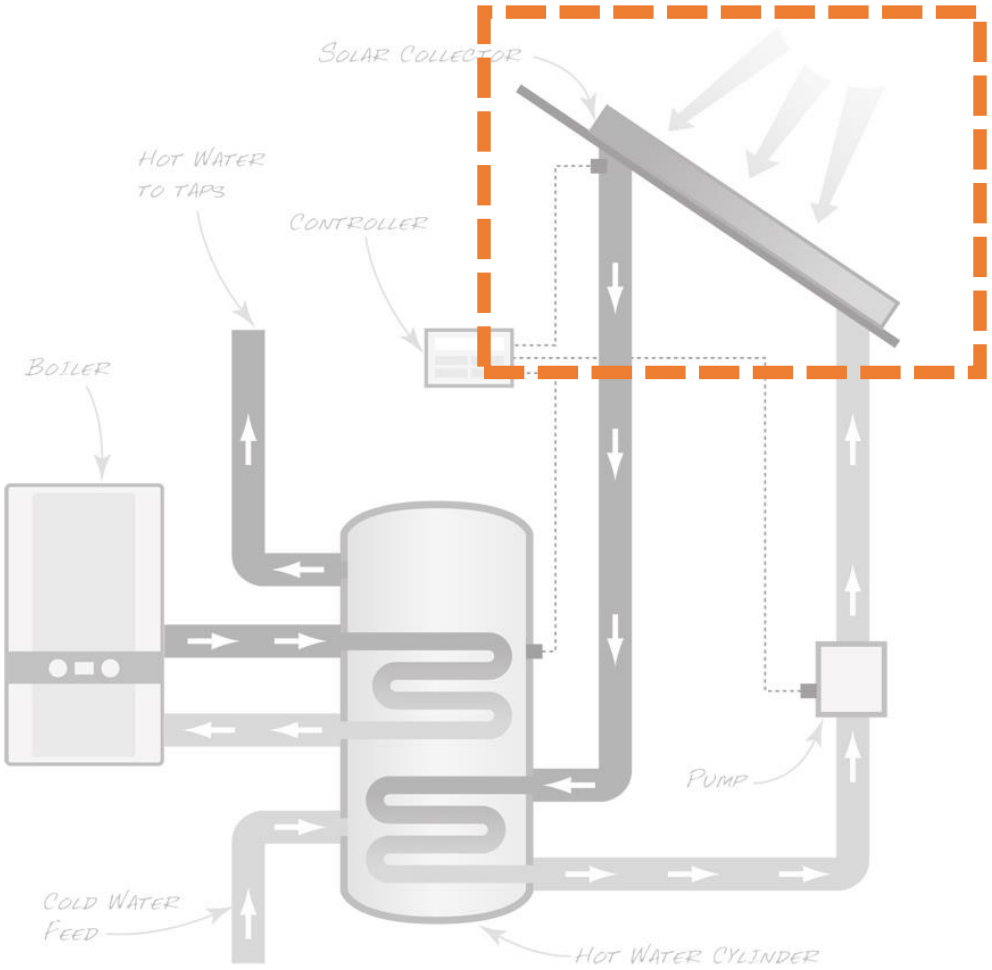
Saules termālās enerģijas aprēķini

Termālais kolektors



Jauda (W; kWh/m^3)

Efektivitāte (%)

Termālo kolektoru efektivitāte

- Kolektora efektivitāte atkarīga no apkārtējās gaisa temperatūras
- Mainīgs rādītājs, ko parasti aprēķina
- Efektivitātes noteikšanas parametri:
  - Zero-loss efficiency (optical efficiency; efficiency) – **n0** (%)
  - 1st order heat loss coefficient – **a1** W(m^2k)
  - 2nd order heat loss coefficient – **a2** W(m^2k^2)
- Kolektora kopējā efektivitāte nav tas pats kas *efficiency* tehniskajos datos

