

# **Designing Solar Thermal Applications**



**Murat Aydemir**

**Viessmann Middle East FZE**

General Manager (M.Sc. Mech.Eng., ASHRAE)

**Doha Green Conference Workshop**

The Moevenpick Towers and Suites, Doha 10.12.2009

# 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](http://www.viessmann.com)



**VIESSMANN**

# Viessmann Headquarter

Allendorf (Eder), Germany 130 km North of Frankfurt



VIESSMANN

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

## 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



**Energy sources:** Oil, natural gas, solar, bio energy (wood, biogas), natural heat

**Output range:** 1,5 kW to 20.000 kW

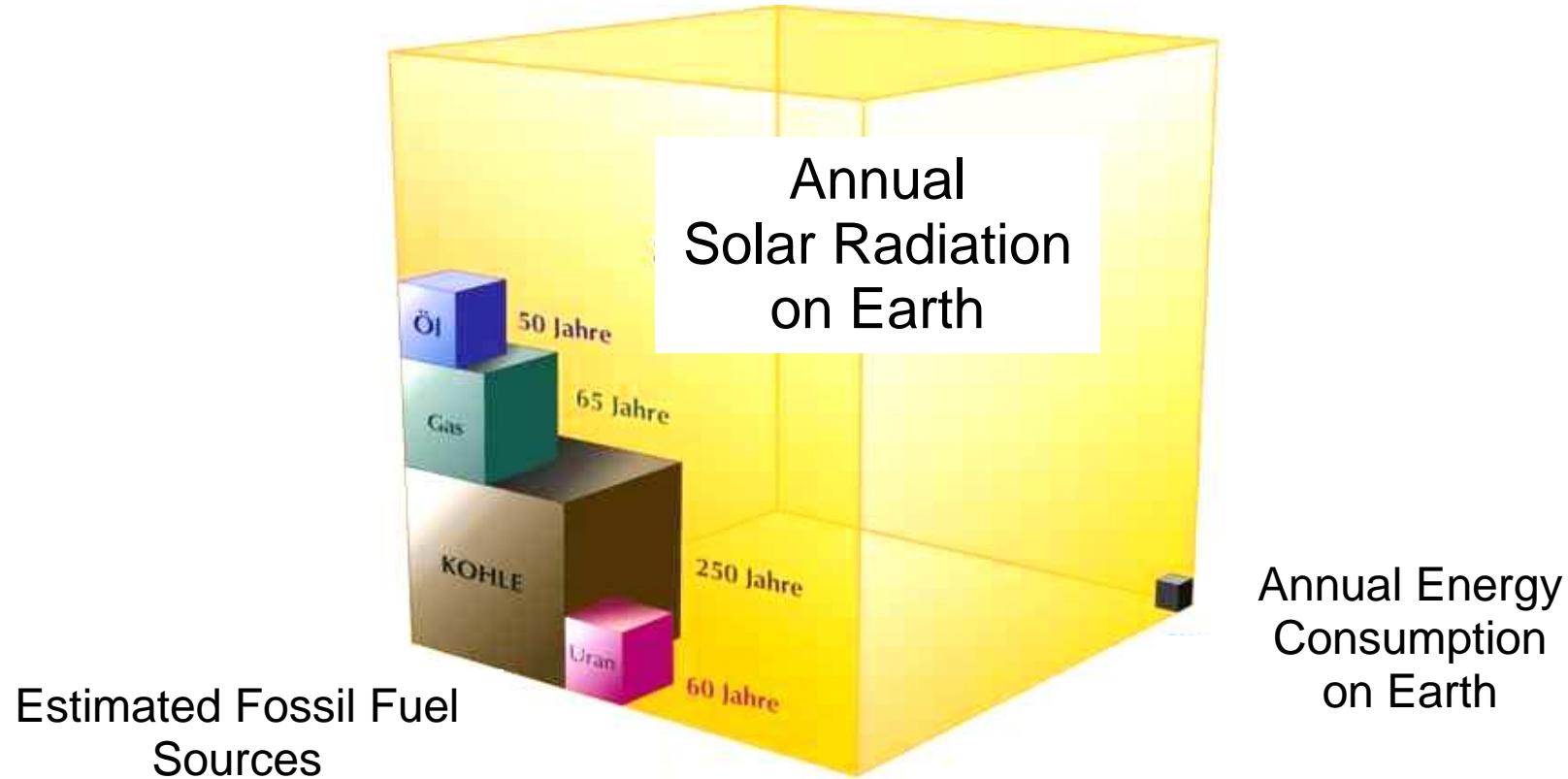
**Range categories:** 100 Plus, 200 Comfort, 300 Excellence

**System solutions:** Integrated system components

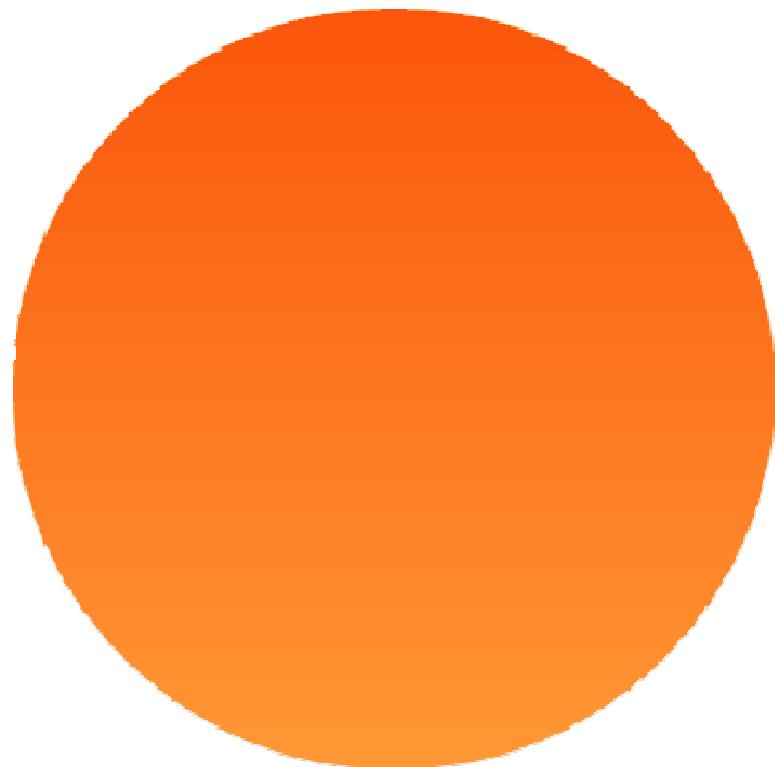
**VIESSMANN**

# Solar Energy – The power source of the earth

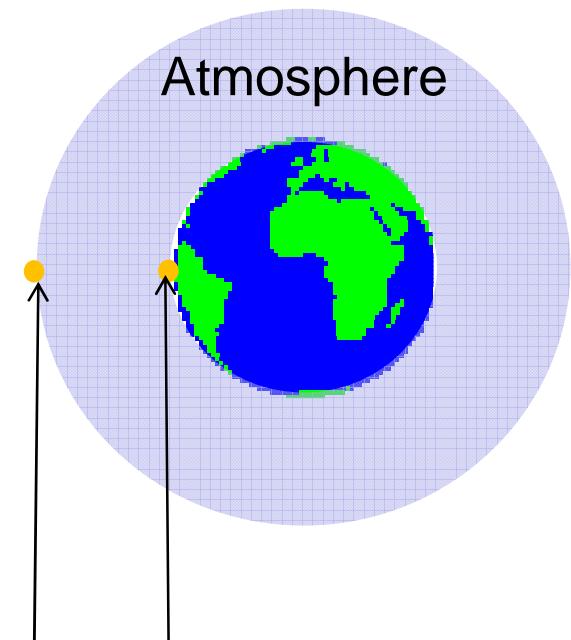
In less than four hours the sun radiates the **annual energy demand of the world's population** to the earth.



# Solar radiation on the Earth



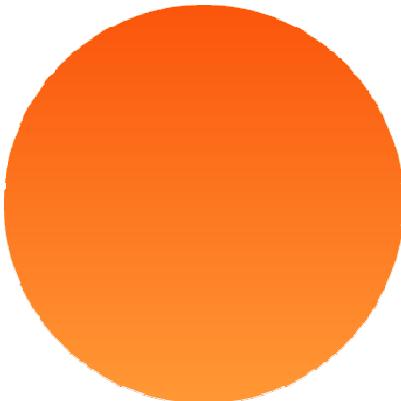
1360 W/m<sup>2</sup>



1000 W/m<sup>2</sup>

# Solar energy

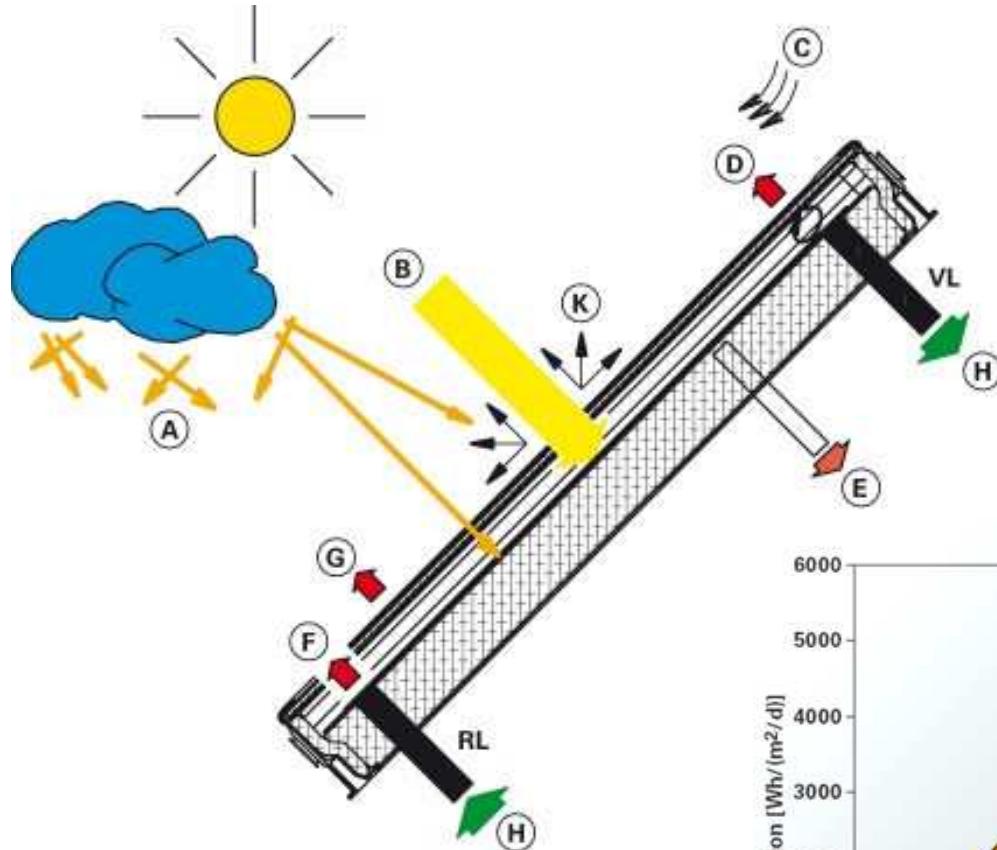
Annual energy amount (global radiation)



