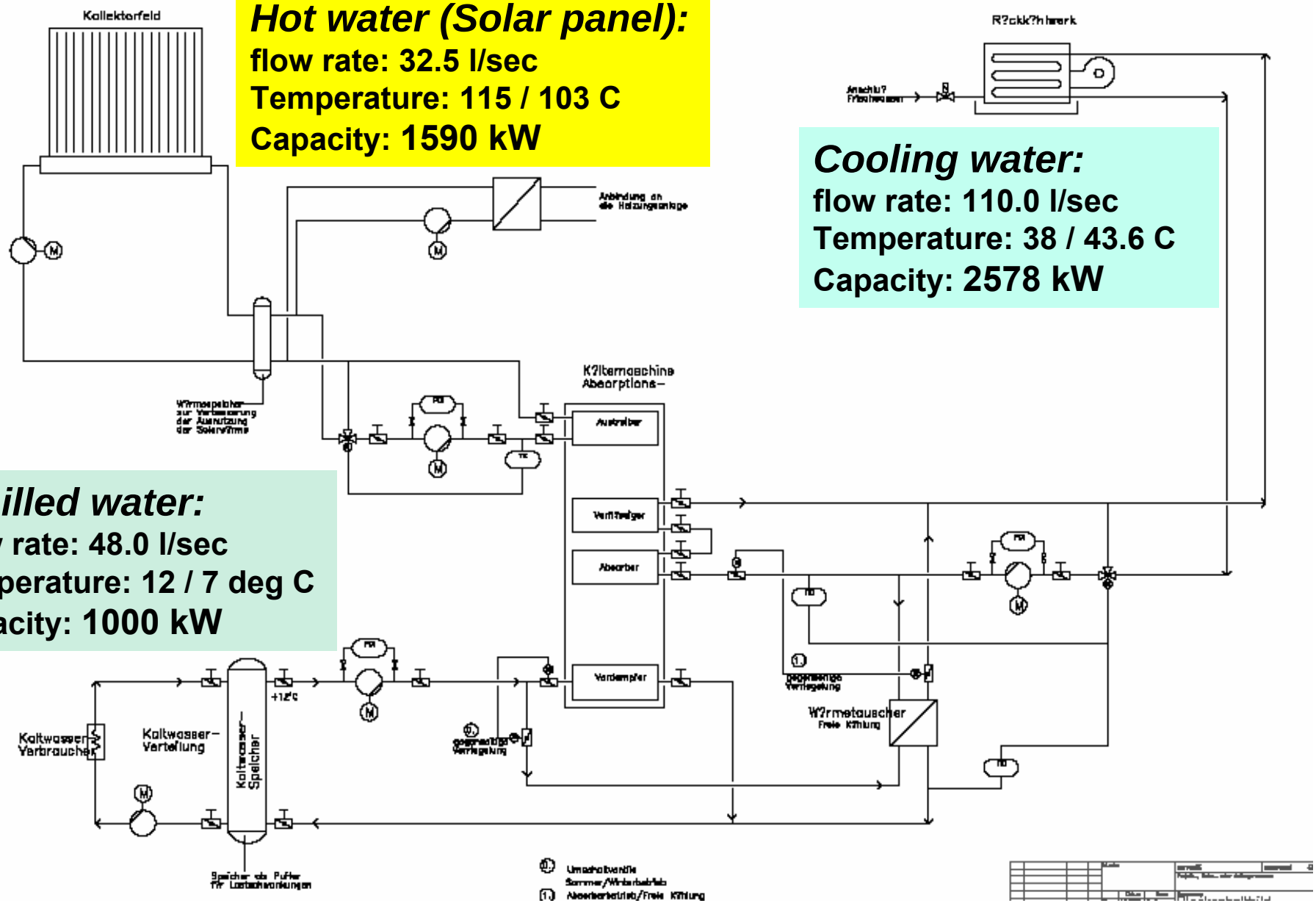
Thermosiphon is the easiest solution:
No power supply, no pump, no control, works everywhere
Advantages of closed loop system:
No tank on collector, architecturally better installation
Hot water resirculation possible, less water losses, no problems with low water quality
Better control, higher efficiency, no over night cooling losses
Best for **large scale** solar systems

