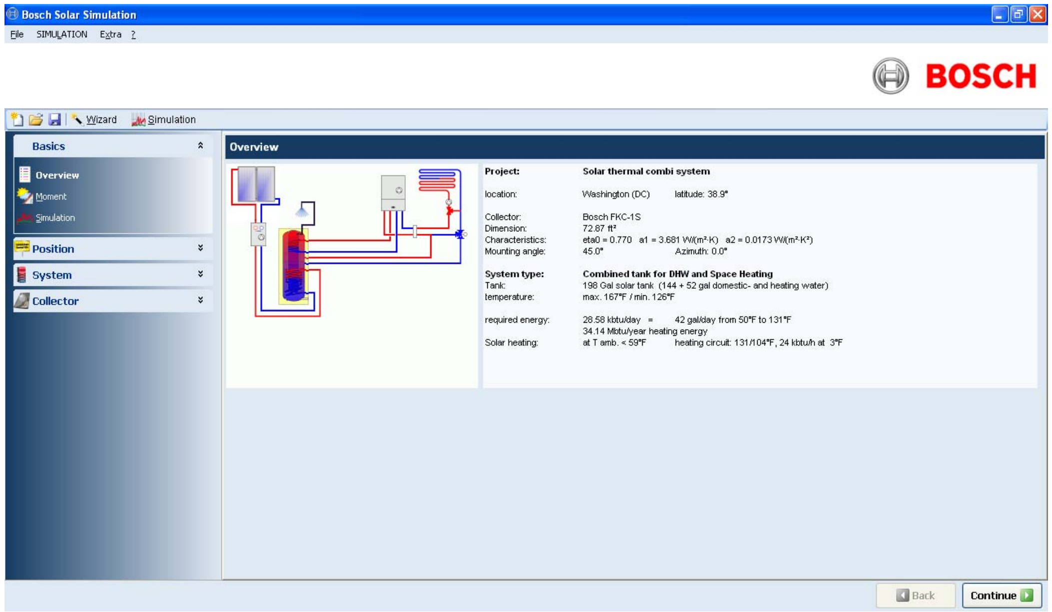
GetSolar Overview

GetSolar - Bosch Solar Thermal Sizing Tool

Purpose of GetSolar



- GetSolar is a computer software tool for simulating residential and commercial Solar Thermal Systems quickly and effectively
- The software aids in the sizing of both collector arrays and water storage volume for DHW, Space Heating, Pool Heating, and Combi Systems

Sizing Options

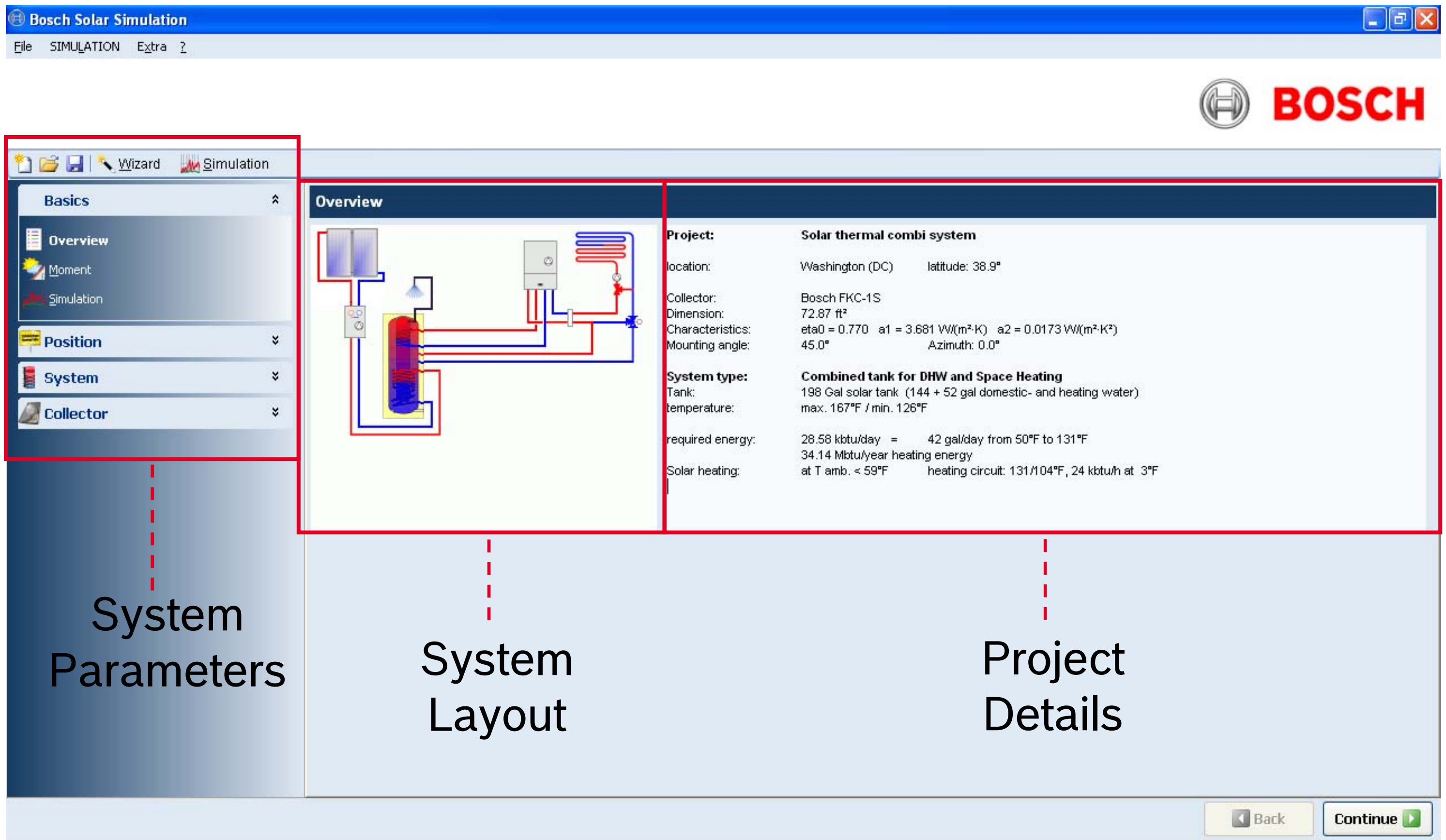
- 2 Options:
  - Wizard
    - Streamlined process for quickly sizing an application with minimal details and at default system settings
  - System Parameters (detailed system setup)
    - More comprehensive methodology with ability to add and change the various parameters of the system giving a more accurate system design

Methodology for Using GetSolar

- Best method:
  - Step 1: Use the wizard to get an initial estimate for the number of collectors, total storage, and solar fraction
  - Step 2: Go through the system parameters menus and make changes where applicable
  - Step 3: Simulate the system and analyze the results
  - Step 4: If necessary, go back and optimize the system by altering the various parameters including number of collectors, tank volume, and system type

- Rules of thumb:
  - 1.5 gallons of storage per 1 sqft of collector surface area for DHW
  - 2 gallons of storage per 1 sqft of collector surface area for DHW + Space Heating
  - Set the collector angle near the latitude angle of the project location for DHW only and add 15 degrees to the latitude for Space Heating

Overview (Home) Screen



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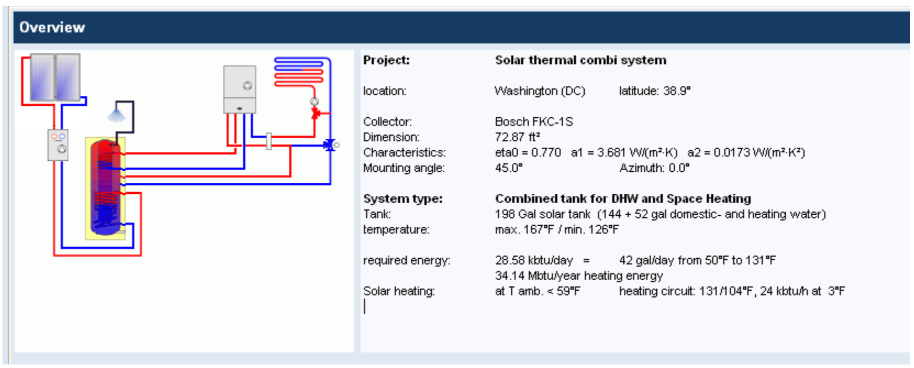
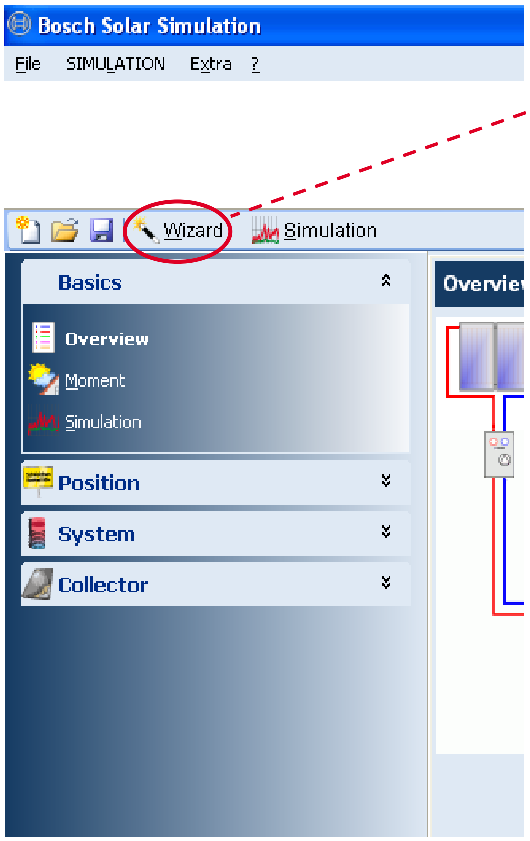
Project Details



- The project details at the overview screen include:
  - Dimension: Total square footage of collectors
  - Collector Characteristics:
    - eta0: conversion factor
    - a1: heat transmission coefficient
    - a2: heat transmission coefficient

Wizard



→ The Wizard may be accessed from any window by clicking the "Wizard" button on the top left

