DIMENSIONING OF DOMESTIC HOT WATER SYSTEMS

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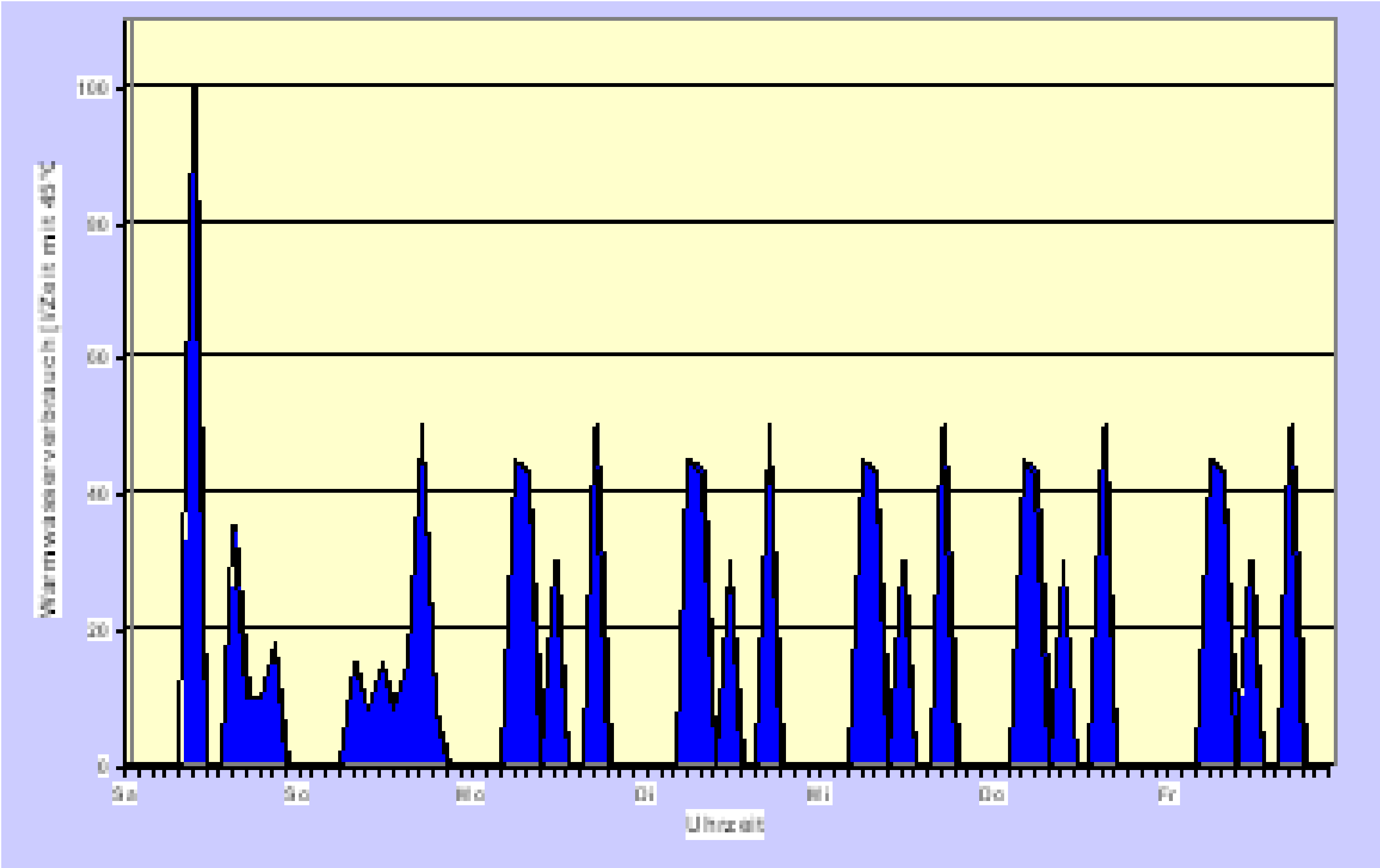
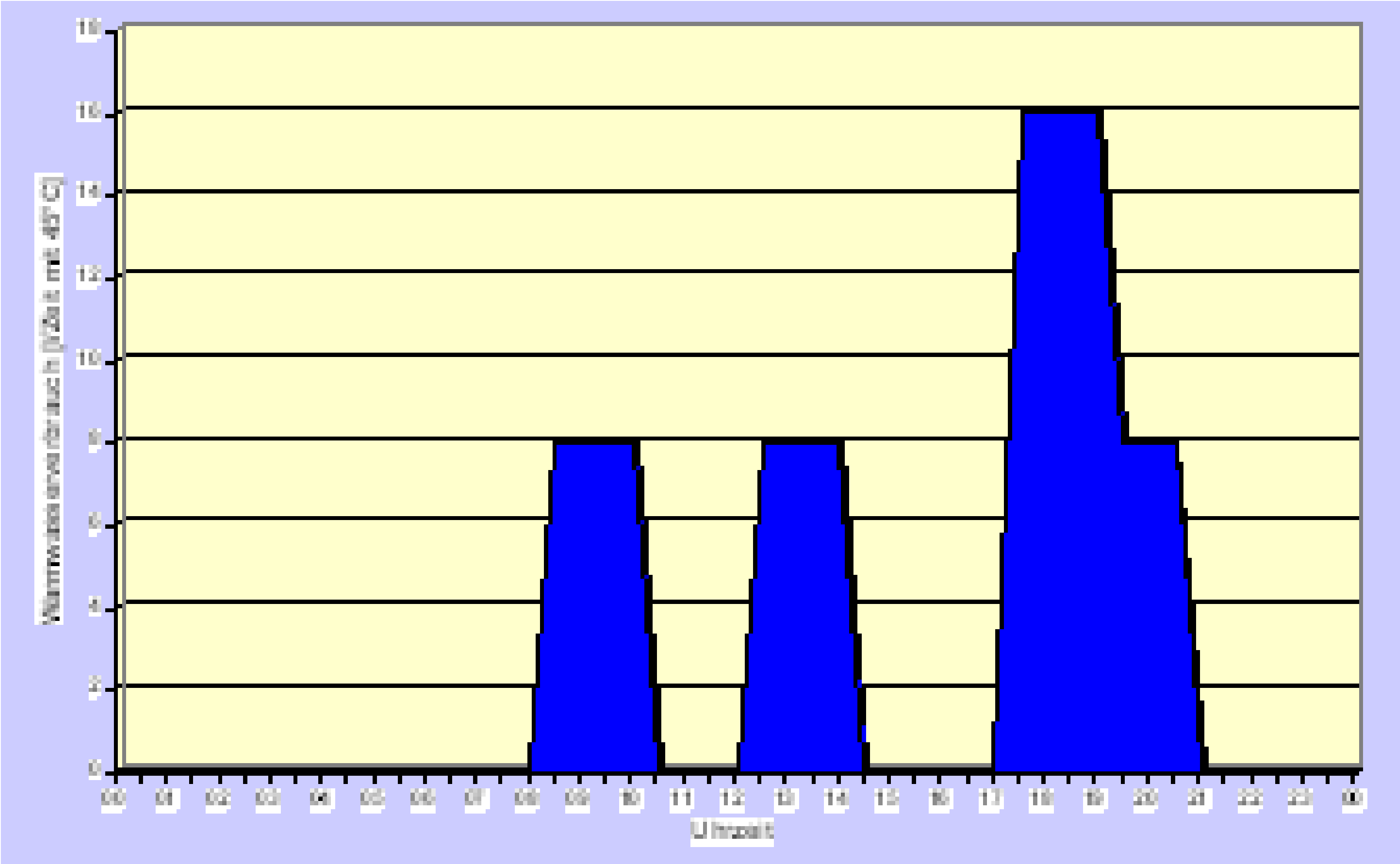
Hot Water Demand Profile for a Week