Viessmann Vitosol 200-T

Specification

Type SD2A		**2 m²**	**3 m²**
Number of tubes		20	30
Gross area (required when applying for subsidies)	m^2	2.88	4.32
Absorber area	m^2	2.01	3.02
Aperture area	m^2	2.14	3.23
Installation position (see figure below)		Ⓐ, Ⓑ, Ⓒ, Ⓓ, Ⓔ, Ⓕ	
Spacing between collectors	mm	47	47
Dimensions			
Width a	mm	1418	2127
Height b	mm	2043	2043
Depth c	mm	143	143
The following values apply to the absorber area:			
– **Optical efficiency**	%	78.9	79.1
– **Thermal loss correction value k_1**	$W/(m^2 \cdot K)$	1.36	1.10
– **Thermal loss correction value k_2**	$W/(m^2 \cdot K^2)$	0.0075	0.0076
Thermal capacity	$kJ/(m^2 \cdot K)$	10.0	10.1
Weight	kg	61	95
Liquid content (heat transfer medium)	litres	4.2	6.2
Permiss. operating pressure (see chapter "Solar expansion vessel")	bar	6	6
Max. idle temperature	°C	295	295
Steam output			
– Favourable installation position	W/m^2	100	100
– Unfavourable installation position	W/m^2	200	200
Connection	Ø mm	22	22

Tehniskās informācijas datubāzes

http://www.seai.ie/Your_Building/BER/BER_Assessors/Technical/HARP_Database/Solar_Thermal

https://secure.solar-rating.org/

Termālo kolektoru efektivitāte

$$n = n0 – a1*(Tm-Ta)/G – a2*(Tm-Ta)2/G$$

- n – kolektora efektivitāte
- n0 – zero-loss efficiency
- a1 – 1st order heat loss coefficient
- a2 – 2st order heat loss coefficient
- G – saules starojuma intensitāte (Wh/m^2 ; W/m^2)
- Ta – apkārtējās vides (gaisa) temperatūra
- **Tm** – kolektora (siltumnesēja) vidējā temperatūra (+/- 50^OC)