Example: Selection of a Solar cooling system in UAE

Hot water (Solar panel):
flow rate: 32.5 l/sec
Temperature: 115 / 103 C
Capacity: 1590 kW

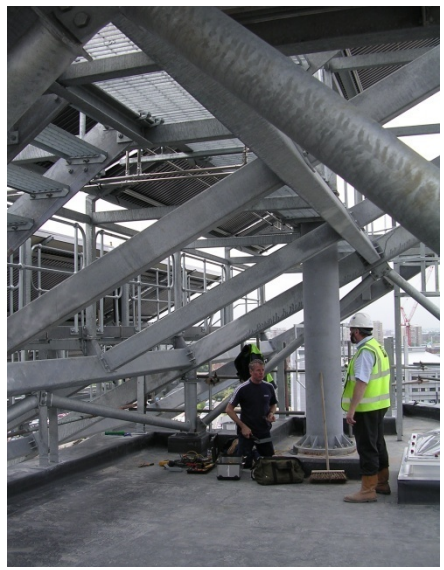
Cooling water:
flow rate: 110.0 l/sec
Temperature: 38 / 43.6 C
Capacity: 2578 kW

Chilled water:
Flow rate: 48.0 l/sec
Temperature: 12 / 7 deg C
Capacity: 1000 kW



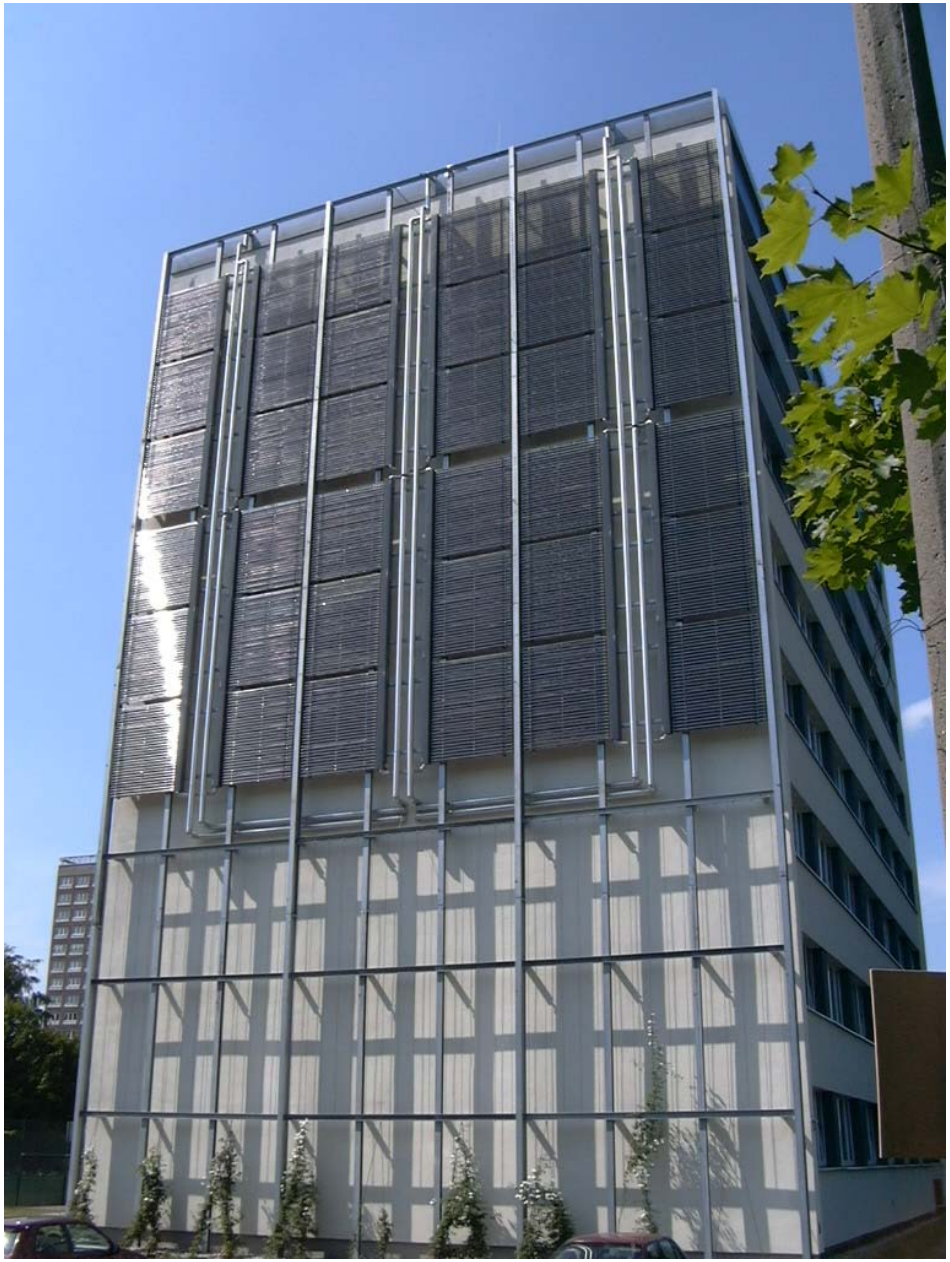
Installation examples

Case study –
Green Building, Manchester



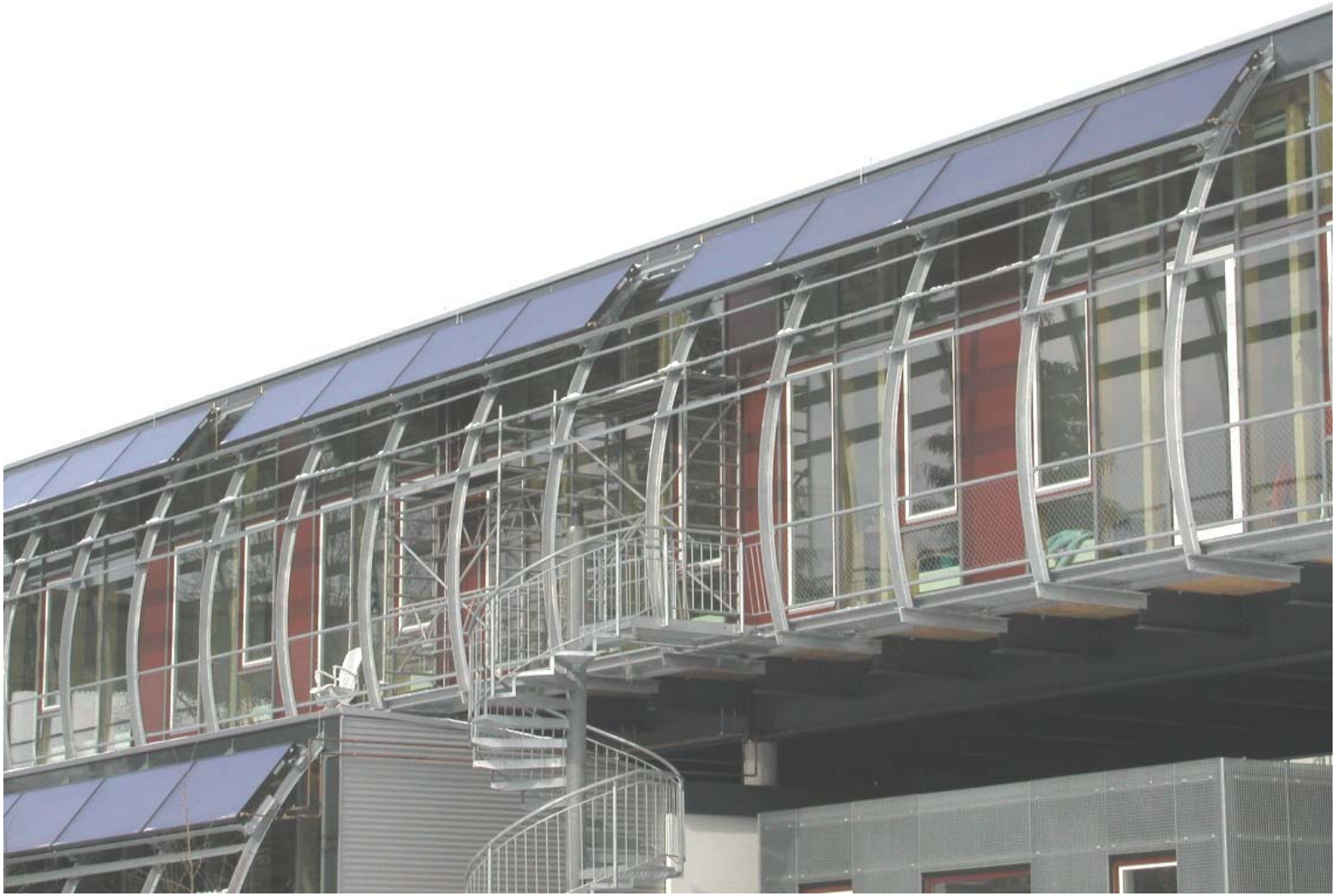
Installation examples

Installation examples



Vacuum tube collectors on a vertical surface