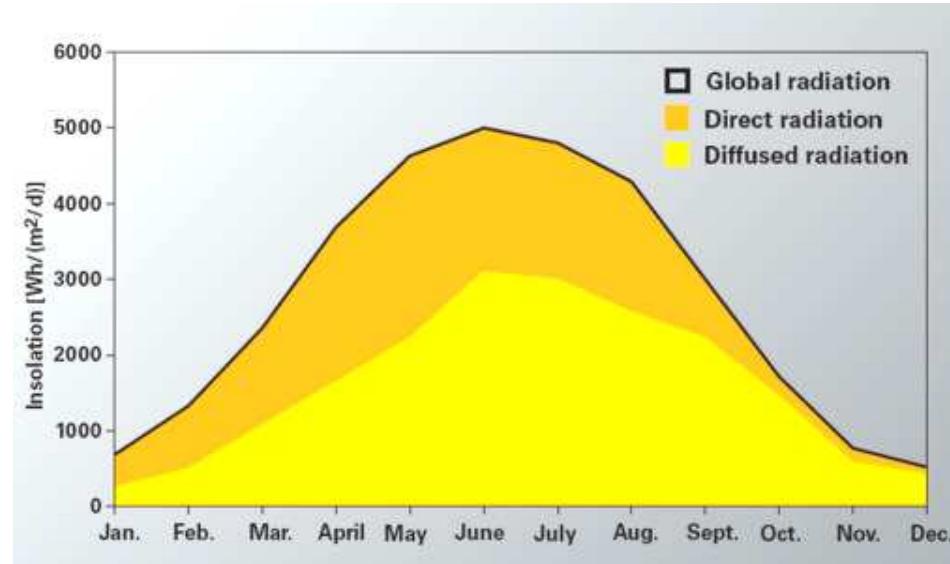
Country	City	Annual energy amount kWh / m <sup>2</sup> x year
UAE	Dubai	2027
<b>Qatar</b>	<b>Doha</b>	<b>1990</b>
Saudi Arabia	Riyadh	1873
Jordan	Amman	1870
Syria	Damascus	1862
Lebanon	Beirut	1734
Italy	Milano	1241
France	Paris	1127
Germany	Frankfurt	1087
UK	London	899

# Solar radiation on the Earth

Utilisation of solar energy in the collectors Output / losses



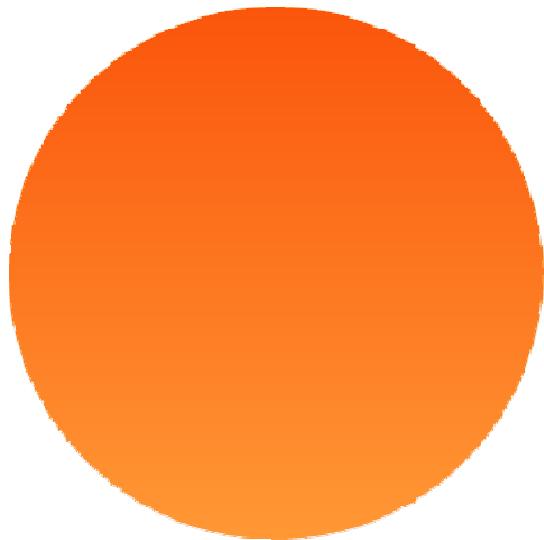
- A diffused radiation
- B direct solar radiation
- C wind, rain, snow, convection
- D convection losses
- E thermal conduction losses
- F heat radiated by the absorber
- G heat radiated by the glass cover
- H useful collector output
- K reflection



-Diffuse radiation of Doha is 44,5 %

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

# Solar Energy related to buildings



**Concentrated  
Solar Power**



→ Heat



**Electricity  
(direct with PV)**



→ Solar lighting

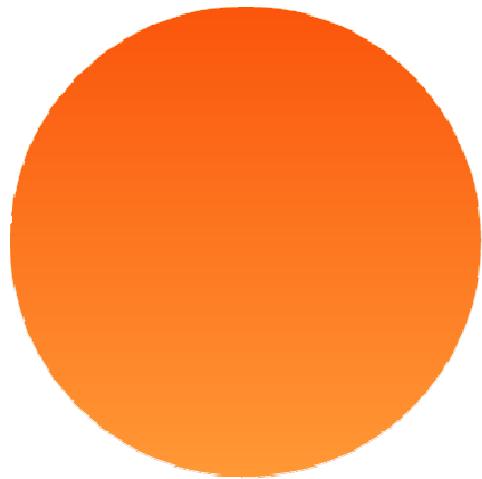


→ Bio Fuels



# 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

**VIESSMANN**

# Solar-thermal: Heat through sunshine



**Vitosol 100/200-F  
Flat**



**Vitosol 200-T  
tube**

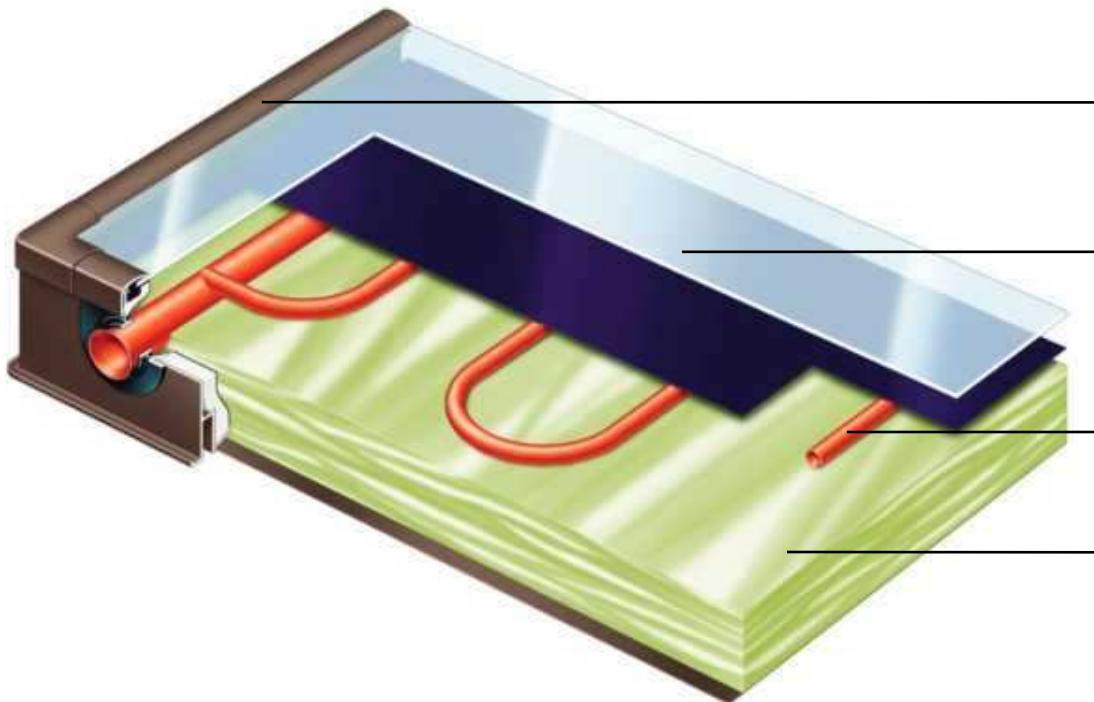


**Vitosol 300-T  
tube-heat pipe**

**VIESSMANN**

# Vitosol 200-F

## Flat collector



All round folded aluminium frame

Stable, highly transparent cover made from special glass

"S" patterned copper absorber

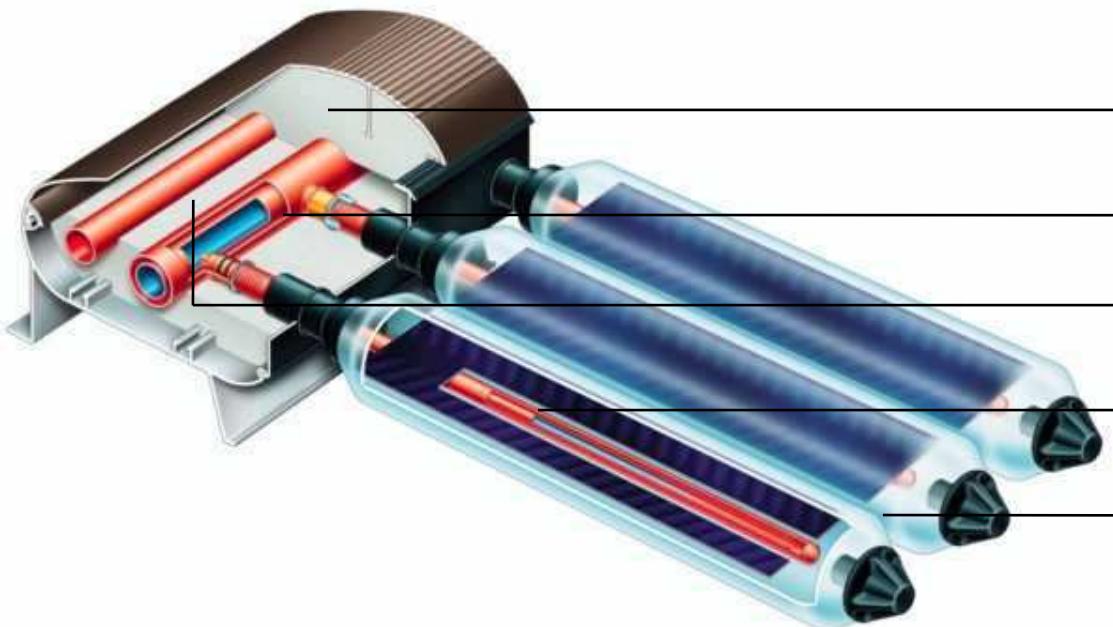
Highly effective thermal insulation

**VIESSMANN**

# Vitosol 200-T

Evacuated tube collector with copper absorber, direct flow

**VIESSMANN**



Highly effective thermal insulation

Coaxial distributor pipe

Header

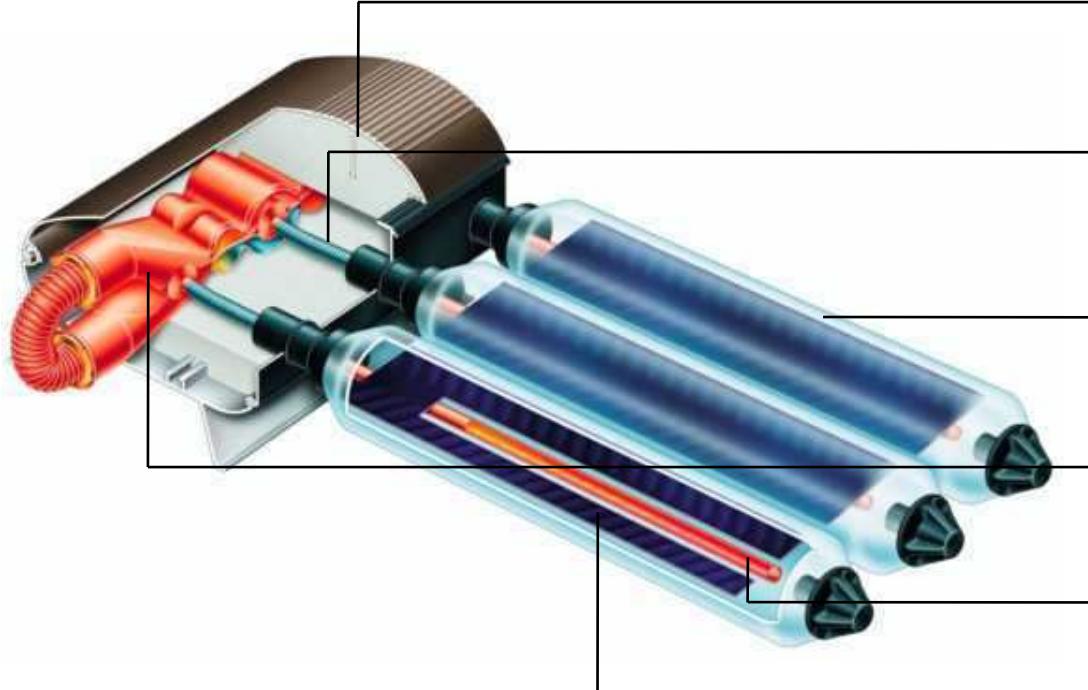
Direct flow Sol-titanium coated absorber