Hot Water Demand Profile for a Day



DIMENSIONING OF HOT WATER SOLAR SYSTEMS

Hot water demand for different users at a hot water temperature of 50 ℃

		Low demand (litres)	Medium demand (litres)	High demand (litres)
Residential buildings	per person and day	30	50	60
Sport facilities	per shower	20	30	50
Accommodation	per bed	20	40	60

STORAGE TANK CAPACITY

When the daily hot water demand has been determined, the volume of the storage tank can be specified. It should be some 0.8 to 1.2 fold the daily demand for regions with high solar radiation and 2 to 2.5 fold the daily demand for regions with lower solar radiation (central and northern Europe) so that consumption peaks can be met well and cloudy days can be compensated

An example - for central European climatic conditions: For an high hot water demand (HWD) of 50 litres per person (P), the daily demand (DD) for a four-person household is 200 litres. The volume of the storage tank (VSt) is thus calculated as follows:

$$V_{St} = HWD \times P \times 2 = 50 \times 4 \times 2 = 400 \text{ litres}$$

As the manufacturers do not offer tanks in every possible size, the choice has to be made among those generally available on the market. However, it is recommended that the storage tank capacity is not less than 90% and not more than 120% of the calculated volume.

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An example - Regions with high solar radiation and low hot water demand :
For an low hot water demand (HWD) of 30 litres per person (P), the daily demand (DD) for a four-person household is 120 litres. The volume of the storage tank (VSt) is thus calculated as follows:

$$V_{St} = HWD \times P \times 1.2 = 30 \times 4 \times 1 = 120 \text{ litres}$$

As the manufacturers do not offer tanks in every possible size, the choice has to be made among those generally available on the market. However, it is recommended that the storage tank capacity is not less than 90% and not more than 120% of the calculated volume.

COLLECTOR AREA

When the daily hot water demand is known the collector area can be determined. The required collector area depends on several factors such as

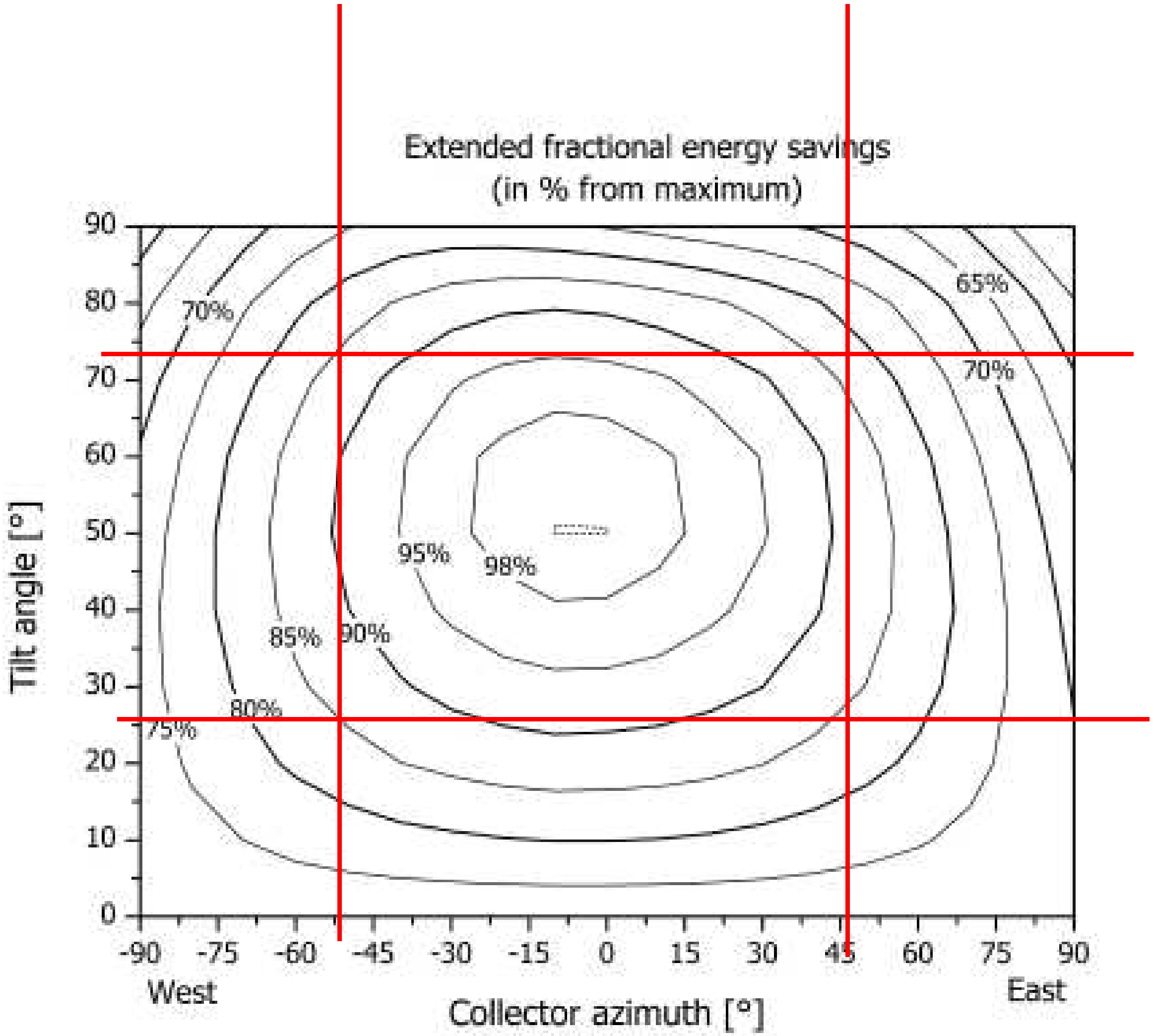
- COLLECTOR TYPE
- SIZE OF THE SOLAR STORAGE TANK
- LOCATION, TILT, AND ORIENTATION OF THE COLLECTORS
- LOCAL CLIMATIC CONDITIONS

