



Consumer Guide

Energy Efficiency

Helping you make the right decisions to reduce
your electricity consumption

BREA - Barbados Renewable Energy Association
www.brea.bb





Best advice? ... *Efficiency starts with you.*

The cheapest reduction in consumption for any household or business is achieved by changes in behaviour. Therefore it is very important that any energy efficiency target is a family goal/business objective. There are no silver bullets. Get everyone involved in reducing the consumption and you will be successful.

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Table of Contents

INTRODUCTION	4
THE NATIONAL GOAL	5
THE GOVERNMENT’S SMART ENERGY PROGRAM	8
FIRST STEP: KNOWING WHERE AND HOW YOU USE ENERGY	9
UNDERSTANDING YOUR ELECTRICITY BILL.....	9
USING A WHOLE HOUSE POWER MONITOR.....	13
BENEFITING FROM AN ENERGY AUDIT.....	15
WHAT CAN WE DO TO BE MORE EFFICIENT?	16
LIGHTING	16
NOT ALL LED LIGHTING IS CREATED EQUAL	18
COOLING	21
IMPROVE EFFICIENCY OF TRADITIONAL AIR CONDITIONERS	21
NEW MORE EFFICIENT AIR CONDITIONERS.....	22
DC INVERTER	23
SOLAR THERMAL	24
SOLAR POWERED AIR CONDITIONING SYSTEM.....	25
WATER HEATING	25
SOLAR WATER HEATING.....	25
FLAT PANEL COLLECTOR SYSTEM.....	26
EVACUATED TUBE COLLECTORS	27
HOUSEHOLD APPLIANCES	29
SELECTING THE MORE ENERGY EFFICIENT APPLIANCE	30
.....	33
ENERGY MANAGEMENT	ERROR! BOOKMARK NOT DEFINED.
ENERGY MANAGEMENT SYSTEMS	34
BUILDING FOR ENERGY EFFICIENCY	35
ENERGY EFFICIENCY & CONSERVATION TIPS	40
REFERENCES & LINKS:.....	42
ABOUT US	43



Introduction

Barbados has committed itself to a number of sustainable energy targets which are based on three pillars: Renewable Energy, Energy Efficiency and Energy Conservation. The primary focus is on reducing the level of fossil fuel imported into the island. The government is aware that in its many efforts to satisfy this mandate, it will not be successful without general public awareness and engagement. To this end, it has partnered with the Barbados Renewable Energy Association to produce an Energy Efficiency Consumer Guide. This consumer guide is targeted at all consumers, residential and business. Its purpose is to raise the level of awareness of the general public of Barbados on the importance of energy efficiency and energy conservation at an individual level and a national level. This guide will only look at energy efficiency as it pertains to electricity generation which is a high consumer of fossil fuel, although there is recognition that transportation also accounts for a significant portion of the fossil fuels imported. It is envisioned that a separate effort would be focused on transportation.

The guide will hope to achieve its objective by covering the following topics:

- The National energy efficiency goal
- Understanding your consumption profile
- Understanding your options to reduce
- Understanding how household appliances impact
- What is Energy Management
- Start right – Build in efficiency at design stage
- Some energy efficiency and Conservation tips

The intended outcome of this guide is for you to be better positioned to participate in the national goals to achieve the energy efficiency targets set out by the government while making a meaningful impact on your own energy use in your homes and your businesses. The adoption of energy efficiency practices will help our economy to reduce expenditure on the importation of fossil fuel and reduce operating cost for homes and businesses.

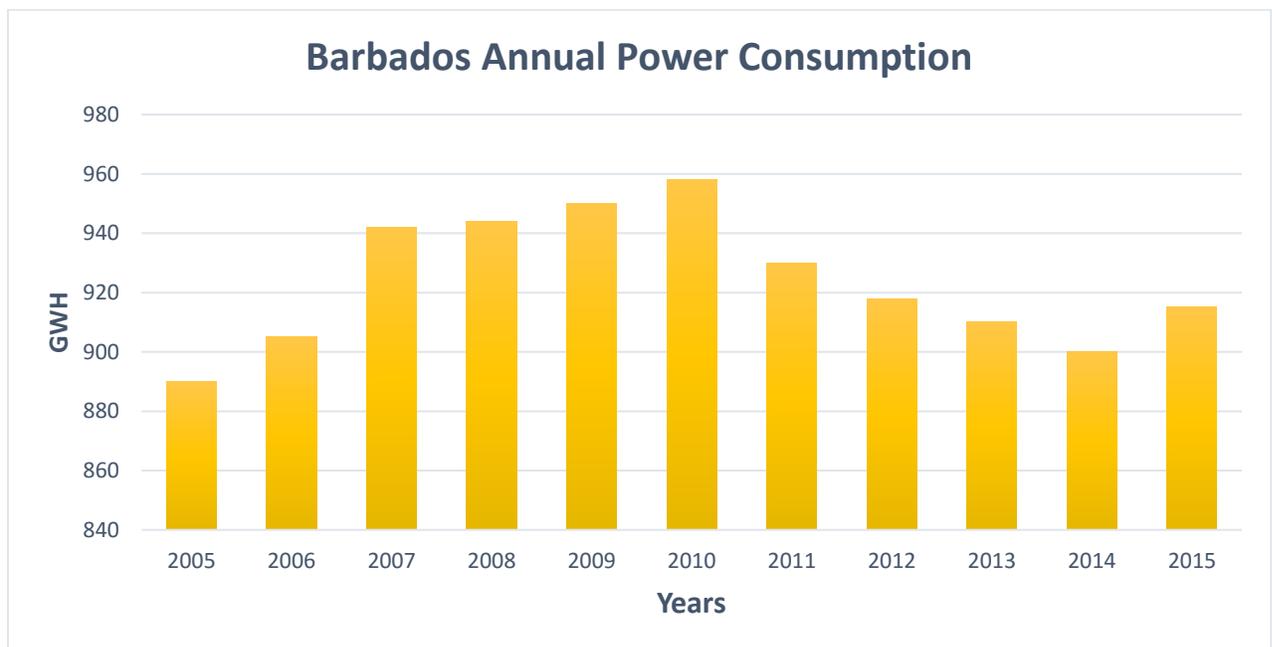
Although this guide is entitled Energy Efficiency, it is clear that “energy efficiency is not energy conservation”. The guide will use both approaches to achieve the reduction of the consumption of electricity and may not necessarily make any distinction between the two. *(Turning off a light when not in use is an example of energy conservation. Replacing an incandescent lamp with a compact fluorescent lamp, which uses much less energy to produce the same amount of light is an example of energy efficiency.)*



The National goal

Barbados has its energy efficiency target as 22% of the annual average electricity consumption by 2029. The Barbados Light & Power has seen a steady decline in demand on the grid from a peak of 960.9 GWH in 2010 to 900.3 GWH in 2014. This represents a 6.3% reduction in demand over 4 years which is 1.58%/ year. Then in 2015, consumption went up to 915 GWH, representing a 1.63% increase over 2014.

To put this in context, in pre-2015, the average electricity rate was approximately \$0.70/KWH. Therefore, Barbados reduced its electricity bill by approximately \$10.60 Million/year and an accumulative saving of \$42.4 Million year on year. The rate then went down to approximately \$0.40/KWH which encouraged an increased spend of approximately \$6 Million in 2015 which reduced the accumulative savings to \$36.4 Million. These savings are significant for the country, but what is important to note is the impact reduced rates could have. It therefore demonstrates why energy efficiency will become increasingly important.



In 2015, the government revised its draft sustainable Energy Policy. The target has not changed, but the 2015 consumption numbers show that it will be challenging. This means that the Government may need to revisit the approach in the draft policy on energy efficiency. A more structured way of coordinating all the efforts and tracking the results against a yearly target, would probably be the best approach. Below are extracts for the Government's draft policy.



- **Power Utility Regulation for Energy Efficiency**—This describes the Government's policy on cost recovery for efficient generation;
- **Energy Efficiency in New Buildings and Facilities**—This represents the Government's policy on the adoption of energy efficient building standards in new buildings;
- **Energy Efficiency in Existing Buildings and Facilities**—This outlines the Government's policy on retrofitting existing buildings for increased energy efficiency and tools for implementation.
- **Energy Efficient Lighting**—This lays out the Government's policy on phasing out inefficient lights and replacing them with energy efficient ones.
- **Efficient Electricity Transmission and Distribution**—This recognizes the need to continue the ongoing trend of efficient transmission and distribution of electricity.
- **Environmental Sustainability of Energy Efficiency Products**—This outlines the Government's policy on safeguarding Barbados' natural environment throughout the production, use, disposal, reuse, and recycling of energy efficiency products.
- **Development and Value Retention of Energy Efficiency Products and Services**—This presents the Government's policy on encouraging and supporting the domestic invention, development, manufacturing, and assembly of energy efficiency products, and related services, to maximize the creation and retention of value from energy efficiency in Barbados.

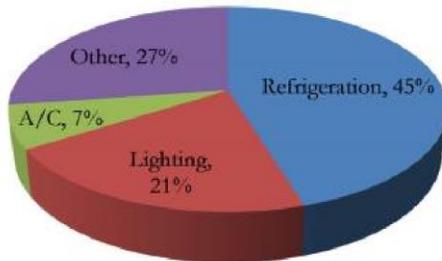
The final national policy is currently being developed. The Government's targets are very realistic as similar reduction gains have been achieved in other countries. However, it will be challenging to achieve without a very structured approach and the involvement of all citizens.



