RWANDA
UTILITIES
REGULATORY
AUTHORITY

Inspiring development

GUIDELINES PROMOTING ENERGY EFFICIENCY MEASURES

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1. PREFACE

1.1. Introduction

One of the duties of the Rwanda Utilities Regulatory Authority (RURA) is to ensure the operation and development of a safe, efficient and economic energy sector in Rwanda. These guidelines are a supplement to efforts being undertaken by the Ministry of Infrastructure (MININFRA) and the Energy, Water and Sanitation Authority (EWSA) in educating the public on energy efficiency in general.

Efficient energy use, sometimes simply called energy efficiency can be interpreted as the reduction of energy use for a given service or level of activity, or more aptly as the art of "Doing more with less". Energy efficiency and renewable energy are said to be the twin pillars of a sustainable energy policy.

In industry, electrical energy is the lifeblood of manufacturing since it is used to convert raw materials into finished products. Furthermore, electrical energy is also one of the most convenient, safe and form of energy for use in the home. But with climate change and declining economies taking centre stage globally in recent years, it is imperative that energy is used efficiently both to cut usage costs and protect the environment.

In many countries, energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted. Efficient use of electricity can go a long way in reducing the national electrical load and hence delay capital intensive generation and transmission projects.

1.2. Purpose

These guidelines aim at guiding electricity consumers on how to promote energy efficiency use. These guidelines outline some measures that will help in the efficient use of electricity mainly applicable to businesses/industry, institutional premises and residential consumers.

1.3. Definitions

Unless the context otherwise requires, the terms used in these guidelines have the following meaning:

"**Authority**" means Rwanda Utilities Regulatory Authority;

"Carbon finance" means a mechanism that facilitates the financial reward through carbon credits for the reduction of greenhouse gas emissions by emitters in developing countries;

"Energy auditor" means a person who carries out inspection, survey and analysis of energy flows for energy conservation in a building, process, or system to reduce the amount of energy input into the system without negatively affecting the output;

"Energy conservation" means efforts leading to a decrease in energy consumption;

"Energy investment plan" means the allocation of resources for the purpose of advancement, capacity growth, and improvement of energy efficiency and conservation measures;

"MEPS (Minimum Energy Performance Standard)" is a specification containing a number of performance requirements for an energy-using device, and that effectively limits the maximum amount of energy that may be consumed by a product in performing a specified task;

"Facility" includes factories, commercial buildings and institutional buildings;

"Owner or occupier" includes the charterer or a lessee of a facility;

2. GENERAL GUIDELINES

This section outlines the measures that will help the industry and business and residential customers to succeed, to some extent, in promoting energy efficiency use.

2.1. Energy efficiency standards and Appliance labelling

All facilities shall be required to meet Minimum Energy Performance Standards (MEPS) that effectively limits the maximum amount of energy that may be consumed by a product in performing a specified task. In addition, all home appliance and equipment types that consume energy should bare their labels and meet MEPS for the purpose of efficient energy use and energy conservation.

Energy efficiency standards and labels are sets of procedures and regulations that, respectively, prescribe the minimum energy performance of manufactured products and the informative labels on these indicating products' energy performance. They are meant to help the market recognize energy efficiency and act on it. The standards prohibit the production and import or sale of appliances and other energy-consuming products less efficient than the minimum requirements. These standards not only help to save energy but also to assure a level playing field by eliminating products with burdensome operating costs and hastening the development of innovations that bring improved performance.

2.2. Energy Management

Energy management can be defined as the use of engineering and economic principles to control the use and cost of energy to provide needed services. An energy management strategy is particularly important in industry but some of the activities can be scaled down to achieve energy efficiency at offices and homes. Effective energy management has four fundamental components:

- Efficient Purchasing – purchasing electricity at lowest available cost (if different options are available).
- Efficient Operation – operating equipment that consumes energy as efficiently as possible.
- Efficient Equipment – upgrading or replacing existing equipment with more energy efficient versions whenever it is cost effective to do so, but without compromising safety.
- Efficient Design – designing of new or existing plant/buildings using most efficient technologies.
  – harmonic current suppression devices should be used in the electrical installation for high-rise buildings to avoid electrical fires.

