

#### Purpose of GetSolar Ele SIMULATION Extra 3 ( BOSCH 🎦 😅 🛃 🔨 Wizard 🛛 🊂 Simulation Basics Solar thermal combi system Washington (DC) latitude: 38.9\* cation ollector Bosch FKC-1S 72 87 ft2 eta0 = 0.770 a1 = 3.681 V//(m²-K) a2 = 0.0173 V//(m²-K² 45.0\* Azimuth: 0.0\* Position Combined tank for DHW and Space Heating 198 Gal solar tank (144 + 52 gal domestic- and heating water) max. 167\*F / min. 126\*F System Collector emperature 28.58 kbtu/day = 42 gal/day from 50°F to 131°F at 1 amb c 39°F heating circuit: 131/104°F, 24 kb tu/h at 3°F at Tamb < 59°F Back Continue 🚺

- 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**



### **Project Details**

	Overview		Project: location: Collector: Dimension: Characteristics: Mounting angle: System type: Tank: temperature: required energy: Solar heating:	Solar thermal combi system         Washington (DC)       latitude: 38.9"         Bosch FKC-1S         72.87 ft <sup>2</sup> eta0 = 0.770       at = 3.681 W/(m <sup>2</sup> ·K <sup>3</sup> )         45.0"       Azimuth: 0.0"         Combined tank for DHW and Space Heating         198 Gel solar tank (144 + 52 gal domestic- and heating water) max. 167"F / min. 126"F         28.58 kktudey =       42 gal/day from 50"F to 131"F         34.14 Mitturyear heating energy at T amb. < 59"F heating circuit: 131/104"F, 24 kbtuh at 3"F
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- 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



### Wizard

	Solar thermal combi system			
	postcode         location           33601         Tampa (FL)           08601         Trenton (NJ)           85701         Tucson (AZ)           74101         Tulas (OK)           20001         Washington (CC)           LMM-L4N         Barrie           T1X-T3Z         Calgary	Count USA USA USA ) USA ) CDN CDN		
	15A-16X Edmonton B3H-B3V Halifax	CDN CDN	<u>v</u>	
ancel				

- 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



### 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



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# Wizard: DHW Only

Domestic water 46 gal/day Hot water temp. 125 °F 28.81 kbtu/day 10516 kbtu/year Solar Combisystem	sy Do
Dormestic water       46       gal/day         Hot water temp.       125       9F         28.81       kbtu/day       10516         Kbtu/gar       →	Do •
Hot water temp. 125 °F 28.81 kbtu/day 10516 kbtu/year	
28.81 kbtu/day 10516 kbtu/year	٠
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Package option 🧧	th

- 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



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# Wizard: DHW / Space Heating

Hot <u>w</u> ater temp.	125 °F	·				
	28.81 kbt	u/day	10516 kb	tu/year		
☑ Solar <u>C</u> ombisyste	m	- 1			 -	
Heating energy dem	and		34144 kb	tu/year		
Sum			44660 Kb	tu/year		
T. limit for <u>h</u> eating			59 °F			
					1	
	E	ackage option 🔼				••~
					 	_

