ENERGY WATER PERFORMANCE TOOL FOR EXISTING BUILDINGS – Office Buildings

Guidelines on How to use the Tool

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Contents

Section 1
Introduction

The global trend of energy efficiency in buildings is shifting from a focus based purely on design initiatives towards ensuring that the intended performance parameters are achieved in operation. In 2009, the United Nations Environmental Programme - Sustainable Buildings and Climate Initiative (UNEP SBCI) issued a discussion document titled, “Greenhouse Gas Emission Baselines and Reduction Potential from Buildings in South Africa”. One of the six recommendations in this paper emphasises the importance of retrofitting and increasing the energy efficiency (and hence reducing the CO_2 emissions) of existing buildings.

In 2011 the Green Building Council of South Africa (GBCSA), in response to the demand of the South African Property Sector, began the development of this energy and water benchmarking tool for existing buildings, starting with office buildings. This tool will ultimately fit into the overall GBCSA existing building performance rating tool, but in itself forms an incredibly useful tool for industry. The energy and water benchmarking tool can assist building owners to understand where their building performance sits in relation to other similar buildings in industry, as well as in relation to other buildings in their own portfolio. This becomes a powerful tool for making decisions on which buildings to retrofit, hold or sell, and also becomes a powerful communication tool to prospective tenants or buyers.

A project team of locally (Aurecon) and internationally recognised consultants (Exergy) and peer reviewers (ICF International) led by the GBCSA, conducted the research, data collection and statistical analysis as part of the development of the pilot tool for benchmarking energy and water performance of existing office buildings.

The purpose of this document is to provide an overview of the Energy Water Performance Tool, describe its functionality, and offer guidelines to users intending to determine the energy and water performance of office buildings when compared to that of a benchmark or market average.

Section 2
Overview of the Energy Water Performance Tool

The Energy Water Performance Tool is an operational performance measurement tool which rates the performance of a whole building, by comparing the energy and water usage figures against a national "average" benchmark that is adjusted for the following factors:

- Climate;
- The number of computers;
- The number of occupants;
- The annual vacancies;
- Operating hours.

The building is then positioned on a 10 level scale based on its performance relative to the benchmark.

The operational energy and water performance of the buildings does not take into consideration differentiation between parameters such as building technology, quality, level of service, etc., which is what the Green Star SA asset rating tool does.

2.1 Eligibility Criteria

2.1.1 Building Type and Use

The Energy Water Performance Tool caters for the rating of office buildings only. Definitions related to office space and use are presented below:

Term	Definition
Office	A facility used for business activities such as administrative, clerical and similar information-based duties. Spaces dedicated to office support activities are also included.
Office support facilities	Adjacent to office areas and provide support services to the office or its occupants. Office support facilities typically include receptions, meeting rooms, training rooms, IT and other equipment facilities; kitchenettes; staff amenities; refreshment areas; recreation areas; child care facilities, etc.
Exclusive office use	Public access is not allowed in these building zones except for visitors to the office areas.
External User	A user of an IT or communication service provided from the premises to be rated, but who is not an occupant of the premises.

Suitable for office use	Suitable for continuous occupation as an office, with appropriate lighting and ventilation

In cases where the non-office portion does not exceed 10% of the GLA, the energy and/or water use of the non-office area(s) can be included or excluded from the rating at the owner or assessor's discretion. The excluded non-office area(s) must be separately metered and excluded from the figures entered into the rating tool.

In cases where the non-office portions exceeds 10% but not 30% of the GLA, the energy and/or water use of the non-office area(s) in excess of the 10% must be separately metered and excluded from the figures entered into the rating tool, such that the maximum non-office portion included in the rating does not exceed 10%.

Buildings with a summed non-office area that exceeds 30% of the total building GLA are generally not classed as office type buildings, and may therefore not be rated under this tool unless the office GLA and associated energy use can be fully quarantined from the non-office uses.

2.1.2 New Buildings

New buildings or buildings undergoing major refurbishments are not eligible for rating until the entire building is fit for occupation and is at least 75% occupied. A full year of operation at this minimum occupancy of 75% is required to undertake the rating.

