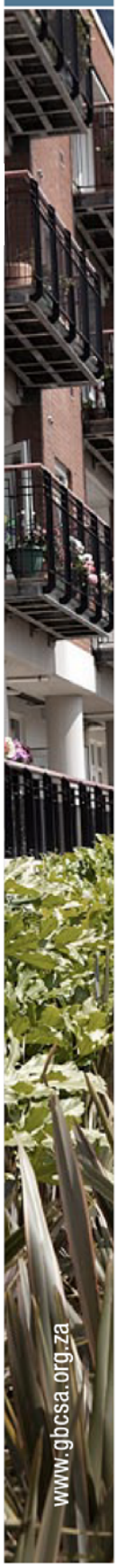
Green Star SA - Multi Unit Residential v1

HOT WATER CALCULATOR GUIDE

Version 1.0



GREEN BUILDING COUNCIL
OF SOUTH AFRICA

Green Star SA Multi Unit Residential v1

Hot Water Calculator Guide

First Released: 27th October 2011

Last Update: 27th October 2011

Change Log

Date	Changes

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1 Introduction

The aim of the Hot Water Calculator (the 'Calculator') is to estimate the energy use and associated emissions from a dwelling's hot water heating systems in order to reward efficient hot water systems. The calculation method used is based on the UK Standard Assessment Procedure for dwellings (SAP) 2005 and 2009.

The actual project emissions for heating hot water are estimated, and are compared with a notional project where the 50% of the hot water demand is provided with a heat pump (with a seasonal COP of 3.0) and 50% is heated with an electric resistance element. Points are then awarded based on the percentage improvement over the notional building.

There are two ways to improve the score:

1) To reduce hot water consumption by using efficient amenity fittings as entered into the Potable Water Calculator.

2) To improve the greenhouse gas emission efficiency of the heating system, such as using solar energy or gas.

IMPORTANT NOTE: The use of the Calculator is strictly for benchmarking purposes in Green Star SA – Multi Unit Residential v1 only and **MUST NOT** be used for the design or sizing of solar water heating systems.

2 Dwelling Information

Dwelling information from the Input sheet is transferred automatically to the calculator. Note that the water consumption is based on the Potable Water Calculator results and thus this should be completed first.

IMPORTANT NOTE: *The Potable Water Calculator must be completed PRIOR to completing the Hot Water Calculator, regardless of whether points are being claimed in Wat-1 Occupant Amenity or not.*

Once the Potable Water Calculator is completed and reference and estimated consumption figures are determined, the calculator estimates the amount of thermal energy required by each dwelling type for both the notional and actual dwelling types. Figure 1 (over page) displays the dwelling type information which is generated automatically from the Building Input page and the Potable Water Calculator.

HOT WATER ENERGY USE							
Dwelling details				Notional Dwelling			
						Consumption Data	
Type #	Dwelling Type Name	Number of this type	Design occupancy	Hot Water Consumption (L/year)	Hot Water GHG emissions ($kgCO_2e$/year)	Hot Water Consumption (L/year)	Hot Water Energy Requirement (kWh/year)
1	1 bedroom - East	5	2	29 872	1 389	25 415	1 334
2	1 bedroom - North	14	2	29 872	1 389	25 415	1 334
3	2 bedroom - East	7	3	44 807	2 084	38 122	2 001
4	2 bedroom - North	15	3	44 807	2 084	38 122	2 001
5	Penthouses	4	5	74 679	3 473	63 537	3 336
6							

Figure 1: Dwelling type and notional / actual hot water demands

3 Calculator Guidance

To commence, the user must enter whether the *Compulsory Initiative* for the Ene-7 Hot Water Energy Use. See the Green Star SA – Multi Unit Residential v1 Technical Manual for more details.

3.1 Hot Water System Types

The Calculator can account for solar water heating systems, gas boilers, heat pumps and cogeneration (waste heat) systems. The Calculator does not distinguish between centralised systems with reticulation, or decentralised (i.e. individual) systems. As such, there is no difference in how the Calculator is used for centralised or decentralised hot water systems.

For each dwelling type the 'Primary hot water system' can be selected from the following systems:

- Heat pump
- Solar
- Boiler
- Waste heat (Cogeneration)

Different systems can be selected for each dwelling type. When a system is selected for a dwelling type, additional input fields become available.