→ 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

					1
nnual heating ei	nergy			1	1
etSolar calculates the quirement. This value	e relation b has to be	etween th given here	e solar yiel	d used for	heating in s
or systems with a hea utton [>>]. It calculate nnual course of the or <i>nnual heating energy</i>	ating water as the annu utside temp = <u>Living S</u>	r tank, the ual heating perature at <i>pace (ft</i> <b>2</b> )	annual hea energy res the chosei <i>Heat requ</i>	ting energy sulting from n position. irement (k)	y can be ma 1 the nomin: 5tu/ft3yr]
22 - 1244.		CI	imate Zon	es	
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
-value of building	Ave	rage heat kbi	ing energ u/ft² per y	y requirer ear	nent
lo insulation	45	30	23	14	5
100	32	21	16	10	4
iood	16	11	8	5	2
'ery good	9	6	5	3	1
xcellent	6	4	3	2	1
	etSolar calculates the quirement. This value or systems with a hea- titon [>>]. It calculate nual course of the ou- nowal heating energy 	etSolar calculates the relation b quirement. This value has to be or systems with a heating water itton [>>]. It calculates the ann nual course of the outside tem <i>course</i> of temp <i>course</i> of	etSolar calculates the relation between the quirement. This value has to be given here or systems with a heating water tank, the inton [>>]. It calculates the annual heating nual course of the outside temperature at onual heating energy = Living Space (D2) Con 2 Con 1 Zone 2 Con 1 Zone 2 Con 1 Zone 2 Con 2 Con 2 Con Con 32 Con Coo 32 Con Coo 16 11 Coo 16 11 Coo 9 6 Spood 9 6 Coc 4	etSolar calculates the relation between the solar yiel quirement. This value has to be given here. or systems with a heating water tank, the annual heat totor [>>]. It calculates the annual heating energy re- nual course of the outside temperature at the chosen onual heating energy = Living Space (It3) × Heat requi- to an energy = Living Space (It3) × Heat requi- course of the outside temperature at the chosen onual heating energy = Living Space (It3) × Heat requi- value of building Average heating energy kbtu/ft <sup>2</sup> per y lo insulation 45 30 23 'oor 32 21 16 food 16 11 8 fery good 9 6 55 ixcellent 6 4 3	etSolar calculates the relation between the solar yield used for quirement. This value has to be given here. or systems with a heating water tank, the annual heating energy titon [>>]. It calculates the annual heating energy nual course of the outside temperature at the chosen position. <u>nowal heating energy = Living Space (It2 × Heat requirement (kit</u> ) <u>Climate Zones</u> <u>Zone 1</u> Zone 2 Zone 3 Zone 4 <u>Value of building</u> <u>Climate Zones</u> <u>kbtu/ff<sup>2</sup> per year</u> <u>lo insulation</u> <u>45</u> 30 23 14 <u>Yoor</u> <u>32</u> 21 16 10 <u>Good</u> <u>16</u> 111 8 5 <u>fery good</u> <u>9</u> 6 5 3 <u>ixcellent</u> <u>6</u> 4 3 22

- 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/r ecs97/zonemap.pdf



### **Climate Zone Map**

#### U.S. Climate Zone Map



### 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

🗐 Bosch Solar Simulation	System Parameters:
Eile SIMULATION E <u>x</u> tra <u>?</u>	<ul> <li>Basics: include overview, moment, and simulation</li> <li>Position (location): position,</li> </ul>
Mizard     Basics     Overview     Moment     Simulation	<ul> <li>shadow (shading), WetSyn data (meteorological data)</li> <li>System: System type, temperatures/consumption/tanks, space heating, pool, and back-up</li> </ul>
Position     *       System     *       Image: Collector     *	<ul> <li>Collector: collector type, parameters, solar circuit</li> </ul>
	BOSCH

### 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



### 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.



### 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
  - Direct light = irradiation on a plane vertical to the direct light
  - Diffuse light = diffuse light on the horizontal plane
  - Irradiation on 1m<sup>2</sup> of active collector surface-Irradiation on the whole active surface of the collector
  - Collector feed temperature
  - Collector stagnation temperature



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### 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



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# System Parameters (Basics): Simulation Results

Simulation r	esults							X
energy balan	ce eco-ba	alance Gra	aphs Curve	s				
Project: location: Collector: Characteristi Mounting ang System type: Tank: temperature:	S Vi 7 cs: e gle: 4 C 1 r	olar therm /ashington 2.87 ft <sup>a</sup> ta0 = 0.770 5.0° combined ta 98 Gal sola 1ax, 167°F/	al combisy (DC) latii Bos a1 = 3.68° Azin ank for DHW ar tank (144° min. 126°F	stem tude: 38.9" sch FKC-18 I W/(m <sup>2,</sup> K) muth: 0.0" ( and Space + 52 gal do	a2 = 0.011 Heating mestic-ar	73 WW(mª·K록) nd heating w	vater)	Image: Solar yield       Image: Eco balance
requirea ene	rgy: 2 3	8.58 kbtu/d 4.14 Mbtu/y	ay = 42 rearheating	gai/day fron energy	n 50°F to 1	31*F		Text 1
Solar heating	): a'	t⊤amb.<{	59°F hea	ating circuit:	131/104°F	, 24 kbtu/h	at 3°F	
Month	solar yield	Solar heating	solar ' irradiation	back up energy	Solar fra dhw	nction heating	efficiency	Text 2 🕼
January: February: March:	1084 1357 1703	715 1017 1340	2507 2860 3439	174 167 176	38 38 37	9 16 26	43 47 50	
April: May: June:	1598 1056 1002 1043	1041 0 0	3485 3769 3688 2740	128 9 1	59 101 98	46 0 0	46 28 27 28	Image 2 42
August: September: October:	1043 1047 954 1438	0 0 834	3679 3499 3293	3 12 104	99 93 61	0 0 54	28 27 44	
November: December: Total:	1209 916 14406	911 <u>596</u> 6454	2360 2040 38367	184 <u>179</u> 1144	32 34 67	21 9 19	51 <u>45</u> 38	
factor of savir specific annu	ngs for sdh Ial collecto	w and spa ryield: <b>19</b> 4	ce heating: 8 kbtu/ft²	31.3%				
								Done