2.1.3 Existing Buildings

A full year of operation with a minimum occupancy of 75% is required to undertake the rating.

2.1.4 Building Size

The benchmark is based on data from buildings that were typically greater than 1 000m^2. Buildings below this size are not excluded from using the rating but may be affected by the inevitable physical differences between small buildings and large buildings.

2.1.5 Whole Building Rating

The metering strategies implemented in the majority of the existing commercial buildings in South Africa allow only for metering of whole building energy/water consumption, with a limited number of new and refurbished buildings providing sub-metering of the base building and tenant areas. Consequently, this Energy Water Performance Tool was developed to accommodate the rating of whole buildings only.

Although whole building rating tools provide realistic figures for benchmarking purposes, they do not have the same market transformation potential as a separate base building and tenancy rating. It is expected that market pressures will gradually transform the metering arrangements

in buildings to allow for separate tenants and base building metering schemes. Once sub-metered data becomes more widely available, a rating system which differentiates between tenants and base building areas can be introduced.

2.2 Input Parameters

The key input parameters for the Energy Water Performance Tool are as follows:

- Building details (name address);
- Postal code;
- Gross Lettable Area (GLA);
- Occupancy hours;
- Number of computers;
- Energy consumption data;
- Number of occupants;
- Water consumption data.

Definitions and other information regarding these input parameters are provided in the following section; along with the verifiable records required to obtain an official energy and water rating.

2.3 Key Concepts

2.3.1 Building Zone

For the purposes of this rating tool, the rated building is taken to be the sum of all building zones nominated for inclusion in the rating. A building zone denotes an area or a collection of spaces in the building which share the following distinct characteristics:

- Included or excluded from the rating;
- Office or non-office usage;
- Equal annual vacancies;
- Equal weekly operating hours.

This is typically the smaller of a single storey of a multi-storey building or an individual tenancy.

2.3.2 Vacancy

The vacancy is the total number of days over the analysis year that the building zone was unoccupied. For non-office portions, the vacancy is taken to be zero regardless of the actual figure.

Section 3
Detailed Input Parameters

3.1 Building Details

3.1.1 Postal Code

The effect of the local weather patterns is normalized to ensure an equitable rating for different climatic zones.

Although climate does not necessarily influence the energy performance as much as generally perceived, it has been highlighted as an influencing variable which was taken into consideration during the development of this Energy Water Performance Tool. The effect of local climate on the energy and water performance of a building is accounted for by determining the position of the building using its postal code.

The South African postal code system consists of four digit codes ranging from 0001-9999 (please note that the number range 9000-9299 is excluded as this belongs to regions in Namibia). The weather corrections are related to the following postal code ranges:

Province	City/Town/Region	Postal Code Range
Limpopo	Northern and eastern regions	0699-0999
	Southern and western regions	0500-0698
North West	Northern regions	0300-0499
	Southern and central regions	2500-2899
Gauteng	Johannesburg	2000-2199
	Tshwane	0001-0299
	West Rand	1700-1799
	Ekurhuleni	1400-1699
	Soweto and Vereeniging/Vanderbijlpark	1800-1999
Mpumalanga	Northern regions	1000-1399
	Southern regions	2200-2499
Northern Cape	Kimberley and eastern regions	8300-8799
	Namaqualand region	8100-8299
	Interior and northern (Gordonia) regions	8800-8999
Free State	Bloemfontein and interior and southern regions	9300-9399, 9900-9999
	Northern regions	9400-9699

	Eastern regions	9700-9899
KwaZulu Natal	Ethekwini	4000-4099
	Pietermaritzburg and the Midlands	3200-3799
	Richards Bay and northern regions	2900-3199, 3800-3999
	North Coast	4300-4499
	South Coast	4100-4299
	Eastern Griqualand regions	4500-4730
Western Cape	Greater Cape Town area and Cape Peninsula	7100-7299, 7400-8099
	Garden Route regions	6500-6699
	Karoo regions	6700-7099
	West Coast regions	7300-7399
Eastern Cape	East London	5200-5299
	Port Elizabeth	6000-6099
	Northern regions	5300-5499
	Southern regions	6100-6499
	Interior regions	4731-5199, 5500-5999

3.2 Building Metrics

3.2.1 GLA

For a whole building rating, the rated area in the Energy Water Performance Tool is defined by the Gross Lettable Area (GLA) or Rentable Area as per the SAPOA definitions 1 (August 2005) in m^2), also referred to as Gross Rentable Area by the Independent Property Databank (IPD).