ANGLE OF TILT

Latitude [degree]	Best collector tilt in:					
	June	Orientation	**Sept./March**	Orientation	**December**	Orientation
50 N	26.5	S	50	S	73.5	S
40 N	16.5	S	40	S	63.5	S
30 N	6.5	S	30	S	53.5	S
20 N	3.5	N	20	S	43.5	S
15 N	8.5	N	15	S	38.5	S
10 N	13.5	N	10	S	33.5	S
Equator = 0	**23.5**	**N**	**0**	**-**	**23.5**	**S**
10 S	33.5	N	10	N	13.5	S
15 S	38.5	N	15	N	8.5	S
20 S	43.5	N	20	N	3.5	S
30 S	53.5	N	30	N	6.5	N
40 S	63.5	N	40	N	16.5	N
50 S	73.5	N	50	N	26.5	N

As a general rule, the optimum angle of tilt is equal to the degree of latitude of the site

ORIENTATION



ORIENTATION

Optimum tilt angle – Example 1: Vienna, Austria

Location: Vienna, Austria

Latitude: 48 degree north (see table: latitude = 50 degree)

For a south-orientated surface, the optimum tilt angle in December is 73.5°. In June, the most favourable angle would be 26.5°. An angle of 45 - 50° is ideal for use throughout the year.

ORIENTATION

Optimum tilt angle – Example 2: Windhoek, Namibia

Location: Windhoek, Namibia

Latitude: 20 degree south (see table: latitude = 20 degree)

For a north-orientated surface, the energy gain in June is largest for a tilt angle of 43.5°. In December, the most favourable angle would be 3.5°but south facing. An angle of 20° is ideal for use throughout the year.

