CENTRE FOR RENEWABLE &
SUSTAINABLE ENERGY STUDIES

Energy Efficiency

UNIVERSITEIT iYUNIVESITHI STELLENBOSCH UNIVERSITY 100 1918 · 2018

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation

Eskom

Energy Efficiency: What Can We Do?

- **Be the change** – Energy efficiency starts with the decisions we each make, such as taking shorter showers, switching off lights and appliances when not in use, dressing warmly instead of switching on the heater, and walking instead of driving short distances.
- **All hands on deck** – Energy efficiency is for everyone. Each small energy-saving action saves watts, which collectively adds up to megawatts of electricity saved.
- **Make a world of difference** – energy efficiency is not just about saving money. It is about living within Nature's ability to provide for our energy needs and to absorb the impacts of these. Reducing our energy demand and switching to renewables will make a world of difference.
- Energy efficiency needs to be achieved through **behavioural changes** as well as through **new energy-efficient technology**. For example, a solar geyser with electrical back-up will not save much electricity if people drain all the stored hot water by taking long showers or if they all shower at night when the sun is not shining.

Energy Efficiency: Energy Audit

Measure energy use to manage it!

- Do an **energy audit of your home** to find out what activities and **appliances use the most electricity** and what changes you can make to **reduce consumption**.
- To do this you need to **record the wattage of the appliances** and multiply this by the hours that the appliance is **running actively** – i.e. is not in standby mode.

Electrical appliance	Qty	Power		Usage time per day in hours (h)	Energy consumption per day in kWh	No. of days	Total energy consumption in kWh
		Watt (W)	Kilowatt (kW)				
Light bulb	1	100	$\frac{100}{1000} = 0,1$	$\frac{30min}{60min} = 0,5$ h	0,1 kW x 0,5 h = 0,05 kWh	5	0,05 kWh x 5 days = 0,25 kWh
Kettle	1	1600	$\frac{1600}{1000} = 1,6$	$\frac{48min}{60min} = 0,8$ h	1,6 kW x 0,8 h = 1,28 kWh	5	1,28 kWh x 5 days = 6,4 kWh

Energy Efficiency: Energy Audit

Energy consumption in the home:

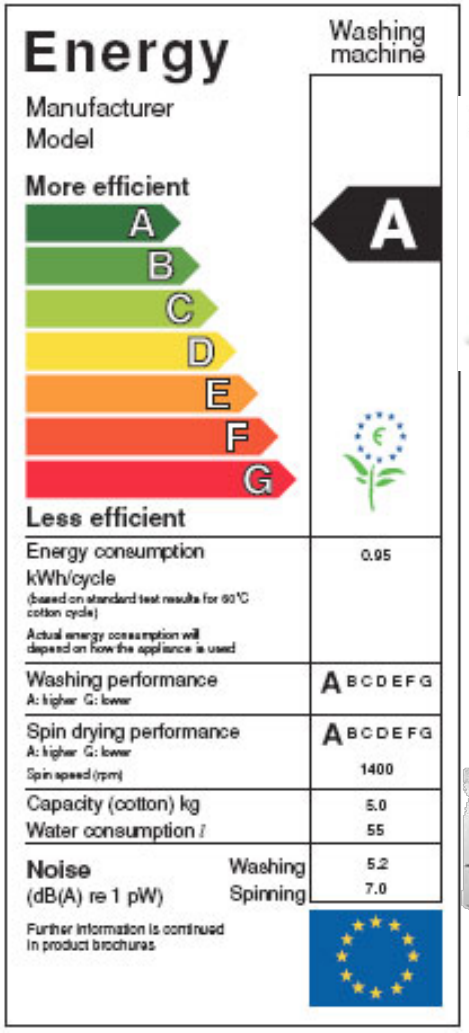
- Because we use so many electrical appliances in our homes every day, a large amount of electrical energy is consumed. For practical reasons we measure the **power (W)** of appliances in **kilowatt (kW)** and the time for which they are used in **hours (h)**. Therefore, the amount of energy consumed is measured in **kilowatt-hour (kWh).**
- Municipalities measure and sell our electrical energy consumption in kilowatt-hour (kWh). **1 kWh** is often referred to as **1 'unit'** and costs approximately R1.80. In other words, for every 1 hour I use my 1 000 W toaster or other appliance, it costs me R1.80.

Practical assignment:

- Electricity generated by burning coal causes almost 0.915 kg of CO_2 /kWh to be released. In other words, for every 1 hour I use my 1 000 W toaster, almost 1 kg of CO_2 is being released into the atmosphere. Select any 10 electrical appliances in your home and complete the table over a period of five days.