➢ **Dimensions of Energy Management**

There are three dimensions of energy management namely:

a) Technical – the energy consuming devices and systems that use energy efficiently or inefficiently;

b) Organizational – the structure and management systems that can support or hinder the achievement of energy efficiency goals; and

c) Human Behavior – the personal values, attitudes and practices of individuals in the organization (or home) that impact on energy use.

➢ **Energy Management program**

An energy management program is the process of implementing energy management through:

- Policy setting;
- Energy auditing;
- Behavioural change through awareness campaigns;
- Identifying and implementing technical and procedural solutions; and
- Planning for future facilities and services;

To start an energy management program the following two steps should be taken:

- Put administrative and management structure in place which includes appointing a person responsible for energy management;
- Conduct an energy audit

2.3. Energy Audit

An energy audit is an inspection, survey and analysis of energy flows in a facility with a view to establishing alternatives that can reduce the energy costs. Audit is required to identify the most efficient and cost-effective Energy Conservation Opportunities (ECOs) or Measures (ECMs). Energy conservation opportunities (or measures) can consist in more efficient use or of partial or global replacement of the existing installation. The survey consists of:

- Organizing electricity data – online metering, collecting billing data, load profiles, load factor, power factor, baseline consumption, etc.
- Understanding utility rates and structures – cost of using energy and power, i.e. energy vs. demand charges
- Identifying all electrical power consuming equipment, operating hours, operating procedures, areas for potential savings, etc

In industries where there is more than one form of energy, which is mostly the case, the above activities should be carried out for all available forms of energy used.

➢ Types of Energy Audits

There are three common types of energy audits namely: Preliminary, Detailed and Investment-grade.

2.3.1. Preliminary energy audit

The preliminary audit (alternatively called a simple audit, screening audit or walk-through audit) is the simplest and quickest type of audit. This inspection is based on visual verifications, study of installed equipment and operating data to identify any glaring areas of energy waste or inefficiency.

Typically, only major problem areas will be uncovered during this type of audit. Corrective measures are briefly described, and quick estimates of implementation cost, potential operating cost savings, and simple payback periods are provided. This level of detail, while not sufficient for reaching a final decision on implementing proposed measures, is adequate to prioritize energy-efficiency projects and to determine the need for a more detailed audit.

2.3.2. Detailed (General) energy audit

The detailed audit (alternatively general energy audit) expands on the preliminary audit described above by collecting more detailed information about facility operations and by performing a more detailed evaluation of energy conservation measures. It provides a breakdown of the energy use and a quantitative evaluation of the energy conservation opportunities and measures selected to correct the defects or improve the existing installations.

This level of analysis can involve advanced on-site measurements and sophisticated computer-based simulation tools to evaluate precisely the selected energy retrofits. A detailed financial analysis is performed for each measure based on detailed implementation cost estimated, site specific operating cost savings, and the customer's investment criteria. Sufficient details are provided to justify project implementation.

2.3.3. Investment-Grade

The investment grade energy audit is the most sophisticated of all the types of energy audit. It requires detailed energy modellling, analysis of the facility, and energy meter data for several years. It provides a detailed analysis of Capital-

Intensive Modifications focusing on potential costly Energy Conservation Opportunities requiring rigorous engineering study.

2.4. Equipments for energy audit

Listed below are some instruments used to measure data needed in carrying out an energy audit.

- Multimeter – to measure voltage, current and resistance of electrical equipments;
- Lux meter – to measure lighting levels;
- Smart energy meters – to provide information on how end users use their electricity on real-time basis and track electricity consumption;
- Thermometers and thermocouples – to measure temperature of operating equipment and work spaces;
- Ultrasonic flow meter – to measure flow of liquids, such as hot water process fluids;
- Infrared temperature gun – to measure temperature of steam line exteriors and other hard-to-reach equipment;
- Measuring tape – to check dimensions of walls, ceilings, windows and distances between equipment;
- Ultrasonic leak detector – to detect leaks in steam and compressed air distribution systems;
- Combustion analyser – to estimate combustion efficiency of fossil fuel burning machines.