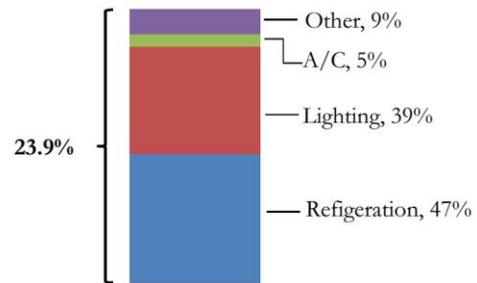
The following charts show that the three major power consuming sectors having different consumption profiles. Therefore different approaches will be necessary for effectiveness at a national level.

Residential Sector

Electricity end-use, residential

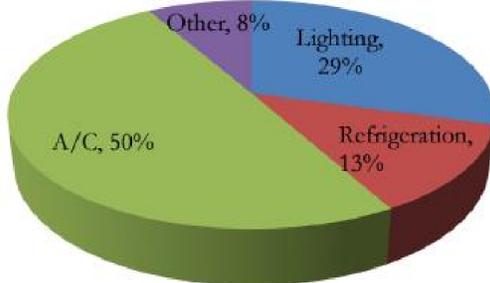


Estimated savings potential, %

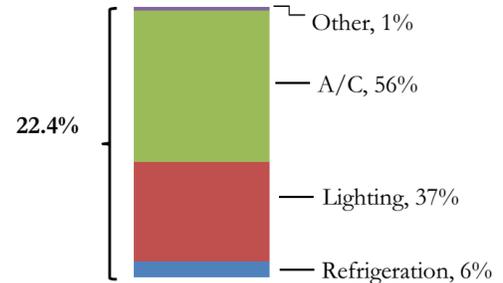


Commercial (including hotels) and public sector

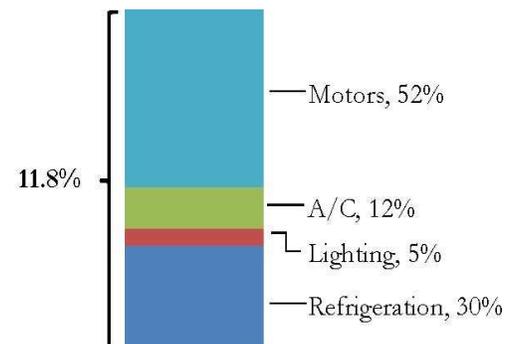
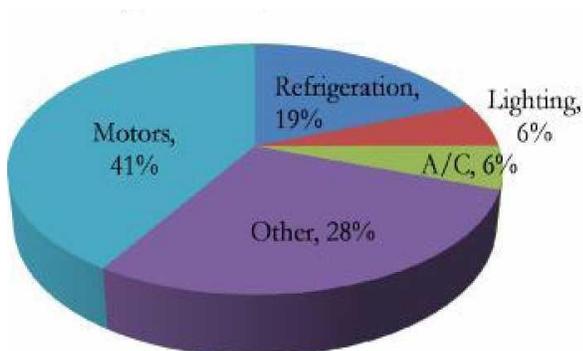
Electricity end-use, commercial (including hotels) & public



Estimated savings potential (commercial, hotels, public), %



Industrial Sector





The Government's Smart Energy Program

The Division of Energy has initiated the Government's approach to energy efficiency through an IDB-funded Smart Energy program. Energy efficiency is a growing policy priority for many countries around the world. It is widely recognised as the most cost-effective and readily available means to address numerous energy-related issues, including energy security, the social and economic impacts of high energy prices and concerns about climate change. At the same time, energy efficiency increases competitiveness and promotes consumer welfare.



One of the funding programmes that has had some success to date is the Smart Fund accessible through the Enterprise Growth Fund Limited. The Energy Efficient (EE) Lighting Distribution Facility was created to enable the distribution of free energy efficient lighting, by selected retailers on a first-come-first served basis to residential customers of the Barbados Light and Power Co. Ltd. This facility was accessed by Caribbean LED who successfully executed the programme. They distributed 45,000 LED 7 watt bulbs to 9,000 households in Barbados. This was a \$1 Million investment that saved \$2 Million a year in electricity costs. The bulbs will last over 10 years at average usage i.e. \$20 Million savings.

There is also a rebate programme for retailers of energy efficient appliances to pass on savings to the consumers. Retail stores like Courts can provide rebates of up to \$500 on the purchase of selected energy efficient appliances.

Major stake holders in the sector believe that the government can do more to incentivize home owners and businesses alike to embrace more energy efficiency products and services. The tremendous success of the solar water heating industry in the 70s is representative of a good example of how government incentives can make effective policy.



First step: Knowing where and how you use energy

Before embarking on any energy efficiency initiative it always makes sense to know where and how energy is being consumed in your home or business. This is a very simple and basic concept. There are a number of ways to do this and they vary in cost and complexity. This can be achieved in three different ways:

1. Understanding your electricity bill.
2. Using a whole house power monitor.
3. Getting an energy audit done.

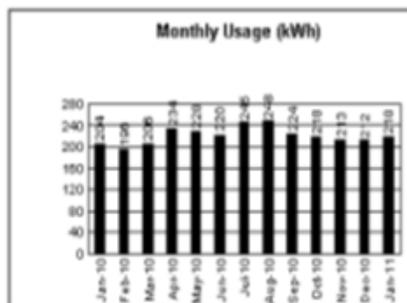
Understanding your electricity bill

Understanding the electricity bill is the cheapest way to establish a baseline of electricity consumption. The bill has several useful pieces of information: the daily average, month usage and the monthly trend, to name a few. This guide will explain where to find them and how to use them to help in any effort to reduce electricity consumption.

The first thing to understand is the difference between Kilowatts (KW) and Kilowatt hours (KWH). Kilowatts is the instantaneous power required by a piece of equipment/appliance or device. Kilowatt hours is the amount of power used by that equipment over time. Therefore you can have a Dryer that requires 4.0Kw to function. However you only use it for 1 hour four times a month. That will mean the dryer would use 16 KWH for the month with a daily average of 0.571 KWH for the month (assuming a 28-day billing cycle).

Ruby Park		Premise ID: 123456789						
	Meter No.	Read Date	Reading	RC	Usage (kWh)	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	Q01234	2011/01/13	24126	R	218	33	6.61	0.336561
Previous	Q01234	2010/12/11	23908	I	212	30	7.07	0.337912

Billing Detail		Domestic Service	
Customer Charge	\$	10.00	
Energy 1st Bk 150 kWh @ \$0.15 per kWh	\$	22.50	
Energy 2nd Bk 68 kWh @ \$0.176 per kWh	\$	11.97	
Fuel 218 kWh @ \$0.336561	\$	73.37	
Sub Total	\$	117.84	
VAT 17.5%	\$	20.62	
Current Charges	\$	138.46	
10% Discount (of Energy and Customer Charges)	-\$	4.45	
VAT on Discount Adjustment	-\$	0.78	
Total if paid by 2011/01/30	\$	133.23	



The daily average is the most important information because it shows how much electricity is being used each day. This is the best and quickest way to determine if more or less electricity has been used on a month by month

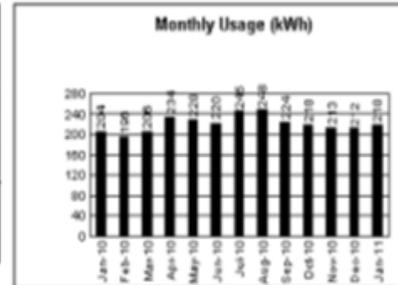
basis. The daily average is the only piece of information on the bill that is not impacted by anything else but the usage unless it's an interim bill where the utility company estimates what was consumed based on the average of previous bills.



Right next to the daily average on the bill shows the number of days recorded for that billing cycle. Therefore bills higher than normal must be put in context by checking the number of days in the billing cycle and the daily average.

Ruby Park							Premise ID: 123456789	
	Meter No.	Read Date	Reading	RC	Usage (kWh)	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	Q01234	2011/01/13	24126	R	218	33	6.61	0.336561
Previous	Q01234	2010/12/11	23908	I	212	30	7.07	0.337912

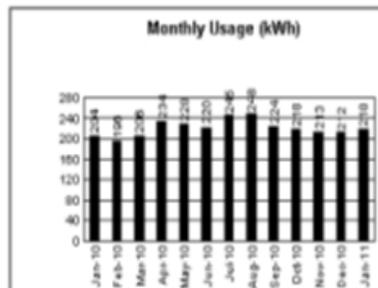
Billing Detail		Domestic Service	
Customer Charge	\$	10.00	
Energy 1st Blk 150 kWh @ \$0.15 per kWh	\$	22.50	
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If the number of days in the cycle is more than normal and the daily average is about the same it means that the monthly average is the same, although the usage for the month is higher. It is commonly known that these types of bills are taken out of context and are very mis-leading.

Ruby Park							Premise ID: 123456789	
	Meter No.	Read Date	Reading	RC	Usage (kWh)	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	Q01234	2011/01/13	24126	R	218	33	6.61	0.336561
Previous	Q01234	2010/12/11	23908	I	212	30	7.07	0.337912

Billing Detail		Domestic Service	
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VAT on Discount Adjustment	-\$	0.78	
Total if paid by 2011/01/30	\$	133.23	



The monthly usage shown on the bill is not the monthly average. It is the amount of electricity used for the billing cycle. This is why it is better to start understanding the daily average first because that is easier to put the bill in context. The monthly usage becomes useful when looking back at previous

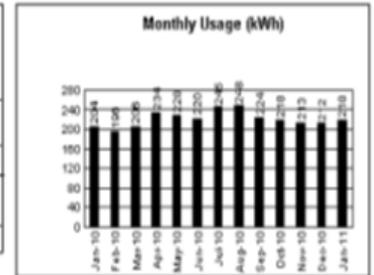
month's usage for the year. The bill provides a graph that shows the usage per month for a period back from the current month, which makes it easy to see any seasonal trends e.g. more frequent use of air conditioners in the hotter periods of the year.