- 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

genergy balance       eco-balance       graphs       Curves         Project:       Solar thermal combi system       image: system       image: system       image: system         location:       Washington (DC)       latitude: 38.9"       image: system       image: system       image: system         Dimension:       72.87 ft <sup>a</sup> Bosch FKC-1S       image: system       <	
Project:       Solar thermal combi system         location:       Washington (DC)       latitude: 38.9"         Dimension:       72.87 ft <sup>a</sup> Bosch FKC-1S         Mounting angle:       45.0"       Azimuth: 0.0"         System type:       Combined tank for DHW and Space Heating (4)       Image: 28.58 kbtu/day = 4.42 gal/day from 50°F to 131°F         Solar heating:       at T amb, < 59°F       heating circuit: 131/104°F, 24 kbtu/h at 3°F	
conv. energy:         Gas-tired condensing boiler           fuel utilization eff:         96% / 77% / 63% in winter / spring, autumn / summer         Text 1 %           Month         solar         energy         CO2.           yield         saving         saving         Text 2 %           Itentilization eff:         96% / 77% / 63% in winter / spring, autumn / summer         Text 2 %           Month         solar         energy         CO2.           yield         saving         saving         Text 2 %           Itentilization eff:         96% / 77% / 63% in winter / spring, autumn / summer         Text 2 %           March:         1703         2212         22         271           April:         1598         2154         22         264           May:         1065         1675         17         206           June:         1002         1631         166         195           July:         1043         1656         17         203           August:         1047         1662         17         204           September:         946         1052         11         129           Total:         14406         19731         197	
Doge	

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



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# System Parameters (Basics): Simulation Results



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



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# 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



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### **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.



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### **Project Report**

Bosch Solar S	Simulation 2.0.11	- Solar simu	Ilation -	
Project infor	mation			
Name	Solar the	rmal combi system		
location	Washingt	on (DC)		
Bosch FKC-1S 153.1 ft <sup>2</sup> Gross 45.0° Moun 0.0° Azimu combined tank 198 Gal solar ta 288 + 103 gal (domestic- and	s area ting angle uth ank heating water)			dom. hot water <b>100 gal/day with 125°F</b> heating energy <b>34.14 Mbtu/year</b> 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**