Electrical appliance	Qty	Power		Usage time per day in hours (h)	Energy consumption per day in kWh	No. of days	Total energy consumption in kWh
		Watt (W)	Kilowatt (kW)				

Energy Efficiency: Challenges



- People are being challenged by **increasing electricity prices** and by **new technology** to be creative and develop a range of appropriate solutions for cooking, water heating and lighting.
- Most modern appliances and machines, ranging from cars to kettles, are much more energy-efficient than their older counterparts.
- Domestic appliances such as kettles and washing machines use large amounts of electricity.
- **Energy-efficient appliances** are designed to waste as little energy as possible.
- For example, an energy-efficient refrigerator will be better insulated, be less noisy, have no ice on the inside or condensation on the outside, will probably last longer and will use less electricity.
- Energy-efficient appliances actually amount to ‘more with less’.

Energy Efficiency: How to Reduce Energy Use

- **Clothes irons:** Dry shirts on hangers to reduce ironing.
- **Tumble drier:** Use a washing line instead.
- **Kettle:** Boil what you need, do not fill the kettle to the top each time you boil water.
- **Electric oven and grill:** Rather cook with a Wonderbag or do quick stir fries.
- **Electric heaters:** Warm yourself by putting on warmer clothes and only heating a microwave bean bag instead of heating the whole room.
- **Air conditioners for cooling:** These use between 1.5 - 2 kW per hour. Rather use an electric fan, which uses between 50 - 100 W per hour.
- **Electric hot water geyser:** Have shorter showers to save both electricity AND water.
- **High power security lights:** Use either a motion detector light or a day/night time switch.

Energy Efficiency: New Technology

We need to consider the **costs** and **environmental impact** of staying with old technology compared to the **return on investment** that new efficient technology provides.

Solar Chargers

A small photovoltaic(PV) panel can be used for charging lights, laptops and cell phones.

Lighting

A solar geyser can be used for heating water through an evacuated tube or flat panel system.

Solar geyser

Lighting

Compact fluorescent lights (CFL's) are more energy efficient than incandescent bulbs, but contain mercury.

CFL

Light emitting diodes (LEDs) are the future of lighting.

LED

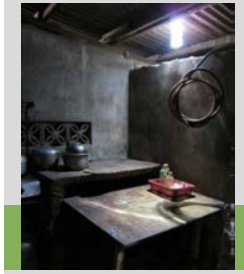
Energy Efficiency: Low Technology Options

Far from being a ***'poor man's choice'*** appropriate **low technology energy- efficient appliances** make home owners **resilient** to high energy prices and give them a level of **energy independence.**

Lighting

The Consol Solar Jar™ stores energy during the day in a small photovoltaic panel on the lid and releases light at night.

Consol Solar Jar



A solar bottle bulb is a cheap skylight alternative. It consists of a 2 liter plastic bottle, which equals a 50 W light bulb.

Skylight: Solar Bottle Bulb

Water Heating

The black pipe absorbs the heat of the sun and the length of the pipe forms the storage for the heated water.

Black Pipe Solar Heater

The portable Tshisa Box solar water suitcase can heat 10 litres of water in 4 hours – so twice a day in summer.

Tshisa Box

Energy Efficiency: Low Technology Options for Cooking

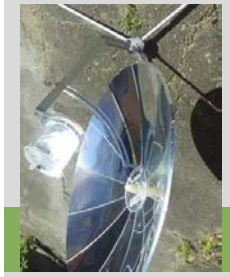
Solar ovens and solar cookers can be used to:

- cook food,
- pasteurise water,
- dry fruit or vegetables , and
- sterilise utensils.

Solar Cooking

A solar oven is a box made of insulating material with one face of the box fitted with a transparent medium such as glass or plastic to trap the heat.

Solar Oven



A solar cooker is characterised by a large reflective surface that focuses the solar energy on a pot to produce a relatively high temperature.

Solar Cooker

Energy Efficiency

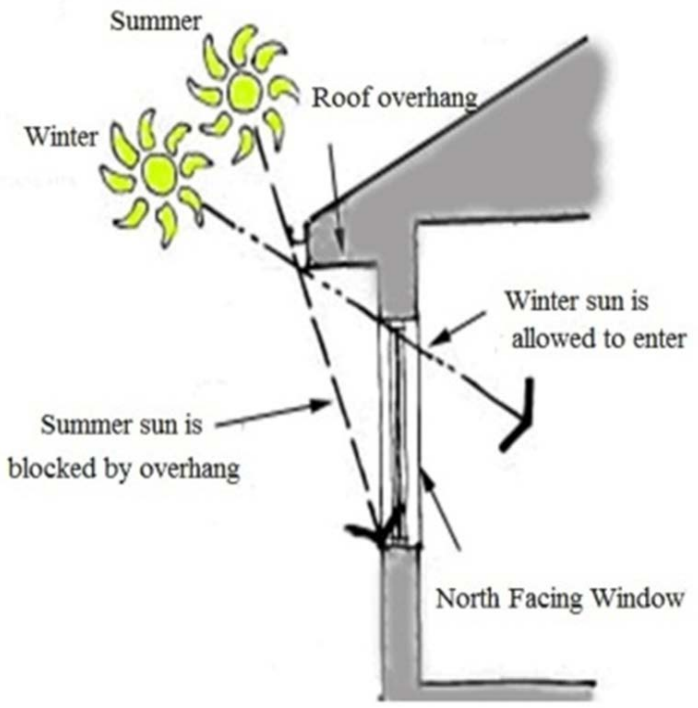
The Wonderbag is a slow cooker that retains heat to continue cooking.