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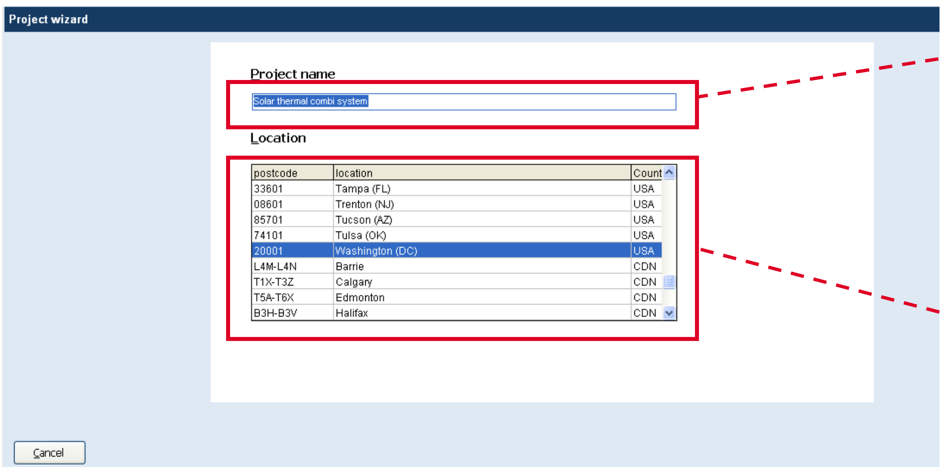
Wizard



→ Clicking the Wizard button will bring up this screen. The following options are present here:

- Project Name:
  - Enter the project name here
  - The project name can also be entered and edited by going to "File" -> "Project Info"
- Location:
  - Select the location either by scrolling through the list or typing in the name

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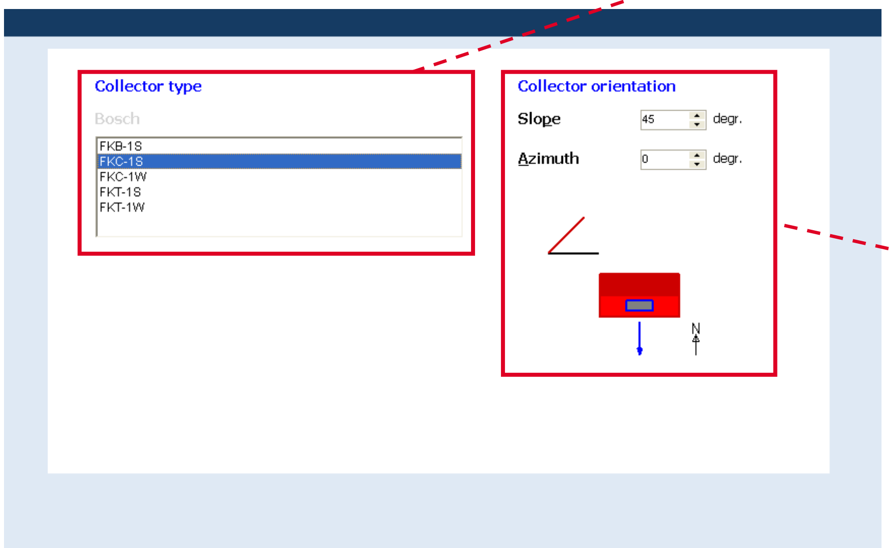
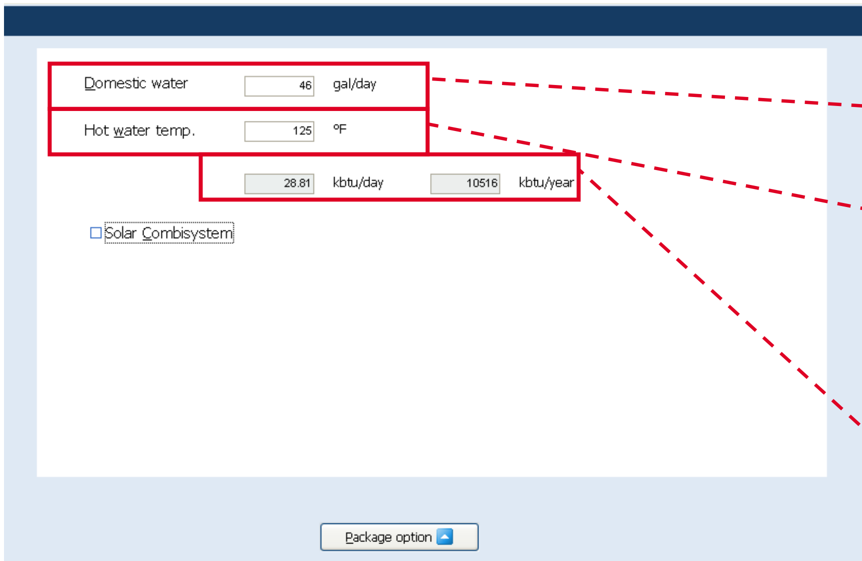
Wizard: Collector Details



→ Collector Type:
- Select the type of collector for the system
- Both portrait and landscape for FKT-1 and FKC-1 collectors are provided

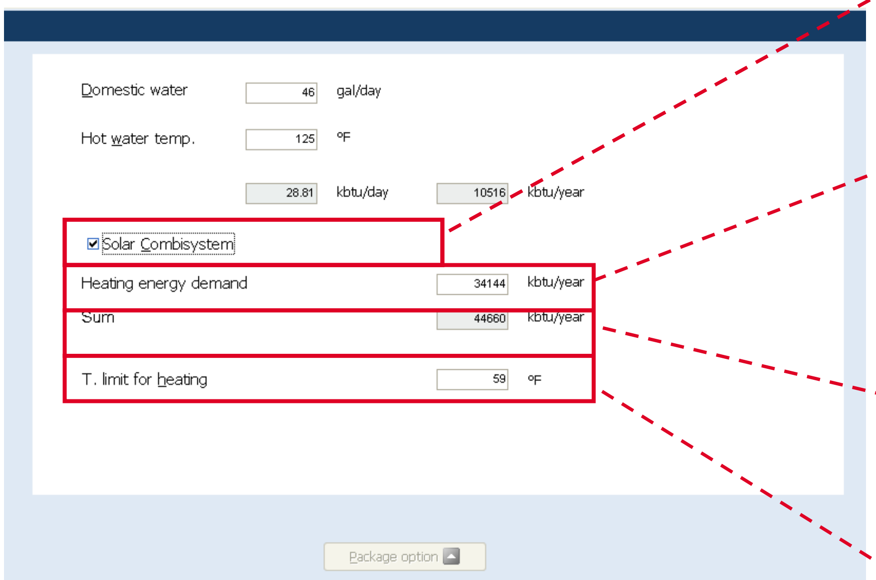
→ Collector Orientation:
- Enter the slope and azimuth values at which the collectors will be simulated
- Note: the red collector image and the triangle changes as the azimuth and slope values are altered

Wizard: DHW Only



- Enter parameters regarding the system itself
- Domestic Water:
  - Total DHW load in gallons/day
- Hot Water Temp:
  - Desired hot water supply temp, typically 120 degrees F for DHW only
- The two boxes below these show the total kBtu required per day and per year

Wizard: DHW / Space Heating



- Solar Combisystem:
  - Clicking this button brings up the parameters for Space Heating
- Heating Energy Demand (building heat loss):
  - Enter the space heating energy demand in kBtu/**year**
- Sum:
  - Sum of the DHW and space heating load
- T. Limit for Heating:
  - Warm weather shut-down

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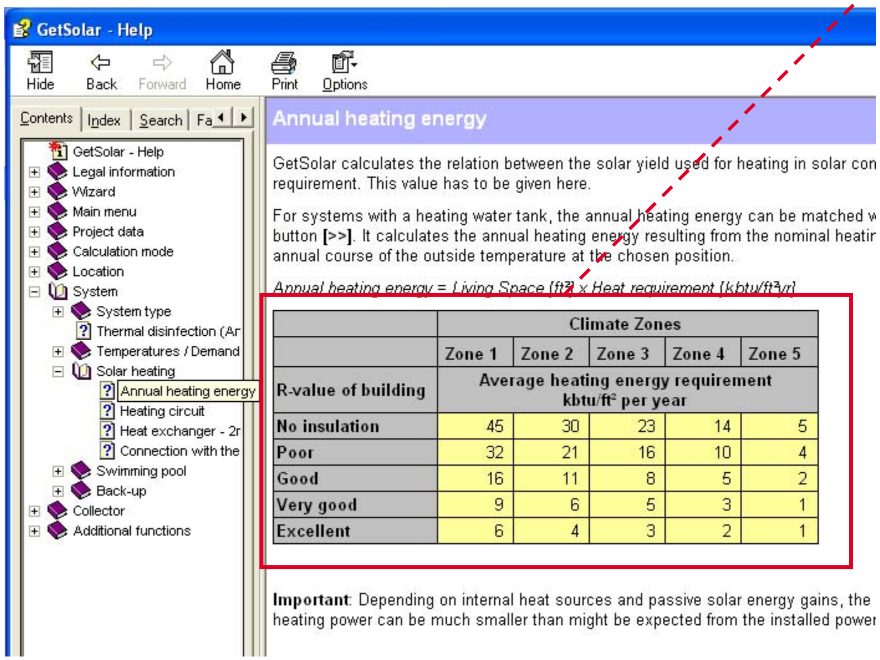
Wizard: Heating Energy Demand



	Climate Zones				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
R-value of building	Average heating energy requirement kbtu/ft² per year				
No insulation	45	30	23	14	5
Poor	32	21	16	10	4
Good	16	11	8	5	2
Very good	9	6	5	3	1
Excellent	6	4	3	2	1

- A table with heating requirements is provided in the help section and may be used as a reference for estimating the space heating requirement if unknown.
- Location:
  - Help -> System -> Solar Heating -> Annual heating energy
- Climate Zone Map:
  - http://www.eia.doe.gov/emeu/recs/recs97/zonemap.pdf