Installation examples
Solar panels as shading elements for the building



Installation examples in UAE
Jebel Ali Process heating system

Solar Absorber gross surface area : 300 m^2

Energy produced by collectors : 376,4 MWh/year

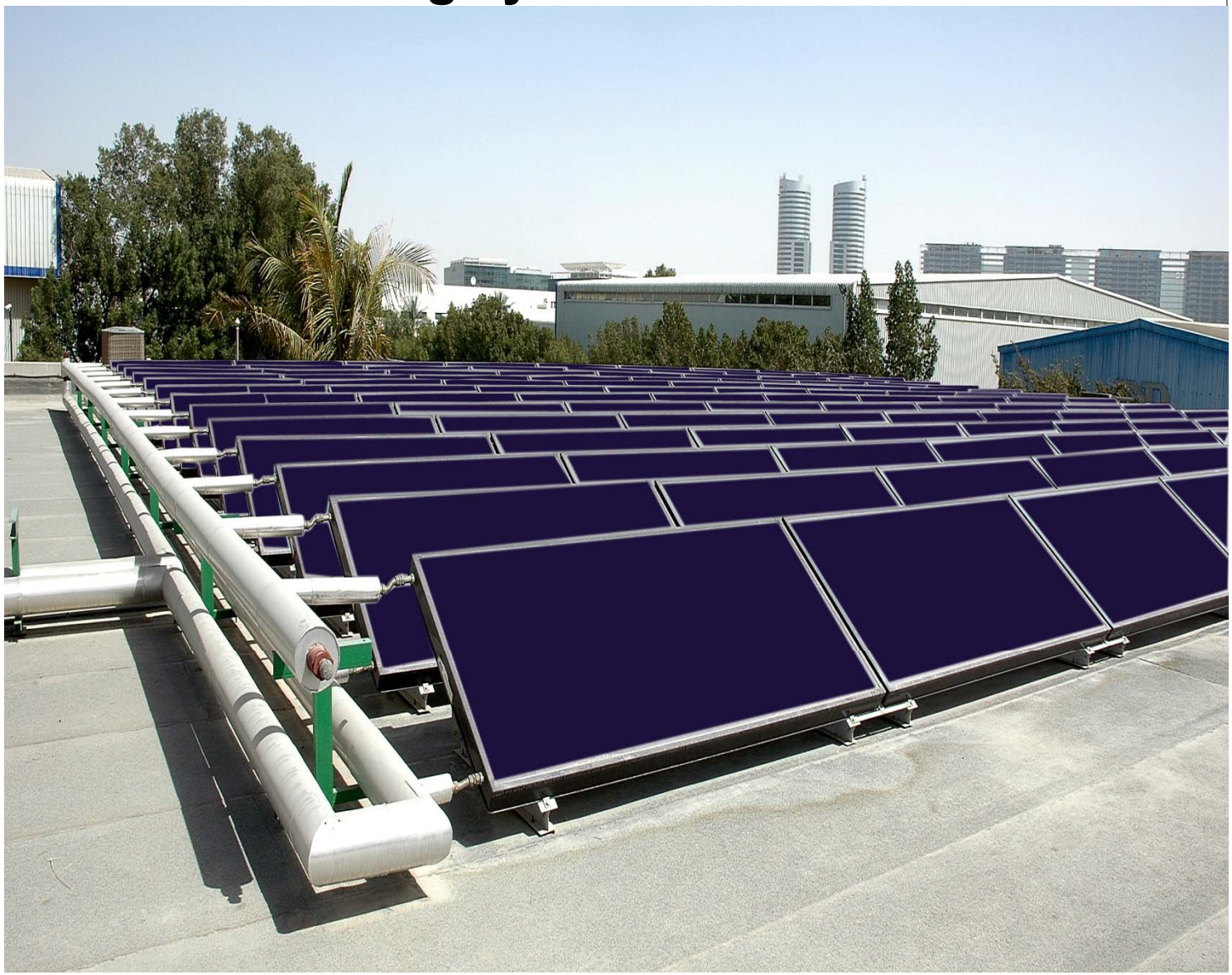
Diesel savings : 48 100 liters/year.