Termālo kolektoru jauda

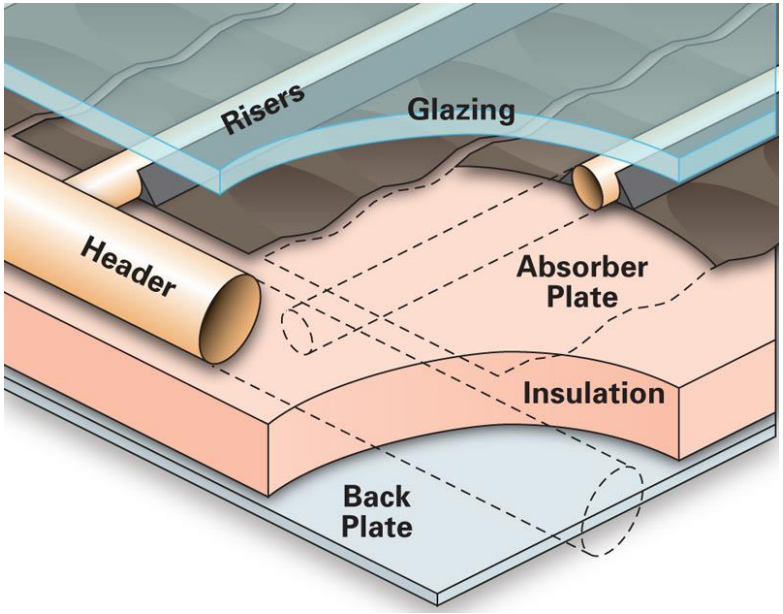
$$A*(n0*G - a1*(Tm-Ta) - a2*(Tm-Ta)2)$$

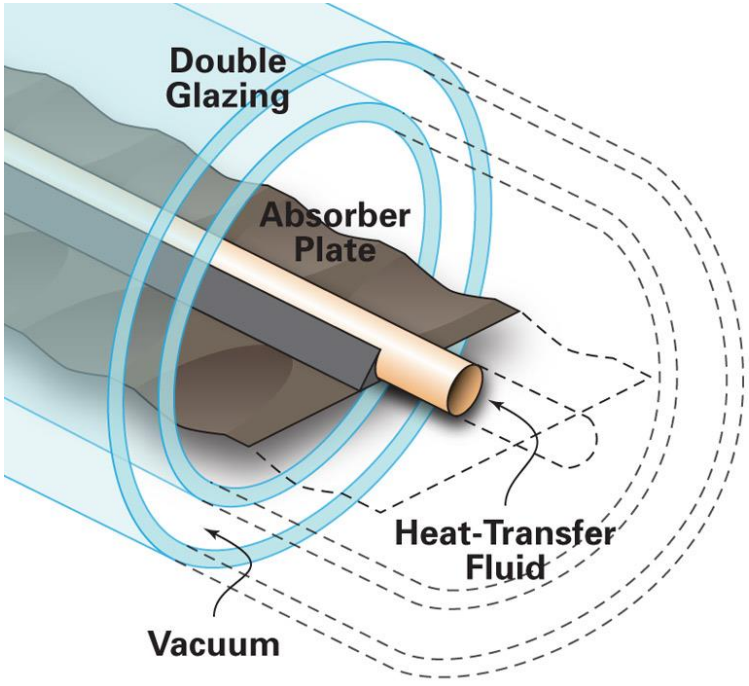
- n – kolektora efektivitāte
- n0 – zero-loss efficiency
- a1 – 1st order heat loss coefficient
- a2 – 2st order heat loss coefficient
- G – saules starojuma intensitāte (kWh/m^2 ; W/m^2)
- Ta – apkārtējās vides (gaisa) temperatūra
- **Tm** – kolektora (siltumnesēja) vidējā temperatūra (+/- 50^OC)
- A – kolektora laukums

Termālo kolektoru laukums

- **Gross area** – kolektora rāmja garums × augstums (nav saistīts ar efektivitāti. Vairāk der, lai noskaidrotu vai uz jumta pietiks vietas)
- **Absorber area** – absorbētāja laukums
  - plakanais absorbētājs plakanajam kolektoram
  - absorbētāja plāksnīte vakuuma kolektoram
- **Aperture area** – virsmas laukums par kuru saules starojums nokļūst kolektorā (izmanto aprēķinos)
  - stikla virsma plakanajam kolektoram
  - caurulītes iekšējais diametrs vakuuma kolektoram