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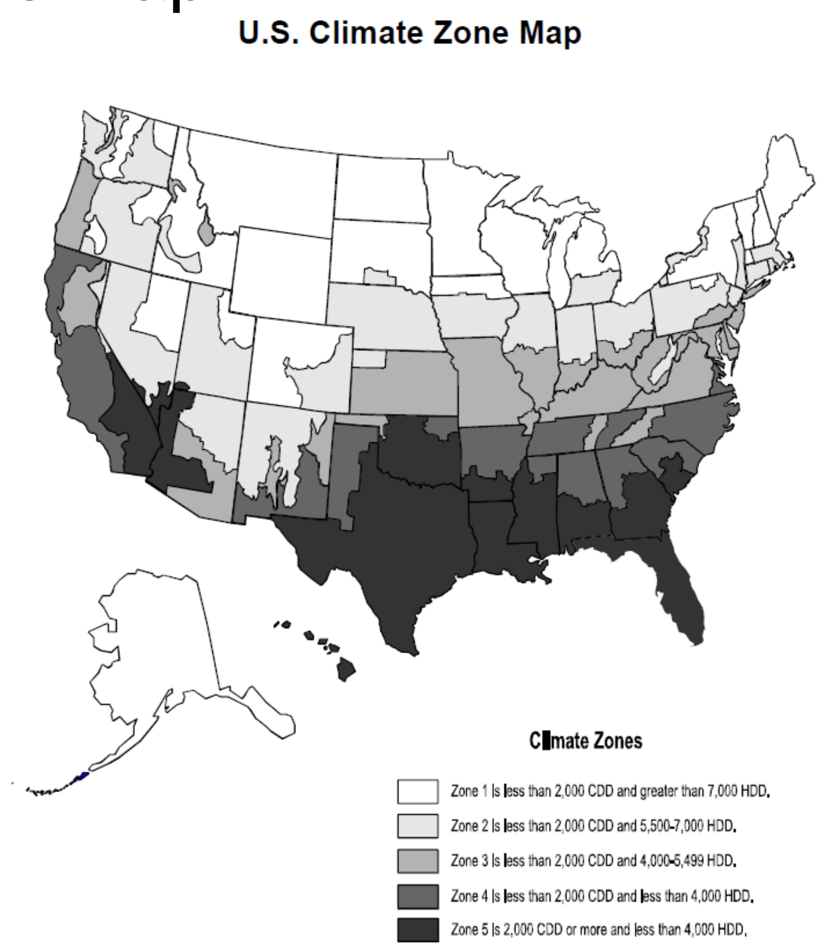
Climate Zone Map



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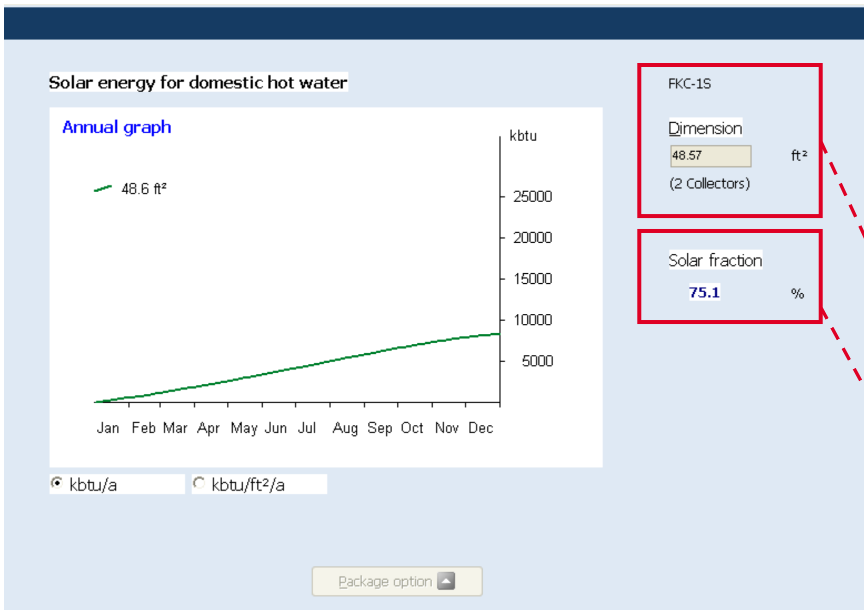
Wizard: DHW Results



- This window displays a graph with the annual solar energy gained in 1 full year
- On the right of the graph is the total gross square footage of the collectors
- Also displayed is the solar fraction provided by this system
- If this is a DHW only system, then the total water storage will be shown in this window along with the option to select a Bosch package

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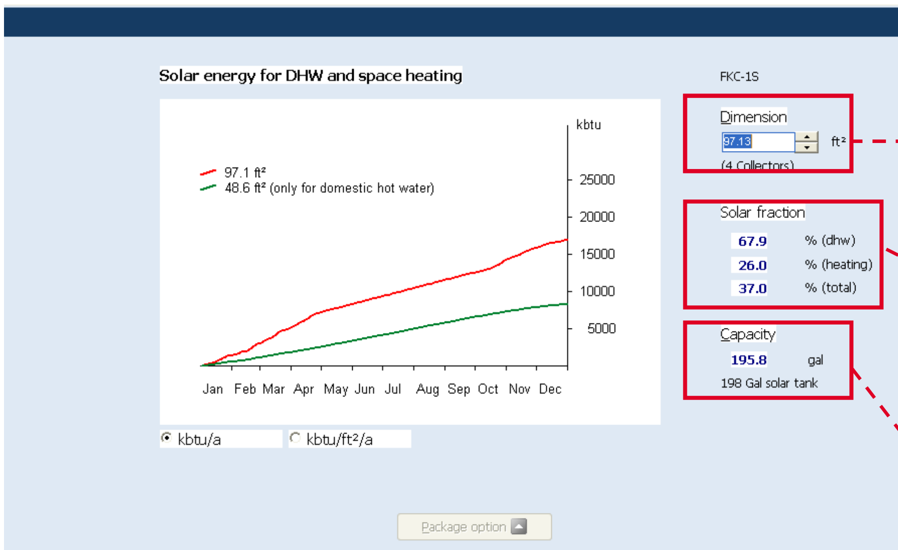
Wizard: DHW and Space Heating Results

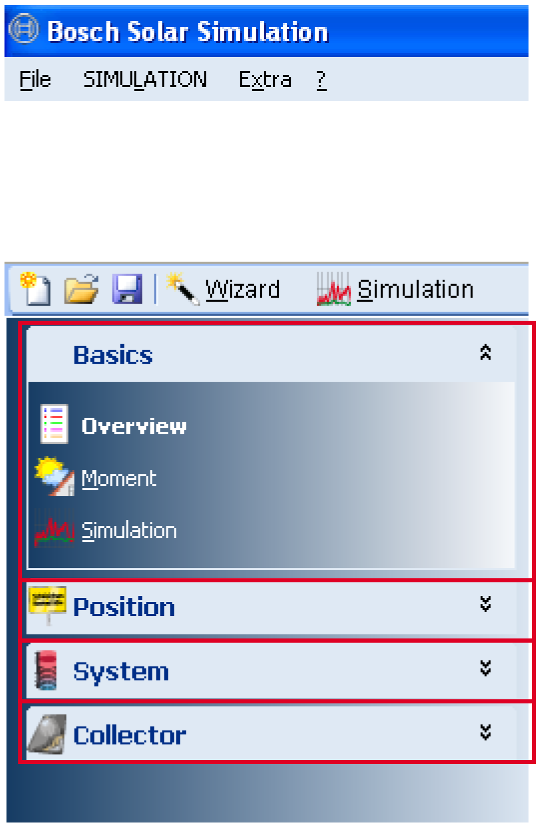


- This window is similar to the DHW only one with the following differences:
  - The total number of collectors increase to accommodate for space heating
  - The solar fraction is displayed split into DHW and Space Heating along with the total solar fraction
  - The total water storage requirement is displayed

Wizard: Results

- At the end of both of the results window, one can edit the number of collectors used by either clicking on the up and down arrow buttons.
- Once the desired result is met, click the OK button to exit the wizard and save the system
- The system will now be saved in GetSolar and is ready either be edited further or simulated.
- After clicking the OK button, GetSolar will proceed to the Home Screen displaying the new values and sizing

System Parameters



➔ System Parameters:

- Basics: include overview, moment, and simulation
- Position (location): position, shadow (shading), WetSyn data (meteorological data)
- System: System type, temperatures/consumption/tanks, space heating, pool, and back-up
- Collector: collector type, parameters, solar circuit

System Parameters: Basics

- Overview: General overview of the project
- Moment: System data and performance at a specific instant of time
- Simulation: Detailed analysis of the system including full project report for distribution to customer

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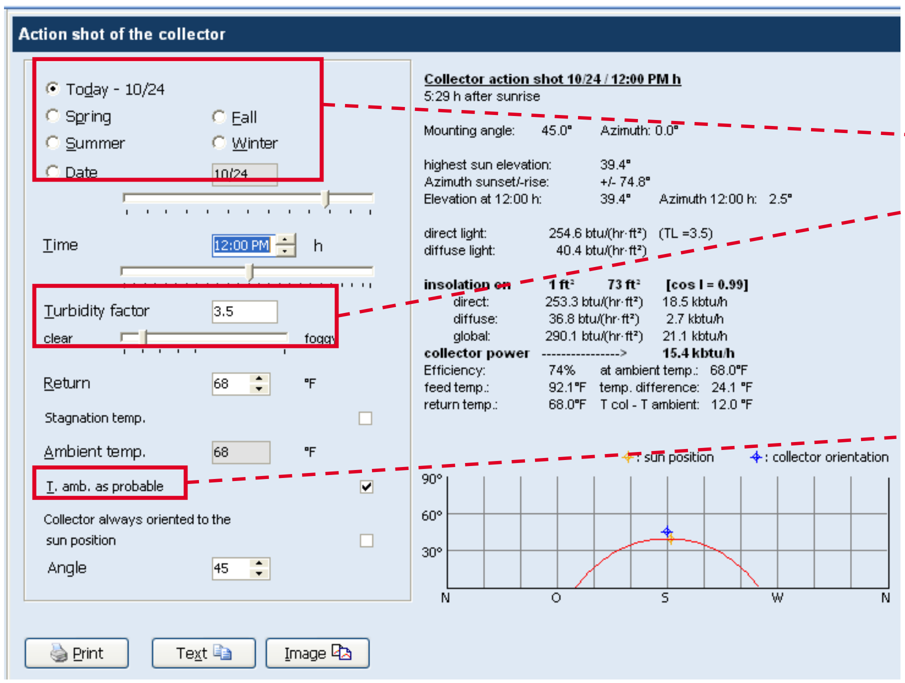
System Parameters (Basics): Moment



- The moment section represents system parameters and performance at a certain instant of time
- Here the reference time is selected
- Turbidity factor is used to determine how much of the suns rays are passing through the atmosphere and reaching the collectors
- Clicking the T. amb as probable option uses the average ambient air temperature values of the location.