The GLA is the total area of the building enclosed by the dominant face, adjusted by deducting major vertical penetrations. It comprises the usable area plus common areas of the building but excludes car parking. GLA is therefore the area assigned for exclusive use by occupants / tenants, including common areas such as:

- Building entrance foyers;
- Plant and server rooms on tenant floors;
- Toilet areas on the tenant floors;
- Access or circulation areas on tenant floors.

The figure below depicts the method of how the GLA is measured.

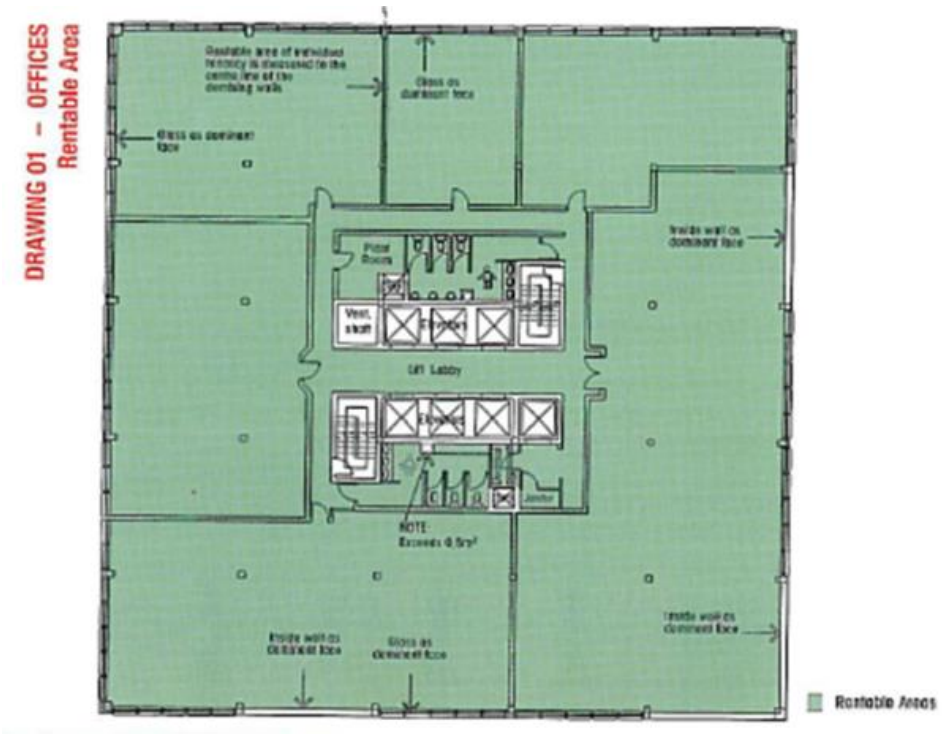

Figure 1: Gross Lettable Area or Rentable Areas (as per SAPOA)

The rated area to be entered in the tool constitutes the floor area measurement for base building (common area) and tenancy (usable area). If GLA needs to be adjusted for non-office spaces or spaces allocated to external users, or different occupied hours profiles in multi-zone buildings, then

a more detailed input will be required. In this case, the GLA is defined as the GLA of all the included zones, adjusted to account for vacancies.

Example:

A building of 920m² has been occupied during the rating period as follows:

- 500 m² occupied for the entire rating period of 12 months;
- 150 m² vacant for 15% of the year (55 days);
- 250 m² non-office area vacant for 10% of the year (37 days); (Note: since this is non-office area, 0 vacant days are assigned);
- 20 m² excluded.