High grade, low ferrous glass

# Vitosol 300-T

Evacuated tube collector with copper absorber, heat pipe technology

**VIESSMANN**



Highly effective thermal insulation

“Dry” connection, no direct contact between carrier and heat transfer medium

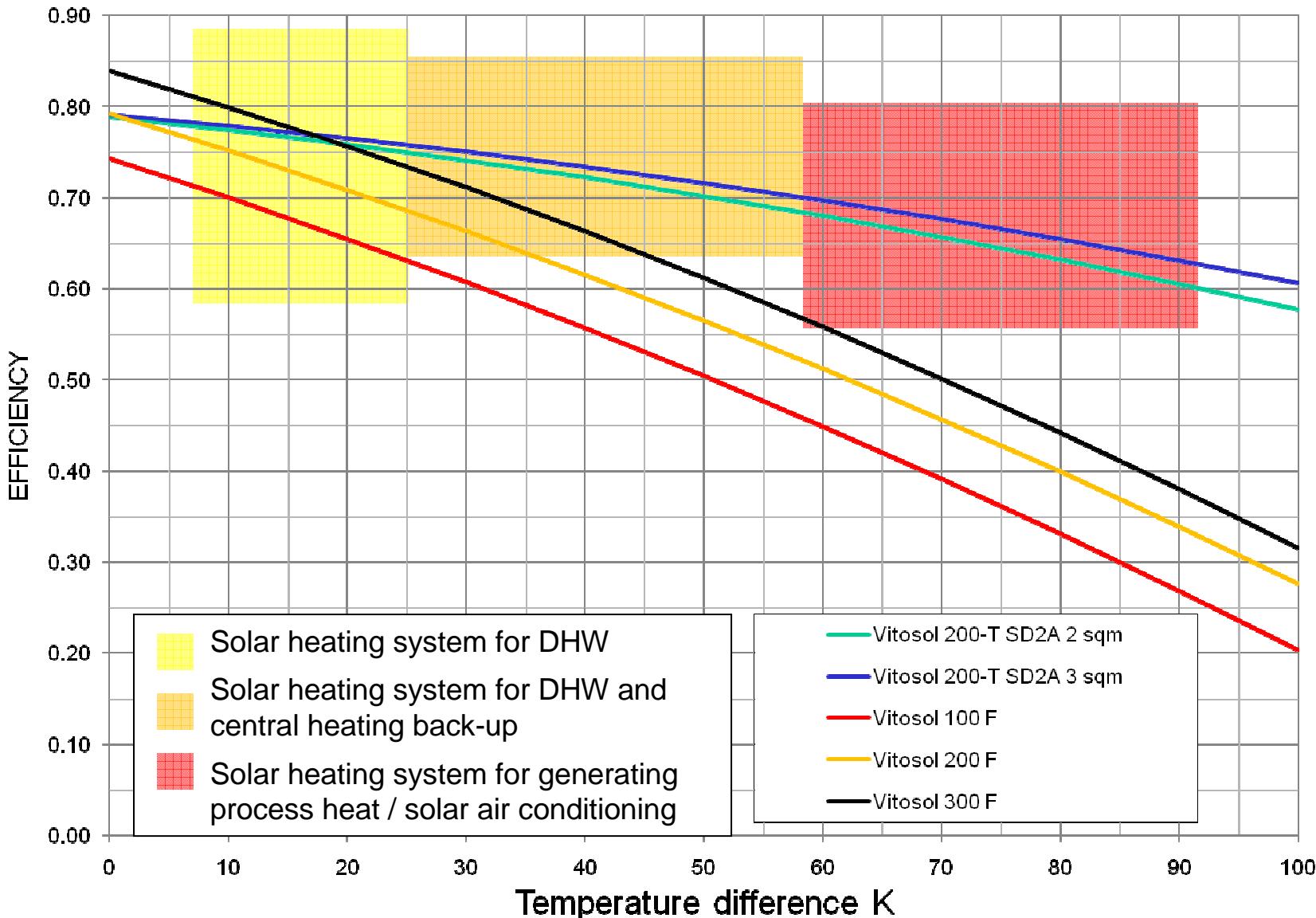
High grade, low ferrous glass

Duotec twin-pipe heat exchanger with integral overheating protection

Heat pipe

Sol-titanium coated absorber

# Solar Thermal Collector efficiency



**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

# Life expectations of solar collectors



**VIESSMANN**

# Life expactations of solar collectors



**30 years**



**35 years**

**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

# 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



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



#### 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



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



#### 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

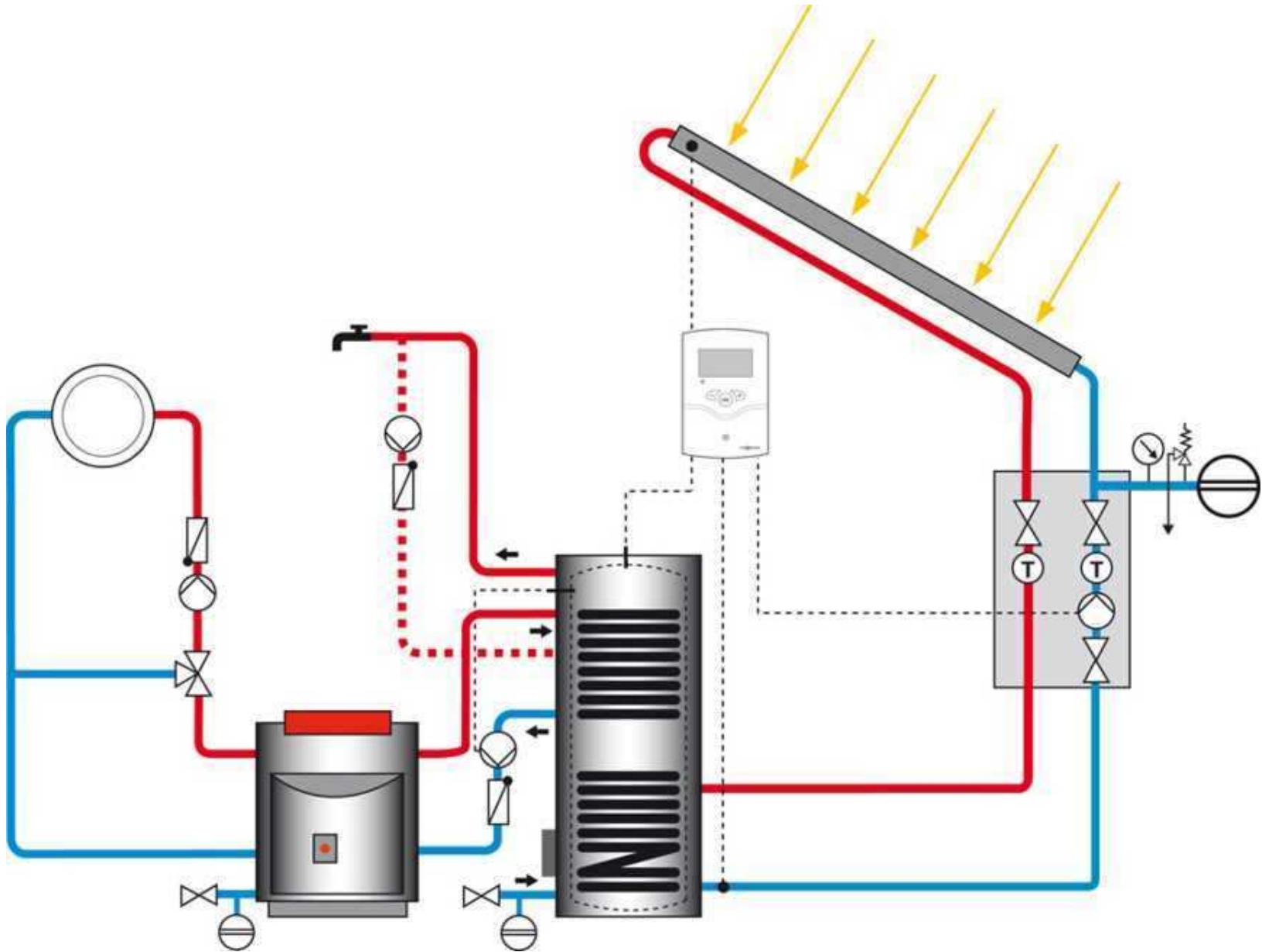
#### Customer

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

#### Test Collector

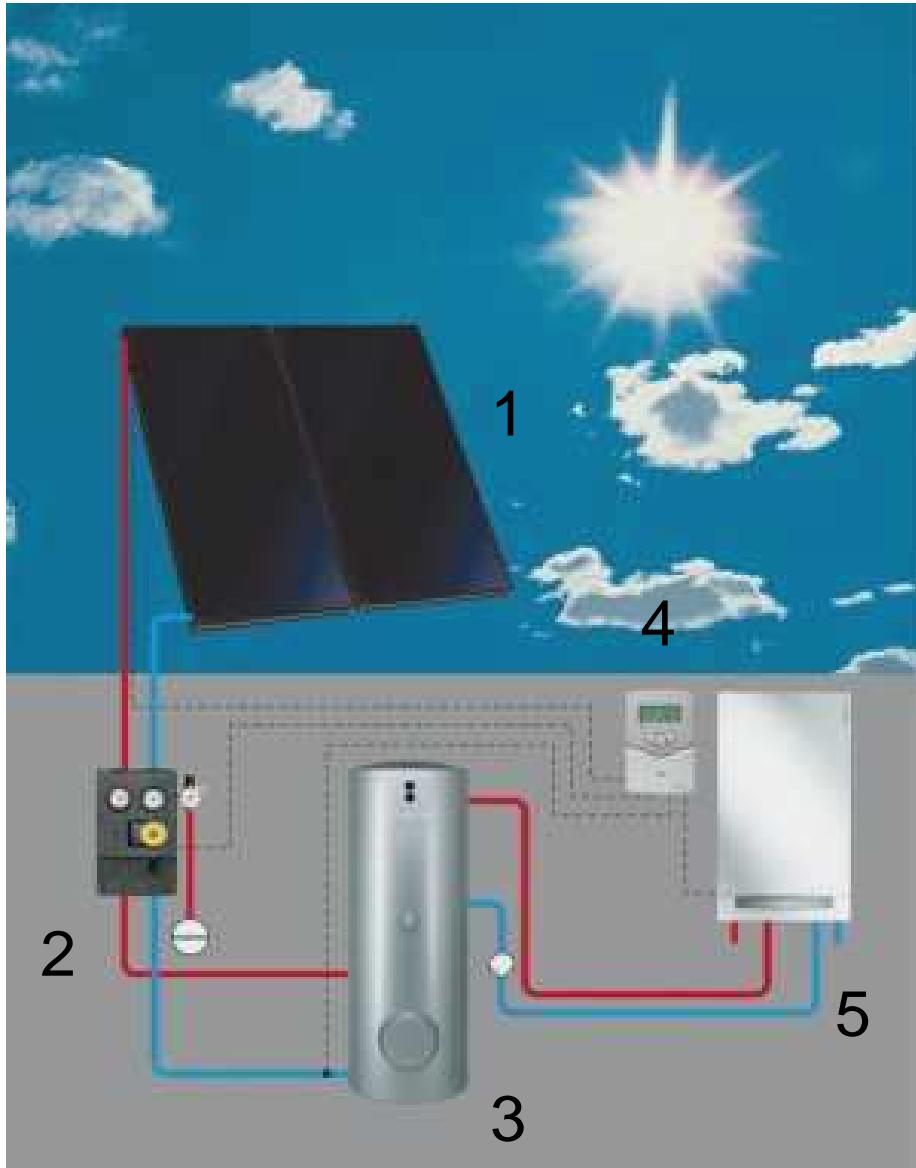
Type Vitosol 200-F  
Manufacturer Viessmann Werke GmbH & Co. KG  
Serial- or Prototype Serial type  
Year of production 2006  
Serial number 7188383613498102

# Solar thermal hot water generation



VIESSMANN

# 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

**VIESSMANN**

- Planning data
- Basic information => For Solar: Daily consumptions  
=> For Backup peak consumptions
- 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**