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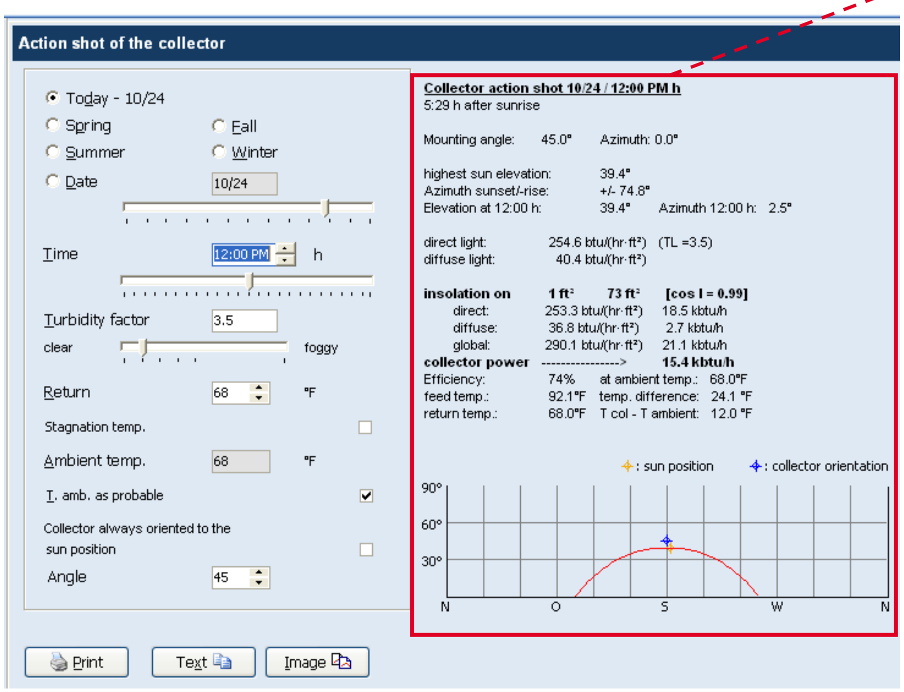
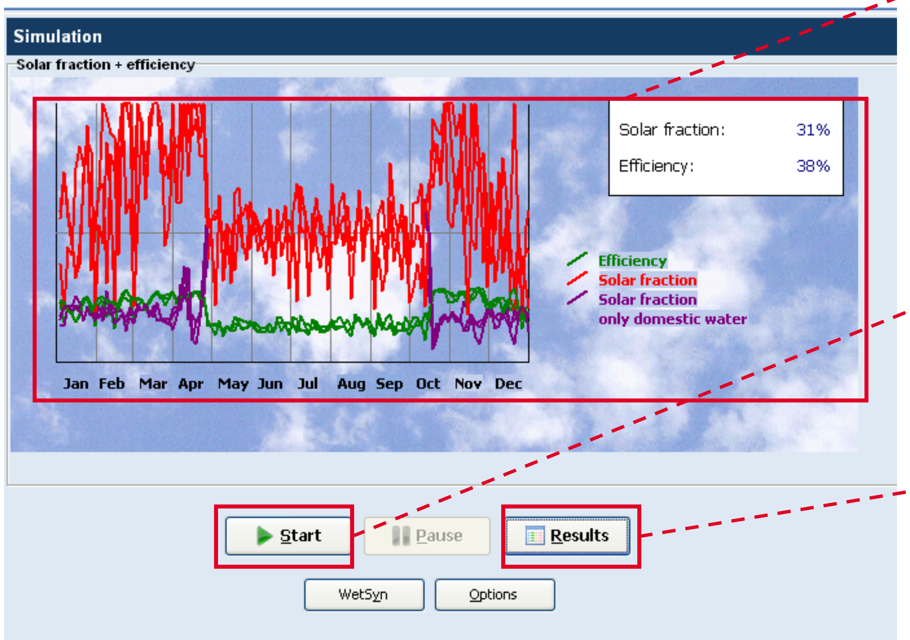
System Parameters (Basics): Moment



On the right side are details of the systems performance including the following information:

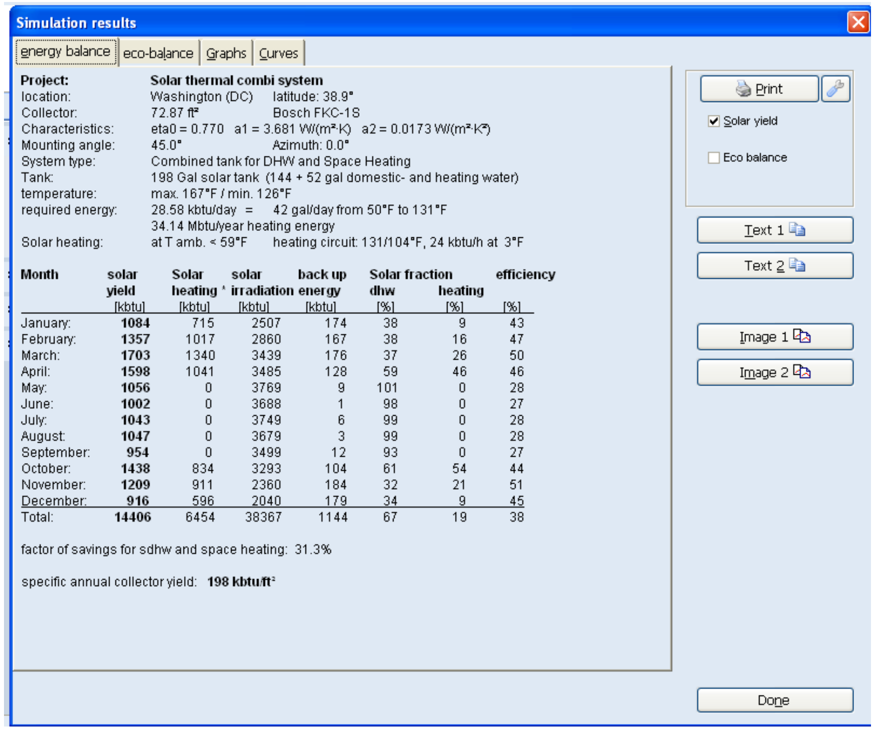
- Elevation and azimuth of the sun
- Cosinus of the angle between the sun and the vertical of the collector (Cos I)
- Direct light = irradiation on a plane vertical to the direct light
- Diffuse light = diffuse light on the horizontal plane
- Irradiation on 1m² of active collector surface-Irradiation on the whole active surface of the collector
- Collector feed temperature
- Collector stagnation temperature

System Parameters (Basics): Simulation



- → Graph and table displaying system efficiency, solar fraction, and solar fraction for DHW only throughout a given time period of either 1 or 3 years
- → Clicking either the start or continue button begins the solar calculation
- → The results button displays the details of the simulation including savings in energy throughout the year

System Parameters (Basics): Simulation Results



Project: **Solar thermal combi system**
location: Washington (DC) latitude: 38.9°
Collector: 72.87 ft² Bosch FKC-1S
Characteristics: eta0 = 0.770 a1 = 3.681 W/(m²·K) a2 = 0.0173 W/(m²·K²)
Mounting angle: 45.0° Azimuth: 0.0°
System type: Combined tank for DHW and Space Heating
Tank: 198 Gal solar tank (144 + 52 gal domestic- and heating water)
temperature: max. 167°F / min. 126°F
required energy: 28.58 kbtu/day = 42 gal/day from 50°F to 131°F
34.14 Mbtu/year heating energy
Solar heating: at T amb. < 59°F heating circuit: 131/104°F, 24 kbtu/h at 3°F

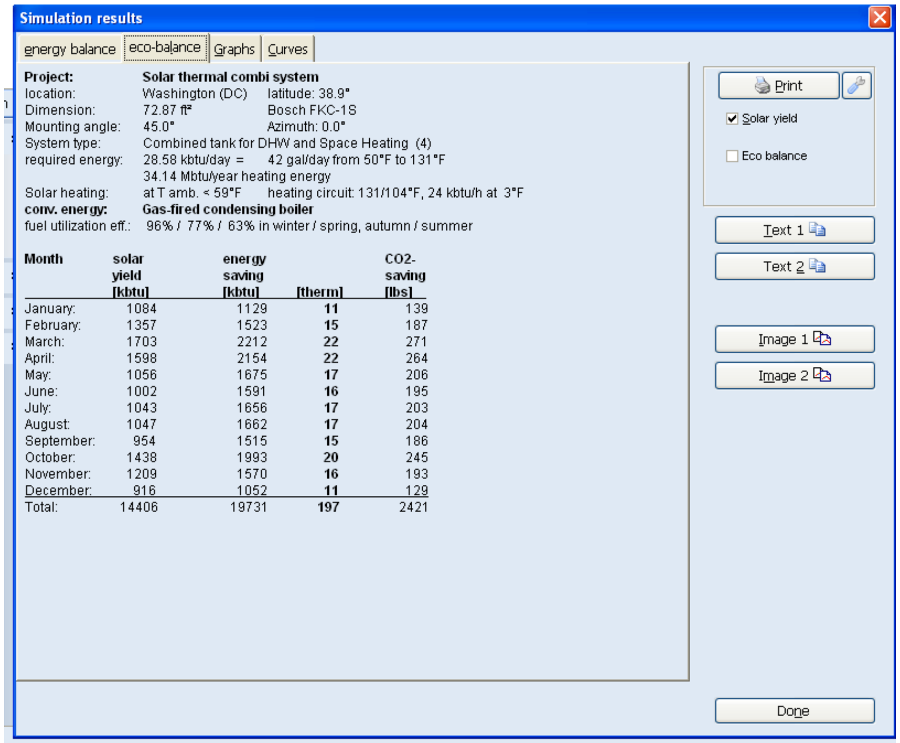
Month	solar yield [kbtu]	Solar heating * [kbtu]	solar irradiation [kbtu]	back up energy [kbtu]	Solar fraction dhw [%]	Solar fraction heating [%]	efficiency [%]
January:	**1084**	715	2507	174	38	9	43
February:	**1357**	1017	2860	167	38	16	47
March:	**1703**	1340	3439	176	37	26	50
April:	**1598**	1041	3485	128	59	46	46
May:	**1056**	0	3769	9	101	0	28
June:	**1002**	0	3688	1	98	0	27
July:	**1043**	0	3749	6	99	0	28
August:	**1047**	0	3679	3	99	0	28
September:	**954**	0	3499	12	93	0	27
October:	**1438**	834	3293	104	61	54	44
November:	**1209**	911	2360	184	32	21	51
December:	**916**	596	2040	179	34	9	45
Total:	**14406**	6454	38367	1144	67	19	38

factor of savings for sdhw and space heating: 31.3%

specific annual collector yield: **198 kbtu/ft²**

- The image on the right is the results window that pops up after the calculation has completed. This window is broken down into four tabs:
  - Energy balance:
    - Details on the system performance, solar contribution and back-up usage both monthly and annually