Each system and the additional fields are described below.

a) Solar Hot Water Systems

Where the development is provided with solar hot water systems, the type of solar collector must be selected. The solar collector input panel is displayed in Figure 2.

SOLAR COLLECTOR SPECIFICATIONS (IF APPLIC.)	User Defined	Default Values
Solar Collector Type:	Flat Plate (Glazed)	
Zero-Loss' Collector Efficiency:		0.75
Collector Heat Loss Coefficient:		6
Ratio of Aperature Area to Gross Area:		0.9
Site Location:	Climatic Zone 1 (Johannesburg)	

Figure 2: Solar collector input panel

Three common solar collector technologies can be selected for the development:

- Flat plate (glazed);
- Unglazed; or
- Evacuated tube;

Users may enter performance specification data of the actual solar collector system used, with reference to supporting documentation (i.e. manufacturer product datasheet of the system). The data required is;

- The Zero-loss collector efficiency (defined below);
- The heat loss coefficient (defined below); and,
- Aperture area ratio.

Zero-loss collector efficiency (%): Ratio of solar energy that is absorbed by the collector excluding thermal loss.

Collector heat loss coefficient U [W/(m2K)]: Total heat loss from the collector due to convection and radiation per unit area and temperature difference.

However, where a generic system is used or the actual performance specifications of a system are unknown, default values provided within the Calculator may be used.

The user must select the site location such that the Calculator uses accurate solar radiation data. The available climate zones are the 6 Climatic zones as defined in SANS 204:2011, and selection of climate zone must be based on this.

The additional data fields which must be completed are displayed in Figure 3 below.

Solar Water Heating System Data							
Panel Area (m^2)	Panel Orientation	Tilt Angle (from horizontal)	Panel Overshading	Storage Tank Volume (L)	Estimated Solar Energy Harvest (kWh)	Supplementary Heating Energy Required (kWh)	Type of Supplementary Hot Water System
4.00	North	30°	Very little (< 20%)	300	1 033	302	Heat Pump
4.00	North	30°	Very little (< 20%)	300	1 033	302	Heat Pump
6.50	North	30°	Very little (< 20%)	350	1 508	493	Heat Pump
6.50	North	30°	Very little (< 20%)	350	1 508	493	Heat Pump
8.00	North	30°	Very little (< 20%)	400	2 233	1 102	Heat Pump

Figure 3: Solar hot water system input data fields

A review of each input into the solar water heating system data field is provided in Table 1 (over page).

Data	Comment
Panel area (collector area)	Total panel area (including the frame) per dwelling type in square meters.
Orientation	User to select orientation closest to actual orientation from drop down list (e.g. North can be taken as ±22.5° from true North).
Tilt	Angle of the panel from the horizontal. Five options are provided ranging from horizontal to vertical and the most appropriate must be selected.
Overshadowing	This takes into account shading from buildings and vegetation. Four options ranging from very little (<20%) to heavy (>80%) can be selected (this is a rough estimation that does not require modelling).
Storage volume	The volume of the pre-heat store or the dedicated solar volume of a combined cylinder (in Litres).
Type of Supplementary Hot Water System	Most solar water heating systems have a backup/top up heating source (e.g. electric immersion element), which must be considered the supplementary system. The supplementary system should be selected, and the required data entered into 'Heat pump data' and/or 'Fuel data', depending on the selection.

Table 1: Solar hot water system input data.

b) Heat Pump Hot Water Systems

The only data which needs to be entered for heat pump systems is the Coefficient of Performance (COP) and data on the fuel type. A review of each input for heat pump systems data is provided in Table 2.

Data	Comment
Coefficient of Performance (COP)	If the seasonally adjusted COP (SCOP) is available this should be used. However, as the seasonal data is not commonly available from most heat pump manufacturers in South Africa it is acceptable to use the rated COP given by the manufacturer.
Fuel Type	The fuel type for the heat pump (most commonly mains electricity).
Recovery Efficiency	Only applicable for non-electric fuel sources.

Table 2: Heat pump hot water system input data.

c) Boiler Hot Water Systems

These include direct electric resistance boilers and boilers using other fuel sources. A review of each input for heat pump systems data is provided in Table 3 (over page).