PIPING

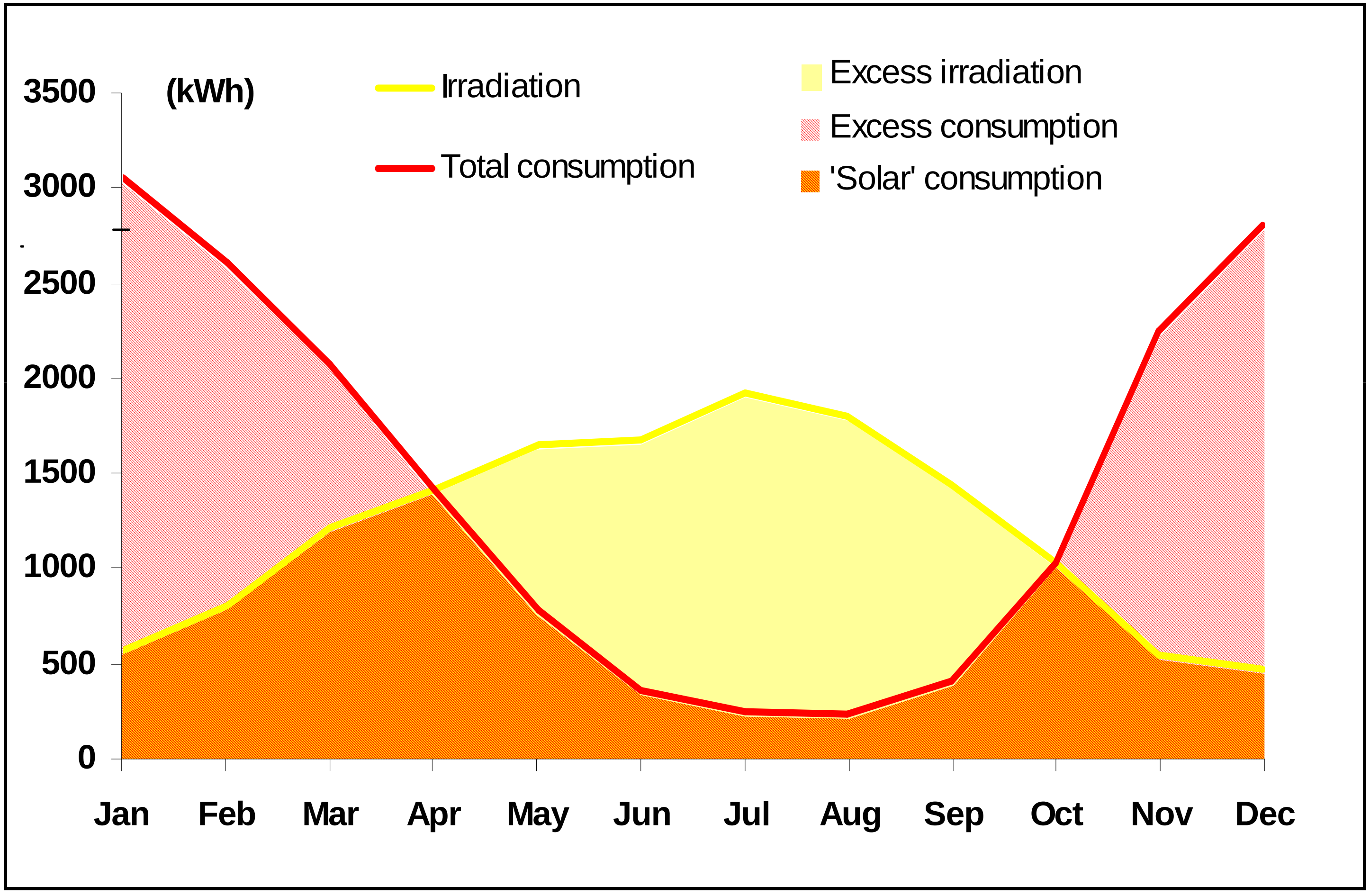
Flow and return pipes (solar loop)

Collector area [m²]	**inner diameter of the pipe** [mm]	**inner diameter of the pipe** ["]
1 - 2	16	1/2
4 - 6	20	3/4
10 - 12	25	1
15 - 20	32	1 1/4
25 - 30	40	1 1/2

Dimensioning of domestic hot water solar systems for central European conditions

Daily hot water demand [litres]	Solar storage capacity [litres]	Collector area* SC [m^2]
- 100	200	4
- 200	400	6
- 300	500 – 750	8 - 12
- 500	750 - 1000	12 - 16