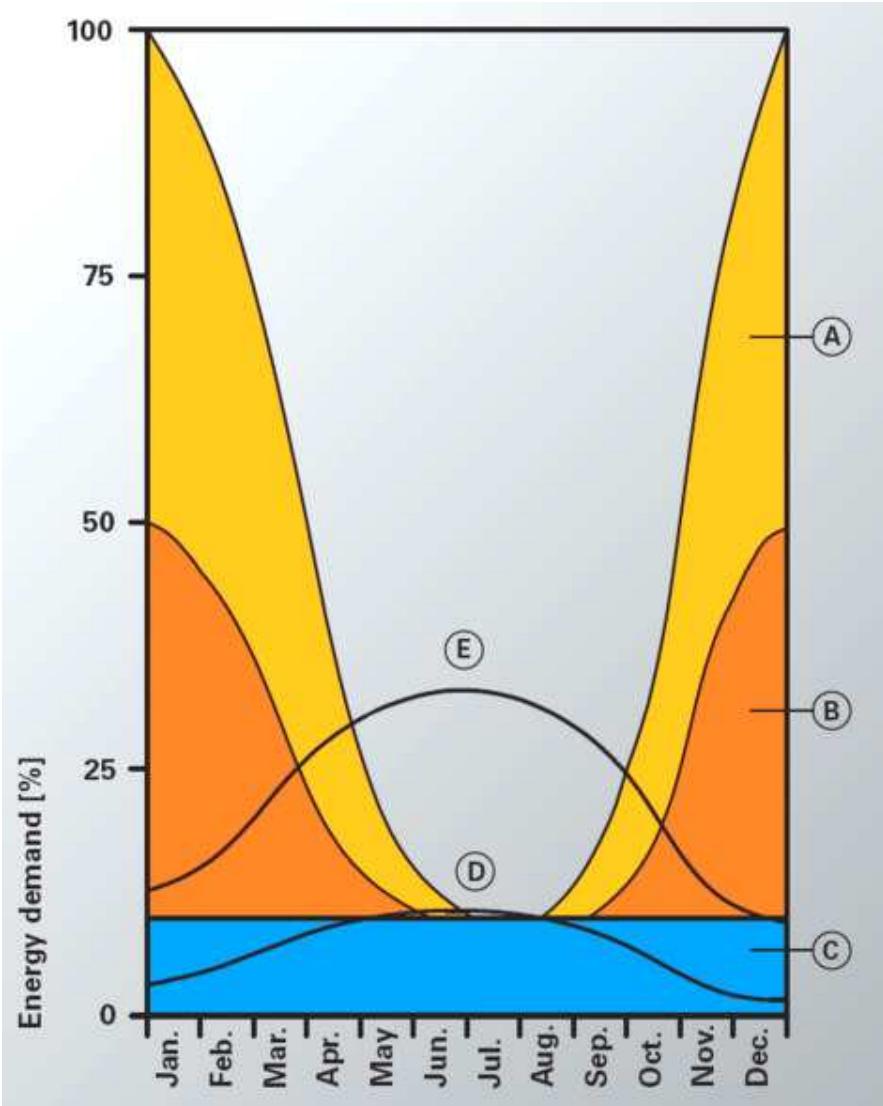
## Planning data

- Location: Beirut – Lebanon
- Roof characteristics
  - Flat roof
  - Direction towards south
- No of persons: 4 persons
- DHW temperature 60°C
- Cold water temperature:
  - Winter 10°C
  - Summer 20°C
- Back-up system: oil boiler

**VIESSMANN**

# Design of a solar thermal system for DHW

## Basic information



### Consumption

A – Room heating requirement of a building

B – Room heating requirement of a low-energy house

C – Hot water required

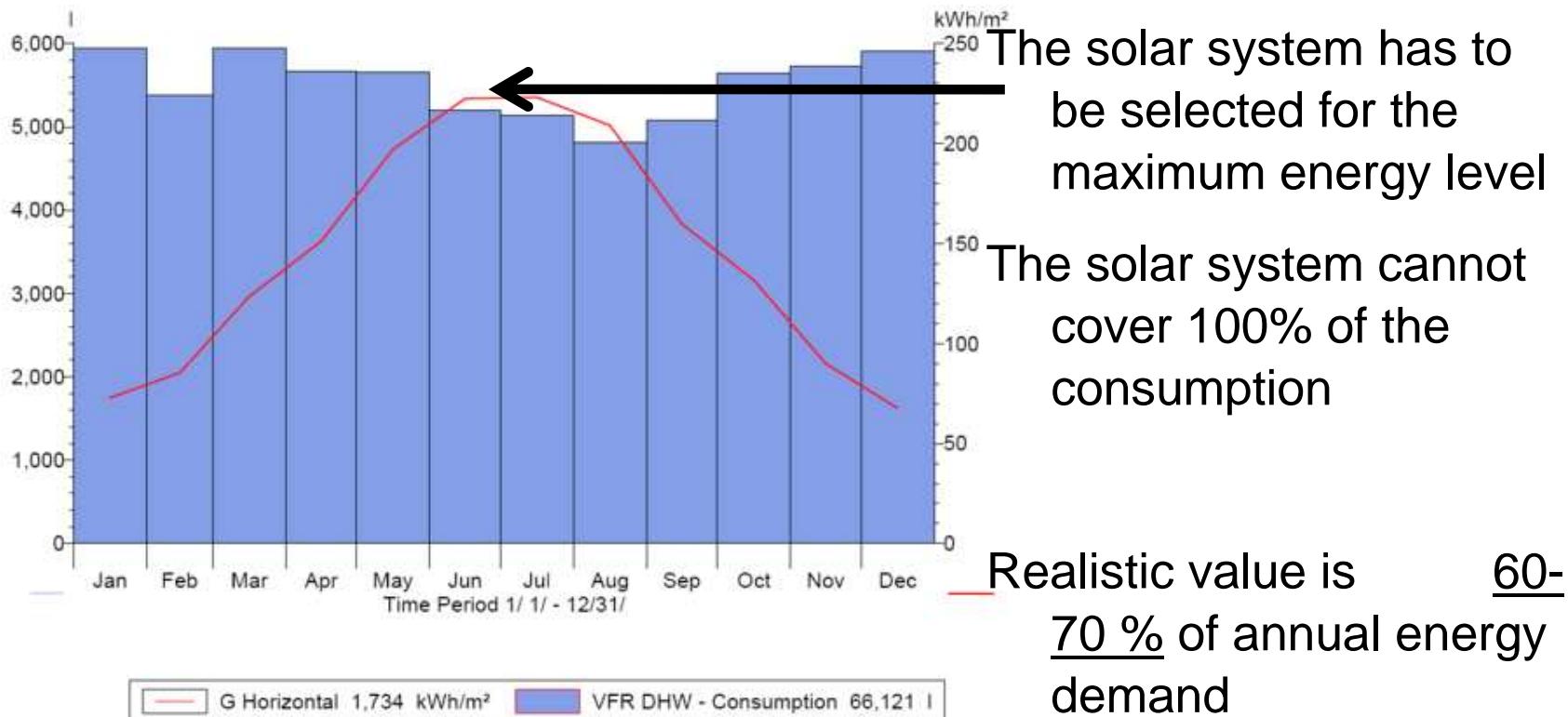
### Gain

D – Solar energy yield with 5 m<sup>2</sup> of absorber surface area

E – Solar energy yield with 15 m<sup>2</sup> of absorber surface area

# Design of a solar thermal system for DHW

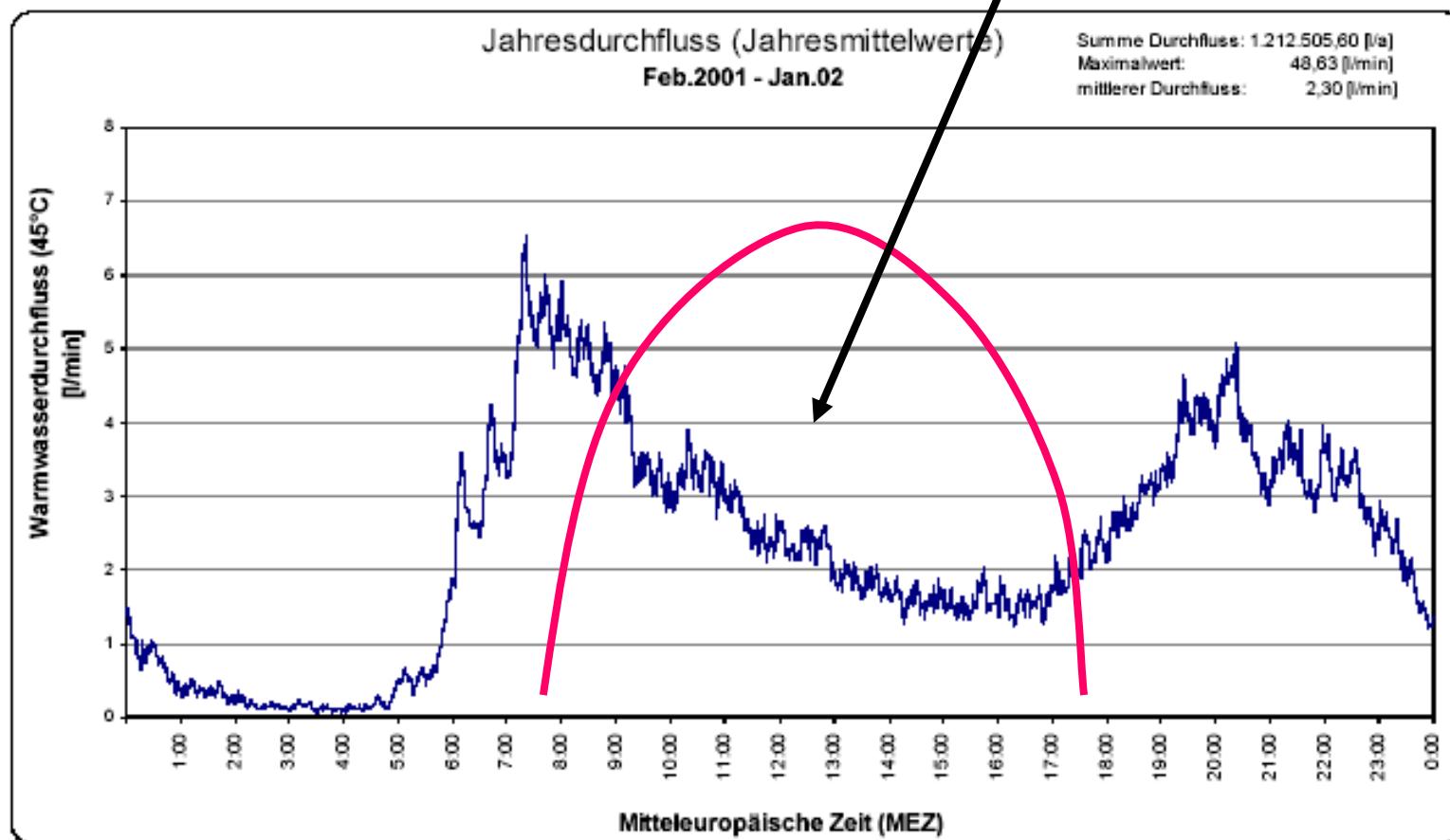
## Basic information



# 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

## DHW cylinder volume

**VIESSMANN**

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

Daily DHW demand	Cylinder capacity
100 l	300 l
150 l	
200 l	400 l
250 l	
300 l	500 l
350 l	

Max 50 l/pers/day at 60°C

DHW temperature of 60°C

or  
70 l/pers/day at 45°C



In our case:

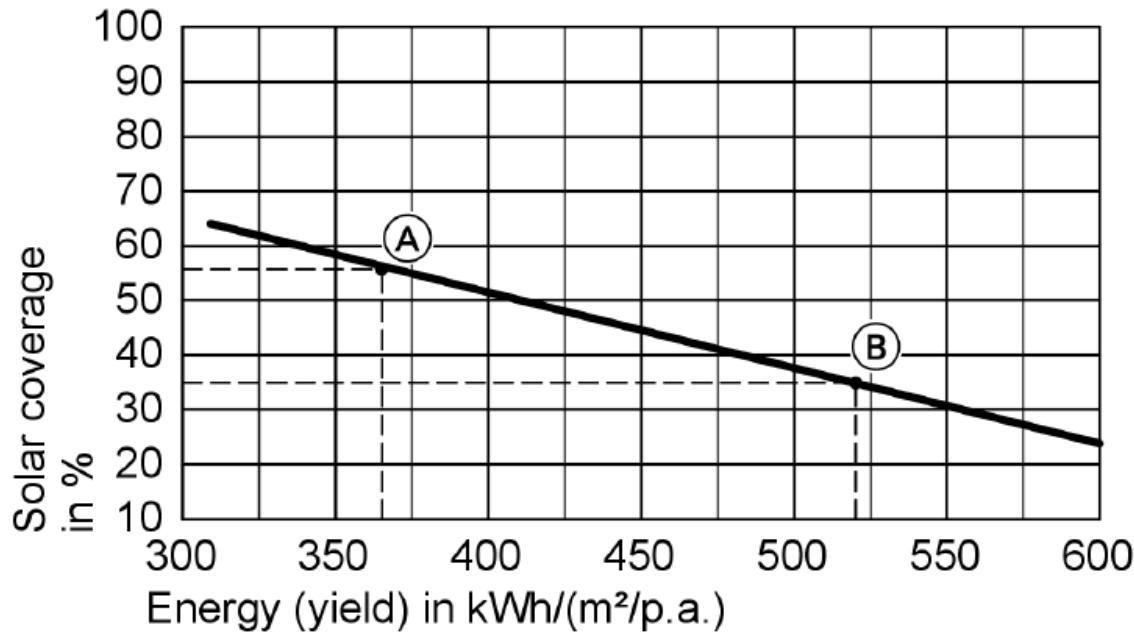
4 pers x 50 l/pers/day = 200 l/day at 60°C or 280 l/day at 45°C

=> the cylinder capacity 400 l.