Termālo kolektoru laukums





Vienkāršoti aprēķini

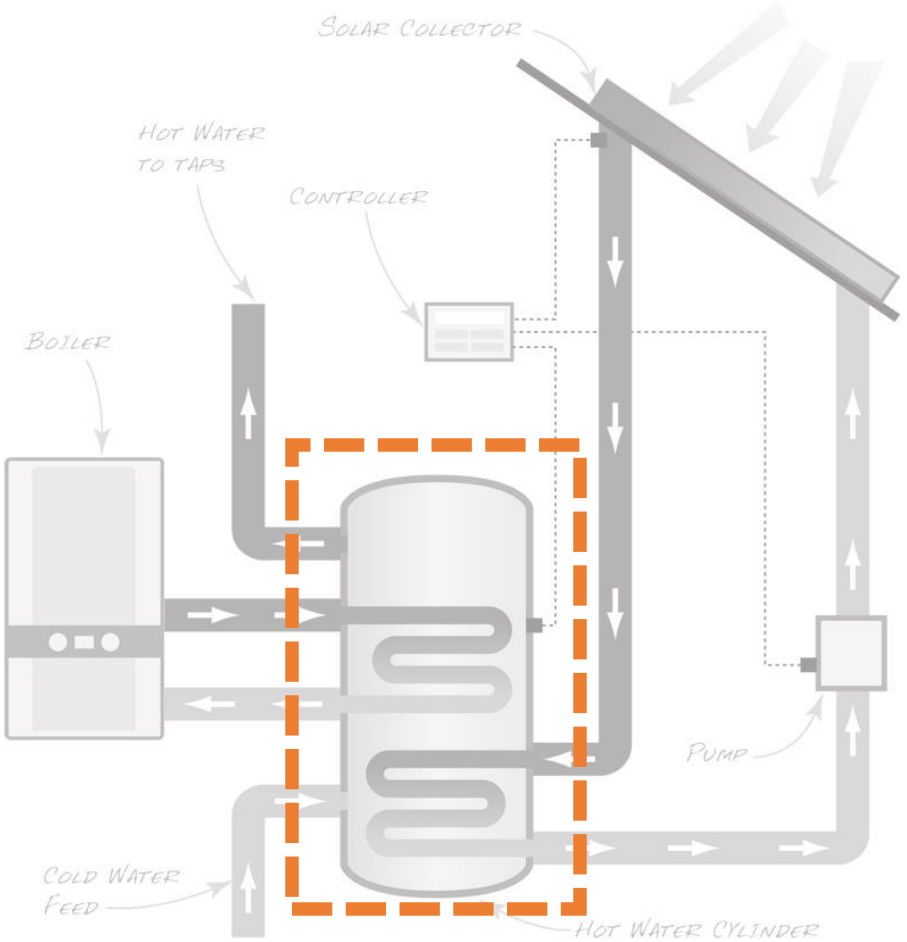
Tonēti kolektori – 0,29*H0*Aa

Netonēti kolektori – 0,44*H0*Aa

H0 – gada vidējais saules starojums (kWh/m^2)

Aa – kolektora diafragmas (aperature) laukums (m^2)

Ūdens rezervuārs



Tilpums (L ; m^3)

Cik jaudīgu kolektoru vajag, lai to uzsildītu?

Ūdens rezervuārs – mājsaimniecības

$$V_{St} = DHW * 1.2$$

V_{St} – ūdens rezervuāra tilpums

DHW – dienas vidējais ūdens patēriņš (l/24h)

Ūdens rezervuārs – viesnīcas

$$V_{St} = [(P * O * DHW) + HWD_K] * 1.2$$

V_{St} – ūdens rezervuāra tilpums

P – personas (max visos numuros)

O – noslodze (cik no visiem numuriem aizņemti)

DHW – dienas vidējais ūdens patēriņš (l/24h)

HWD_K – dienas vidējais ūdens patēriņš virtuvē (l/24h)

Nepieciešamā kolektora jauda

$$Qs = (m \times Cp) \times \Delta T$$

Qs – nepieciešamā kolektora jauda (kWh)

m – ūdens rezervuāra tilpums (m^3)

Cp – siltumietilpība ūdenim (1.16 kWh/m^3 K)