It is also important to pay attention to the column called RC. The “I” means it’s an interim bill and the “R” means the meter was read by a utility agent. An interim bill is a bill computed on the average of the last three months and not based on the actual usage. The actual usage on a bill is always indicated by the “R”. The interim bill is responsible for many failed energy reduction efforts. Home owners with good intentions get discouraged after a month- long effort at being more efficient only to see a high bill and are unable to put it in context because of a lack of understanding of the bill.

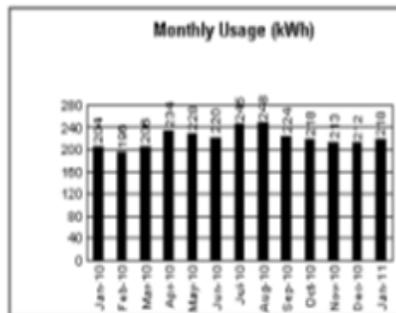
Ruby Park		Premise ID: 123456789						
	Meter No.	Read Date	Reading	RC	Usage (kWh)	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	Q01234	2011/01/13	24126	R	218	33	6.61	0.336561
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Billing Detail		Domestic Service	
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Sub Total		\$	117.84
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Current Charges		\$	138.46
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Ruby Park		Premise ID: 123456789						
	Meter No.	Read Date	Reading	RC	Usage (kWh)	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	Q01234	2011/01/13	24126	R	218	33	6.61	0.336561
Previous	Q01234	2010/12/11	23908	I	212	30	7.07	0.337912

Billing Detail		Domestic Service	
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Energy 2nd Blk 68 kWh @ \$0.176 per kWh		\$	11.97
Fuel 218 kWh @ \$0.336561		\$	73.37
Sub Total		\$	117.84
VAT 17.5%		\$	20.62
Current Charges		\$	138.46
10% Discount (of Energy and Customer Charges)	-\$	4.45	
VAT on Discount Adjustment	-\$	0.78	
Total if paid by 2011/01/30		\$	133.23



One of the most important things that requires close attention is the Fuel Clause Adjustment (FCA). This is found at the extreme right of the bill. The Fuel Clause Adjustment is calculated according to the Fuel Clause approved by the Fair Trading Commission (FTC) and may vary

from month to month. This number is used to calculate your bill and varies depending on the cost of oil. The cost of the oil is factored into the amount on each bill via the FCA. Therefore, when oil prices are relatively low, the FCA is low and the bill will be lower. Conversely, if the cost of oil is relatively high the electricity bill will increase, all else being equal.

Last but not least is the Demand Charge, which is only relevant for commercial bills. The demand charge is determined from the peak electricity required every month. Therefore if a piece of equipment requires 15KVA on startup (e.g. a center air conditioning unit) it will be used at the end of the month to calculate the demand charge. The charge can go up or down each month depending on what is the peak consumption for the month. The utility rationale for this charge is to cover the cost of reserving the extra capacity to meet the peak demand whenever it is required.



So understanding the electricity bill is a great place to start any energy efficiency drive without spending any money. It will not show how much electricity is consumed during the day or at night, nor will it show what period has the high usage. The bill only gives the average consumption. To get more detail a power monitor or engagement of an energy professional to conduct a power audit would be required.

Billing Information

Next Scheduled Regular Reading Date: 2014/06/16

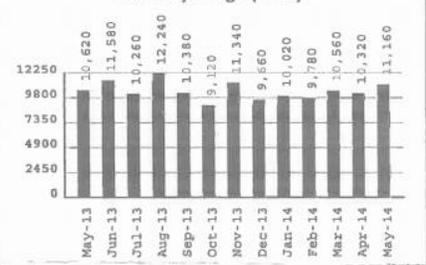
One Financial Place, Collymore Rock										Premise ID: 1253210257
	Meter No.	Read Date	Reading	RC	Multi	Usage (kWh)	kVA	Days	Daily Avg. (kWh)	Fuel Adj. (\$)
Present	D33801	2014/05/16	8800	R	60	11,160	32	32	348.75	0.41542600
Previous	D33801	2014/04/14	8614	R	60	10,320	34	31	332.90	0.39292100

Billing Detail

Secondary Voltage Power

Customer Charge	\$ 20.00
Demand Charge 32 kVA @ \$24.00 per kVA	\$ 768.00
Energy 11,160 kWh @ \$0.138 per kWh	\$ 1,540.08
Fuel 11,160 @ \$0.415426	\$ 4,636.15
Sub Total	\$ 6,964.23
VAT 17.5%	\$ 1,218.74
Current Charges	\$ 8,182.97

Monthly Usage (kWh)





Using a whole house power monitor

In the previous section it was indicated that the electricity bill is a good place to start. However if more detail is needed a whole house power monitor would be required. A power monitor is one of the most effective energy conservation tools. It gives all the information needed to make the right decisions on how to use energy in a home or business. Being able to actually see that the fridge uses more electricity when the fridge door is opened may

encourage better habits. There are a number of good whole house power monitors to choose from and they are available from a number of local suppliers. A good monitor should be able to show consumption in KW at near real-time with a refresh rate of between 12 to 30 seconds. The monitor should have a memory and ability to show the daily average and monthly average in KWH. It must also have at least a two channel input to monitor split-phase power which is what is used in Barbados. It is



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CURRENT COST

also recommended to use the type that uses current clamps to read the current and programmable to the voltage provided by BL&P (110V to 120V). Once a monitor is selected it is recommend to use an electrician to install it. However, with a little understanding of electricity installation is not difficult for a keen home or business owner.

The benefit of power monitors as opposed to using an electricity bill, is that it provides real-time information on consumption. This also makes it possible to determine consumption by time of day or night. The way to get the most out of a monitor is to determine the baseline usage for the home or business. This is simply done by unplugging everything in the home besides the fridge and/or any other appliances/devices that must be energized e.g. a security system. Record the consumption and note it as the baseline. Then start plugging back in all other devices/equipment as normal. Having established the baseline it allows for great understanding of how every appliance and device in the home or business impacts on the total usage. This becomes the basis for developing a reduction plan.



Control and monitor your electricity usage - **anytime, anywhere.**

Some power monitors are supplied with a computer program that allows greater analysis of the home's or business' power usage data. Some can even be accessed over the Internet or via a phone app to allow home owners or business owners/management team the ability to manage consumption at all times. This feature is particularly helpful when trying to implement changes. It facilitates monitoring and policing of energy reduction programs and policies at all times. Some monitors can identify what appliances are being used, indicate which appliance consumes the most energy and make suggestions on how often you should use them to achieve a specific electricity bill target.

These more advanced monitors normally are more expensive but the intelligence and insight they can provide validates the extra spend when that level of detail is required.





Benefiting from an Energy Audit.

A power or energy audit is the most involved and most expensive way to understand how power is consumed. Audits can range from basic to complex and follow industry standards and formats for the process and for how the information is collected and presented to the client. There are standards commonly used like ASHRAE in the US or the ISO50002, however there are a number of parts to these standards that are not relevant to Barbados.

ASHRAE was formed as the American Society of Heating, Refrigerating and Air-Conditioning Engineers by the merger in 1959 of American Society of Heating and Air-Conditioning Engineers (ASHAE) founded in 1894 and The American Society of Refrigerating Engineers (ASRE) founded in 1904.

The Barbados National Standards Institute (BNSI) has adopted the ISO 50002 standard for Energy Audits. These standards are recommended to ensure that the output of any audit presents consistent information in a consistent format. An audit should provide a breakdown of the loads that make up the total consumption in a business or home. The information in an audit is meant to give a view of the areas of concern to the business or home owner or any practitioner reviewing it. It should provide a list of high consuming appliances, devices or equipment so that a plan can be developed to address them. A comprehensive audit will also make recommendations as to what areas can be addressed and what can be done to address them.

ISO50002 – ENERGY AUDITS

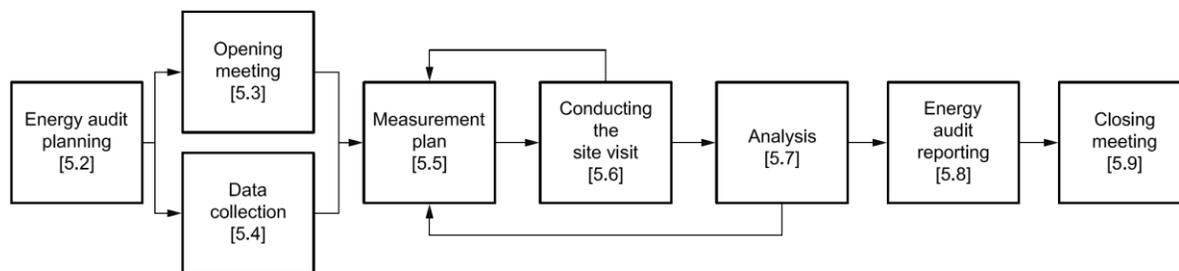


Figure 1 — Energy audit process flow diagram



What can we do to be more efficient?

There are two ways to be more efficient: 1) Behavioural changes and the adoption of procedural changes to cut out wastage in the day to day activities at work and at home. 2) The retro-fitting and adoption of energy efficient appliances, equipment and devices. Let's start by looking at the appliances/devices/equipment that are more efficient.