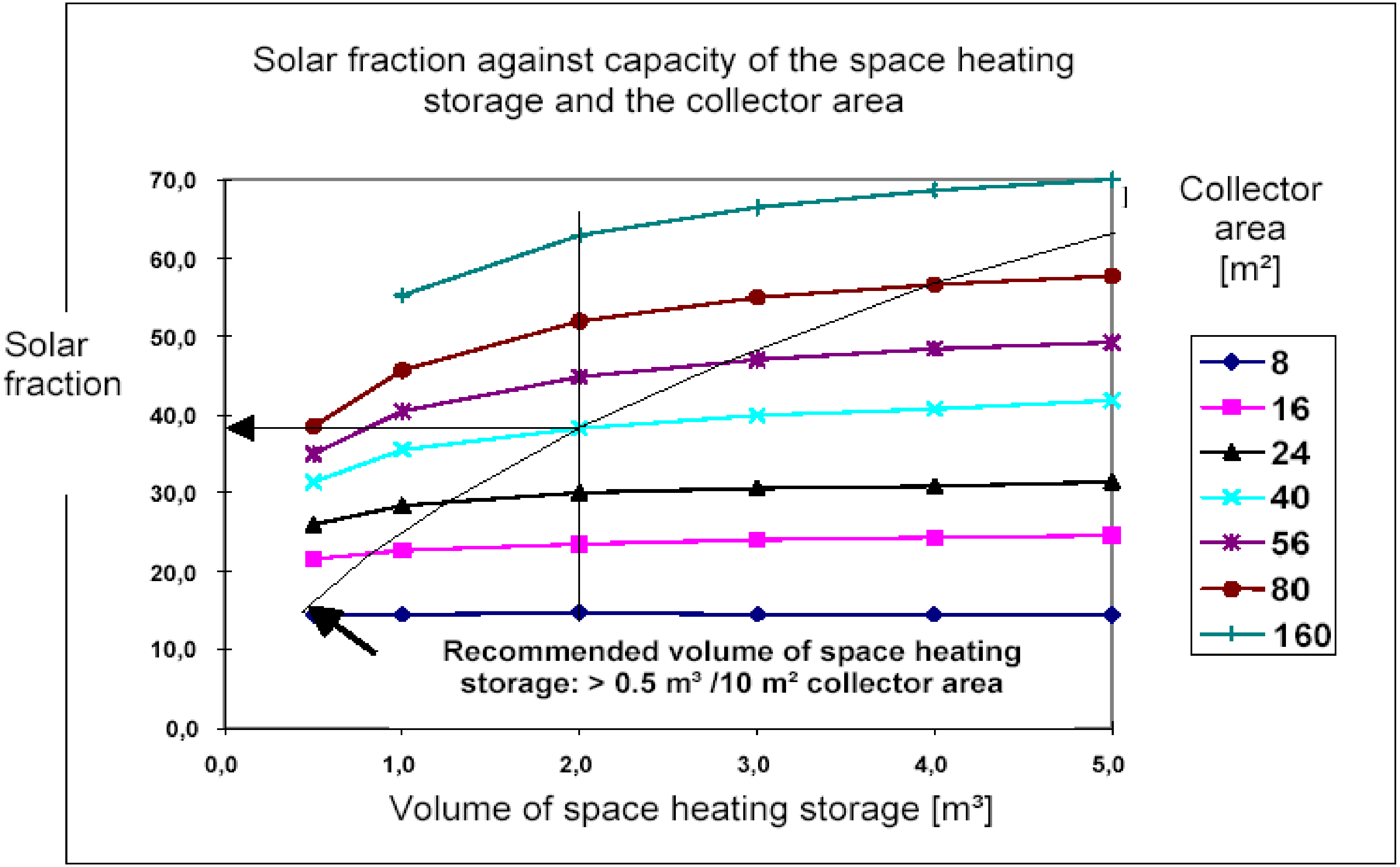
Dimensioning - Solar Combisystems



Dimensioning - Solar Combisystems

Single family house	
Location	Graz, Austria
Heat load	8 kW
Flow- and return temperature of the space heating system	40/30 °C
Hot water demand	
Dayly demand	200 l at 45 °C
Solar Collector	
Collector area	30 m² flat-plate collector
Orientation	South
Tilt angle	45°
Hot water Storage	
Volume	500 Liter
Space heating storage	
Volume	2.000 Liter
Storage insulation	150 mm (Lambda = 0,05) W/mK)

Dimensioning - Solar Combisystems



Dimensioning - Solar Combisystems for Multi-Family Houses

Dimensioning of Collector area and Storage Volume

	Solar Fraction Total Heat Demand [%]	Solar Fraction Hot Water Demand [%]	Collector area [m² per Person]	Storage volume [litre / m² collector area]
Dimensioning: Cost/Performance Optimum	15 - 20	50 - 60	0,9 - 1,4	50 - 70
Dimensioning with approx. 100% Solar fraction in Summer	25 - 30	70 - 75	1,8 - 2,2	60 - 80