ΔT – karstā / aukstā ūdens temperatūras starpība (K) – **298**

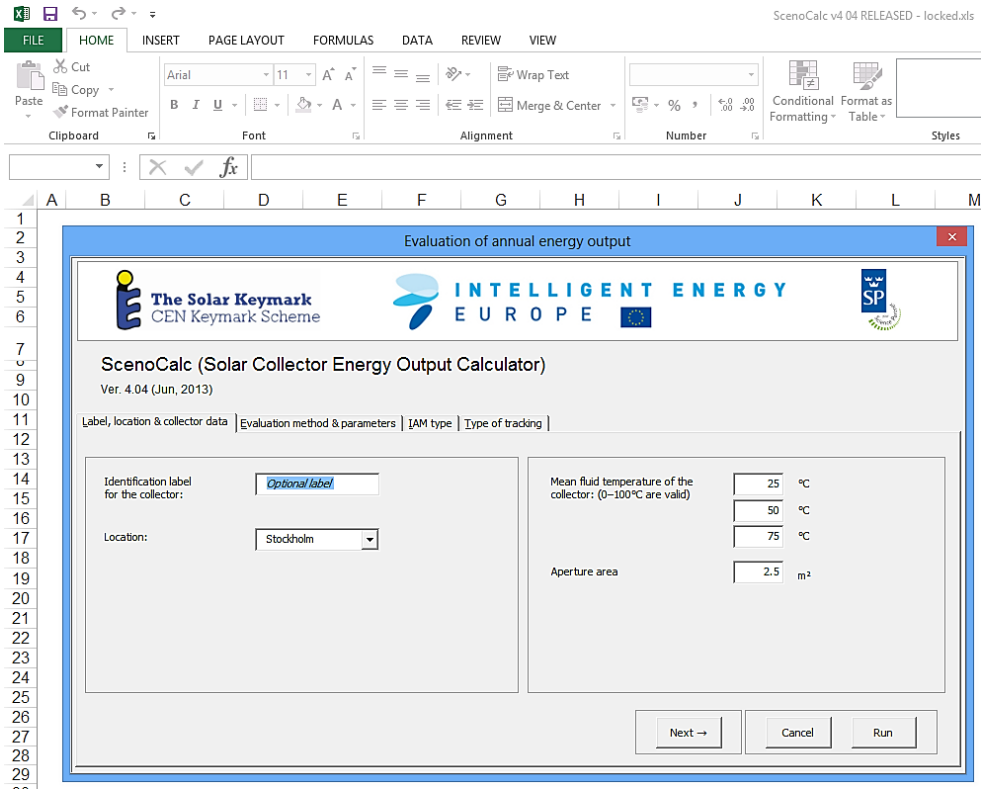
Auksts ūdens – **20 ^{O}C**

Karsts ūdens – **55 ^{O}C** (tvertnē)