2.5. Energy Accounting

Before energy costs can be managed, they first have to be known. Energy accounting provides feedback (from the energy audit analysis) on how much energy an organization uses and how much it costs. It also provides a means to effectively communicate energy data that staff, building occupants and managers can use to improve cost management.

Specifically, energy accounting assists with:

- Recording and attributing energy consumption and costs – this requires a full understanding of the electricity tariffs/utility bills
- Troubleshooting energy problems and billing errors
- Providing a basis for prioritizing energy capital investments
- Evaluating energy programs success and communicating results
- Creating incentives for energy management
- Budgeting more accurately

An owner or occupier of a facility may investigate the inclusion of the relevant components of an energy investment plan into a project to be registered under the Clean Development Mechanism or any other carbon finance mechanism in place.

2.6. Demand-Side Management

The demand Side Management consist of planning, implementation, and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. The Demand Side Management covers the complete range of load-shape objectives, including strategic conservation and load management, as well as strategic load growth.

The load management programs seek to lower peak demand during specific, limited time periods by temporarily curtailing electricity usage or shifting usage to other time periods. Peak demand management does not necessarily decrease total energy consumption, but could be expected to reduce the need for investments in networks and/or power plants.

3. ENERGY SAVING TIPS

This part of the guidelines looks at the recommended measures that home users can implement on their appliances to cut down their consumption of electricity and hence reduce their utility bills. Some of the measures are really easy as all they require is to change a habit with zero spending while others might require some associated costs or investing in energy efficiency equipments. It is to be noted that some of the measures applicable to residences can be scaled up and applied to the industry/business sector and by the same token some of the measures for industries/business can be downscaled and applied to the residential sector.

The first step to taking a whole house energy efficiency approach is to find out which parts of the house use the most energy. A home energy audit will pinpoint those areas and suggest the most effective measures for cutting the energy costs. A simple home energy audit can be conducted by the house occupant or by an independent energy auditor for a more comprehensive examination. Improving the energy efficiency of homes can save money, help the environment, and improve comfort of the house occupants.

3.1. General tips

- Use appliances of appropriate capacity and features best suited for its application;
- Switch off appliances that are not in use or after use;
- Maintain appliances regularly for optimal energy efficiency performance;
- Replace aging, inefficient appliances. Even if the appliance has a few useful years left, replacing it with a top-efficiency model is generally a good investment ;
- Look for “Energy label” and buy the most energy efficient when purchasing appliances.

3.2. Water heating

- Turn the geyser (water heater) thermostat down to a lower temperature of 60 degree Celsius ;
- Turn the geyser off for the most part of the day apart from mornings and evening when more hot water is needed ;
- Avoid using hot water unnecessarily and minimize hot water usage for bathing and cleaning purposes;
- Use the shower rather than bathtub. Showers can use up to 50% less hot water than a bath and hence less energy required;
- Repair leaking taps. The more hot water tap leaks, the more the geyser works and wasting substantial amount of energy ;
- Insulate the geyser and hot water pipes. The insulations will reduce standby heat loss and heat lost through the walls of the tank ;
- Install a programmable thermostat on geysers or other heating appliances. A programmable thermostat can make a big difference in the energy consumption by a geyser because it tells the appliance exactly when it has to come on and go off.
- Install the water heater as close as possible to the taps;

3.3. Refrigeration

- Don’t open the refrigerators doors unnecessarily and make sure the air tight seals are intact ;
- Let hot foods cool down to room temperature before putting them into the refrigerator ;
- Defrost the freezer compartment of the refrigerator on a regular basis ;
- Place the refrigerator away from direct sunlight, stove, heat vents or other heat sources ;
- Leave enough space behind the refrigerator for ventilation;
- Clean the condensing coil at the back of the refrigerator on a regular basis to provide better heat dissipation ;
- Set the refrigerator at right temperature using the dial or knob. The colder their refrigerator is, the more energy it takes to keep it that way;
- Cover all food stored in the refrigerator ;
- Keep the freezer full when possible. The fuller the freezer, the less cold air you lose when opening the door ;

3.4. Electronics

This refers to electronics used for entertainment, office equipments, or in telecommunication. As the number of these electronics per household increased in recent years, so too has the energy use in this sector. As the amount of time that people spend using these electronics has been increasing, their energy consumption is becoming a larger concern.