Lighting

Lighting represents a major portion of the energy used in homes and businesses. Therefore changing the traditional bulbs to more efficient bulbs has a big impact. The most common type of light bulbs used in Barbados are incandescent bulbs with a high concentration in homes, closely followed by fluorescent tubes which are widely used in commercial properties. The chart below shows that incandescent bulbs are the most inefficient bulb type, and the LED bulb is the most efficient. CFL or Compact Fluorescent Light are also very efficient bulbs, however they don't last as long as LED and they contain mercury which is very poisonous. Disposing of the old bulbs must be done correctly to avoid a BIO-Hazard. LED therefore is now the preferred bulb for all energy efficiency retro-fits.

LED (Light Emitting Diodes) are the latest and most exciting technological advancement in lighting. LEDs are solid-state lighting devices that utilize semiconductor materials instead of a filament or neon gas. A LED light is a tiny chip encapsulated in an epoxy resin enclosure.

If manufactured properly with quality components they are extremely energy efficient and long lasting. LEDs operate differently from traditional incandescent light bulbs. LEDs are far more rugged and durable than traditional light bulbs. LED technology also offers many additional advantages over metal halide, high pressure sodium, incandescent, fluorescent and compact fluorescent lighting products such as:

- Lower energy usage (up to **90% more efficient**).
- Exceptionally longer life span (up to **120,000 hours for new LED street lights**). Most LED lights will run for over 50,000 hours before they start to deteriorate.
- Reduced maintenance costs. Because they last so much longer than traditional lights you will not have to replace them as often.
- Reduced heat and therefore lowers cooling costs and improves safety. LEDs are normally cool to touch
- LED lights are easy to install and will replace any type of traditional light
- LED bulbs do not contain Mercury which is highly toxic and a threat to our environment if not disposed of properly



	Incandescent 	Halogen 	CFL 	LED 
450 lumens	40W	29W	9W	5W
800 lumens	60W	43W	14W	7W
1,100 lumens	75W	53W	19W	10W
1,600 lumens	100W	72W	23W	18W
Life	1 Year	1-3 Years	6-10 Years	10-30 Years
Cost	\$6.30/Mo	\$4.54/Mo	\$1.45/Mo	\$1.13/Mo

Light bulb comparison

The cost per month was calculated by assuming an electricity rate of \$0.45/KWH, with the bulbs being used for 5hrs per day for 28 days (which is a typical BL&P billing cycle).

LEDs have a lifespan of up to 120,000 hours compared (New types of LED Street Lights) compared to 1,500 hours for incandescent bulbs. A good quality LED light will last over 7 years (constant use) before needing replacement. On average, LED bulbs last 10 times as long as compact fluorescent bulbs, and 33 times longer than typical incandescent bulbs. A long lifespan of LEDs will dramatically reduce maintenance costs and lower long-term operating costs compared to traditional incandescent and fluorescent tubes.

LED lifespan scenarios:

- 50,000 hours powered 4 hours/day = 34-year lifespan
- 50,000 hours powered 8 hours/day = 17-year lifespan
- 50,000 hours powered 24 hours/day = 6-year lifespan



Not All LED Lighting Is Created Equal

While it is widely accepted that LED bulbs are the best choice for lighting today and all LED bulbs will save money, it must be noted that all LED bulbs are not manufactured the same and therefore do not deliver all the same benefits. Some manufacturers over-inflate the savings and the cost variances. There are many LED manufacturers on-line who sell bulbs very cheaply, but don't always deliver the same level of quality and longevity as the more expensive bulbs.

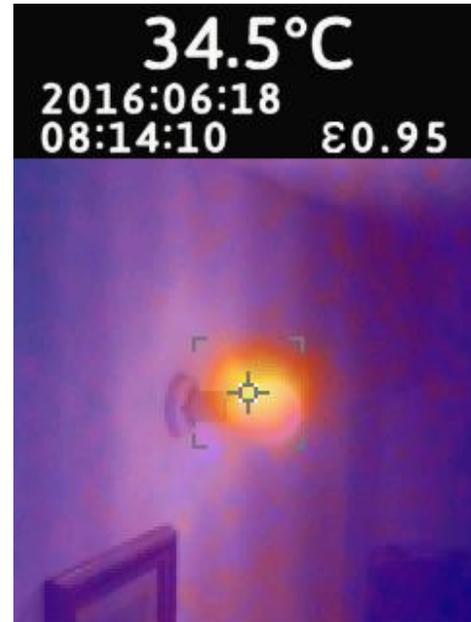
When buying a lamp that is rated for 1000 hours, it will never shine the same as the day it was first installed. This is called Lamp Depreciation. It is not common knowledge that the same principle of Lamp Depreciation applies to LED lighting. LEDs tend to lose some of their light output or Lumens, half way through their life cycle. Color Rendering Index or CRI, and the color temperatures also tend to go down. This is why it is important to consider the quality and manufacturer you are purchasing from for LED lighting.



Temperature of a 7W CFL
Bulb after being on for 3 mins.



Temperature of a 7W LED
Bulb after being on for 3mins.



As you can see LED bulbs operate cooler than even a CFL bulb. Therefore the right lighting will also help with your cooling.



Here are a few tips to consider when purchasing LED bulbs:

1. Select Shape

- Spotlights for track lighting
- Floods for outdoor and recessed lights
- LED candles for wall sconces and decorative fixtures
- A-line bulbs for room lighting and lamps

2. Choose Brightness and Energy Efficiency

- Look for bulbs with high lumens and low wattage for the best energy cost savings
- Divide the lumens by the wattage to determine the best brightness-to-energy usage ratio

3. Choose Color Temperature

- Soft light for indoor applications and small areas
- Bright light for outdoor lighting and indoor task lighting

4. Match Fixture Base

- Screw-in bases include miniature candelabra, candelabra, intermediate and Medium
- Pin bases typically have two pins, such as those used for many halogen lights



Always look for one of these marks on your products



Cooling

It is fair to say that cooling represents the highest consumer of energy in most businesses. This is in spite of all the street lights and lights in homes in Barbados. The peak consumption of electricity is during the day which is predominately because of air conditions cooling offices, hotels and homes. There are three main types of air conditioning systems; Central Air, Window units and Split units. The Central Air is typically found in commercial buildings and Split & Windows in small offices and homes. Traditional air conditioning use is powered by alternating current (AC) compressors which circulate the refrigerant through condensing coils to dissipate the heat, much like how your fridge works. Depending on what temperature the unit is set too will determine how long the compressor will run.

Improve efficiency of Traditional Air Conditioners

The number of cycles during the day is dependent on how well the temperature of the room can be maintained. The inefficient use of an air conditioning system can be caused by the following reasons:

1. A poorly maintained air conditioning unit may cause one or a combination of these problems:
 - a. **Thermostat problems:** Often, the reason that an air conditioner stops its cooling cycle early is because a faulty thermostat tells it to. A thermostat that is incorrectly reading temperatures or is positioned in a house where it receives drafts or direct sunlight will make the compressor turn on and off at the wrong times. Repair technicians can usually fix the problem by replacing or moving the thermostat.
 - b. **Refrigerant leaks:** Loss of refrigerant through leaks will cause multiple problems for an air conditioning system. One of the major signs that a leak has occurred is when the air conditioner begins to short-cycle. Since low refrigerant is an immediate threat to a compressor, you need repair specialists to fix this right away.
 - c. **Clogged air filter:** When too much debris chokes the airflow through the filter of an air conditioner, the evaporator coil will not be able to absorb sufficient heat and will start to shut down early. Be sure to clean the air filter at least once a month during summer.
2. Poor insulation of the room: Poor insulation prevents the room from maintaining the targeted temperature. Therefore, the air conditioning units will cycle more often to try maintain it.
3. Incorrect sizing of the air conditioning unit can cause it to cycle more than normal because it is unable to cool the room to the desired temperature.



New more efficient air conditioners

There are now several alternatives to the traditional air conditioning systems: Direct Current (DC) inverter air conditioners, Solar Thermal air conditioners and Solar Powered air conditioners.

	Traditional Air Con	DC Inverter	Solar Thermal	Solar Powered
9000 BTU	500W	30-60%	20-40%	100%
12000 BTU	1100W	30-60%	20-40%	100%
15000 BTU	1400W	30-60%	20-40%	100%
18000 BTU	1600W	30-60%	20-40%	100%
22000 BTU	2000W	30-60%	20-40%	100%
24000 BTU	2600W	30-60%	20-40%	100%

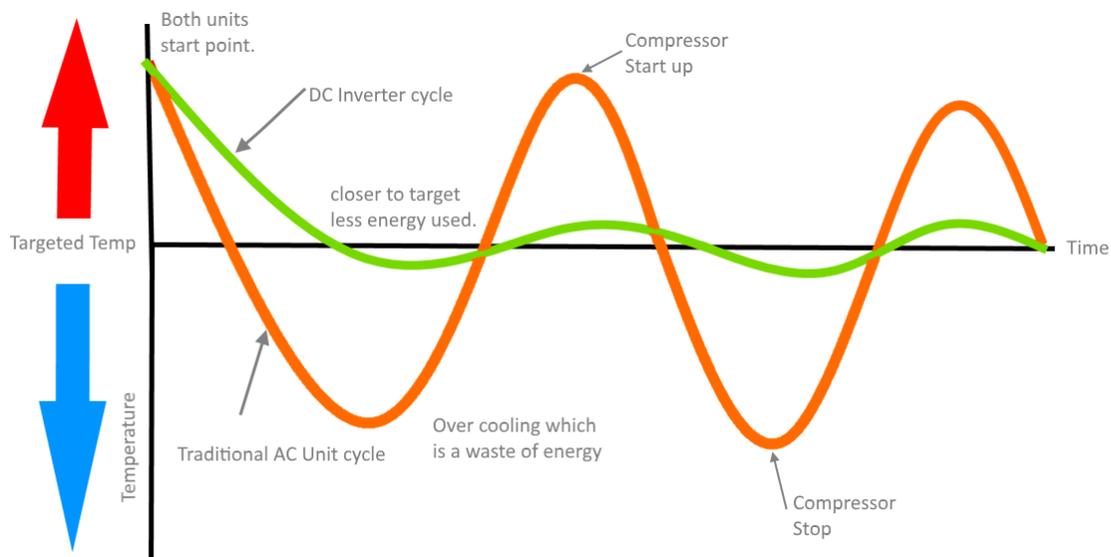
Air Conditioner efficiency comparison

NB the percentage saving is relative to the amount of electricity used by a standard air conditional unit.