System Parameters (Basics): Simulation Results

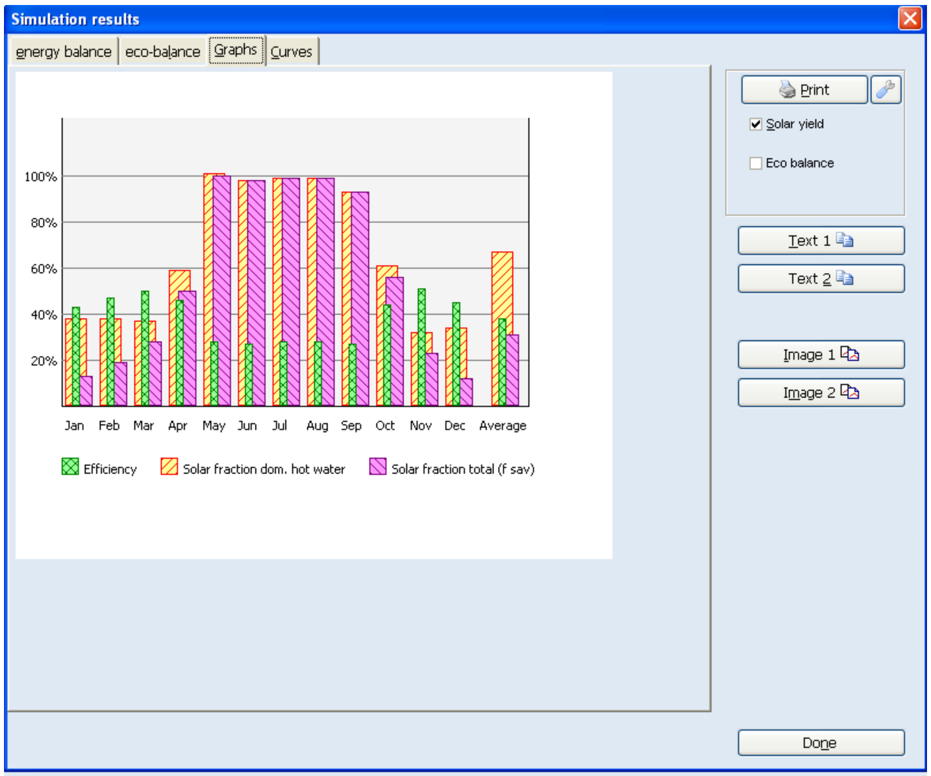


Project: Solar thermal combi system
location: Washington (DC) latitude: 38.9°
Dimension: 72.87 ft² Bosch FKC-1S
Mounting angle: 45.0° Azimuth: 0.0°
System type: Combined tank for DHW and Space Heating (4)
required energy: 28.58 kbtu/day = 42 gal/day from 50°F to 131°F
34.14 Mbtu/year heating energy
Solar heating: at T amb. < 59°F heating circuit: 131/104°F, 24 kbtu/h at 3°F
conv. energy: **Gas-fired condensing boiler**
fuel utilization eff.: 96% / 77% / 63% in winter / spring, autumn / summer

Month	solar yield [kbtu]	energy saving [kbtu]	[therm]	CO2-saving [lbs]
January:	1084	1129	11	139
February:	1357	1523	15	187
March:	1703	2212	22	271
April:	1598	2154	22	264
May:	1056	1675	17	206
June:	1002	1591	16	195
July:	1043	1656	17	203
August:	1047	1662	17	204
September:	954	1515	15	186
October:	1438	1993	20	245
November:	1209	1570	16	193
December:	916	1052	11	129
Total:	14406	19731	197	2421

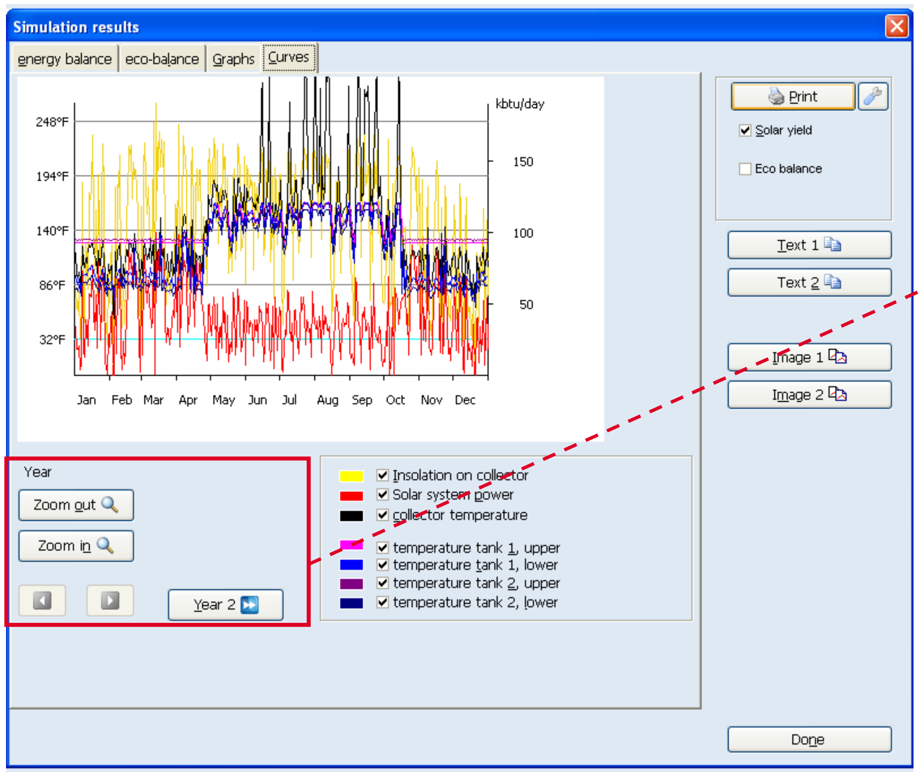
- Eco-balance:
  - Details on monthly and annual energy savings and CO2 reductions

System Parameters (Basics): Simulation Results



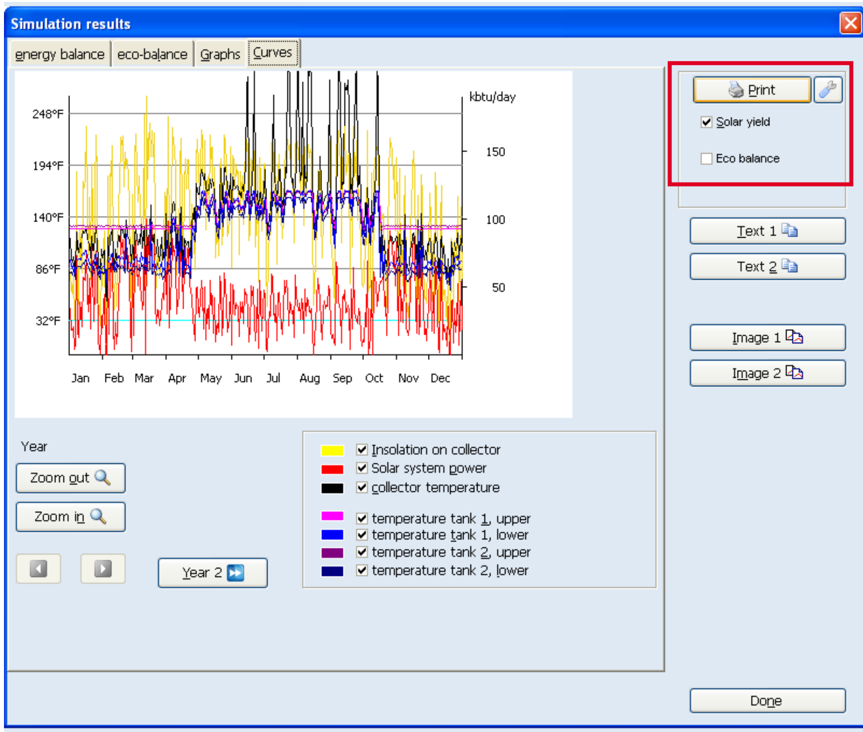
- Graphs:
  - Graphical monthly breakdown of solar fraction for DHW, solar fraction for Space Heating and efficiency

System Parameters (Basics): Simulation Results



- Curves
  - Graphs showing the temperature ranges for the different points of the system.
  - Can be zoomed in or out to show graph for yearly, monthly and even daily values by clicking the zoom in and zoom out buttons

Project Report



→ Once the simulation results have been confirmed, the project report may be created. This is done by clicking on the print button at the top right of the results window. The report may be 1 to 3 pages, depending on whether the Eco-Balance and/or Solar yield selections are chosen or not.

Project Report

Header: adresse, name etc. can be entered here (<File> <Print options>)

Bosch Solar Simulation 2.0.11 **- Solar simulation -**

Project information

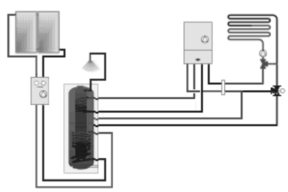
Name **Solar thermal combi system**

location Washington (DC)

Bosch FKC-1S
153.1 ft² Gross area

45.0° Mounting angle
0.0° Azimuth

combined tank
198 Gal solar tank
288 + 103 gal
(domestic- and heating water)



dom. hot water
100 gal/day with 125°F

heating energy
34.14 Mbtu/year
Solar heating
at T amb. < 59°F
heating circuit 131/104°F

Gas-fired condensing boiler

- ➔ The top half of the first page shows the system layout along with a summary of the project parameters.
- ➔ If selected in the print options, the header details will be displayed, along with company logo

Project Report

Results

required energy	Hot water and storage heat losses	25190 kbtu/year
	heating energy	34144 kbtu/year
	Total	59334 kbtu/year
Solar fractions	dom. hot water	65.0%
	Heating	36.4%
	factor of savings for sdhw and space heating	48.5%
Key values	Efficiency	37.5%
	specific annual collector yield based on the collector gross area	188 kbtu/ft²
solar yield	dom. hot water	16369 kbtu/year
	Heating	12429 kbtu/year
	Total	28798 kbtu/year
eco balance	energy saving	39724 kbtu/year 397 therm
	CO2 reduction	4874 lbs/Year

The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from the model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration only. It does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing the design, all assumed parameters that have led to the results of the pre-design simulation should be checked against the actual design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.