The vast majority is consumed by home entertainment systems and home office equipment. But small energy users, including portable devices with battery chargers, make up a significant share—not because they use a lot of energy individually, but because of their sheer numbers. There are several steps to minimize the energy used by the electronics in a home:

- Put your computer and monitor to sleep if you are away from your machine for 5 to 15 minutes. Do not leave the computer in 'sleep' mode overnight as it is still drawing a small amount of energy ;
- Turn off and unplug all electronics when not in use. There are "plug leaking energy" in many electronics devices such as TV's, VCR's, chargers, adapters, computer peripherals and other electronics even when they are switched off ;
- Plug home electronics and office equipment into a single power (smart) strip with an on/off switch. This will allow you to turn off all power to the devices in one easy step to avoid the plug leaking energy;
- Unplug battery chargers for electronics such as cell phones, digital cameras when the battery is full as they still draw some amount of energy even when these devices are not plugged into. According to studies, cell phones only use 5% of the power that is pulled out of the wall to charge their batteries;
- Consider buying a laptop instead of a desktop computer. Laptops consume considerable less amount of power than desktops.

3.5. Ironing

- Iron clothes in large batches. Ironing large batches of clothing at one time saves energy as the iron does not have to be reheated;
- Switch off the pressing iron once it has reached the correct temperature. Efficiency can be optimised by completing the ironing with the iron already switched off utilizing the stored heat energy especially for fabrics requiring low heat;
- Switch off the pressing iron if interrupted whilst ironing ;
- Iron low temperature fabrics first to reduce warm up times.

3.6. Lighting

- Make use of the natural day lighting and thereby eliminate the need to switch on the lights during the day time;
- Switch off the lights when no one is in the room. If possible, acquire automatic switching apparatus;
- Replace light bulbs with Compact Fluorescent Lamps (CFLs). These energy saving bulbs last longer and use about five times less energy than ordinary incandescent bulbs;
- Remove unneeded lamps where lighting levels are too high;
- Keep your lights and lampshades clean to get the maximum lighting effect;
- Paint walls in light colours so that light is reflected back into the room and not absorbed into the walls;
- Reduce background light levels and rely more on task lighting. Concentrate light just where it is needed by keeping ceiling lights turned off and by using table or floor lamps;
- Place floor lamps and hanging lamps in corners, the reflection of the walls will give more light.

3.7. Cooking

Opportunities for energy savings in food preparation come from more efficient appliances and equipment as well as behavioural changes. Appliance selection, cooking and food preparation practices, higher-efficiency equipment and new cooking technologies hold the greatest promise for energy savings.

- Cook several dishes in one session when using oven;
- Avoid opening the door of the oven until the food preparation is done;
- Defrost food without using the microwave oven or any other electrical appliance ;
- Use efficient appliances like microwave ovens or toaster ovens for cooking and baking in small quantities;

- Use smaller appliances such as toasters and microwave ovens to cook when possible as they use much less energy that conventional ovens;
- Use cooking pan (pots) that are good heat conductor. Certain materials also work better than others and usually result in more evenly cooked food. For instance, copper-bottom pans heat up faster than regular pans. In the oven, glass or ceramic pans are typically better than metal;
- Keep your stovetop clean and shiny When burner pans become blackened from heavy use, they can absorb a lot of heat, reducing burner efficiency ;
- Match the size of the pot (pan) to the size of the hot plate;
- Use electric kettles for boiling water. Kettles are more energy saving that cookers or hotplates;
- Boil only the needed amount of water in a kettle or store excess hot water in a flask;
- The kettle element should always be immersed in water;
- Use electric kettles that can switch off automatically when the water has boiled. Unplug the kettle when not in use.