DC Inverter

The DC inverter is now the most popular of all the alternatives. It addresses the main weakness of the traditional system; the AC compressor. AC compressors need a high surge of energy to get them started, but DC compressors do not and therefore the new systems replace the AC for a DC compressor. This requires an inverter to convert the AC power we use in our homes and businesses to DC to power the DC compressor. The system goes a little further to provide efficiency. It improves on the weaknesses of the traditional air conditioner where the compressor turns on and over cool then turns off. The DC inverter never turns off it just slows down and speeds up when the temperature drops below the targeted point. As the diagram below illustrates. The combination of the two changes result in a 30% - 60% reduction in energy consumption to the traditional system.



Key benefits for a DC inverter air conditioning system:

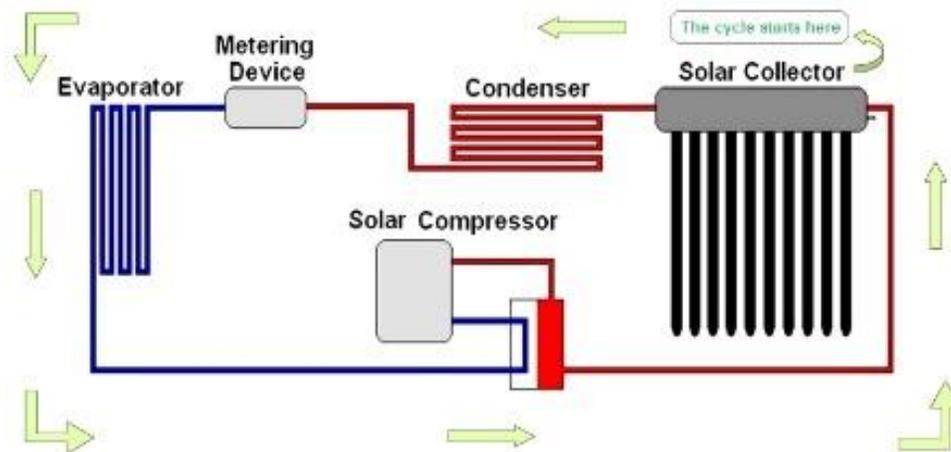
- At least 30% - 60% cheaper to run as it consumes less power
- Far quicker to achieve desired temperature
- The startup time is reduced by 30%
- Much quieter
- No temperature fluctuations, maximizing comfort level
- No voltage peaks from compressor



Solar Thermal



Solar Thermal air conditioning systems, commonly called Solar Air Conditioners are not to be confused with solar powered air conditioning systems. The solar thermal system uses the sun's heat energy to increase the temperature of the refrigerant which makes it easier for the pump to circulate it. This results in less energy used to achieve the targeted temperature.



There is now an emergence of a new system which is a combination of a DC inverter with a solar thermal air conditioner. These systems are expected to provide you with a 50% - 75% saving from a typical system.



Solar Powered Air Conditioning system

These air conditioners are not that commonplace yet because they are relatively expensive. The design is very simple, they used all DC powered components so it can be powered directly from batteries and the solar panels without any need for an inverter. Please note that the efficiency figure of 100% is relative to the usage of utility electricity. These systems use power but it is all DC from solar panels and batteries. Therefore as far as using electricity from the grid they are 100% efficient.



Water Heating

Solar Water Heating

The most efficient way to heat water is a solar water heating. Solar water heating is a very mature technology and has been in Barbados since the late 1970's. Barbados has gained international recognition for being a pioneer in this technology. Today solar water heating has become so commonplace that most people don't recognize the high quality of local manufacturers of water heating systems.

“Barbados’s efforts to encourage the widespread adoption of solar water heating technology has been a success. The island’s 280,000 inhabitants now boast more than 50,000 solar water heaters installations and save over 100,000 MWh of energy per year.” *Climate and Development Knowledge Network (CDKN) September, 2012.*



The Solar Water Heating industry in Barbados emerged in the early 1970s in response to the major oil shock, where prices increased threefold in the space of one year. Like many SIDS in the Caribbean, Barbados relied heavily on imported fossil fuels providing 95% of the country's energy needs.

In 1973 Canon Andrew Hatch of Christian Action for Development made a solar water heater out of an old oil drum and fixed it to the roof of his church. Recognising the potential of the technology, James Husbands founded Solar Dynamics, the first solar water heating company on the island, in 1973 and soon had the opportunity to demonstrate the technology at the highest levels of government. "The Prime Minister, Tom Adams, wanted a water heater. We installed one of our units at his house and he was very pleased with it." Having the country's leader see his annual gas consumption drop by 70% was a new business owner's dream.
- *Climate and Development Knowledge Network (CDKN) September, 2012.*

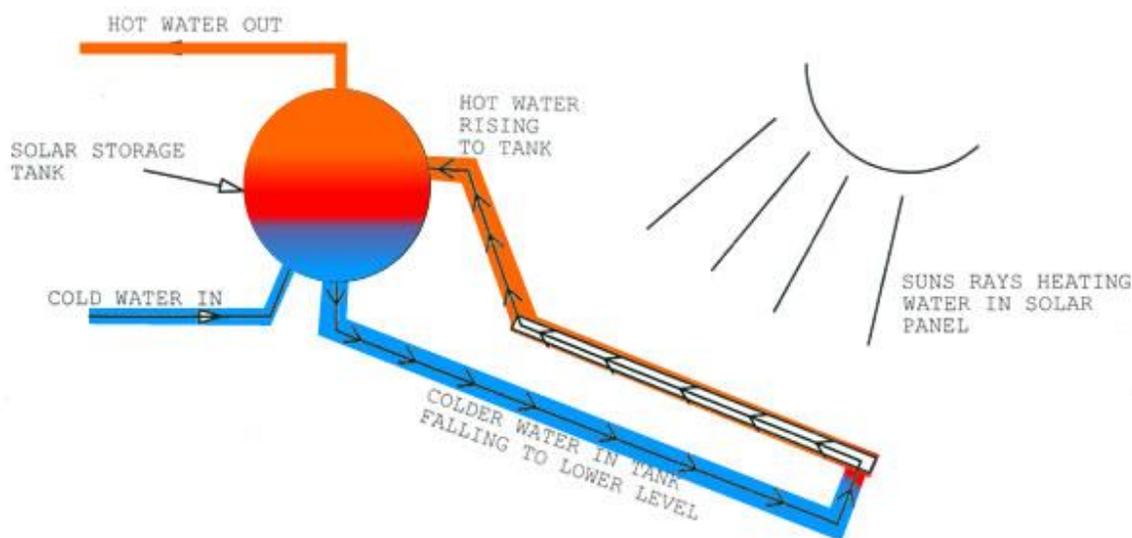


This pioneering effort was quickly followed by Sunpower Limited, which is now considered the number one company in Barbados.

The main benefit of a Solar Water Heating System is to have the use of hot water without having to continually pay for electricity or gas to heat the water. A solar water heating system is ideal for many applications, and is used successfully by many hotels, restaurants, and other industries.

Flat Panel Collector system

This is the most common in Barbados. Flat panel collector systems use a natural convection phenomenon called 'Thermosyphon' which is based on the principle that hot water rises while cold water falls. At the beginning of the process, cold water in the storage tank falls to the bottom of the storage panels, where it is heated by the sun. Heated water will then rise through the copper absorber tubes, continuing to be heated until it leaves the collector panel, where it is stored in the tank until ready for the household needs.



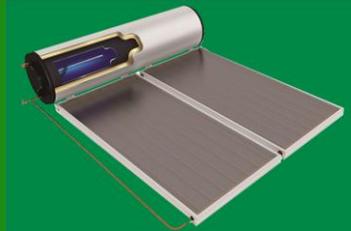
Evacuated Tube Collectors

Evacuated tube collectors are a slightly more recently developed technology. There are several varieties of evacuated tubes, however the most commonly used type employs the use of a heat pipe surrounded by a glass tube that is under a vacuum. The glass tube actually consists of two walls of glass. In between the two walls, all the air is removed, resulting in a vacuum in the same manner as a clear Thermos bottle would function. This vacuum is the best insulation one could ask for, and gives the evacuated tubes a much better heat retention than air space. The heat pipe is also pressurized, allowing the water to boil very rapidly, at a very low temperature (usually between 75F and 80F). As the water boils, it carries the collected heat to the top of the collector, where the heat is then collected by water or heat transfer liquid that flows around the top of the heat pipe, and then transferred to a storage tank or elsewhere in the system.





Tips for purchasing a Solar Water Heater



Involve your architect or the sales representative at the design stage in recommending the size of your system. It is important to consider the size of the property, the number of people using the system as well get input from the architect.

If you prefer not to have the tank on the roof, you'll need a pump system. Your architect or contractor must be advised by the system provider if an electrical supply is required for the pump or if the system has an integrated solar PV power system for the pump. The roof designs must be able to accommodate the fittings in terms of leaving sufficient clear space around the panels and fixing them to the roof.