# Design of a solar thermal system for DHW

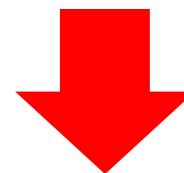
## Absorber surface area

VIESSMANN

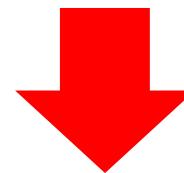


- Ⓐ Conventional sizing for DHW systems in detached houses
- Ⓑ Conventional sizing for large solar heating systems

Higher solar coverage



Higher collector temperature



Less collector efficiency

# Design of a solar thermal system for DHW

Absorber surface area

Solar radiation ~1000 W/m<sup>2</sup>

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

Daily maximum gain 6 – 7 kWh/m<sup>2</sup> (Check Meteorological data !!)

The DHW temperature 60°C/10°C

The DHW flow: 6/50 = 0.12 m<sup>3</sup>/(h x m<sup>2</sup>)

100 l of DHW at 60°C per m<sup>2</sup> of collector



In our case:

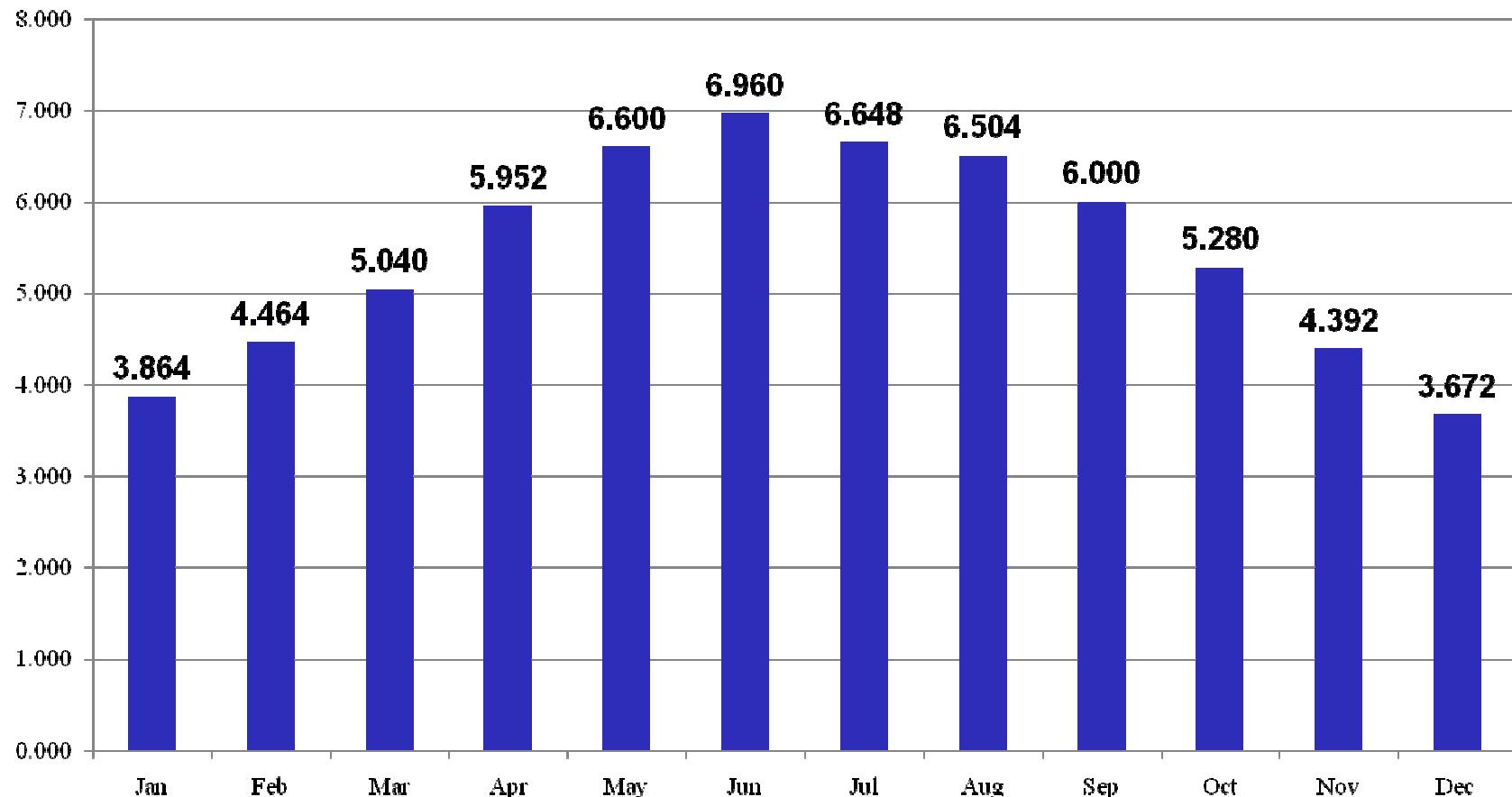
400 l/day / 100 l/m<sup>2</sup> = 4 m<sup>2</sup> => 2 collectors Vitosol 200F

# Design of a solar thermal system for DHW

Meteorological data for Doha

**VIESSMANN**

Doha Daily Average Global Radiation kWh/m<sup>2</sup>.day



# Design of a solar thermal system for DHW

## Pipe sizing

Flow rate in the collector array:

- The safe flow rate:

- Vitosolic – flat collectors – 25 l/(h x m<sup>2</sup>)
- Vitosolic – tube collectors – 40 l/(h x m<sup>2</sup>)

- The maximum flow rate:

- Vitosolic – flat collectors – 40 l/(h x m<sup>2</sup>)
- Vitosolic – tube collectors – 60 l/(h x m<sup>2</sup>)

Flow velocity:

- do not exceed 1 m/s
- recommended: 0.4 to 0.7 m/s

# Design of a solar thermal system for DHW

## Pipe sizing

**VIESSMANN**

Flow rate (total collector area) l/h	l/min	Flow velocity in m/s						
		Pipe dimension						
		DN 10	DN 13	DN 16	DN 20	DN 25	DN 32	DN 40
		Dimensions						
		12 x 1	15 x 1	18 x 1	22 x 1	28 x 1.5	35 x 1.5	42 x 1.5
100	1.67	0.35	0.21	0.14	—	—	—	—
125	2.08	0.44	0.26	0.17	—	—	—	—
150	2.50	0.53	0.31	0.21	—	—	—	—
175	2.92	0.62	0.37	0.24	0.15	—	—	—
200	3.33	0.70	0.42	0.28	0.18	—	—	—
250	4.17	0.88	0.52	0.35	0.22	0.14	—	—
300	5.00	1.05	0.63	0.41	0.27	0.17	—	—
350	5.83	1.23	0.73	0.48	0.31	0.20	0.12	—
400	6.67	1.41	0.84	0.55	0.35	0.23	0.14	—
450	7.50	1.58	0.94	0.62	0.40	0.25	0.16	0.10
500	8.33	1.76	1.04	0.69	0.44	0.28	0.17	0.12
600	10.00	2.11	1.25	0.83	0.53	0.34	0.21	0.14
700	11.67	2.46	1.46	0.97	0.62	0.40	0.24	0.16
800	13.33	2.81	1.67	1.11	0.71	0.45	0.28	0.19
900	15.00	—	1.88	1.24	0.80	0.51	0.31	0.21
1000	16.67	—	2.09	1.38	0.88	0.57	0.35	0.23
1500	25.00	—	—	2.07	1.33	0.85	0.52	0.35
2000	33.33	—	—	—	1.77	1.13	0.69	0.47
2500	41.67	—	—	—	2.21	1.41	0.86	0.58
3000	50.00	—	—	—	2.65	1.70	1.04	0.70

Recommended pipe dimension

# **Design of a solar thermal system for DHW**

## **Pipe sizing**

In our case:

2 collectors x 2.3 m<sup>2</sup> = 4.6 m<sup>2</sup>

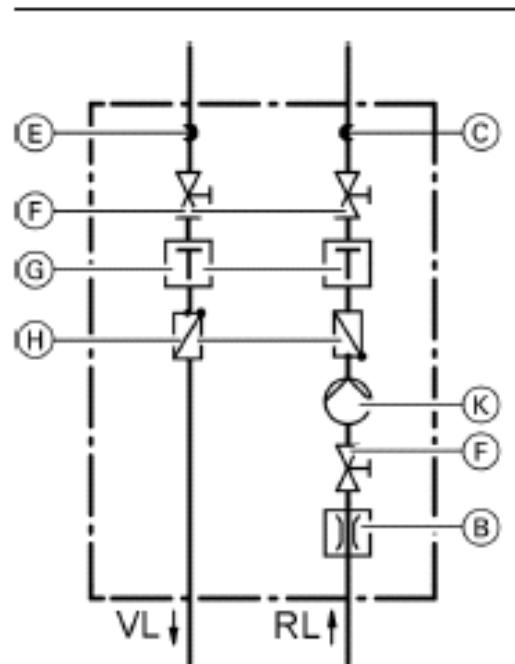
Required flow rate 30 l/(h x m<sup>2</sup>)

Total flow rate (collector area): 138 l/h = 2.3 l/min

From the table, the pipe dimension will be DN10 (12x1) with a flow velocity of 0.493 m/s

# Design of a solar thermal system for DHW

Circulation pump – Solar Divicon



Solar-Divicon construction

- (B) Flow indicator
- (C) Safety assembly
- (E) Pre-cooling vessel connection
- (F) Shut-off valve
- (G) Thermometer
- (H) Non-return valve
- (K) Solar circuit pump

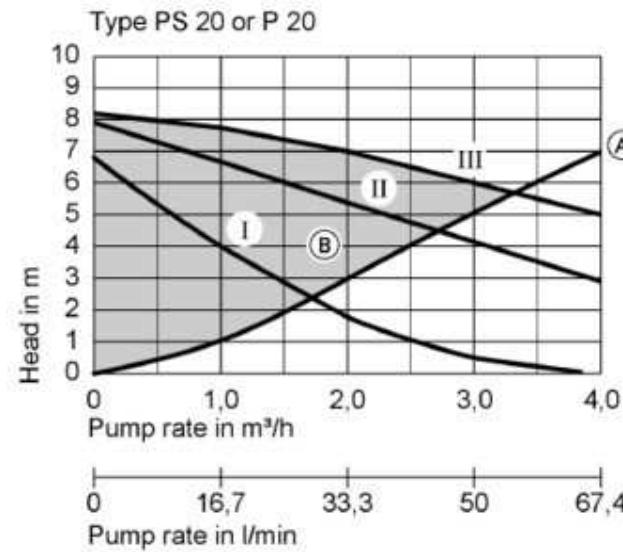
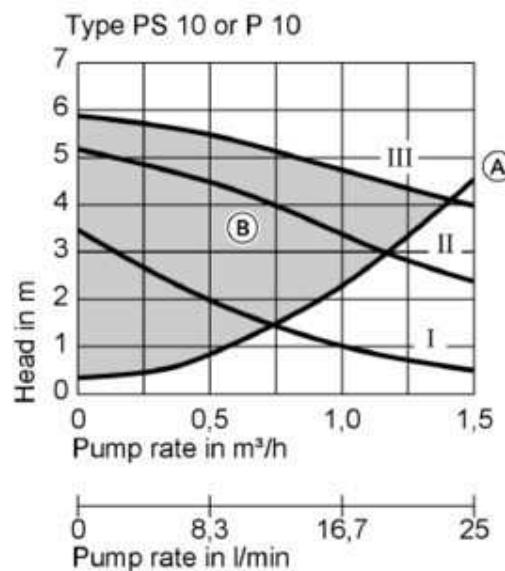
# Design of a solar thermal system for DHW