The GLA to be entered into the rating tool is calculated as follows:

$$\text{GLA} = (500 \times (100 - 0) \div 100) + (150 \times (100 - 15) \div 100) + (250 \times (100 - 0) \div 100)$$

$$\text{GLA} = 877.5\text{m}^2$$

3.2.2 Occupancy Hours

Occupancy hours is defined as the hours for which the building is occupied, measured on a weekly basis when 20% or more of the normal, permanent occupants of the building are present. It is important to note that this measurement is taken in terms of business or normal office activities and not in terms of plant Heating, Ventilation and Air Conditioning (HVAC) system operations.

The occupancy hours of common areas and circulation areas should be taken to be equal to the operating hours of the office portions which they serve.

The total building operating hours are taken to be the area-weighted average of the operating hours of the building zones nominated for inclusion in the tool, w here the zone areas have been adjusted for vacancies.

For non-office zones included in the rating, zero vacant days and a default (median) value of 45 hours should be assigned as the weekly operating hours, regardless of the actual values.

The following example calculation demonstrates how the occupancy hours are determined for multiple building zones:

Example:

A building of 920m² has been occupied during the rating period as follows:

- 500 m² occupied for the entire rating period of 12 months and operational for 40 hours a week;
- 150 m² vacant for 15% of the year (55 days) and operational for 60 hours a week;
- 250 m² **non-office area** vacant for 10% of the year (37 days) and operational for 80 hours a week but with no known public operating hours. (Note: since this is non-office area the default value of 45hours must be assigned, and 0 vacant days);
- 20 m² excluded.

The weekly operating hours to be entered into the rating tool is calculated as follows:

$$\text{Weekly Hours} = \frac{(500 \times (100 - 0) \div 100 \times 40) + (150 \times (100 - 15) \div 100 \times 60) + (250 \times (100 - 0) \div 100 \times \mathbf{45})}{(500 \times (100 - 0) \div 100) + (150 \times (100 - 15) \div 100) + (250 \times (100 - 10) \div 100)}$$

$$\text{Weekly Hours} = 44.3$$

3.3 Energy Usage Inputs

3.3.1 Number of Computers

This is defined as the number of computers used by the building occupants during the weekly operating hours. This number excludes network machines, and spare or training computers which are usually turned off.

For the purpose of this rating tool, a computer can be defined as the following:

Term	Definition
Desktop system	A distinct system unit with an external monitor and external keyboard attached.
Laptop (or notebook)	System unit including screen and keyboard
All-in-one-system	System unit (laptop) with external keyboard or screen

Adding an additional peripheral device to any of the above configuration does not change the number of computers. Larger stand-alone computer installations with no monitors can be counted as single computer.

The number of computers counted must not include any of the configurations that have missing parts, e.g. desk top units with missing monitors or docking station without a laptop.

Only computer systems that are fully operational and being used on a regular (daily, under normal circumstances) basis in the rated premises must be counted. There must be evidence for regular use, such as:

- A person using the computer at the time of the count;
- Computer system being operational;
- A report of a manager or other authoritative source.

Computer systems that are not in regular use must not be counted. Examples of computers not to be counted include those which are:

- Not being set at a person's workstation;
- Discarded due to age and non-productivity;
- Used only occasionally (less than 50% of the time) in low-use training or meeting rooms, etc;
- Dedicated to external users.

For non-office zones included in the rating, the default (median) value of 19m²/computer should be assigned to each of these zones, regardless of the actual computer count in the zone.

The number of computers for each included zone should be adjusted for vacancy. The total number of computers is the sum of the included zone vacancy modified totals.

The following example calculation demonstrates how the number of computers are determined for multiple building zones:

Example:

A building of 920m² with 27 computers has been occupied during the rating period as follows:

- 500 m² with 10 computers occupied for the entire rating period of 12 months;
- 150 m² with 12 computers vacant for 15% of the year;
- 250 m² **non-office area** with 5 computers vacant for 10% of the year (Note: since this is non-office area, the default value of 19m²/computer must be assigned, and 0 vacant days);
- 20 m² excluded.

The weekly operating hours to be entered into the rating tool is calculated as follows:

$$\text{Number of Computers} = [(100 - 0) \div 100 \times 10] + [(100 - 15) \div 100 \times 12] + [(100 - 0) \div 100 \times (\mathbf{250} \div \mathbf{19})]$$

$$\text{Number of Computers} = 33$$

The documentation needed to substantiate the number of computers for an official rating includes:

- Marked up desk layouts for all spaces to be rated;
- Physical count of computers and occupants on site (asset inventory and local server counts of computers are not regarded as acceptable data sources).