Remember to consider your plumbing system, as pipes running in excess of 30 feet to your kitchen or bathrooms will lose heat efficiency.

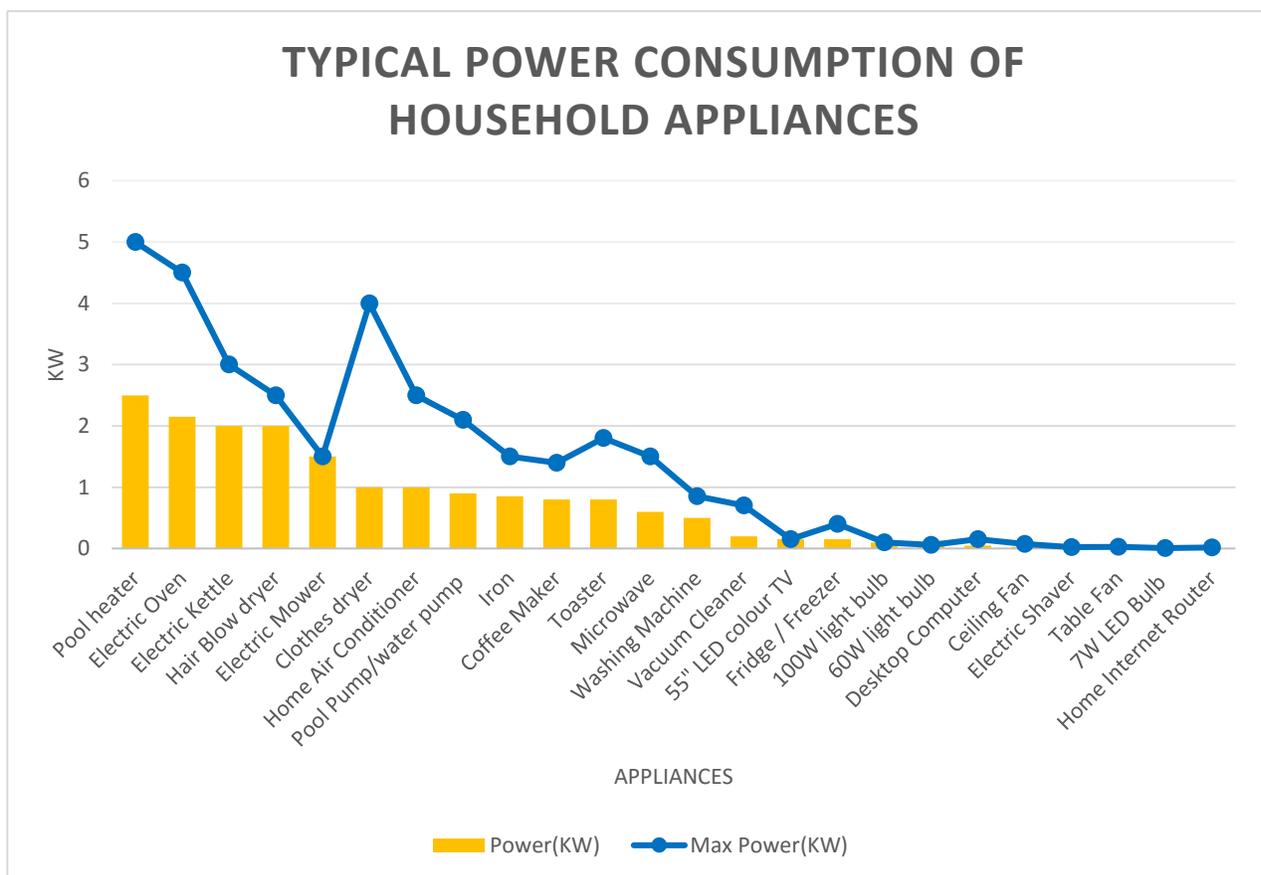
If you have a choice between a roof mounted tank or ground mounted. Here are a few things to consider:

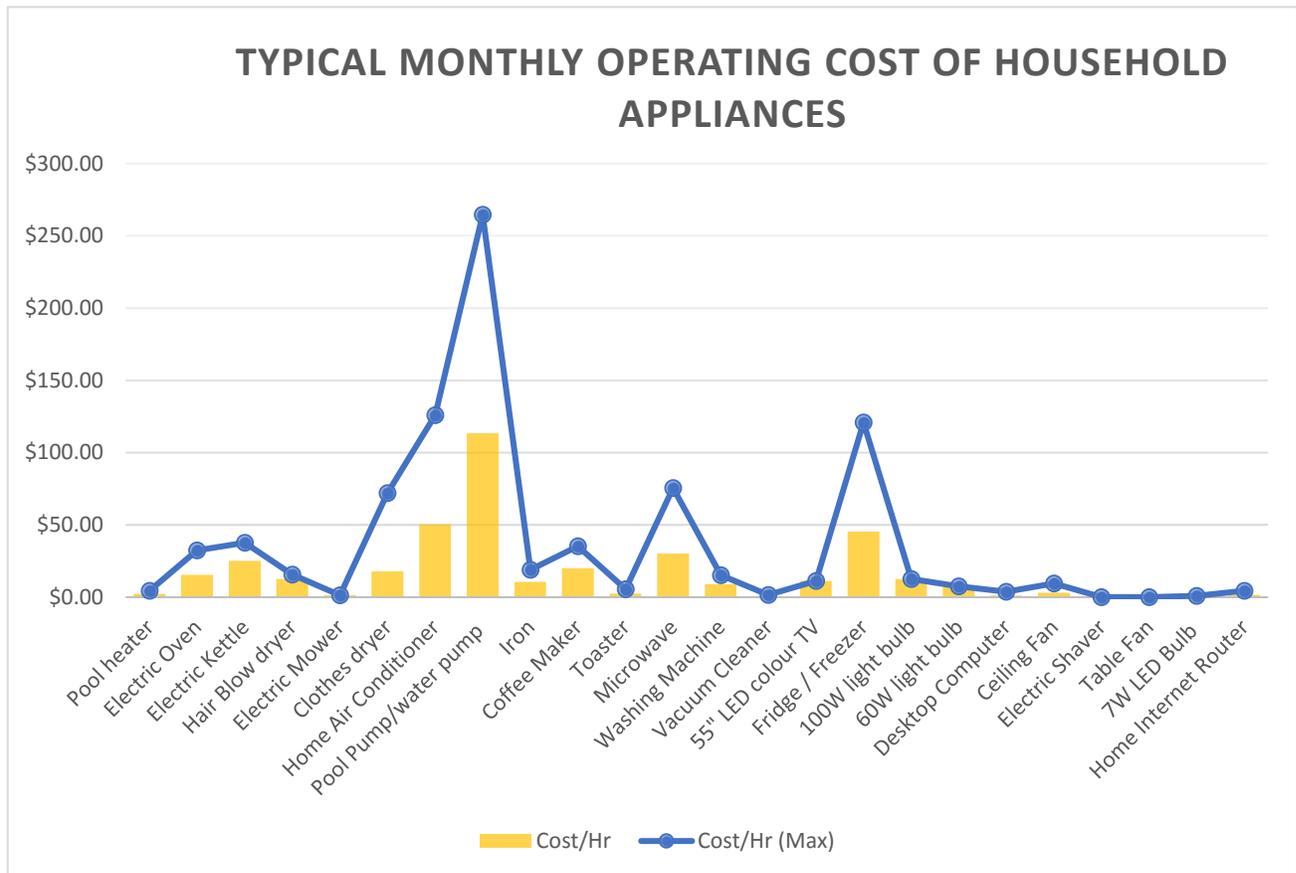
Natural Convection System	Pumped ; or Split Circulation System
No moving parts	Needs mechanical pump, and PV electrical panel for its operation
Produces hot water in direct sunlight, as well as in diffused radiation conditions.	Photo voltaic panel requires direct sunlight to energize the pump, for the system's operation
Produces hot water even in inclement weather	Will produce less hot water year round, and is likely to require boosting occasionally.
Needs a collector ratio of 1sq. ft to 2.4 gallons	Requires a collector area of 1sq. ft to 2 gallons



Household appliances

There are many choices in household appliances with many convenient features. By choosing an energy efficient appliance you can offset the higher initial cost with reduced operating costs throughout the life of the product. However more often than not the more features they have the more power they consume. Below are two charts that will examine the power consumption of a range of household appliances/devices/equipment and then the operating cost in a typical household monthly activity. The number of hours allocated for each appliance is not based on analysis from assessments done for a number of homes. The operating cost is calculated based on a \$0.45/KWH electricity rate and a 28 day billing cycle.





These two charts demonstrate that the highest consuming appliances are not always the highest cost to operate on a monthly basis. It shows that pool pumps can be very costly for those homes that have pools. However the highest consumer for a typical home would be the fridge simply because it is on 24hrs. This followed by the microwave and an electric kettle. The clothes dryer or air conditioners can easily become the highest consumer. However, in this analysis the household uses these appliances only on weekends.

Selecting the more energy efficient appliance

When purchasing appliances for your home there are many competing factors that determine which product you select. Many people shop for features, convenience and cost. However, it is time that we shop based on energy consumption first. It might provide better value to spend more up front for equipment that is going to cost less to operate. The guide will attempt to give you guidance on a number of appliances.



Pool Pump: The first choice should be a variable speed pump. Pool pumps are required to run for a fixed period every day to ensure proper circulation of the chlorine in the water. A variable speed pump starts fast and slows down over time which dramatically reduces the amount of electricity used to circulate the water/chlorine. Power consumption drops by three times for every unit decrease in pump speed. Variable speed pumps can reduce operating cost for the pool by as much as 80%.