Wonder Bag

These stoves use less wood, cook food faster and produce less smoke and greenhouse gases than open fires.

Fuel Efficient Wood Stoves

Energy Efficiency: Passive Solar Energy



- This type of energy can be used for providing heat in winter and cooling down in summer.
- **Buildings** can be designed to **keep energy in** during winter times and **heat out** during summer times.
- **Insulation** can help regulate a home's **temperature.**
- A well-insulated house will be warmer in winter and cooler in summer, creating a healthier living environment.
- Block all **draughts** to keep your house warm in winter.
- **Thick curtains** also trap heat inside in winter and keep it outside in summer.
- **Deciduous trees** can be planted in front of window to keep the **hot summer sun out** and allow the **warm winter sun in** when these trees lose their leaves.

Conserve Energy: Reuse & Recycle

Newspapers, magazines, cardboard boxes, phone books, junk mail, office paper, old letters and egg cartons

All glass bottles and jars; rinse and place in bin, no lids please

Juice and milk cartons

Rinsed soft drink bottles, plastic bottles marked 1, 2 or R (No lids please)

Steel and aluminium cans, aluminium foil and empty aerosols

- **Energy** has been used for everything which **has been made** – it is therefore called **embedded energy.**
- These **manufacturing** processes **use** large amounts of **energy.**
- If we **throw things away** after we have used them, this **energy is wasted.**
- We can **save energy** by **reusing** and **recycling** things.

Energy Transition: Storage Options

- We need to look at the history of our energy choices and our future choices ,and ask what ethical energy choices are.
- The world is in an **energy transition** from dependence **on fossil fuel** to harvesting **renewable energy sources.**
- This is also happening in South Africa, as **home owners, big businesses** and the Department of Energy invest in more wind power, PV power and CSP to generate more of our electricity from renewable sources.
- The ability to **store energy** is the **biggest challenge.** CSP, biogas, hydroelectricity and new battery technology are **storage options.**
- Options for affordable energy storage are a research priority.
- Hugely expensive and environmentally damaging coal and nuclear power stations can now be replaced by smaller, locally produced renewable power generation.
- **Opportunities** for **green jobs** are being created in renewable **energy generation** and in **energy-efficient appliances.**

Energy Transition: Storage Options

To transition in a way that ensures we all enjoy a fair share of renewable energy, we need to understand the following:

- **How our local energy is produced:** Is it wind, hydro, PV, CSP or a combination of these, with coal and gas as a back-up?
- **How to use energy conservatively:** Cost-effective storage of electricity is still an economic and technological challenge.
- **When to use it:** Shifting our consumption patterns to use electricity when the sun is shining and the wind is blowing will become part of our future energy systems.
- The plant will make use of the Central Receiver technology; uses molten salt for thermal storage and as a heat transfer fluid.

Energy-innovation Era

Helio 100 Small CSP Stellenbosch University

We are not in an energy crisis, but in an energy-innovation era.
New technology developments include:

- Helio 100 Small CSP
- Elon Musk's Tesla first-generation Power Wall
- Lithium ion batteries
- Electric bikes and cars
- Solar laptop chargers, etc.

Elon Musk's Tesla Power Wall

Lithium Ion Battery

Electric Motorbike

Solar Laptop Charger

References

Slide 2: Recycling [available online] https://cdn.pixabay.com/photo/2016/10/10/23/21/recycle-1730163_960_720.png

Slide 5:

Slide 6:

Slide 7:

Slide 8: www.*solar-jar.com* *(Solar jar),* *www.isanglitrongliwanag.org* *(xx),* *www.greenaudits.co.za* *(Tshisha Box)*

Slide 9: www.*wonderbag.co.za*

Slide 10:

Slide 11: https://pixabay.com/en/biogas-building-plants-agriculture

Slide 12: https://pixabay.com/en/battery-energy-green-technology , https://pixabay.com/en/biogas-building-plants-agriculture

Slide 13: http://www.eskom.co.za/AboutElectricity/RenewableEnergy/ConcentratingSolarPower/Pages/Concentrating_Solar_Power_CSP.aspx

Slide 14: *www.Mashable.com*