required energy       Hot water and storage heat losses       25190 kbtu/year         heating energy       34144 kbtu/year         For tal       65334 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       188 kbtu/ft <sup>2</sup> based on the collector gross area       16369 kbtu/year         solar yield       dom. hot water       16369 kbtu/year         Heating       12429 kbtu/year         Total       28798 kbtu/year         eco balance       energy saving       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 model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration on lt does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing idesign analysem by a qualified engineer. Before implementing idesign and assume parameters that have left to the results of the pr-design simulation should be checked against the ad esign parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Themotechnology       10	required energy       Hot water and storage heat losses       25190 kbtu/year         heating energy       74144 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       188 kbtu/ft <sup>2</sup> based on the collector gross area       188 kbtu/ft <sup>2</sup> solar yield       dom. hot water       6369 kbtu/year         Heating       12429 kbtu/year         Total       29798 kbtu/year         eco balance       energy saving       39724 kbtu/year         CO2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration onli to dees not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing i design, and assumed parameters that have led to the results of the pre-design simulation should be checked against the ar design parameters. The responsibility for carnying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       1025/2010 5.26.28 PM -	required energy       Hot water and storage heat losses       25190 kbtu/year         heating energy       74144 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       188 kbtu/ft <sup>2</sup> based on the collector gross area       188 kbtu/ft <sup>2</sup> solar yield       dom. hot water       16369 kbtu/year         Heating       12429 kbtu/year         Total       28798 kbtu/year         eco balance       energy saving       39724 kbtu/year         CO2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration on it design and specification of a solar themal system by a qualified engineer. Before implementing idesign, all assumed parameters that have led to the results of the pre-design simulation should be checked against the ad design parameters. The responsibility for carnying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5/26/28 PM -	Results		
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       188 kbtu/ft²         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       3977 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 model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration onbul to design, and aspecification of a solar thermal system by a qualified engineer. Before implementing 1 design, and aspecification of a solar theres stim shave led to the results of the pr-design simulation should be checked against the act design anatheres. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5/26/28 FM - 1	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       188 kbtu/ft²         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         O2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from 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 1 design, and assumed parameters that have led to the results of the pr-design simulation should be checked against the act design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5.26/28 PM - 1	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       188 kbtu/ft²         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         O2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from 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 1 design, and assumed parameters that have led to the results of the pre-design simulation should be checked against the act design anamaters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5.26:28 PM - 1	required energy	Hot water and storage heat losses heating energy Total	25190 kbtu/year 34144 kbtu/year 59334 kbtu/year
Key values         Efficiency specific annual collector yield based on the collector gross area         37.5%           solar yield         dom. hot water Heating         128 kbtu/ft <sup>2</sup> solar yield         dom. hot water Total         16369 kbtu/year 12429 kbtu/year           eco balance         energy saving         39724 kbtu/year           O2 reduction         4874 lbs/Year           The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration of it does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing idesign, all assumed parameters that have led to the results of the pr-design simulation should be checked against the act design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.           © 2010 Bosch Thermotechnology         1025/2010 5:26:28 PM - 1	Key values         Efficiency specific annual collector yield         37.5%           solar yield         dom. hot water         188 kbtu/ft <sup>2</sup> solar yield         dom. hot water         16369 kbtu/year           Total         28798 kbtu/year           eco balance         energy saving         39724 kbtu/year           OC2 reduction         4874 lbs/Year	Key values       Efficiency specific annual collector yield based on the collector gross area       37.5%         solar yield       dom. hot water Heating       128 kbtu/ft <sup>2</sup> solar yield       dom. hot water Total       16369 kbtu/year 12429 kbtu/year         eco balance       energy saving       39724 kbtu/year         CO2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration on it does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing idesign, all assumed parameters that have led to the results of the pre-design simulation should be checked against the ad design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5.26:28 PM -1	Solar fractions	dom. hot water Heating factor of savings for sdhw and space heating	65.0% 36.4% 48.5%
solar yield dom, hot water Heating 12429 bktu/year Heating 12429 bktu/year Total 28798 kbtu/year eco balance energy saving 39724 kbtu/year BCO2 reduction 4874 lbs/Year The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from 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 i design, all assumed parameters that have led to the results of the pre-design simulation should be checked against the ac design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer. © 2010 Bosch Thermotechnology 10/25/2010 5:26:28 PM - 1	solar yield dom, hot water Heating 12429 bktu/year Heating 12429 bktu/year Total 28798 kbtu/year eco balance energy saving 39724 kbtu/year CO2 reduction 4874 lbs/Year CO2 reduction 4874 lbs/Year The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration on It does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing I design, all assumed parameters that have led to the results of the pre-design simulation should be checked adjams the act design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.	solar yield       dom, hot water Heating Total       16369 kbtu/year 12429 kbtu/year         eco balance       energy saving       39724 kbtu/year         eco balance       energy saving       39724 kbtu/year         Box       CO2 reduction       4874 lbs/Year         The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from model due to variations in weather, patterns of use and other variables. The shown system schematic is for illustration onh It does not substitute the design and specification of a solar thermal system by a qualified engineer. Before implementing in design, all assumed parameters that have led to the results of the pre-design simulation should be checked against the act design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.         @ 2010 Bosch Thermotechnology       10/25/2010 5:26:28 PM - 1	Key values	Efficiency specific annual collector yield based on the collector gross area	37.5% 188 kbtu/ft <sup>2</sup>
eco balance     energy saving     39724 kbtu/year       397     therm     397       CO2 reduction     3974 kbtu/year       397     therm       Mark 105/Year     4874 lbs/Year	eco balance       energy saving       39724 kbtu/year         397 therm       397 therm         CO2 reduction       4874 lbs/Year	eco balance       energy saving       39724 kbtu/year         397 therm       397 therm         CO2 reduction       4874 lbs/Year	solar yield	dom, hot water Heating Total	16369 kbtu/year 12429 kbtu/year 28798 kbtu/year
The results are being calculated using a mathematical model. The actual solar output and energy savings may differ from 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 t design, all assumed parameters that have led to the results of the pre-design simulation should be checked against the ac- design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer. © 2010 Bosch Thermotechnology 10/25/2010 5:26:28 PM - ;	the results are being calculated using a mathematical model. The actual solar output and energy savings may differ from 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 design, all assumed parameters that have led to the results of the pre-design simulation should be checked against the ac design parameters. The responsibility for carrying out this check rests with the designer, installer, developer or customer.  © 2010 Bosch Themotechnology	CO2 reduction         4074 ibs real         CO2 reduction         4074 ibs real         CO2 reduction         4074 ibs real         CO2 reduction         CO2 reduction	eco balance	energy saving	39724 kbtu/year 397 therm
© 2010 Bosch Thermotechnology 10/25/2010 5:26:28 PM - 1	© 2010 Bosch Thermotechnology 10/25/2010 5:26:28 PM -	© 2010 Bosch Thermotechnology 10/25/2010 5:26:28 PM - 1	model due to variation It does not substitute design, all assumed p	calculated using a mathematical model. The actual solar outp ns in weather, patterns of use and other variables. The shown the design and specification of a solar thermal system by a qu parameters that have ied to the results of the pre-design simula	ut and energy savings may differ from system schematic is for illustration only alified engineer. Before implementing t ation should be checked against the ac
			model due to variatio It does not substitute design, all assumed p design parameters. T	calculated using a mathematical model. The actual solar outp ns in weather, patterns of use and other variables. The shown the design and specification of a solar thermal system by a qu parameters that have led to the results of the pre-design simul, the responsibility for carrying out this check rests with the design	ut and energy savings may differ from i system schematic is for illustration only alified engineer. Before implementing t ation should be checked against the ac gner, installer, developer or customer.