3.8. Air conditioning

- Use air conditioning only when ventilation is inadequate;
- Always keep all doors and windows closed when operating an air conditioner;
- Use curtains or blinds to shade against sunlight, to reduce air conditioning load;
- Switch off lighting and heat producing appliances that are not in use to reduce air conditioning load.
- Where possible, use electric fans, better with a timer control, instead of air conditioners as they consume less energy;
- Clean the filters of air conditioners regularly. Remove obstructions at air vents (i.e. air inlets and outlets) of air conditioners;
- Switch off air conditioners that are not in use.

3.9. Laundry

Clothes washers and dryers are also among the highest energy-using appliances in homes. Water efficiency is a consideration with clothes washers, as improved water efficiency may help to increase energy efficiency. About 70-90% of the energy used by a washing machine goes towards heating the water, so washers that use less hot water also use less energy. Meanwhile, dryers are the most energy-intensive "white good" in the house, so it pays to use them efficiently.

- It is important not to underload or overload either your washer or dryer. Washing half load of clothes consumes almost the same amount of energy as washing a full load of clothes. Don not overload as such will block the airflow and drastically reduce washing or drying efficiency;
- Separate clothes according to fabric, colours and dirtiness, and wash the clothes according to the washing instruction to save energy;
- Use a low-temperature wash cycle as far as possible and do not use too much detergent;
- Whenever possible, hang-dry the washing clothes in sunlight at outdoors;
- If you cannot air-dry your laundry, save on drying time by drying similar fabrics together and drying multiple loads in quick succession to take advantage of residual heat;
- Remove excess water from clothes or spin dry the clothes at high-speed spin cycle in the washing machine before drying in a tumble dryer can save more energy;
- Clean the lint filter before/after each load to keep the dryer more efficient;
- Remove and fold or hang all items as soon as the dryer stops, to prevent wrinkling and reduce ironing requirements;
- Use cold water for the wash cycle instead of warm or hot (except for greasy stains), and only use cold for rinses. Experiment with different laundry detergents to find one that works well with cooler water;
- If your dryer has a setting for auto-dry, be sure to use it instead of the timer, to avoid wasting energy and over-drying, which can cause shrinkage and shorten the life of your clothes.

3.10. Dishwasher

About 60% of the energy used by a dishwasher goes towards heating the water, so models that use less water also use less energy. Whether you are buying a new dishwasher or using an existing one, you may be able to save a considerable amount of energy by changing the way you operate it.

- Wash with a full load of dishes;

- Air-dry dishes instead of using dishwasher's drying cycle.

3.11. Offices

- Switch off equipments that are not in use;
- When leaving offices, arrange for the last man out to check and switch off the power source to all air conditioners, lightings and office equipments that are not in use;
- Install occupancy/motion sensors to automatically control on/off of lighting in public areas such as corridors, toilets etc;
- Carry out regular maintenance of office equipment for optimal energy efficiency performance;
- Keep all windows, lights bulbs and light fittings clean to maintain optimum lighting performance;
- Switch off photocopiers and printers after office hours;
- Photocopy in batch as it can minimize energy consumption due to less frequent starting;
- Switch off computer after office hours or when leaving the workplace to reduce power consumption;
- Use the power management feature to preset the computer to "sleep" or "hibernation" mode when it is idle;
- Reduce the brightness level of the screen to the lowest comfortable level;
- Procure energy efficient office equipments.

3.12. Industries

The industrial sector offers tremendous opportunity for energy savings, and a significant opportunity to instil the tenets of energy efficiency within facilities that, in turn, employ and influence millions of people. It has thus been an attractive target sector for countries looking to reach new levels of energy savings through efficiency. The sector itself, working constantly to increase shareholder value and reduce expenses, has found energy efficiency investments to be an attractive avenue to achieve those ends.

Because industrial processes are so diverse, it is impossible to describe the multitude of possible opportunities for energy efficiency in industry. Many depend on the specific technologies and processes in use at each industrial facility. There are, however, a number of processes and energy services that are widely used in many industries.

- Use properly sized motors and only run when needed;
- Use high efficiency motors;
- Use electronic variable speed controls where motor loads are variable in normal operation;
- Use cogged belts or improved gears: smooth belts often slip and are not efficient;
- Install improved bearings and lubricate regularly;
- Check power factor regularly and improve with capacitor banks, preferably installed close to the running equipment;
- Maintain all equipment regularly.