CO_2 emissions avoided : 132 500 kg

Application0 : Process heat for hot water loop at manufacturing plant

Installed by Value Addition FZE

Installation examples in UAE
Jebel Ali Process heating system



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Installation examples in UAE
Palm Jumeirah Residential buildings solar hot water system

Solar Absorber gross surface area :

14 x 200 m^2 (2800 m^2)

Energy produced by collectors : 3805 MWh/year

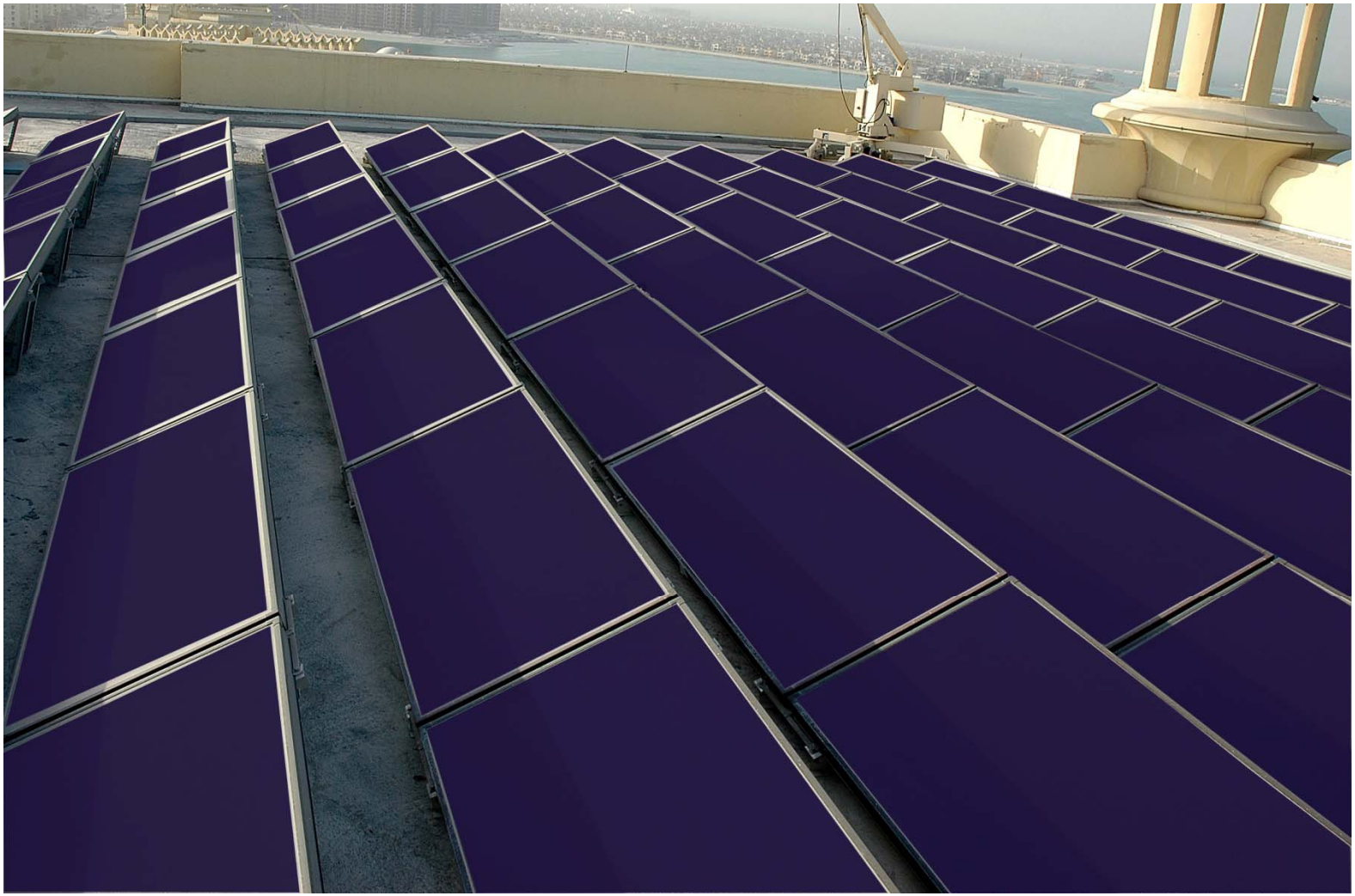
Natural gas savings : 471000 m^3/year.