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



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### **Project Report**

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

Bosch Solar Simula	tion 2.0.11	- energy balance -
Project:	Solar therma	I combi system
location:	Washington (DC	atitude: 38.9°
Collector:	145.70 ft <sup>2</sup> (6 pcs	Bosch FKC-1S
Characteristics:	eta0 = 0.770 a	1 = 3.681 W/(m <sup>2</sup> K) a2 = 0.0173 W/(m <sup>2</sup> K <sup>2</sup> ) [Solar Keymark]
Mounting angle:	45.0°	Azimuth: 0.0°
System type:	Combined dom	estic- and heating water tank
Tank:	198 Gal solar ta max. 179°F / mi	nk (288 + 103 gal domestic- and heating water) n. 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	Solar	solar	back up	Solar fra	ction	efficiency
	yield	heating *	irradiatio	n energy **	dhw	heating	
	[kbtu]	[kbtu]	[kbtu]	[kbtu]	[%]	[%]	[%]
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

ition	l ale al a su l a	water day	
nuon	<u>Snadow</u>	wetsyn data	
<u>k</u>	00510000	Tempo (FL)	
	33001 D0604	Tampa (FL)	
	JOUUI 95704	Trenton (NJ)	UBA
	744.04	Tulco (QL)	LICA
Ľ	20004	Machington (DC)	USA
	AMJI ANI	Barrie	CDN
	L4WFL414	Calmany	
	T5A-T6X	Edmonton	CDN
	10/410/	Halifay	CDN
6	5511 557	Trainax.	
	P Eind		
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	Find	it gort	
	Find	Terr Sort	
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	Find	The second secon	
	Find	Terr Sort	
	T Eind	The second secon	

- 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"