## Circulation pump – Solar Divicon

**VIESSMANN**

The pump has to be selected according to the required flow rate and total pressure drop of the solar system which comprises of:

- collector pressure drop
- pipe work pressure drop
- individual pressure drop values of the fittings
- pressure drop of the internal indirect coil in the DHW cylinder



A – Pressure drop  
curve of Solar  
Divicon or solar  
pump line

B – Residual head

# Design of a solar thermal system for DHW

## Circulation pump – Solar Divicon

**VIESSMANN**

Absorber area m <sup>2</sup>	Specific flow rate in l/(h x m <sup>2</sup> )							
	25	30	35	40	50	60	80	
	Low flow operation		High flow operation					
2	0.83	1.00	1.17	1.33	1.57	2.00	2.67	
3	1.25	1.50	1.75	2.00	2.50	3.00	4.00	
4	1.67	2.00	2.33	2.67	3.33	4.00	5.33	
5	2.08	2.50	2.92	3.33	4.17	5.00	6.67	
6	2.50	3.00	3.50	4.00	5.00	6.00	8.00	
7	2.92	3.50	4.08	4.67	5.83	7.00	9.33	
8	3.33	4.00	4.67	5.33	6.67	8.00	10.67	
9	3.75	4.50	5.25	6.00	7.50	9.00	12.00	
10	4.17	5.00	5.83	6.67	8.33	10.00	13.33	
12	5.00	6.60	7.00	8.00	10.00	12.00	16.00	
14	5.83	7.00	8.17	9.33	11.67	14.00	18.67	
16	6.67	8.00	9.33	10.67	13.33	16.00	21.33	
18	7.50	9.00	10.50	12.00	15.00	18.00	24.00	
20	8.33	10.00	11.67	13.33	16.67	20.00	26.67	
25	10.42	12.50	14.58	16.67	20.83	25.00	33.33	
30	12.50	15.00	17.50	20.00	25.00	30.00		
35	14.58	17.50	20.42	23.33	29.17	35.00		
40	16.67	20.00	23.33	26.67	33.33			
50	20.83	25.00	29.17	33.33				
60	25.00	30.00	35.00					
70	29.17	35.00						
80	33.33							

Use of type PS10 or P10, with a residual head of 150 mbar (1.5 m)

Use of type PS20 or P20, with a residual head of 260 mbar (2.6 m)

# Design of a solar thermal system for DHW

Circulation pump – Solar Divicon

**VIESSMANN**

In our case:

2 collectors x 2.3 m<sup>2</sup> = 4.6 m<sup>2</sup>

Required flow rate 30 l/(h x m<sup>2</sup>)

We can use a Solar Divicon pump PS 10 with a flow rate of ~2.2 l/min.

Absorber area m <sup>2</sup>	Specific flow rate in l/(h x m <sup>2</sup> )		
	25	30	35
	Low flow operation	High flow operation	
Flow rate in l/min			
2	0.83	1.00	1.17
3	1.25	1.50	1.75
<b>4</b>	1.67	<b>2.00</b>	2.33
5	2.08	2.50	2.92
6	2.50	3.00	3.50
7	2.92	3.50	4.08

# **Design of a solar thermal system for DHW**

## Expansion vessel

The expansion vessel has to perform 2 basic tasks:

- Maintaining the pressure at each point of the system within the admissible limits;
- Compensation of the volume variations of the heating water due to temperature variation.

# Design of a solar thermal system for DHW

## Expansion vessel

Selection of an expansion vessel (subject to the collector type and in conjunction with a 6 bar safety valve).



Vitosol-F, type SV

Absorber area in m <sup>2</sup>	System con- tent in l	Static height in m	Recom. expansion vessel capa- city in l
4.6	17	5	25
	18	10	
	20	15	40
6.9	21	5	40
	23	10	
	25	15	
9.2	27	5	40
	29	10	
	31	15	50
11.5	31	5	40
	34	10	50
	38	15	80
13.8	33	5	50
	36	10	
	39	15	80
18.4	50	5	80
	53	10	
	56	15	

Vitosol-F, type SH

Absorber area in m <sup>2</sup>	System con- tent in l	Static height in m	Recom. expansion vessel capa- city in l
4.6	19	5	25
	20	10	40
	21	15	
6.9	23	5	40
	25	10	
	27	15	50
9.2	32	5	40
	35	10	50
	38	15	80
11.5	34	5	50
	38	10	80
	41	15	
13.8	37	5	80
	40	10	
	43	15	
18.4	55	5	80
	58	10	
	61	15	2 x 50

The details in the above tables are standard values. These values must be verified by appropriate calculation

# Design of a solar thermal system for DHW

## Expansion vessel

**VIESSMANN**

### Calculating the nominal volume

$$V_N = \frac{(V_v + V_2 + z \cdot V_k) \cdot (p_e + 1)}{p_e - p_{st}}$$

- $V_N$ = Nominal volume of the diaphragm expansion vessel in litres
- $V_v$ = Safety hydraulic seal (here heat transfer medium) in litres  
 $V_v = 0.005 \cdot V_A$  in litres  
**(min. 3 l)**
- $V_A$ = Liquid content of the entire system  
(see page 32)
- $V_2$ = Increase in volume during system heat-up  
 $V_2 = V_A \cdot \beta$   
 $\beta$  = Expansion factor ( $\beta = 0.13$  for Viessmann heat transfer medium -20 to 120 °C)
- $p_e$ = Permissible end pressure in bar (ü)  
 $p_e = p_{si} - 0.1 \cdot p_{st}$
- $p_{si}$ = Safety blow-off pressure
- $p_{st}$ = Nitrogen inlet pressure of expansion vessel in bar (ü)  
 $p_{st} = 0.7 \text{ bar} + 0.1 \text{ bar/m} \cdot h$   
 $h$  = static height of the system in m  
(see illustration on page 31)
- $z$  = Number of collectors
- $V_k$ = Collector content in litres  
(see page 32)

### Example:

Solar heating system with 2 Vitosol 100, type SV1 each with 1.83 litres

$$\begin{aligned} V_A &= 25 \text{ l} \\ p_e &= 5.4 \text{ bar} \\ p_{si} &= 6 \text{ bar} \\ h &= 5 \text{ m} \end{aligned}$$

$$V_N = \frac{(V_v + V_2 + z \cdot V_k) \cdot (p_e + 1)}{p_e - p_{st}}$$

$$\begin{aligned} V_v &= V_A \cdot 0.005 \\ &= 0.125 \text{ l}, \text{ selected 3 litres} \end{aligned}$$

$$\begin{aligned} V_2 &= V_A \cdot \beta \\ &= 3.25 \text{ l} \\ p_{st} &= 0.7 \text{ bar} + 0.1 \text{ bar/m} \cdot 5 \text{ m} \\ &= 1.2 \text{ bar} \end{aligned}$$

$$\begin{aligned} V_N &= \frac{(3 \text{ l} + 3.25 \text{ l} + 2 \cdot 1.83 \text{ l}) \cdot (5.4 \text{ bar} + 1)}{5.4 \text{ bar} - 1.2 \text{ bar}} \\ &= 15.10 \text{ l} \end{aligned}$$

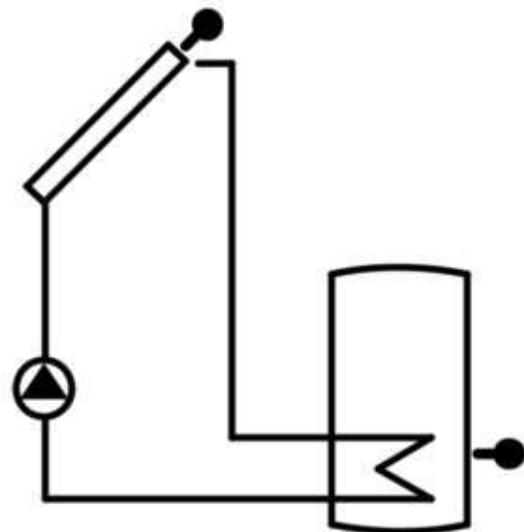
# Design of a solar thermal system for DHW

## Vitosol control unit



Vitosolic 100

- Switching the solar circuit pump for DHW and/or swimming pool water heating
- Electronic limiter for the temperature in the DHW cylinder (safety shutdown at 90 °C)
- Collector safety shutdown



Solar DHW heating with a mono or a dual mode DHW cylinder

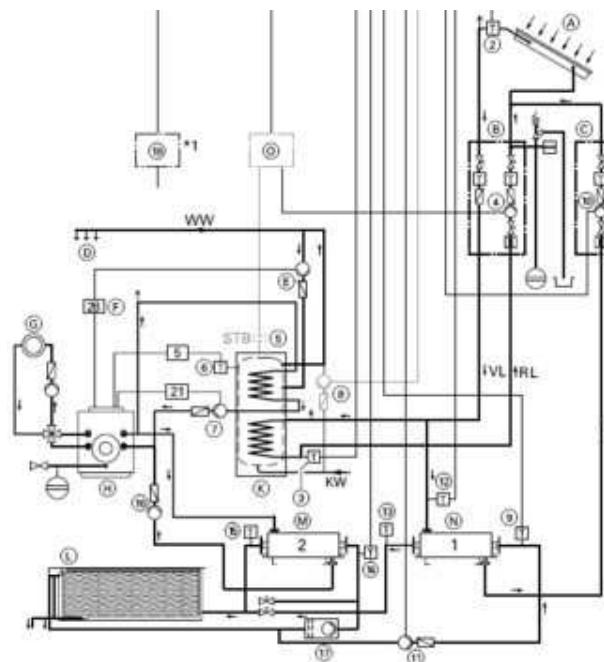
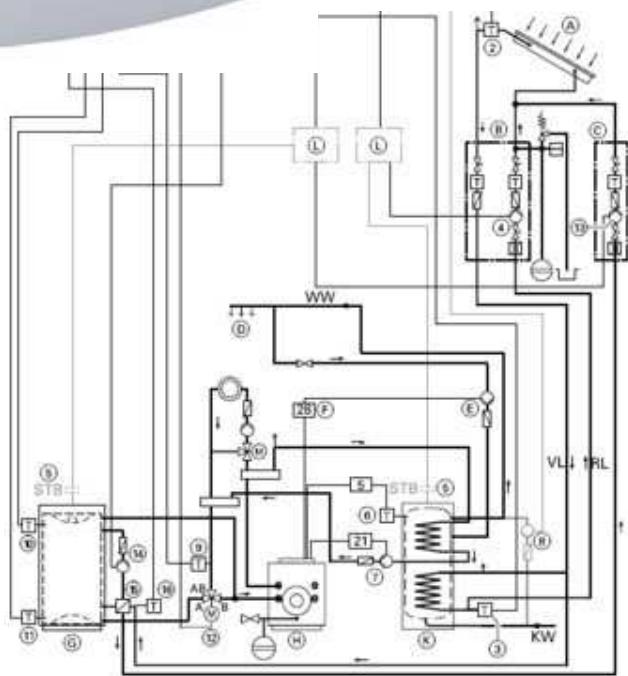
# Design of a solar thermal system for DHW