A second option would be a **solar pumping system**. Solar pumping systems are not new, it simply is a DC powered pump with batteries and a solar panels to power it. These systems are being widely used by farmers in rural underdeveloped areas. However it should be given serious consideration by the local farming community to reduce operating cost. They are also a number of solar pool pump systems available as an alternative to variable speed pumps. Solar pump will not use any electricity from the grid.

Clothes Dryer: The first choice should be using the sun and wind on a clothes line. Which are both free resources and will not use any electricity. However if a dryer is required choose a natural gas clothes dryer. These dryers can work with Natural Gas or Liquefied Petroleum Gas (LPG). Natural gas or LPG is currently a cheaper energy source than electricity.

A second option is a **Heat-Pump Dryers**. These dryers are even more efficient than gas dryers. Heat-Pump dryers operating cost 20-60% less than a traditional electric dryer. Heat-pump efficiency is achieved through recirculating the hot air that is normally vented by a traditional dryer. This allows it to use much less energy to heat the air in the dryer.





Oven/Stove: The first choice should be a gas oven/Stove. These will come in the more modern counter top models as well as the traditional floor standing models. These can work with either natural gas or LPG which is currently a lower cost option than electricity.



A second option is an **induction counter-top** stove. It uses 12% less energy than a traditional electric counter-top, which is not much. However, it comes up to desired temperature in 4-6 mins faster than conventional electric stoves which result in additional savings.



Refrigerator: Newer model refrigerators are very efficient. However, there are now even more efficient fridges called Digital inverter Fridges. Unlike conventional compressors, which just start and stop, a digital inverter compressor has adjustable speeds to suit different cooling demands. So it works smoothly, reduces wear and tear for greater durability, and minimises noise.





ENERGY STAR PRODUCTS



Energy Star is the most recognized energy efficiency certification in the US and they have now expanded to EU-Energy Star. When making a purchase for any appliance try has much as possible to purchase one with the energy star logo.

Certification Integrity

To maintain consumer trust and improve the oversight of ENERGY STAR certified products, homes, and commercial facilities, EPA has implemented third-party certification requirements and testing.

For Products: In order to earn the label, ENERGY STAR products must be third-party certified based on testing in EPA-recognized laboratories. In addition to up-front testing, a percentage of all ENERGY STAR products are subject to "off-the-shelf" verification testing each year. The goal of this testing is to ensure that changes or variations in the manufacturing process do not undermine a product's qualification with ENERGY STAR requirements.

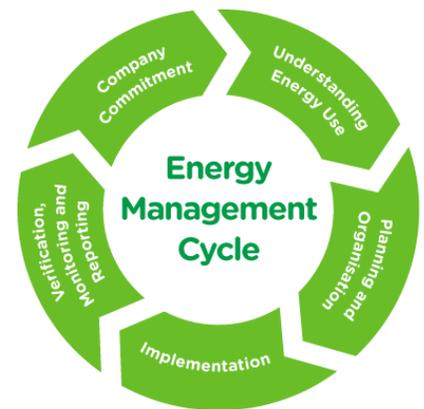


Energy Management

Energy Management – Energy management is the process of monitoring, controlling, and conserving energy in a building or organization. “Energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet the requirements, taking into account environmental and economic objectives.” This is typically the best approach for commercial and industrial businesses, because their power consumption and possible reduction plans are more complex.

This can include, but is not limited to:

1. Collection of energy consumption data.
2. Identifying energy saving opportunities.
3. Developing an energy reduction plan which may include retro-fits of energy saving devices/appliances/equipment or behavioural/procedural modification.
4. Executing the energy reduction plan.
5. Tracking your progress through measuring energy consumption data.
6. Develop a plan to maintain reduced energy levels.



Energy management for a business is meant to uncover operational efficiencies that will save energy and reduce operational cost. The Barbados National Standards Institute (BNSI) has adopted ISO 50001:2011 standard to be the guide for energy management in Barbados.

Energy Management Systems

Energy management systems are systems that control lights, air conditioning units, appliances, outlets & devices to save energy. They can be implemented in commercial buildings, hotels or homes. They use a variety of sensors, switches, apps, programs and touch screen interfaces to control the devices. They range from simple systems that can control one device to systems that can control every appliance, electronic device, light and cooling system in the house or business to effect good energy conservation procedures automatically or initiated by a sensor or by a user via mobile phone, Tablet or computer.

These systems are mature technology in other parts of the world but are not very commonly deployed in the Caribbean. As the grid gets smarter these systems will begin to become more commonplace and will be able to integrate to the utility demand management systems to provide very sophisticated utility integrated energy management systems.



Building for energy efficiency

There are many things that can be integrated into your initial design and construction of your building and home which would reduce the wastage and use of energy.

1. Utilize as much natural lighting as possible by the use of sky lights and windows.
2. Utilize as much natural cooling as possible by the positioning of the windows to facilitate good ventilation, using reflective glass to reduce heat and the roof/ceiling design to minimize the indoor heating from the sun.
3. For buildings and homes that must use air conditioning proper insulation increases efficiency of your cooling system significantly.
4. Careful consideration to room sizes. Design common use areas like a lounge with cooling and lighting as major consideration over aesthetics. Large common areas with high ceilings are expensive to cool and light.

These are a few things to consider and discuss with your architect when designing your office building or home. The right design can reduce your operating expenses due to efficient use of energy.



This building is 25% more efficient than other buildings its size - Good use of natural lighting

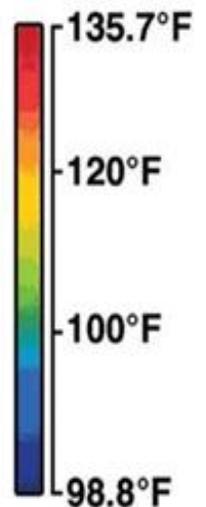


Building finishes

One of the many energy efficient considerations during building is the type of finishes used. There are several type of wall and roof finishes that significantly reduce the effects of the heat from the sun. On a hot day the walls of a house can absorb as much as 90% of the radiant energy (or heat). Even white walls can absorb significant solar radiation. The typical approach to address heat is the use of air conditioning which can be expensive. The right wall finish can make your home or building reduce enough heat to minimize the use of air conditioning and in some cases eliminate the need for an air conditioning system. Some insulated cladding systems can reduce the adsorbed heat by as much as 38°C. Similar levels of heat absorption reduction can be achieve with the right roof finishes.



An insulated cladding finish



Thermal imaging of a wall coating system



Barbados Energy Labelling Programme



The Barbados National Standards Institution (BNSI) is seeking to increase the energy efficiency in the residential sector of Barbados by introducing energy efficiency labels and standards for major electrical household appliances, lighting equipment and other electrical household products.

Labels enable consumers to make informed purchase decisions. Standards prevent inefficient equipment from being imported.

Energy efficiency standards and labels contribute to energy saving. Households, particularly those in the lower income bracket, commerce, industry and the public sector benefit from lower electricity bills. At the same time, the country benefits from lower fossil fuel imports. A reduction in the burning of fossil fuels contributes to environmental protection and climate change mitigation.

The BNSI, its partners, other interested stakeholders, policy makers, importers and retailers of electrical equipment are working towards the following objectives:

1. Increasing knowledge of energy efficiency of domestic appliances
2. Development of the necessary standards, policies and legislation
3. Equipping the relevant institutions with the capacities to implement the standards.

The programme also aims at raising the awareness of energy efficiency among the general public and educating consumers about energy efficiency labels and their implications.

For more information regarding this programme or if you have any questions please contact us or visit our website at www.bnsi.bb.





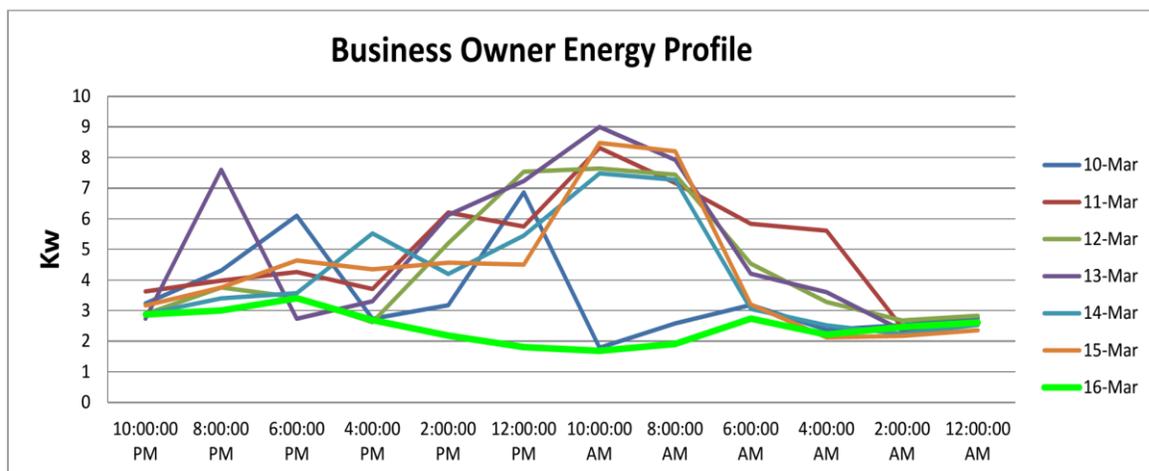
Case Study

Residential/Small Business

The owner's electricity bill was **\$1500.00 - \$1800.00** every month. The power demand was seeing peaks of 9KW. The owner was looking for options to address the high electricity bill and got quotes from several energy companies. The most attractive to the owner at the time was offer for a solar PV system that would have cost \$86,000.00. However it came with financing terms favourable to the owner so he was moving forward. Just before taking the deal he decided to get one more quote and instead was given an audit/assessment which provided revealing information about how he was consuming energy as shown in the profile below.