Karsts ūdens izejā – 50 ^{O}C

Programmatūra

ScenoCalc

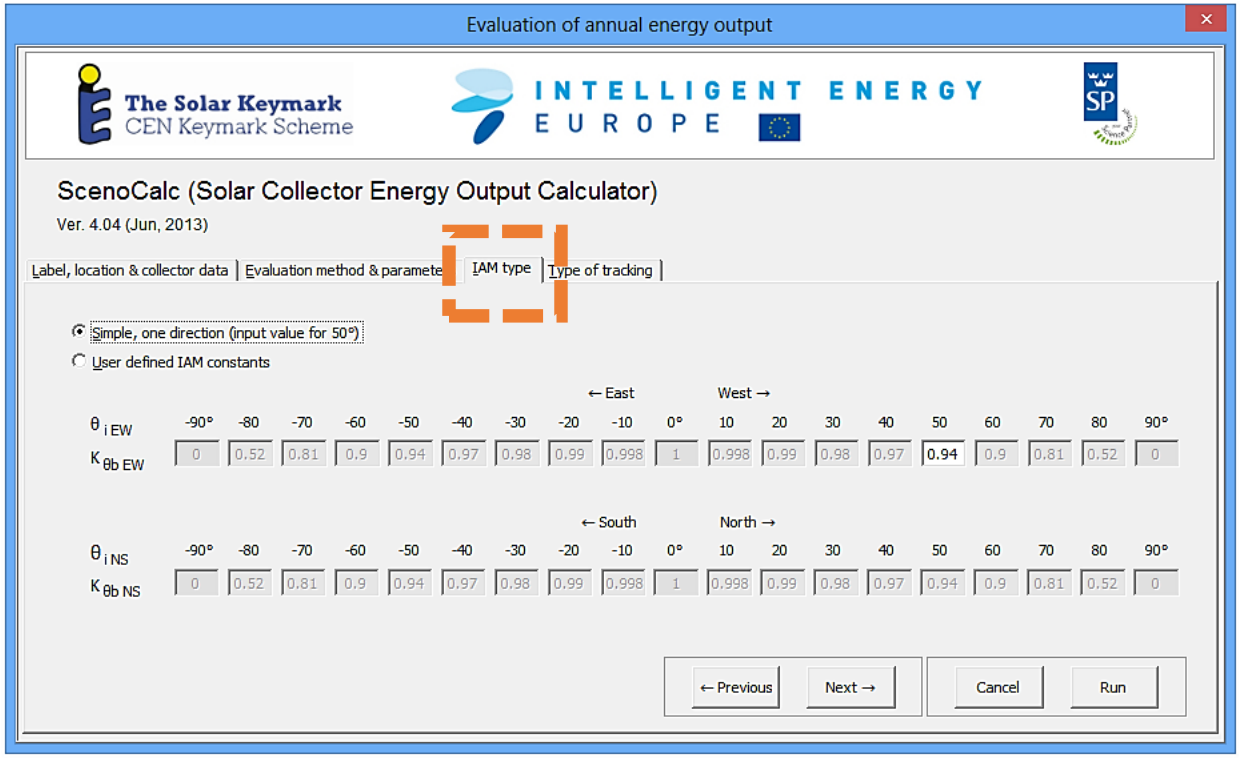


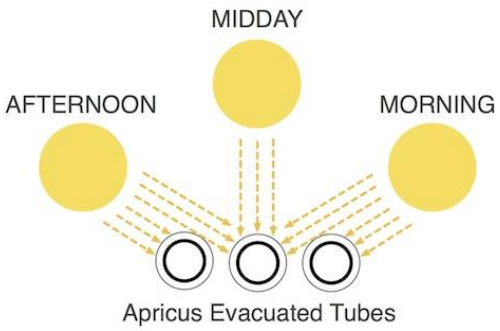
Rezultāts – kWh pa mēnešiem

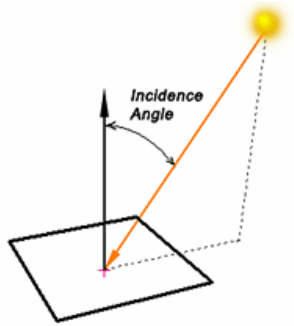
MS Excel Makro programma

SP Technical Research Institute of Sweden

Incident Angle Modifier (IAM)





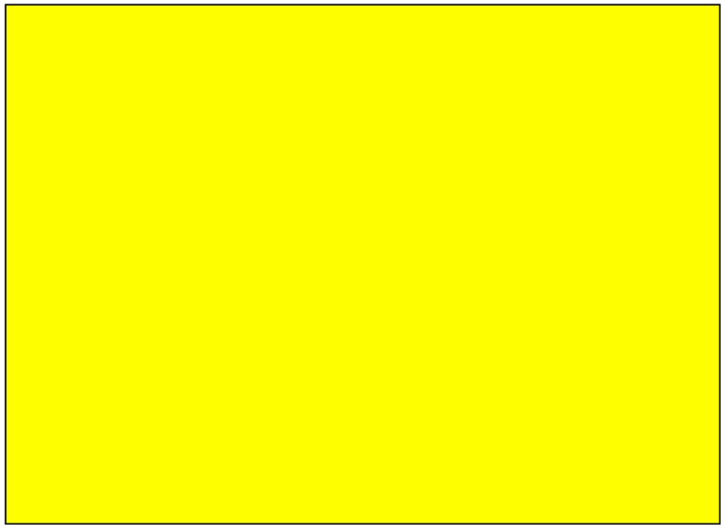


Var izrēķināt http://www.powerfromthesun.net/calculators/AngleCalc.html

Incident Angle Modifier (IAM)