## Vitosol control unit



Vitosolic 200

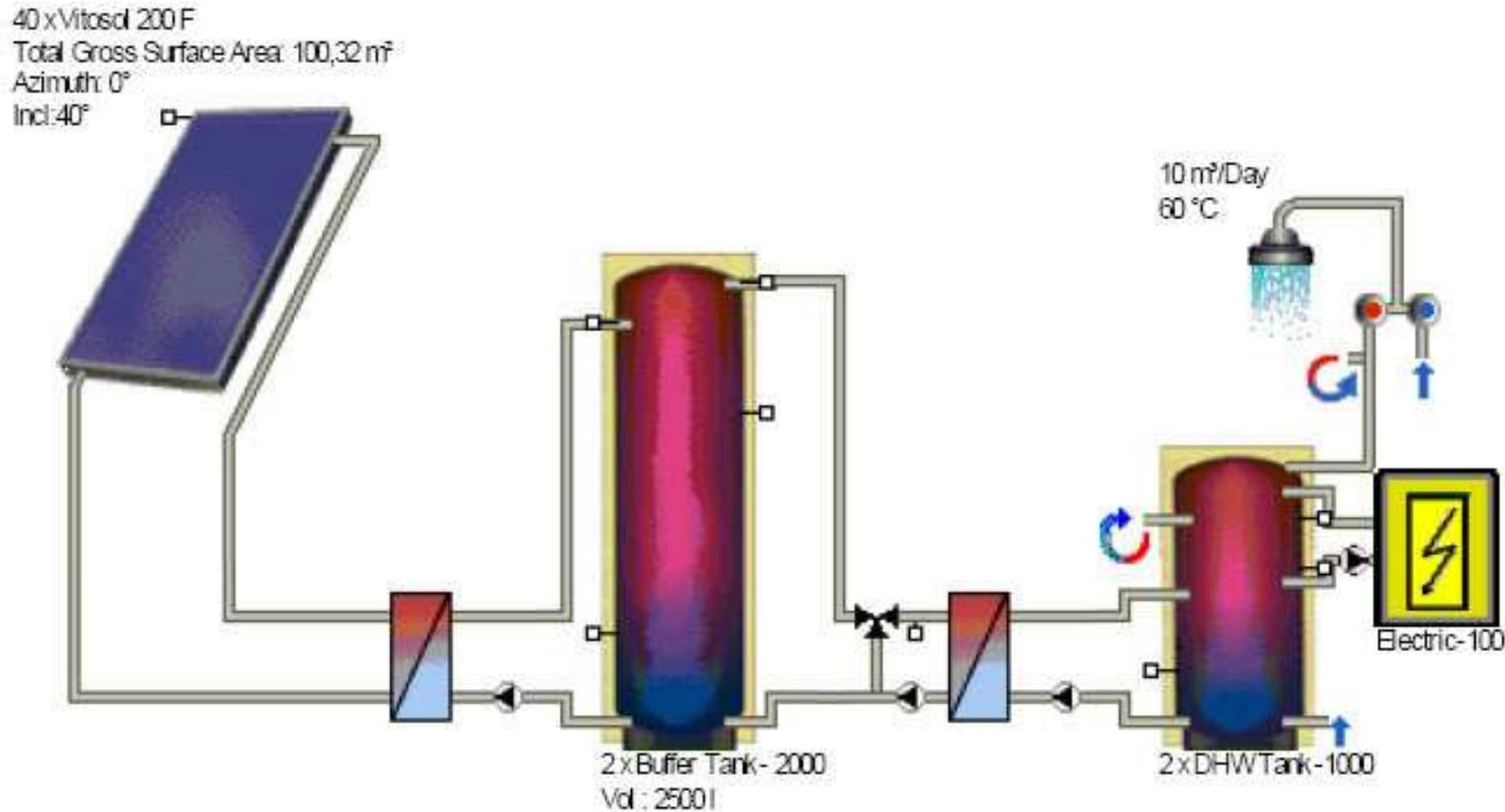
- Switching the solar circuit pump for DHW and/or swimming pool water heating or other consumers (maximum of 4 differential temperature control)
- Electronic limiter for the temperature in the DHW cylinder (safety shutdown at 90 °C)
- Collector safety shutdown



# Design of a solar thermal system for DHW

Large scale solar thermal system – 10000 l/pers/day

**VIESSMANN**

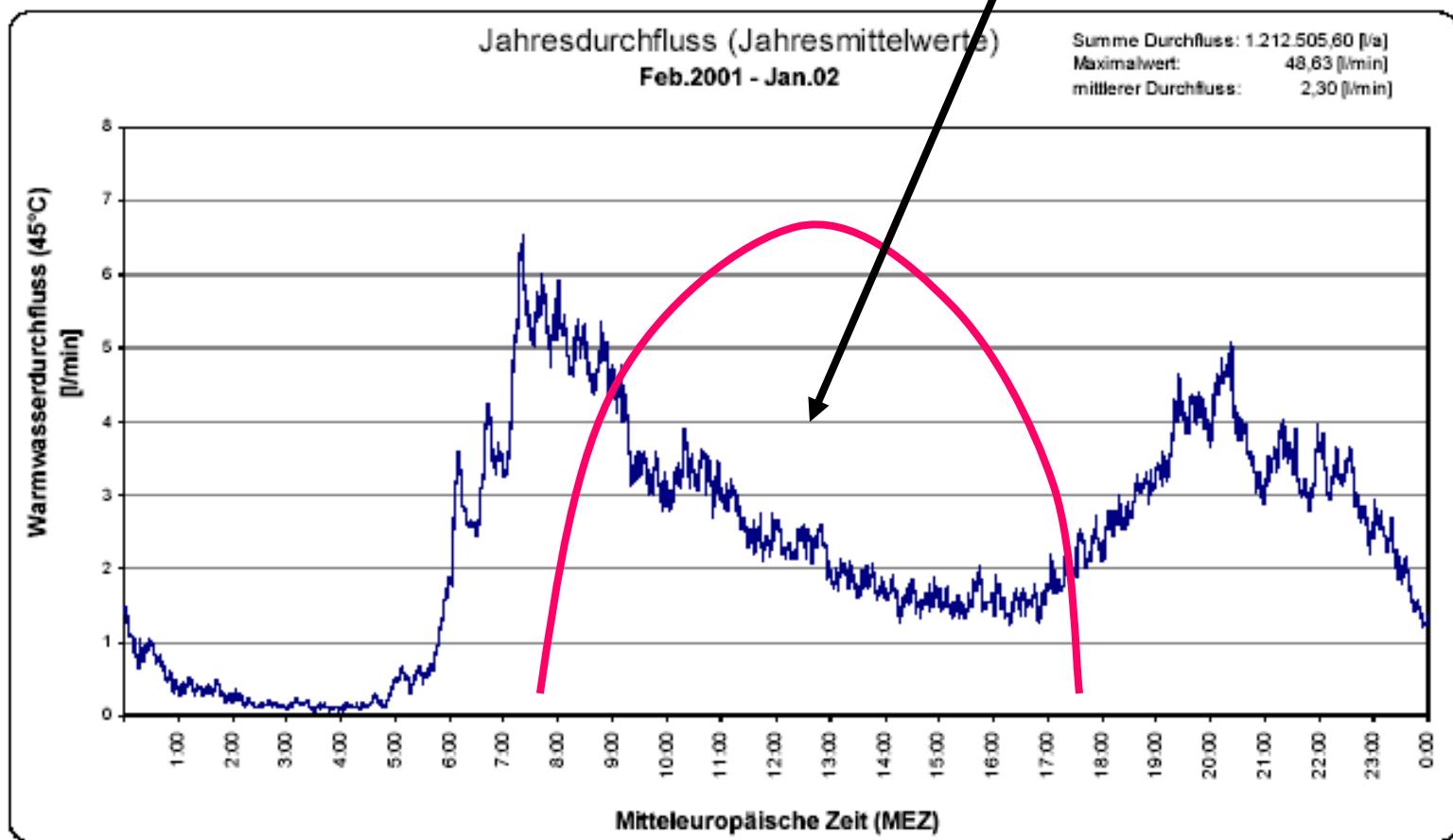


# Design of a solar thermal system for DHW

Large scale solar thermal system – 10000 l/pers/day

**VIESSMANN**

Energy needs to be stored



## **Design of a solar thermal system for DHW**

Large scale solar thermal system – 10000 l/pers/day

The volume of the buffer tank can be approximated as follow:

**50 l buffer tank per square meter of collector area**



## Thumb rules

DHW demand:

50 l/pers/day at 60°C

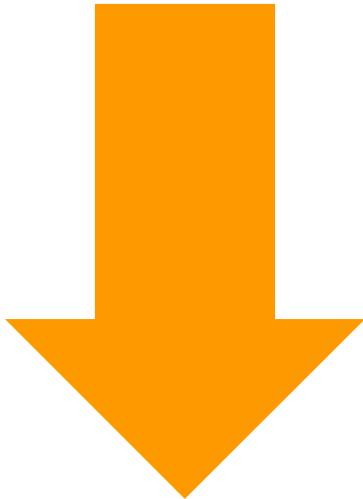
Collector area:

1 m<sup>2</sup> at 100 l of DHW at 60°C

Buffer tank:

50 l/m<sup>2</sup> of absorber area

**Solar simulation**



**T Sol**

**Solar simulation software**

---

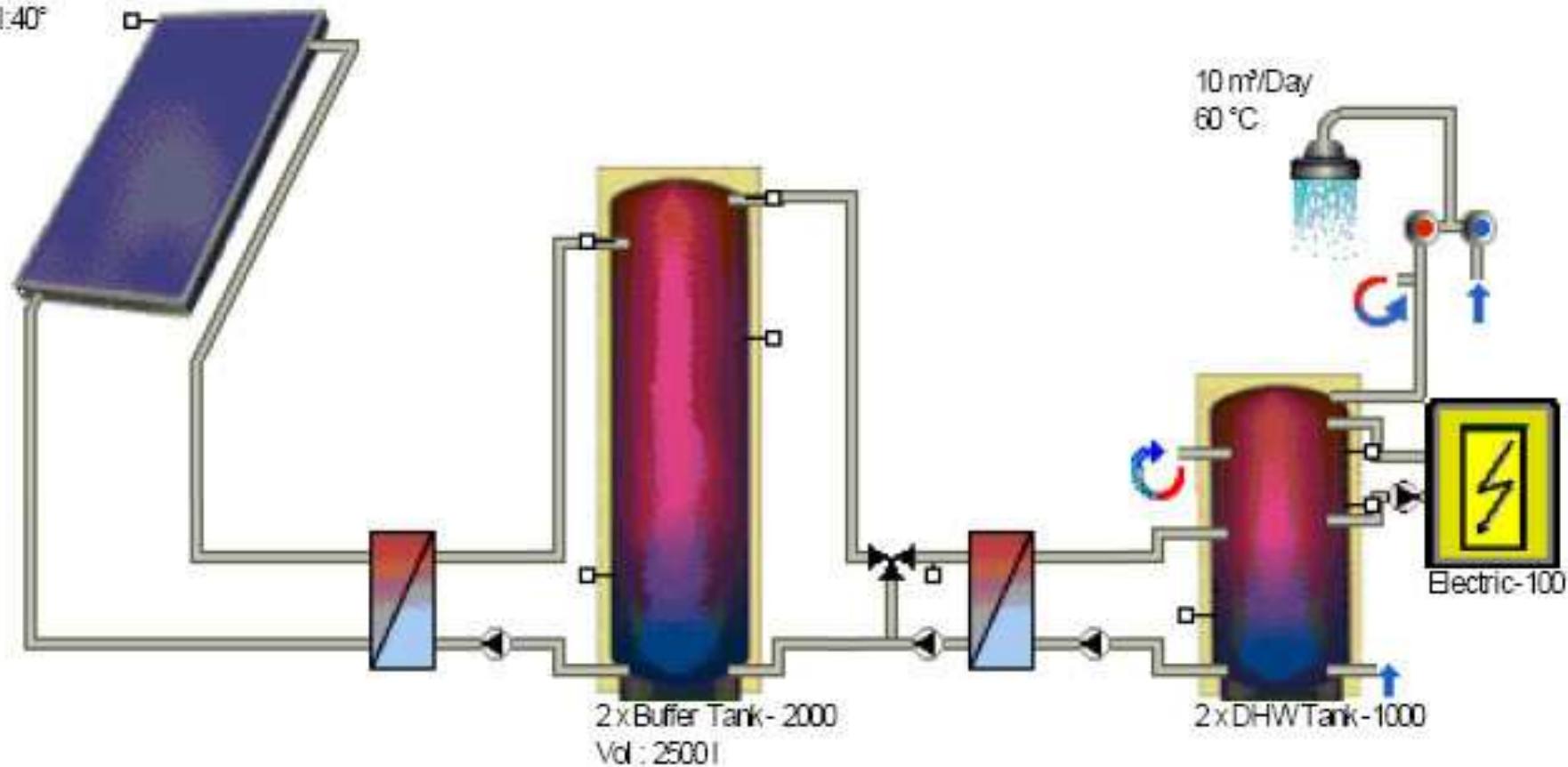
**VIESSMANN**

# Solar simulation

## System design

**simann**

40 x Vitosol 200 F  
Total Gross Surface Area: 100,32 m<sup>2</sup>  
Azimuth: 0°  
Incl: 40°