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- The bottom half of the first page has the annual results for the required energy, solar fraction, annual solar yield, and energy savings

Project Report

Header: adresse, name etc. can be entered here (<File> <Print options>)

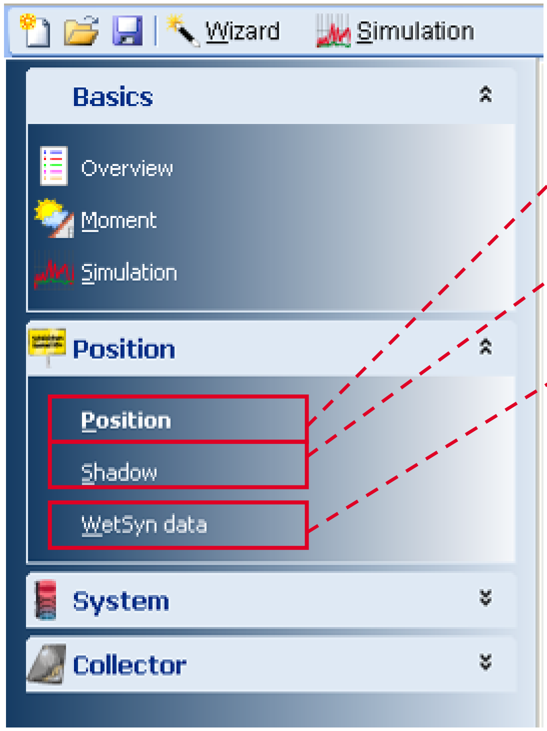
Bosch Solar Simulation 2.0.11 **- energy balance -**

Project: **Solar thermal combi system**
location: Washington (DC) latitude: 38.9°
Collector: 145.70 ft^2 (6 pcs.) **Bosch FKC-1S**
Characteristics: eta0 = 0.770 a1 = 3.681 W/(m^{2}K) a2 = 0.0173 W/(m^{2}K^2) [Solar Keymark]
Mounting angle: 45.0° Azimuth: 0.0°
System type: **Combined domestic- and heating water tank**
Tank: 198 Gal solar tank (288 + 103 gal domestic- and heating water)
max. 179°F / min. 123°F
required energy: 62.63 kbtu/day = 100 gal/day from 50°F to 125°F
34.14 Mbtu/year heating energy
Solar heating: at T amb. < 59°F heating circuit: 131/104°F, 19 kbtu/h at 3°F

Month	solar yield [kbtu]	Solar heating * [kbtu]	solar irradiation [kbtu]	back up energy ** [kbtu]	Solar fraction dhw [%]	Solar fraction heating [%]	efficiency [%]
January:	**2084**	1449	5013	1419	31	19	42
February:	**2563**	2077	5718	1456	25	33	45
March:	**3219**	2617	6875	1462	29	51	47
April:	**3140**	1841	6969	821	64	81	45
May:	**2247**	0	7535	47	102	0	30
June:	**2112**	0	7373	1	98	0	29
July:	**2237**	0	7496	17	100	0	30
August:	**2230**	0	7355	5	100	0	30

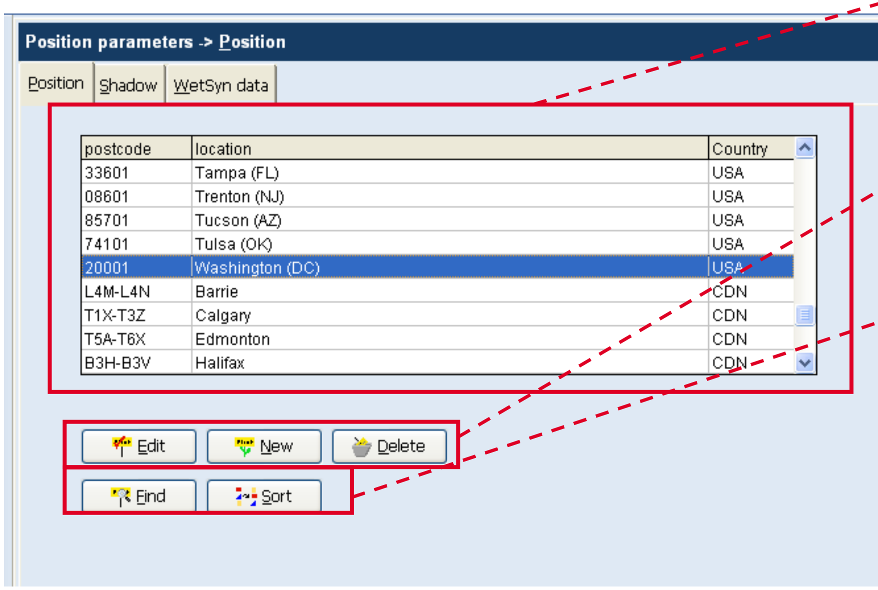
- The second and third pages show system details, energy/eco breakdown monthly and annually, and a graphical representation. The second page is specific to the energy balance (solar yield) and the third page for the eco-balance (energy and CO2 savings). These are the same tables and graphs from the results sections.

System Parameters: Position



- Position: Details on the location of the project
- Shadow: Window for adding shading
- WetSyn Data: Meteorological data

System Parameters (Position): Position



- Location window with ability to pick location in the scroll down menu
- Ability to edit cities, add new cities, and delete cities
- Multiple ways to locate specific location including by scrolling down the menu, searching through “find”, and sorting using “sort”

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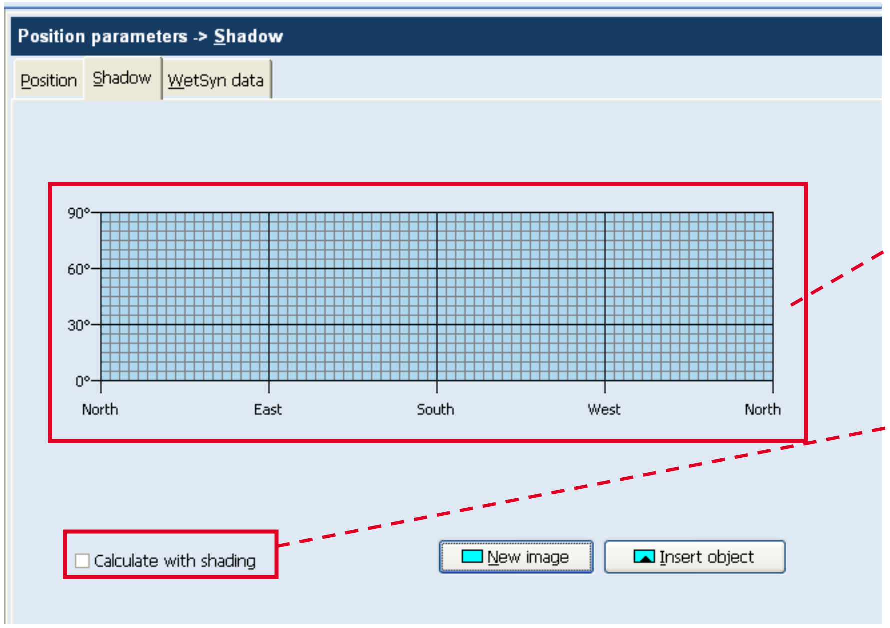
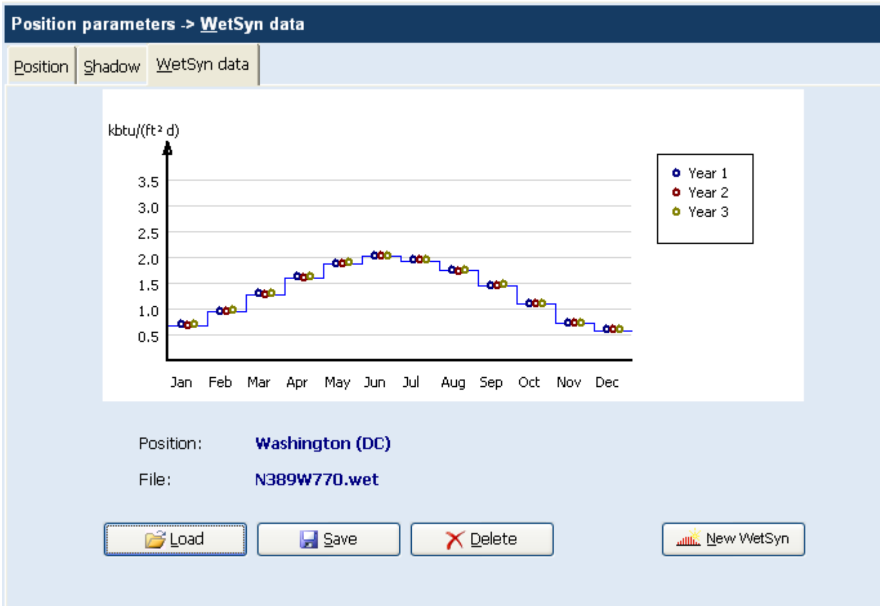
System Parameters (Position): Shadow



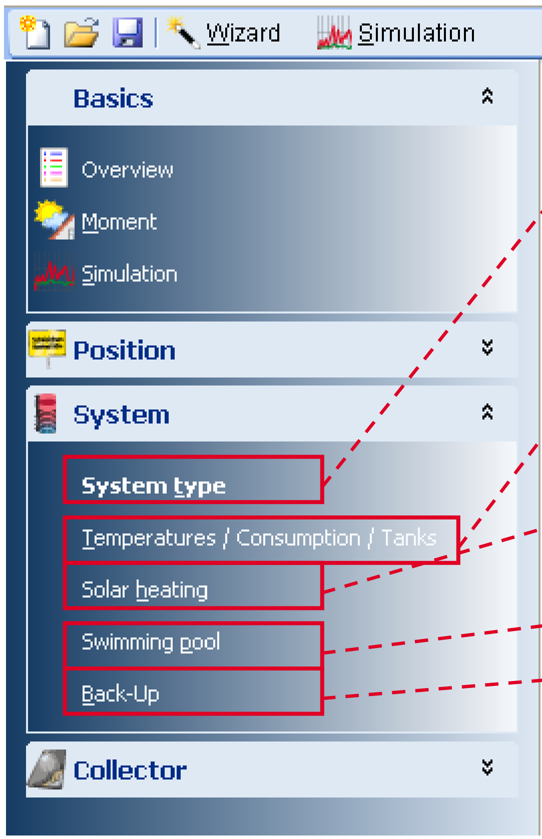
- The shadow window allows for the input of shading and locations of where projections of objects will be present
- The graph provides a visual of the location of the projections at the center of the collector array
- The “Calculate with shading” box must be checked in order to including shading in the simulation

System Parameters (Position): WetSyn Data



- WetSyn data is the meterological data used for determining amount of solar radiation hitting the collectors at the specific location

System Parameters: System



- System type: Variety of system layouts to use specific for the project
- Temperatures/Consumption/Tanks: Inputs for the system loop temperatures, DHW load, and tank sizing
- Solar heating: Specifics for solar heating
- Swimming pool
- Back-up