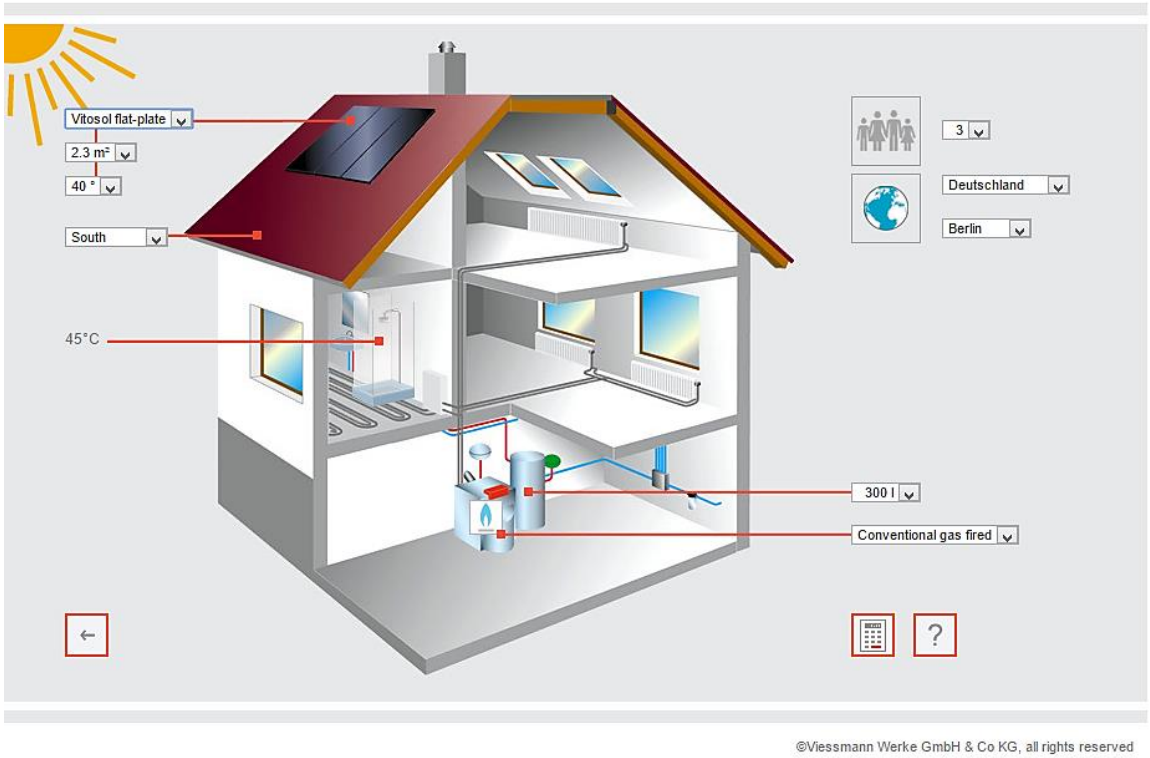
Latitude (deg)=	57
Day Number =	500
Number Of Tracking Axes (0, 1, or 2) =	0
Collector (or Axis) Tilt (deg) =	10
Collector (or Axis) Azimuth (deg) =	80
Solar Time (24-hour decimal format)(hr) =	12

Clear Result Calculate Result



http://www.powerfromthesun.net/calculators/AngleCalc.html

Viessmann Solar software



http://viessmann.solar-software.de

Scan The Sun

STEP 1
define your actual geolocation either by using Google Map or withe the GPS sensor

STEP 2
Contour the shape of horizon ans watch the Sun path on the sky

STEP 3
Check arrangement of the solar collector and get the daily yield of the solar energy depending on the collector orientation.