Data Collected

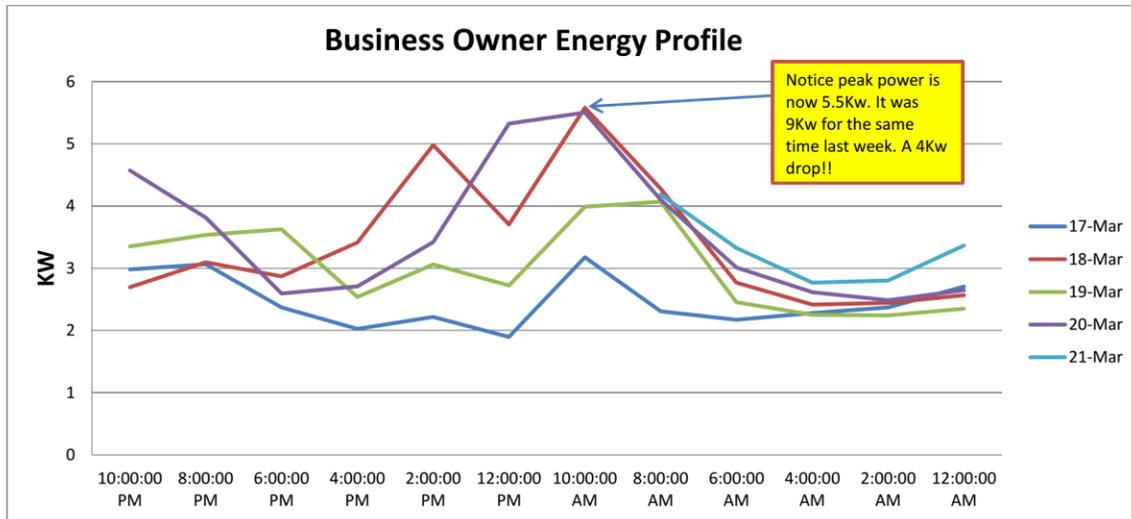
Daily Data before Changes



Based on the report the owner decided not to take the system but instead bought a power monitor to continuously monitor and track the use, made a number of procedural changes including not using the optional electric water heater system that comes with a Solar water heater (as it was used every day to overheat the water). At this stage these changes did not cost anything. It was just the cost of the monitor and some expert advice. The results were immediate as there was a 4KW drop in peak consumption.



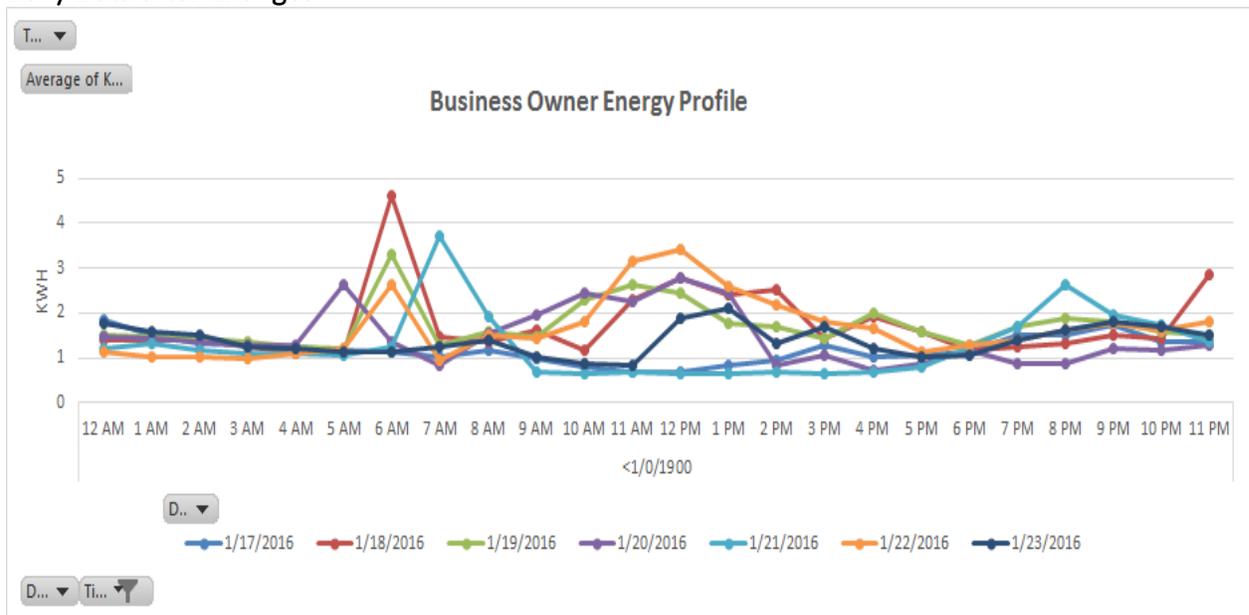
Daily Data After Changes



After seeing immediate and dramatic results the owner decided to invest in a few more changes. The fluorescent tubes were replaced with LED equivalent bulbs and an air conditioning unit that was identified during the audit was replaced with a DC inverter unit. After three months and a total spend of \$4000.00 inclusive of the purchase of the power monitor, the electricity bill went down to \$750.00 - \$850.00 per month.

Here is the profile three years after and you can see the owner has benefited significantly from the Audit and subsequent consultation. He has been able to maintain the new reduced profile with continuous monitoring and managing the consumption.

Daily Data after Changes





Energy Efficiency & Conservation tips

- **Avoid opening the oven unnecessarily** – this reduces the internal temperature which results in extra energy to heat the oven.
- **Use a toaster rather than the oven for making toast** – The toaster will use less energy than an electric oven because it has to heat less space.
- **Use cooking utensils with tight fitting lids** – this will aid in maintain the internal temperature longer and therefore reduce the amount of energy required to cook.
- **Fit the pan to the right size burner** – doing this increases the heating efficiency, which reduces the cooking time and save energy.
- **Turn heat down after liquid has come to the boil** – this simply reduces the amount of energy used.
- **Take all that you need out of the refrigerator at one time when preparing meals-** reducing the number of times you open your fridge will help to maintain the temperature for longer periods which reduces the number of time the compressor has to cycle. Every time you open the refrigerator door, up to 30%of the cold air can escape.
- **Avoid heavy frost build up. Defrost regularly.**
- **Full machine loads save water, detergent and energy, but don't overload**
- **Let the sun dry clothes. Save the dryer for a rainy day**
- **Keep the lint traps in your clothes Dryer clean** – this will allow the dryer to work as efficient as possible.
- **Do as much of your ironing as possible in one session-** keeping the iron hot minimizes the amount of time it has to heat up which reduces the amount of energy used.
- **Don't use your TV set as a radio for back ground noise.**
- **Turn off the TV when no one is watching. Radios, CDs, and cassette players should not play to an empty room.**



- Dimmer switches vary lighting levels and provide energy savings.
- Turn off lights and fans when not in use. Even when you believe you are only leaving the room for a few minutes.
- Get the most out of your security lighting by trimming foliage which obstructs light.
- Check that refrigerator gasket is sealing tightly – a leaking gasket means the fridge will not maintain its temperature as long as it should which results in more energy used to keep the fridge at the desired temperature.
- Choose the right size air conditioning unit for the room size and set the thermostat to where it is just comfortable: 25°C is recommended.
- Use a ceiling fan to help circulate the cool air from the air conditioning unit.
- Install a timer to turn off the air conditioning unit automatically after an hour or two by which time you are asleep.
- Avoid using the electric heater for a solar water heating system – they consume a lot of energy and most people forget them on all day.
- Plug home electronics, such as TVs and DVD players, into power strips; turn the power strips off when the equipment is not in use or plug them up- TVs and DVDs in standby mode still use several watts of power. In the average home, 75% of the electricity used to power home electronics is consumed while the products are turned off. The average desktop computer idles at 80 watts, while the average laptop idles at 20 watts. A Sony PlayStation 3 uses about 200 watts and nearly as much when idle.
- Make sure windows and doors are closed when using an air conditioner.
- Implement occupancy sensor on bathroom/kitchen areas in your businesses – these lights are normally left on for long period when not in use.
- Reduce the level of lighting in non-work areas like walk ways – using two bulbs in a walk way instead of four may not impact on your ability to see to walk but it will reduce energy used in that area by half. (*this should be evaluated based on the lighting requirements in each non-work areas*)



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About us



BREA is committed to the promotion of alternative energy, energy efficiency technologies and systems, supporting the efficient use of alternative energy in all its forms as long as it is relevant to Barbados' situation. BREA is comprised of knowledgeable industry professionals who are passionate about transitioning Barbados towards a sustainable energy sector. Feel free to contact our members should you have any doubts and queries with regards to renewable energy.

We are a Barbadian non-governmental organisation promoting the development and efficient use of renewable and alternative energy resources for Barbados. Our members include the following Barbados companies and institutions:

Caribbean LED
EnSmart Inc
ECO Energy
Future Energy Caribbean
UWI
Williams Solar

Courts (Unicomer Barbados)
Solar Watt
Sun Power
Mega Power
CTA
Barbados Light & Power Ltd.

We invite you to become a member of BREA and help us continue the work of transitioning Barbados to a 100% sustainable energy island with a prosperous economic sector, a healthy social sector and a clean environmental sector.

Visit www.brea.bb to find out how to join.



Supported by the Barbados Human Resource Development Strategy, which is funded by the European Union.



Realising Our Human Potential