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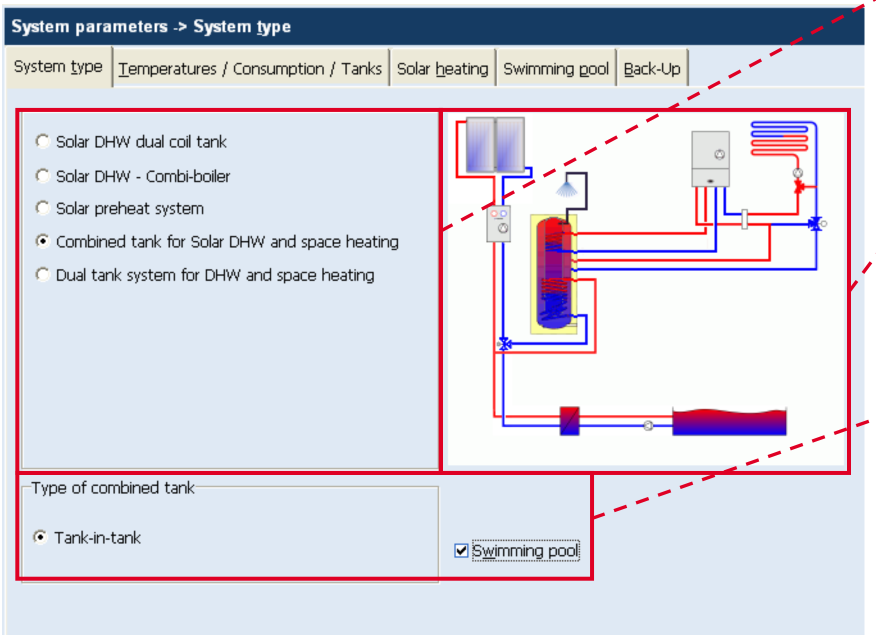
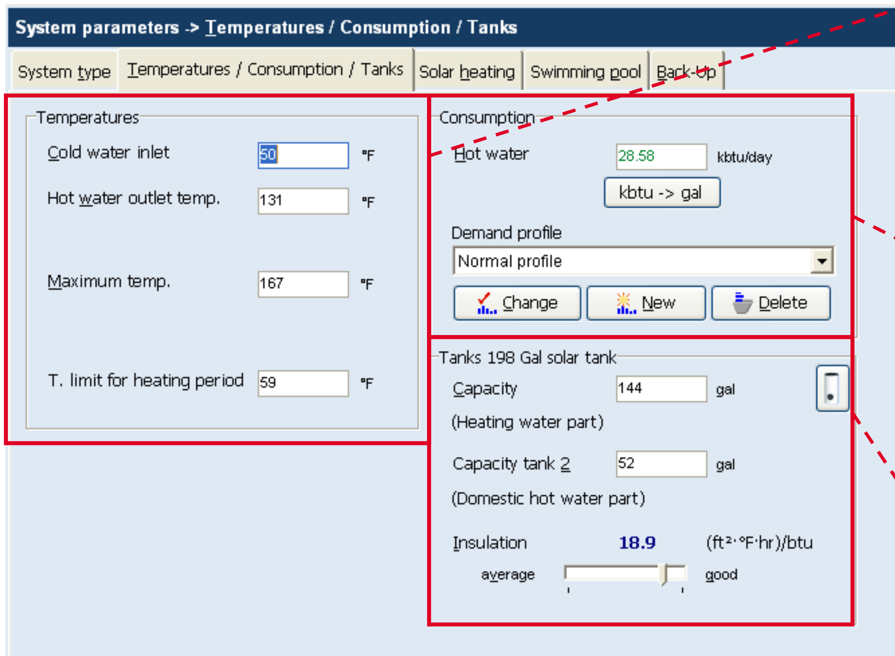
System Parameters (System): System type



- System type
  - Multiple options available to meet the most common system applications
- System Layout
  - Visual depiction of what the system layout looks like
- System specific options
  - Options may include back-up type, swimming pool, or anti legionella

System Parameters (System): Temperatures/Consumption/Tanks



- The temperatures for the collector loop, tanks, and control strategies are located on the left hand side of the screen
- The consumption section allows for changes in DHW load and DHW demand profile for daily and annual usage.
- Tank options vary based on type of system selected, with ability to change tank volume and insulation factor

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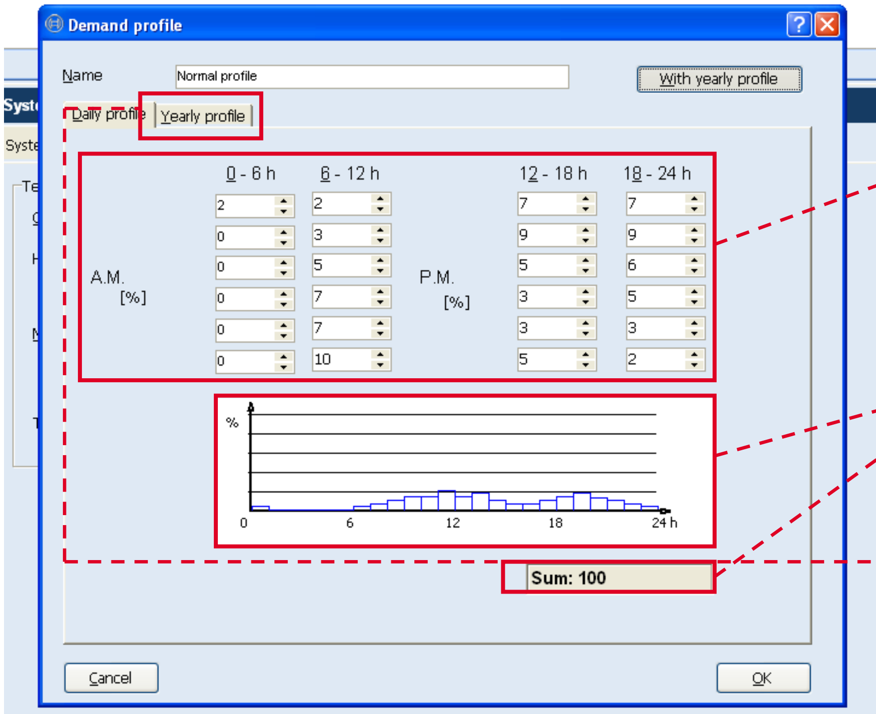
GetSolar Overview

System Parameters (System): Temperatures/Consumption/Tanks – Demand Profile



- The demand profile may be customized to be more specific to the project
- Daily profile values can be changed in this window. Ensure that all values sum up to 100
  - If not, the graph will be colored in red rather then blue advise that the sum is not 100
- Yearly profile values can be edited in the second tab

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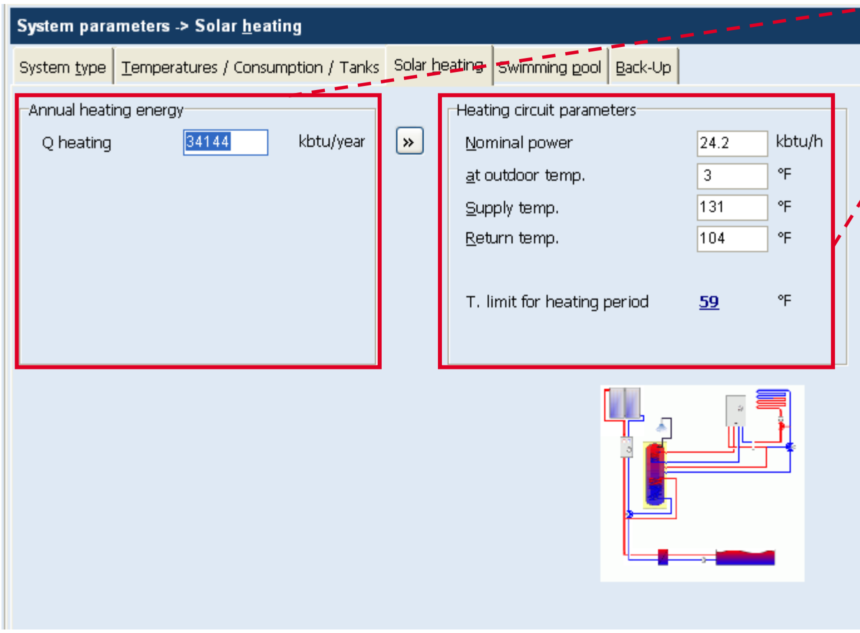
System Parameters (System): Solar heating



- Q heating is the input box for the Space Heating load in kBtu/year
- Specifics of the space heating loop including nominal power, supply temp and return may be edited on the right side

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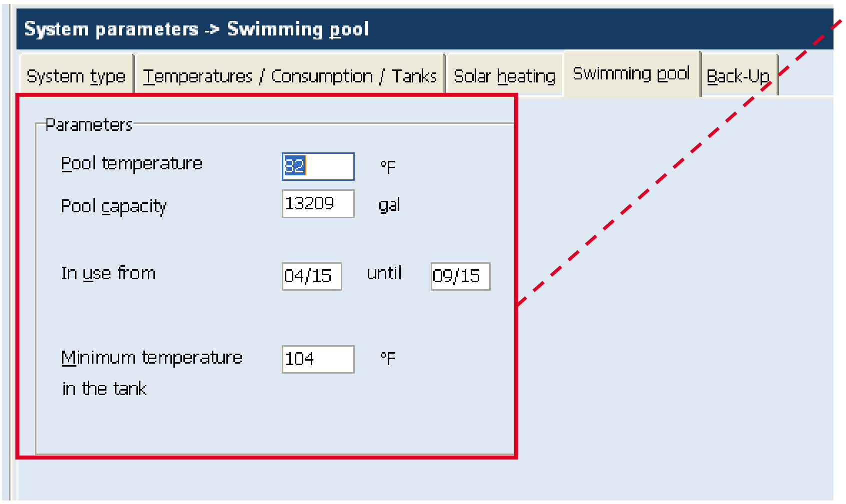
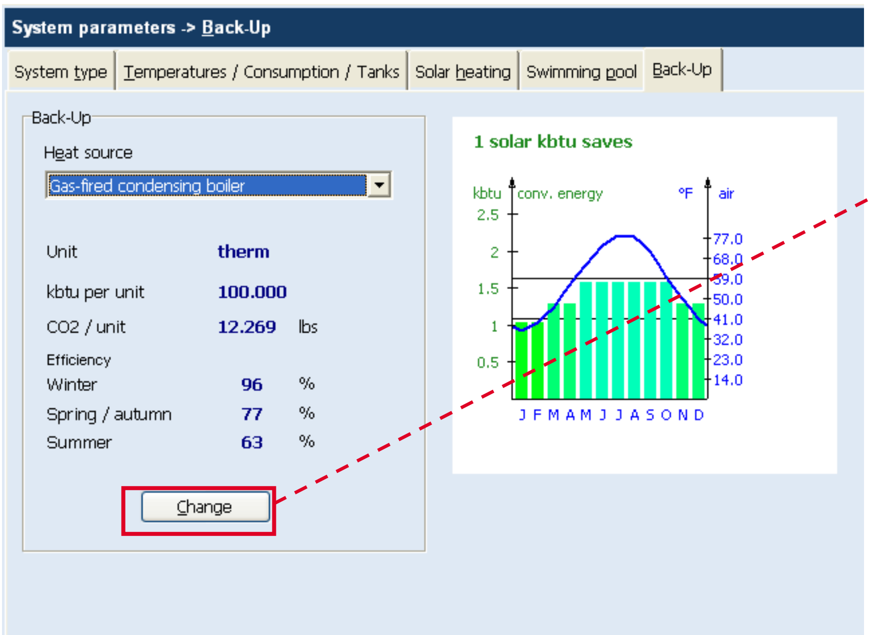
System Parameters (System): Swimming Pool