# Solar simulation

## Results of Annual Simulation

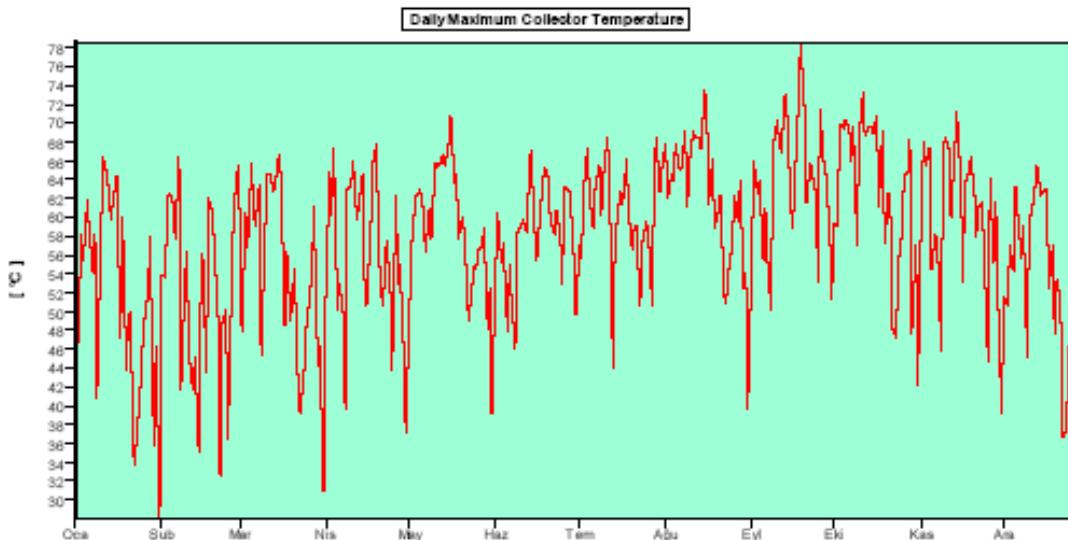
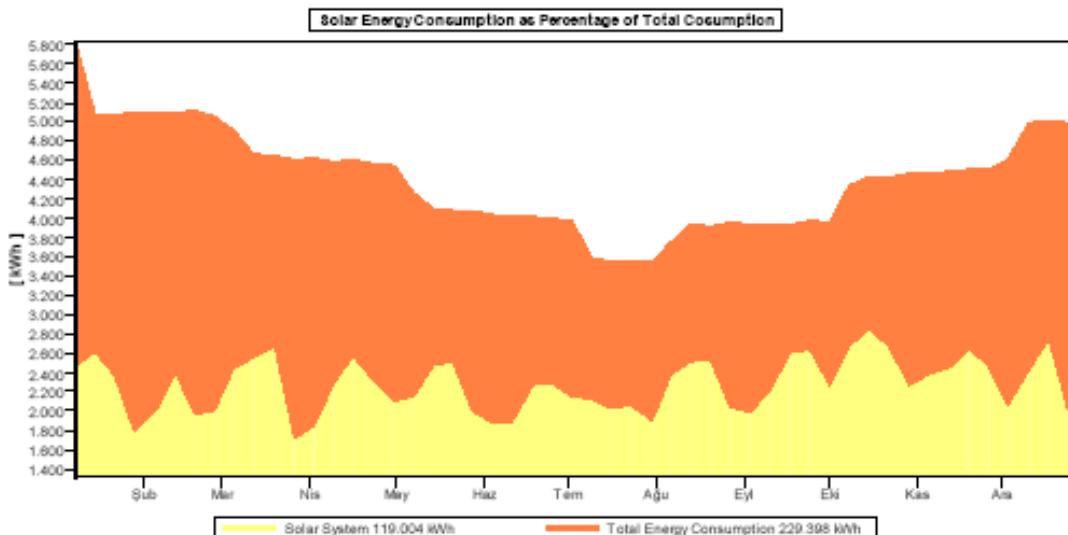
**VIESSMANN**

Installed Collector Power:	70,22 kW	
Collector Surface Area Irradiation:	193,60 MWh	2.079,88 kWh/m <sup>2</sup>
Energy Produced by Collectors:	124,05 MWh	1.332,75 kWh/m <sup>2</sup>
Energy Produced by Collector Loop:	121,10 MWh	1.301,07 kWh/m <sup>2</sup>
DHW Heating Energy Supply:	212,38 MWh	
Solar Contribution to DHW:	119 MWh	
Energy from Auxiliary Heating:	110,39 MWh	

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

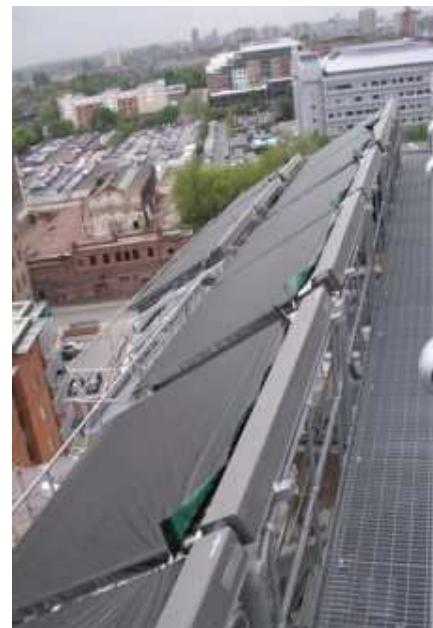
# Solar simulation

Solar energy consumption / Daily max collector temperature



# Installation example

Case study – Green building Manchester



## **Installation example UAE**

Jebel Ali process heating system

Solar absorber gross surface area : 296.1 m<sup>2</sup>

Energy produced by collectors : 376,4 MWh/year

Diesel savings : 48,1 m<sup>3</sup>/year.

CO<sub>2</sub> emissions avoided : 132500 kg

Application : Process heat for hot water loop at manufacturing plant



# Installation example UAE

## Jebel Ali process heating system



**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

## **Installation example UAE**

DHW system – Shoreline Apartments – Palm Jumeirah

Solar absorber gross surface area: 14 x 200 m<sup>2</sup> (2800 m<sup>2</sup>)

Energy produced by collectors : 3805 MWh/year

Natural gas savings : 471000 m<sup>3</sup>/year.

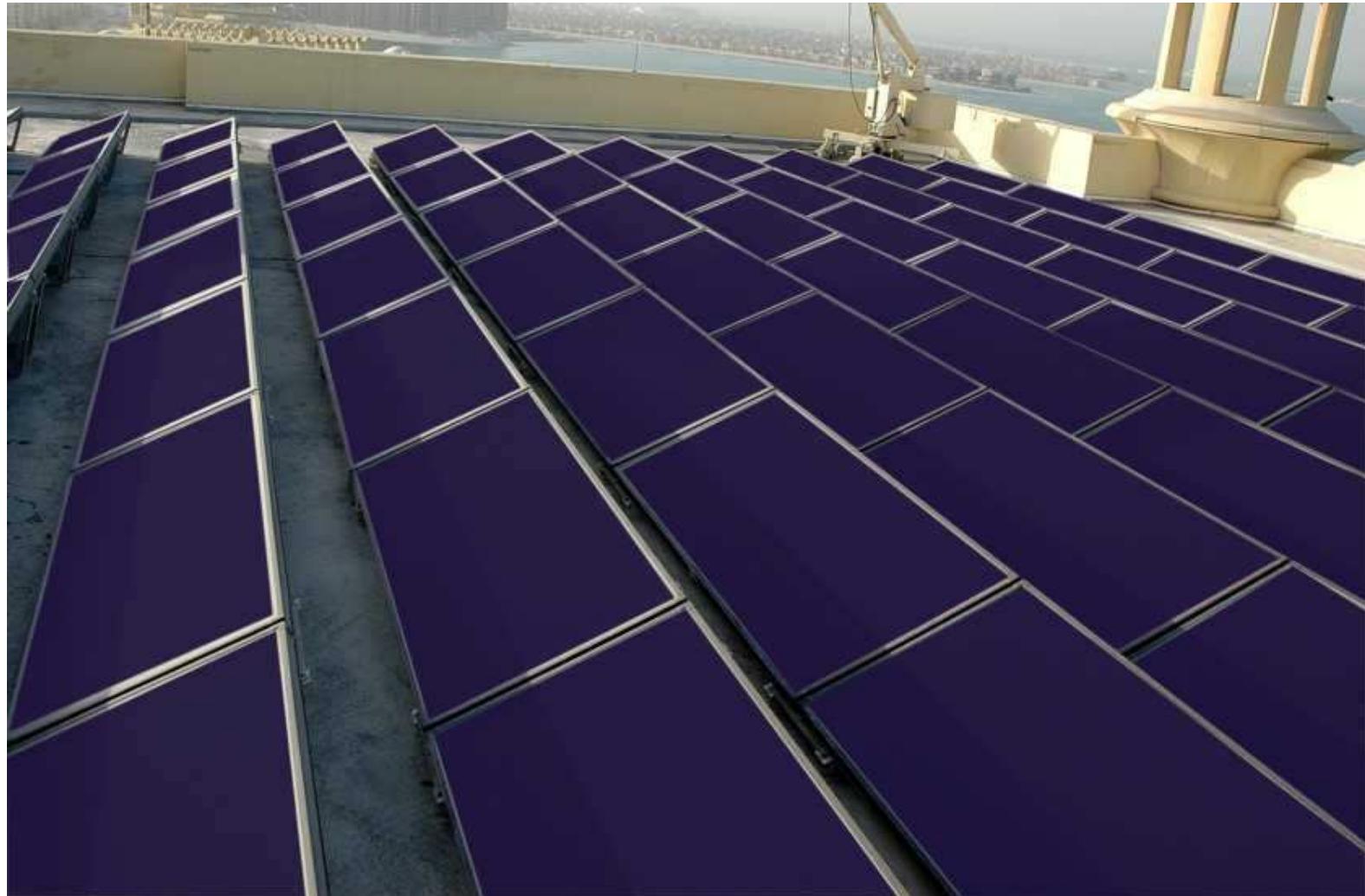
CO<sub>2</sub> emissions avoided : 1 070 000 kg

Application : DHW

Backup system: Gas fired wall hung condensing boilers

# Installation example UAE

DHW system – Shoreline Apartments – Palm Jumeirah



**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

# Installation example UAE

DHW system – Shoreline Apartments – Palm Jumeirah



Viessmann Domestic Hot Water cylinders



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

**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

# Installation example UAE

## DHW system – Villas in Jumeirah



Solar hot water system with electric backup

**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009

## Installation example UAE

DHW system for labour camp in Al Quoz – Dubai



Operational since 2000

**VIESSMANN**

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009



# Questions ?



VIESSMANN

Solar Energy  
Murat Aydemir Viessmann Middle East  
Dubai 20.04.2009



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 > 40 %

## Vitocal 160-A

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

Sample Calculation: 300liters/day hot water

### 1. Electrical heater

$$Q = 300 \times (60-10)/860 = 17,5 \text{ kW}$$

Daily loss 1 kW

**Electric consumption: 18,5 kW**

### 2. Vitocal cylinder with heat pump

$$Q = 18,44 \text{ kW required electricity } 5,2 \text{ kW}$$

Cooling inside approx 17 kW

Saving at the AC of housing

5,7 kW

**Electric consumption:**

$$5,7-5,2 = -0,5 \text{ kW}$$

**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

**VIESSMANN**