# 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

Position	Shadow	WetSyn data		
Fosicion	2010000	<u></u>		
	kbtu/(	6+2 d)		
	ND(d)(	<b>≜</b>		
	3	.5	• Year 1	
	3	.0	o Year 3	
	2	.5		
	2	.0		
	1	.5	200 <sup>-</sup> _200-	
	1	5	L000-L000-	
	Ŭ			
		Jan Feb M	lar Apr May Jun Jul Aug Sep Oct Nov Dec	
	F	ile:	N389W770.wet	
	F	ile : 🎽 Load	N389W770.wet	tSyn
	F	ile :	N389W770.wet	Syn
	F	ile:	N389W770.wet	Syn
	F	ile:	N389W770.wet	ISyn
	F	ile:	N389W770.wet	ISyn
	F	ile:	N389W770.wet	Syn
	F	ile:	N389W770.wet	ISyn
	F	ile:	N389W770.wet	ISyn
	F	ile:	N389W770.wet	ISyn

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



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### System Parameters: System



- System type: Variety of system layouts to use specific for the project
- Temperatures/Consumption/Tank
   s: 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

Temperatu	ires			Consumptio	n				
<u>C</u> old wat	er inlet	50	۴F	Hot water		28.58	kbtu/day		
Hot <u>w</u> ate	r outlet temp.	131	۳F		[	kbtu -> ga			
				Demand p	rofile				
Məvimun	o temp	467		Normal p	rofile			-	
<u></u> aximan	n emp.	107	F	<b></b> _Cha	inge	<mark>∦.</mark> <u>N</u> ew	Delet	e	
				-Tanks 198 (	al solar tan	ık			
T. limit fi	or heating period	59	۳F	<u>C</u> apacity		144	gal		
				(Heating v	vater part)				1
				Capacity f	tank <u>2</u>	52	gal		
				(Domestic	hot water	part)			
				Insulation		18.9	(ft²·°F·hr)/bi	tu	
				a <u>v</u> erag	e		good		
					1	'			
									1

- 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



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

Syst Syst	Operand profile         With yearly profile           Varie         Normal profile         With yearly profile           0 <td< th=""><th>→</th><th>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</th></td<>	→	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
37			<b>BOSCH</b>



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# System Parameters (System): Solar heating

Annual heating energy Q heating 14144 kbtu/year Normal power 24.2 kbtu/h at outdoor temp. 3 °F Supply temp. 131 °F Return temp. 104 °F T. limit for heating period 59 °F	Annual heating energy Q heating 1414 kbtu/year Q heating 1414 kbtu/year Nominal power 4.2 kbtu/h at outdoor temp. 3 °F Supply temp. Beturn temp. 104 °F T. limit for heating period 59 °F	Annual heating energy Q heating 41144 kbtu/year () () () () () () () () () () () () () (	Annual heating energy Q heating 31144 kbtu/year P Mominal power 24.2 kbtu/h at outdoor temp. 3 °F Supply temp. 131 °F Beturn temp. 104 °F T. limit for heating period 59 °F	System <u>t</u> ype		/ Consumption / Tank	s Solar h	eating swimming poo	I <u>B</u> ack-Up			
				-Annual heat	ing energy 3	4 kbtu/year	»	Heating circuit param Nominal power at outdoor temp. Supply temp. Return temp. T. limit for heating	period	24.2 3 131 104 59	kbtu/h °F °F °F	
							]					
									L		•	

 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



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# 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

ollector type Parameters S	olar <u>c</u> ircuit
Solar circuit	
Length	42 ft
	(single distance tank - collector)
M <u>a</u> terial	copper tube - type K 💌 3/4" 💌 🛄
	and the second
Elou rata	0.020 mm (#2
Elow rate	0.020 gpmyrt-
=	1.457 gpm
Medium	propylene glycol/water
Frost protection until	-22 🗘 °F
Volume share antifreeze	47 🛟 %

- The "…" button provides a sizing guide for determining the pipe diameter
- → Flow Rate:
  - FKT-1: 0.009 gpm/ft<sup>2</sup>
  - FKC-1: 0.009 gpm/ft<sup>2</sup>
- 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):
  - 1<sup>st</sup> Resident: 20 Gallons Per Day
  - 2<sup>nd</sup> 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



# Contact Info

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