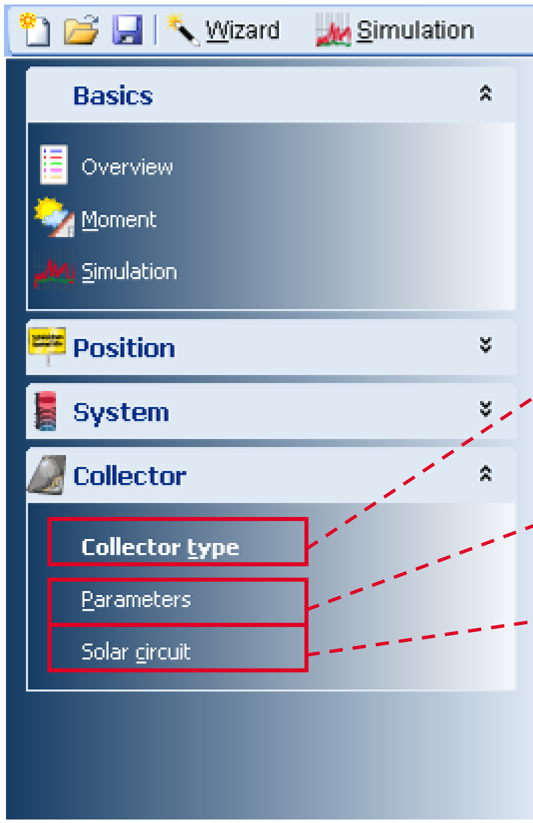
- ➔ Window for integrating pool specifics

System Parameters (System): Back-up



- Menu for selecting and editing the back-up component of the solar thermal system
- Click the change button to customize the back-up to be more specific for the project need
- The final report will use these values as defined in this section for fuel usage, CO2 offset and savings

System Parameters: Collector



- The collector menu is where changes in the collector type, positioning, and solar circuit are made.
- Collector type: change collector type and view specific collector details in this section
- Parameters: input for collector pitch and azimuth
- Solar circuit: specifics for the solar collector loop

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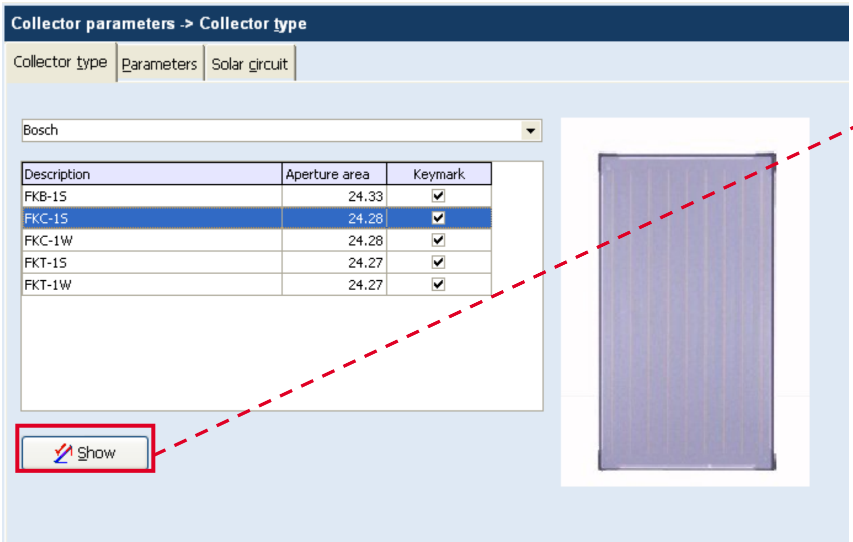
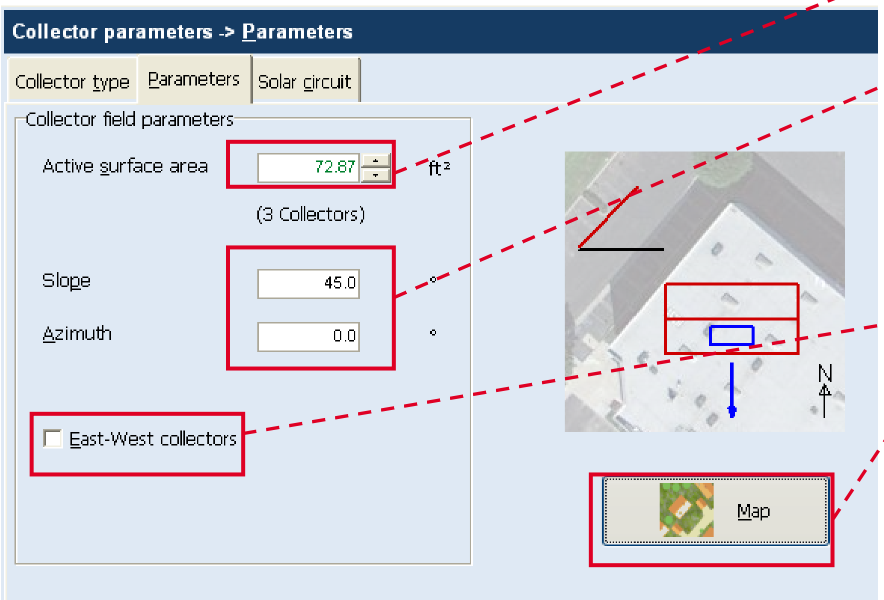
System Parameters (Collector): Collector type



- Option to select the type of collector for the system
- Details for the collector may be accessed by clicking on the “Show” button

System Parameters (Collector): Parameters



- Change the number of collectors by clicking the arrows either up or down
- The slope and azimuth may be altered also to meet project needs
  - As in the wizard window, the collector representations on the right alter as the slope and/or azimuth is changed
- There is also an option for simulating collectors installed East and West
- The map option is useful for determining the azimuth and get an idea of collector location visually.
  - To use, copy the from your computer by clicking "Print Screen" and then press the map button. The image will load up in the map section, where it can be dragged for placement

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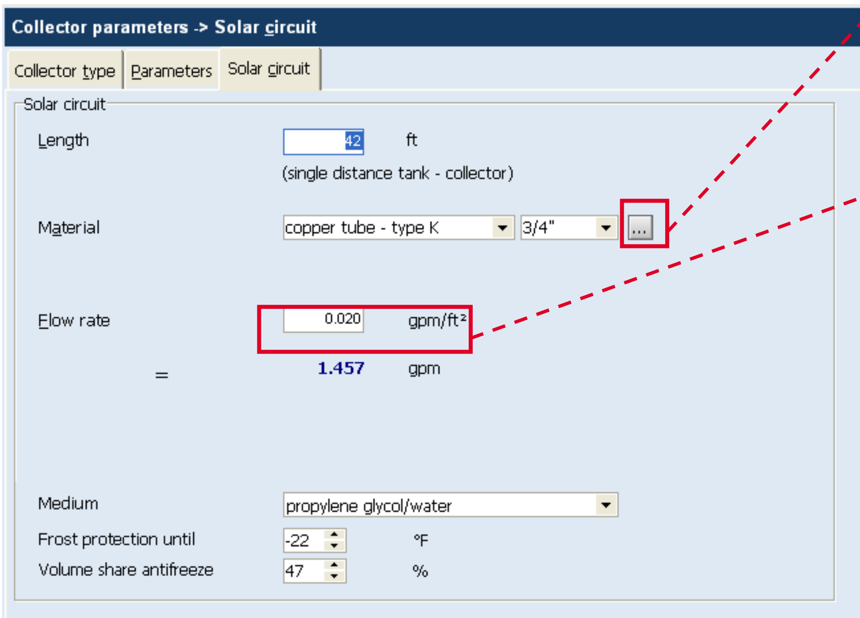
System Parameters (Collector): Solar Circuit



- The "…" button provides a sizing guide for determining the pipe diameter
- Flow Rate:
  - FKT-1: 0.009 gpm/ft²
  - FKC-1: 0.009 gpm/ft²
- The values shown for medium, frost protection, and volume share antifreeze are specific to the Bosch Tyfocor L fluid so should be kept as displayed

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Daily DHW Load Guidelines

- Residential (Based on Water Flow Rate & Sizing Guide for Commercial & Industrial Use, Marlo Incorporated):
  - 1st Resident: 20 Gallons Per Day
  - 2nd Resident: 15 GPD
  - Subsequent Resident: 10 GPD
- Commercial (Based on California Solar Initiative Thermal Program Handbook Rev 3.1):
  - Apartments/Condos: Number of units
    - 2 to 20 units: 42 GPD
    - 21 to 50: 40 GPD
    - 51 to 100: 38 GPD
    - 101 to 200: 37 GPD
    - 201 plus: 35 GPD

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Daily DHW Load Guidelines Cont.

- Student Housing: 15 GPD per unit
- Hotels/Motels: 15 GPD per unit
- Retirement/Nursing Homes: 18 GPD per room
- Office Building without Showers: 1.0 GPD per person
- Restaurants:
  - Meal Service Restaurants: 2.4 GPD per full meal served
  - Quick Service Restaurants: 0.7 Gallons per meal served
- Elementary Schools: 0.6 gal/student/day of operation
- Junior and senior high schools: 1.8 gal/student/day of operation
- Laundries: 20 GPD per 10 lbs per washing machine

Important Notes

- The software must be UN-INSTALLED from your computer before installing an upgraded version
  - To do this follow the following steps
    - Start Menu -> Control Panel -> Add or Remove Programs -> Bosch Solarsimulation US -> Remove
- Following the removal steps
  - Install the new version of GetSolar
  - Delete all files in the following folder:
    - C:\Documents and Settings\SAN1IRV\Application Data\Bosch Solarsimulation US\
- After completing the above steps, GetSolar is ready for use

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