Scan The Sun


SCAN THE SUN
scanthesun.com
1


Click on the map or use GPS
Określ swoje położenie
Help

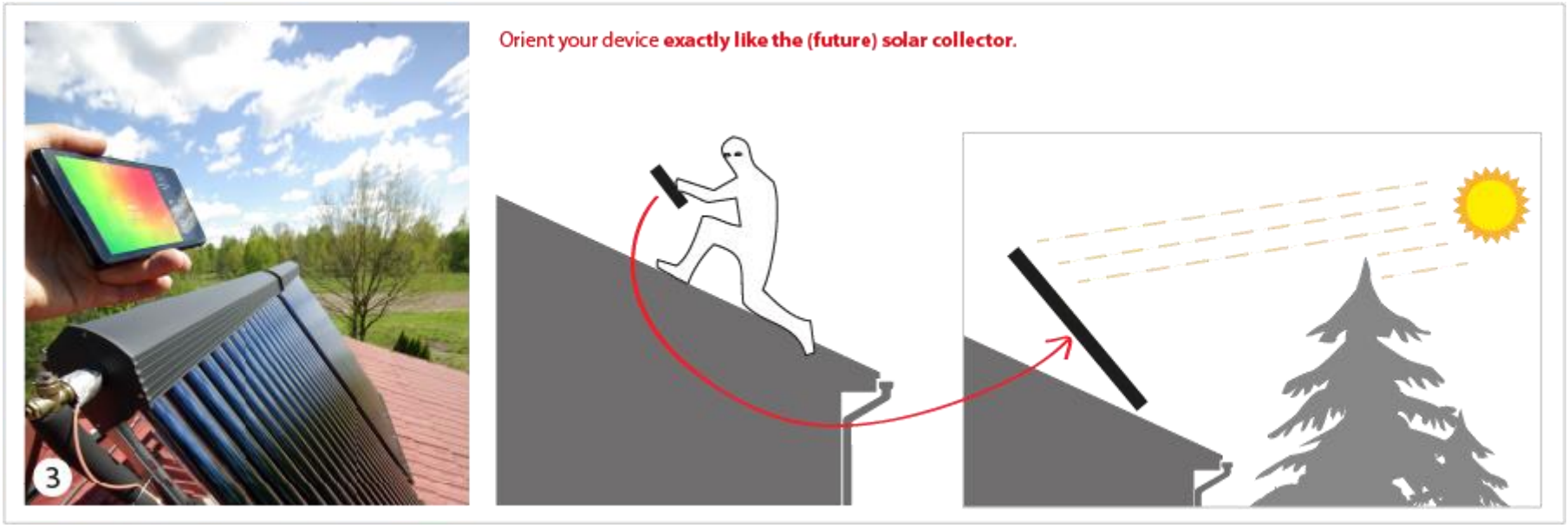
Scan The Sun

Scan The Sun

Undo - removes the last section of contour

Clear - removes whole contour

Scan The Sun


3
Orient your device **exactly like the (future) solar collector.**

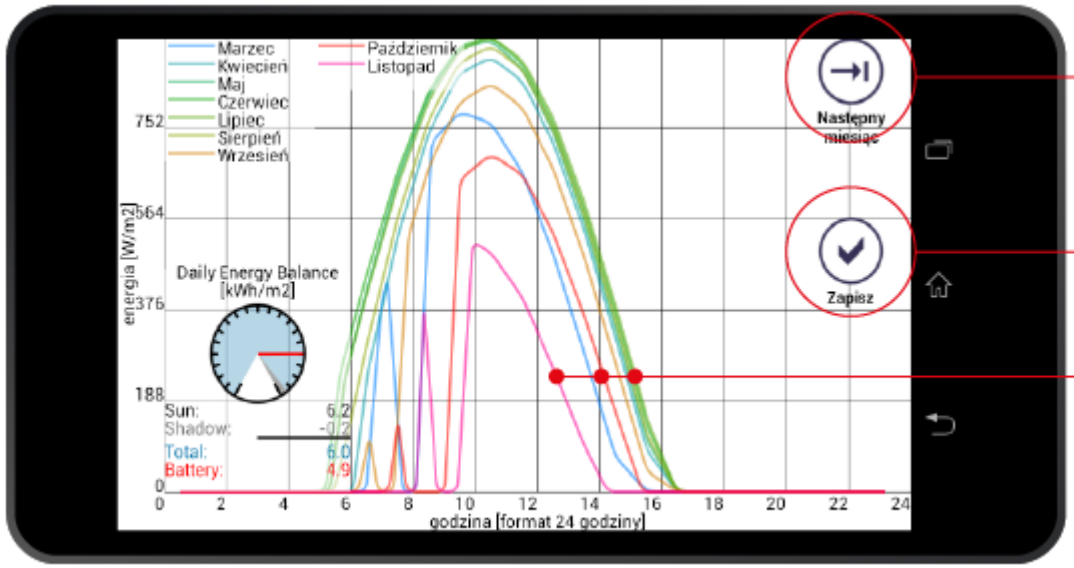
Scan The Sun

Orient your device exactly like the (future) solar collector.

NOTICE!
Treating your phone/tablet as a solar collector
click the '**Daily energy Curves**' button

Select the planned working period of the solar collector

Scan The Sun



Months preview - shows the plot for each month separately

Save - write the plon on the SD card of the device in JPG format.

Daily energy curves