CO_2 emissions avoided : 1 070 000 kg

Backup system Gas fired wall hung condensing boilers

Installed by Value Addition FZE

Installation examples in UAE
Palm Jumeirah Solar Energy System



Viessmann Flat Solar Thermal Panels with original support system and connection pipes

Installation examples in UAE
Palm Jumeirah Solar Energy System

Viessmann Domestic Hot Water cylinders

Viessmann Gas condensing boilers for the backup of the system (109 % efficiency)

Installation examples in UAE
Solar Energy System for villa's in Jumeirah

Solar hot water system with electric backup

Installation examples in UAE
Al Quoz Solar Energy System labour camp

Operational since 2000

Solar energy needs good engineering design and installation to reach the goal !

Together with the design of renewables check the energy saving potential !

Saving + renewable = Target

Vitocal 160-A

Air source heat pump for DHW heating 1,52 kW, 285 liters

Sample Calculation: 300liters/day hot water

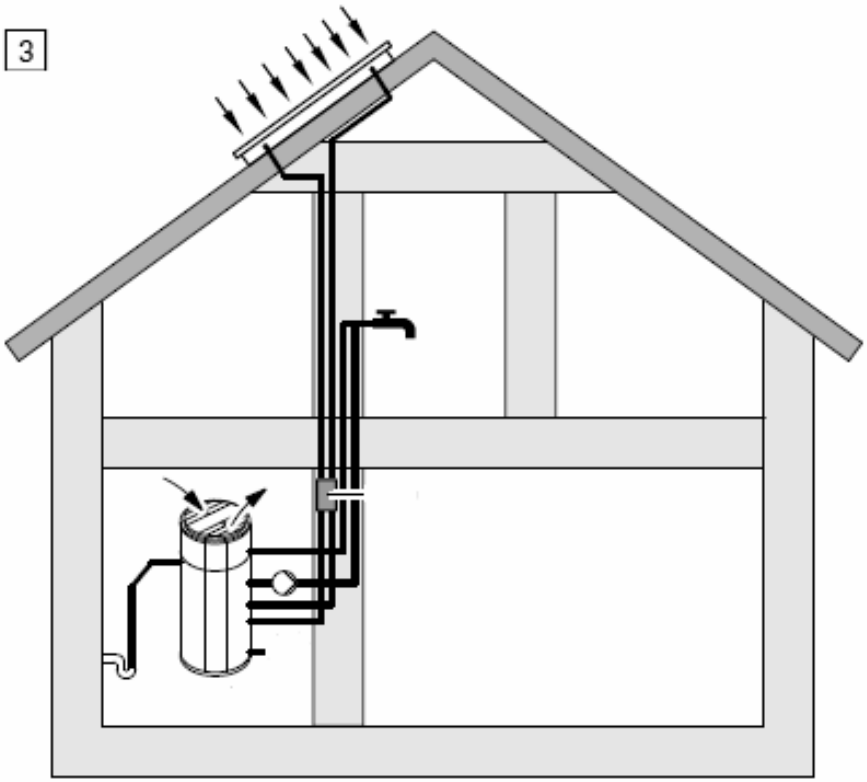
1.Electrical heater
Q = 300 x (60-10)/860 = 17,5 kW
Daily loss 1 kW
Electric consumption: 18,5 kW
2. Vitocal cylinder with heat pump
Q = 18,44 kW required electricity 5,2 kW
Cooling inside approx 17 kW
Saving at the AC of housing
5,7 kW
Electric consumption:
5,7-5,2 = - 0,5 kW