3.3.2 Energy Consumption Data

Building owners or managers who wish to obtain an energy rating for an existing office building are required to enter the total annual consumption figure obtained from 12 consecutive months of council electricity bills and/or metered data. It is vital that only a year's consumption is entered, otherwise the results will not be a true reflection of the building's performance. Most buildings will typically have a value for electricity (in kWh) from utility bills or metered data. Note that energy data must be from actual metered energy and must not be affected by estimates.

Due to the fact that billing data may not always be aligned on a monthly basis, an allowance must be made to ensure that only 365 days' worth of consumption is included. If the data ranges from 334-397 days, it must be scaled accordingly so that only a representative 365 days' data is entered.

If the building has onsite renewable energy sources such as photo voltaic panels that are connected on the building side of the electricity meter, these do not need to be sub-metered

and entered, as the effect of these renewables is accounted for by the reduced consumption from the utility providers. If such power sources are mounted on the building but are connected directly to the grid (on the grid side of the building meter) then they are considered to be unassociated with the building and the generated energy is not permitted to be considered as a credit against the building's consumption.

The energy consumption of all areas forming part of the building i.e. the entire building including basements and car parks, are to be accounted for by the energy records.

For the purposes of this tool, the following definitions concerning meters are applicable:

Term	Definition
Utility Meters	A meter installed and operated by a utility supplier and used to provide data for billing purposes.
Non-utility Meters	A meter installed and operated by the building owner or an outsourced metering service provider, and used to measure distribution of energy and water in the building.

The documentation needed to substantiate the consumption for an official rating includes:

- Calculations or documentation detailing any consumption to be excluded from the rating and substantiation thereof; AND
- Evidence of validation of electricity meters, and records of readings of non-utility meters; OR
- Utility bill data (12 consecutive monthly bills that have been consolidated into an annual consumption figure) for the period that is rated.

3.4 Water Usage Inputs

3.4.1 Number of Occupants

For the purposes of this tool, an occupant is defined as a permanent or part-time employee who is likely to occupy the building for more than 20 hours per week.

For non-office zones included in the rating, the default (median) value of 19m²/person, and zero vacant days, should be assigned to each of these zones regardless of the actual values.

The number of people in each included zone should be adjusted for vacancy. The total number of people is the sum of the included zone vacancy modified totals.

The following example calculation demonstrates how the number of computers are determined for multiple building zones:

Example:

A building of 920m² with 33 occupants has been occupied during the Rating Period as follows:

- 500 m² with 12 occupants occupied for the entire rating period of 12 months;
- 150 m² with 14 occupants vacant for 15% of the year;
- 250 m² **non-office area** with 7 occupants vacant for 10% of the year (Note: since this is non-office area, the default value of 19m²/person must be assigned, and 0 vacant days);
- 20 m² excluded.

The weekly operating hours to be entered into the rating tool is calculated as follows:

$$\text{Number of Occupants} = [(100 - 0) \div 100 \times 12] + [(100 - 15) \div 100 \times 14] + [(100 - 0) \div 100 \times (\mathbf{250} \div \mathbf{19})]$$

$$\text{Number of Occupants} = 37$$

The documentation needed to substantiate the number of computers for an official rating includes:

- Marked up desk layouts for all spaces to be rated;
- Physical count of computers and occupants on site (asset inventory and local server counts of computers are not acceptable data sources).

3.4.2 Water Consumption Data

Building owners or managers who wish to obtain a water rating for an existing office building will be required to enter the total annual water consumption of the building over a period of 12 consecutive months of council water bills and/or metered data. It is vital that only a year's consumption is entered, otherwise the results will not be a true reflection of the building's performance. The annual water consumption, in the appropriate units of kiloliters (kl), can be obtained from utility (council) bills or metered data. Note that water data must be from actual metered water and must not be affected by estimates.

Due to the fact that billing data may not always be aligned on a monthly basis, an allowance must be made to ensure that only 365 days' worth of consumption is included. If the data ranges from 334-397 days, it will be scaled accordingly so that only a representative 365 days' data is entered.