Data	Comment
Fuel Type	The fuel type for the heat pump (most commonly mains electricity).
Recovery Efficiency	This measures how efficiently energy is transferred to the water from the fuel. If unknown a default value of 100% is used for electric boilers and 75% for other fuels (due to heat lost in the plume gases). If the efficiency is known this can be entered and the specification should be highlighted in the documentation.

Table 3: Boiler hot water system input data.

In the case of dwellings with instantaneous gas boilers (i.e. no hot water storage), the rated/default recovery efficiency may be multiplied by a factor of 1.2 to account for the lack of storage heat loss. Instantaneous electric water heaters do not generally provide such a large increase in efficiency and thus no factor is applied to these.

d) Waste Heat Hot Water Systems

No data entry is required for this option. It shall only be used when all the heat used to heat domestic hot water for a particular dwelling type comes from waste heat, such as from co-generation. The water heating of cogeneration systems is taken as carbon neutral and no fuel data needs to be entered.

Peak load calculations must be provided to demonstrate that sufficient heat is available at peak demand periods. If the amount of heat available from the waste source is not sufficient to meet 100% of the hot water demand (e.g. electric backup heating is provided), then the GBCSA requests that a Credit Interpretation Request be submitted outlining an alternative calculation methodology.

3.2 Notes

If several dwellings are supplied with hot water from a centralised system the entries still need to be completed for each dwelling type. For example, if there is a large heat pump serving several dwelling types enter the same COP for every dwelling type.

If there is a centralised solar system for all dwellings or for a group of dwellings, the total panel area and storage volume should be divided between the dwelling types in proportion to the predicted hot water demand for each type.

For example, a development contains 4 dwellings of dwelling type A, with a number of other different dwelling types. The predicted hot water consumption for dwelling type A is 60 kL/year (each), while the total for the development is 1200 kL/year.

Thus the proportion of hot water used in one dwelling is: 60/1200 = 0.05

The development has a centralised solar system that serves all dwellings with a panel area of 20m2 and two tanks with a combined volume of 5000L.

Thus for each dwelling in dwelling type A, the effective panel area is: 20x0.05 = 1m2. Similarly the effective tank volume is: 5000x0.05 = 250L.

If a centralised solar system is used the project team should provide a table showing how the effective panel area and tank size was determined for each dwelling type.

3.3 Results

Based on all of the data entered into the Hot Water Calculator, the Calculator determines the total greenhouse gas emissions associated with hot water generation for the development, for both the notional and actual scenarios. This is illustrated in Figure 4, below.

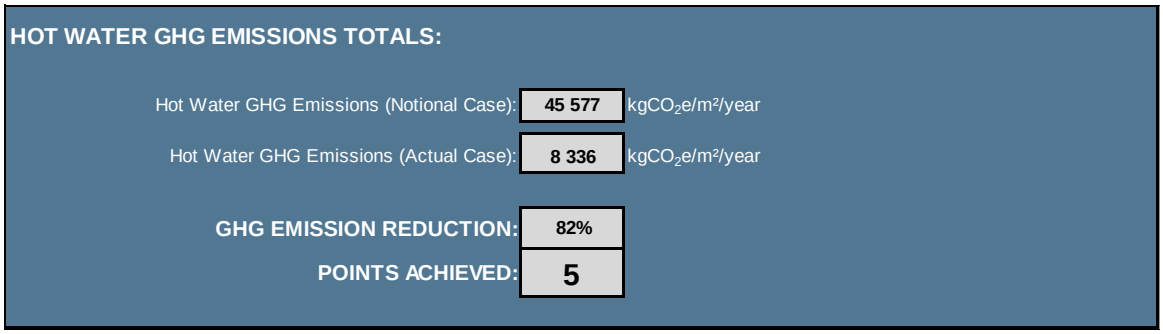

Figure 4: Hot water calculator output results panel.

The total number of possible points is based on the minimum percentage improvement over the notional development. These are awarded as follows:

- 1pt for 15%
- 2pts for 30%
- 3pts for 45%
- 4pts for 60%
- 5pts for 75%.

Please refer to the Green Star SA – Multi Unit Residential v1 Technical Manual for more information.

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