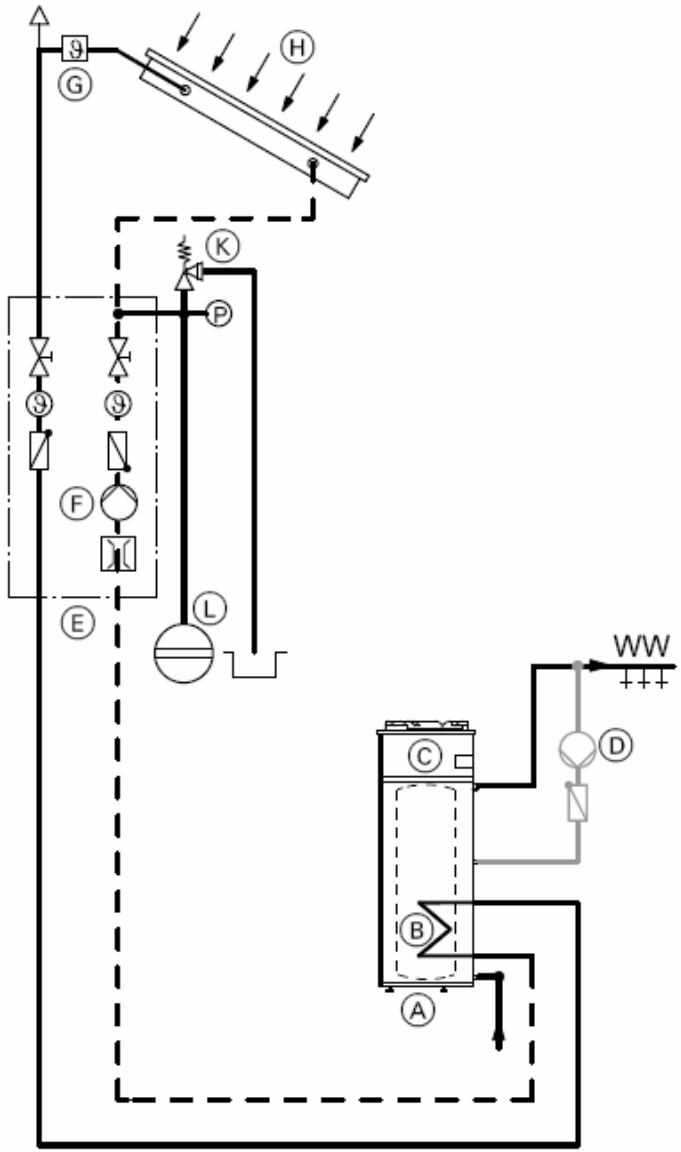
SAVING = 18,5 +0,5 = 19 kW
Annual expected saving 6840 kWh

(Max connected electrical load 500 W)

Vitocal 160-A in combination with solar energy

Max electrical load 500 W for a villa instead of 5-6 kW of electrical heaters





Questions ?

Solar Energy
Murat Aydemir Viessmann Middle East
Dubai 20.04.2009

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