If the building uses recycled (such as grey water) or harvested rainwater, these do not need to be sub-metered and entered, the effect of these renewables is accounted for by the reduced consumption from the utility providers. Borehole water needs to be metered and added to the consumption from utility providers.

For the purposes of this tool, the following definitions concerning meters are applicable:

Term	Definition
Utility Meters	A meter installed and operated by a utility supplier and used to provide data for billing purposes.

Non-utility Meters	A meter installed and operated by the building owner or an outsourced metering service provider and used to measure distribution of energy and water in the building.

The documentation needed to substantiate the consumption includes:

- Calculations or documentation detailing any consumption to be excluded from the rating and substantiation thereof; AND
- Evidence of validation of water meters, and records of readings of non-utility meters; OR
- Utility bill data (12 consecutive monthly bills that have been consolidated into an annual consumption figure) for the period that is rated.

Section 4
Tool Rating Process

A typical process to follow for rating of the energy and/or water performance of the building is outlined below:

Step 1: Obtain the Name and building physical address, including postal code;

Step 2: Calculate the Gross Lettable Area (GLA) in m^2 to be included as part of the rating;

Step 3: Perform building zone analysis to determine the following for input into the Detailed Input Spreadsheet: occupancy hours of the building (per week), number of computers and number of occupants.

Step 5: Obtain and verify 12 consecutive months of energy consumption data. Calculate the total annual energy consumption. This may include electricity, gas, coal, and other energy sources.

Step 7: Obtain and verify 12 consecutive months of water consumption data. Calculate the total annual water consumption;

Step 8: Step 9: Enter the required data in the energy / water section of the tool;

Step 10: Press the “Calculate Energy Benchmark” and/or the “Calculate Water Benchmark” button.

Although the process above outlines the major steps for rating a building in terms of both energy and water performance, the energy and water sub-section in the Energy Water Performance Tool are independent and can be used separately. The Detailed Input Spreadsheet must be used to assist with the above input processing.

Section 5
Rating Scale

The rating bands are based on a 10-point rating scale, with the highest rating being 10 points (a 'Level 10' building), the lowest rating 1 point (a ' Level 1' building), and the benchmark or 'average' building rated at 5 points (a 'Level 5' building). The rating scale is linear with constant increments between levels. This means that the absolute difference between, for example, 2 and 3 points is that same as that between 7 and 8 points. The table below depicts interpretations of the scores that may be obtained by a rated building.

Table 1: Interpretation of rating results

Symbol	Interpretation
1	This represents a building with very poor operational efficiency. The energy/water consumption is 178% to 200% of the average building. Considerable effort should be made to improve the operating efficiency of this building.
2	This rating demonstrates a building with poor energy/water efficiencies. Consumption is between 156% and 178% of an average building with the same characteristics. Significant improvements to the energy/water systems are recommended to improve the operating efficiency of the building.
3	This indicates that the building is operating with energy/water consumption between 133% and 156% of the market average. Considerable improvements to the building's energy/water systems are recommended to improve the operating efficiency of the building.
4	This indicates that the building energy/water efficiency is slightly below that of the market average. The building's energy/water systems consume between 111%-133% of the average building with the same characteristics. Only slight improvements in building operational efficiency are required to bring the building to market average performance.
5	This represents the market average or benchmark building. A building obtaining this rating is therefore operating within 11% of the industry median in terms of energy/water usage efficiency.
6	This rating shows an improvement of 11%-33% on the energy/water efficiency of a building when compared to that of the benchmark.
7	This represents a marked improvement in terms of energy/water usage efficiency of the building, and is operating between 33% and 56% more efficiently than the market average.
8	This rating is awarded to a building which shows a significant improvement of up to 56%-78% in terms of energy/water consumption when compared to that of a similar building with limited efficiency measures.

9	This rating indicates that the building has very low external intakes, due to the efficiency measures implemented, showing a 79-99% improvement compared to the industry benchmark.
10	This rating is energy/water neutral, meaning that the building has a zero net energy/water intake. This building is operating at a 100% improvement over that of the benchmark building.