



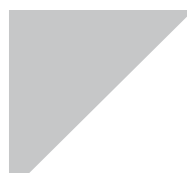
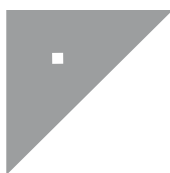
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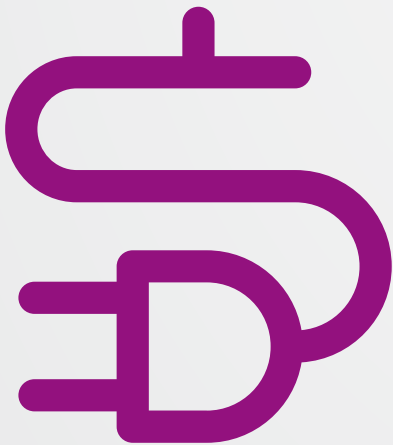


switch to
energy saving
-it's worth it!

Find Affordable Energy-Saving Solutions For Your Facility

This leaflet is intended for technical and financial staff managing public and commercial building stock and may be also applied to dwelling owners.





Electricity is becoming expensive

Zambia committed at SADC level to move towards cost reflective tariffs by 31 December 2019. A first step was implemented in 2017, with a 75% increase of electricity rates. However, a further 150%+ increase of the tariff is likely to be necessary to reach cost reflectivity. Energy efficiency measures are being sought to encourage cost effectiveness and avoid wastage of the available energy.

Apart from reducing energy consumption, some Energy Efficiency measures are markedly cost-effective. **With electricity tariffs on the rise in Zambia, the cost-effectiveness of introducing Energy Efficiency measures will only increase.**



Demanded electricity is **25%** more than the available supply.

2017 saw a **75%** increase of all electricity rates.

A **150%+** increase of tariffs will reflect the real cost of electricity.





Investing in energy efficiency is good business

Energy efficiency is the new norm.

Adopting energy efficiency measures does not impact on your operations. To the contrary, you can actually reduce your energy consumption, lower your maintenance needs and greatly improve the economy of your operation.

Inefficient building design, outdated equipment, and lack of energy conscious behaviour has led to tremendous energy wastage in large buildings. Energy efficiency measures can improve the thermal comfort in your building and cut your electricity bill by up to 64%.



Simple measures can help you save energy, and save money

- **Use up to 67% less electricity**
- **Save money, up to 64% on your electricity bill**



Top energy efficiency actions in buildings

Considering that there is an investment cost to implement certain energy efficiency measures, the payback period can clearly show how the costs of the investment – which would serve a 15-year period, on average (25 years for PV modules) – can be quickly recuperated from the savings in energy consumption –and on both the electricity bill and use of oil.

Energy efficiency is a cheap, quick and trouble-free option.



AIR-CONDITIONING RETROFITTING

\$ simple payback 5 years
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POWER FACTOR CORRECTION

✓
\$\$\$ Best performing action,
simple payback less than 1 year
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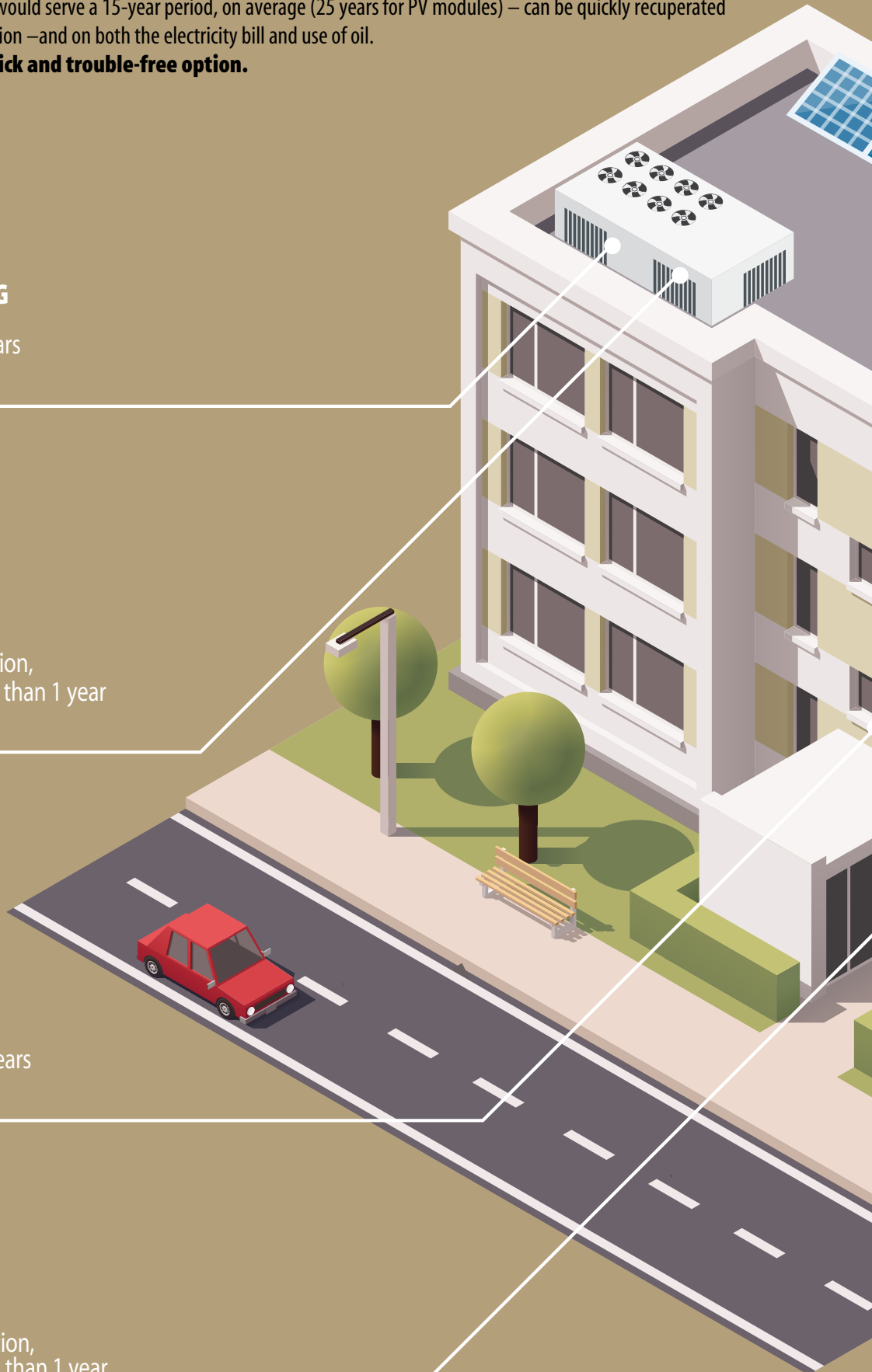
LED LIGHTING & CONTROL

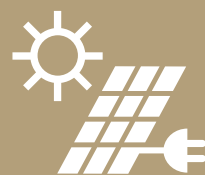
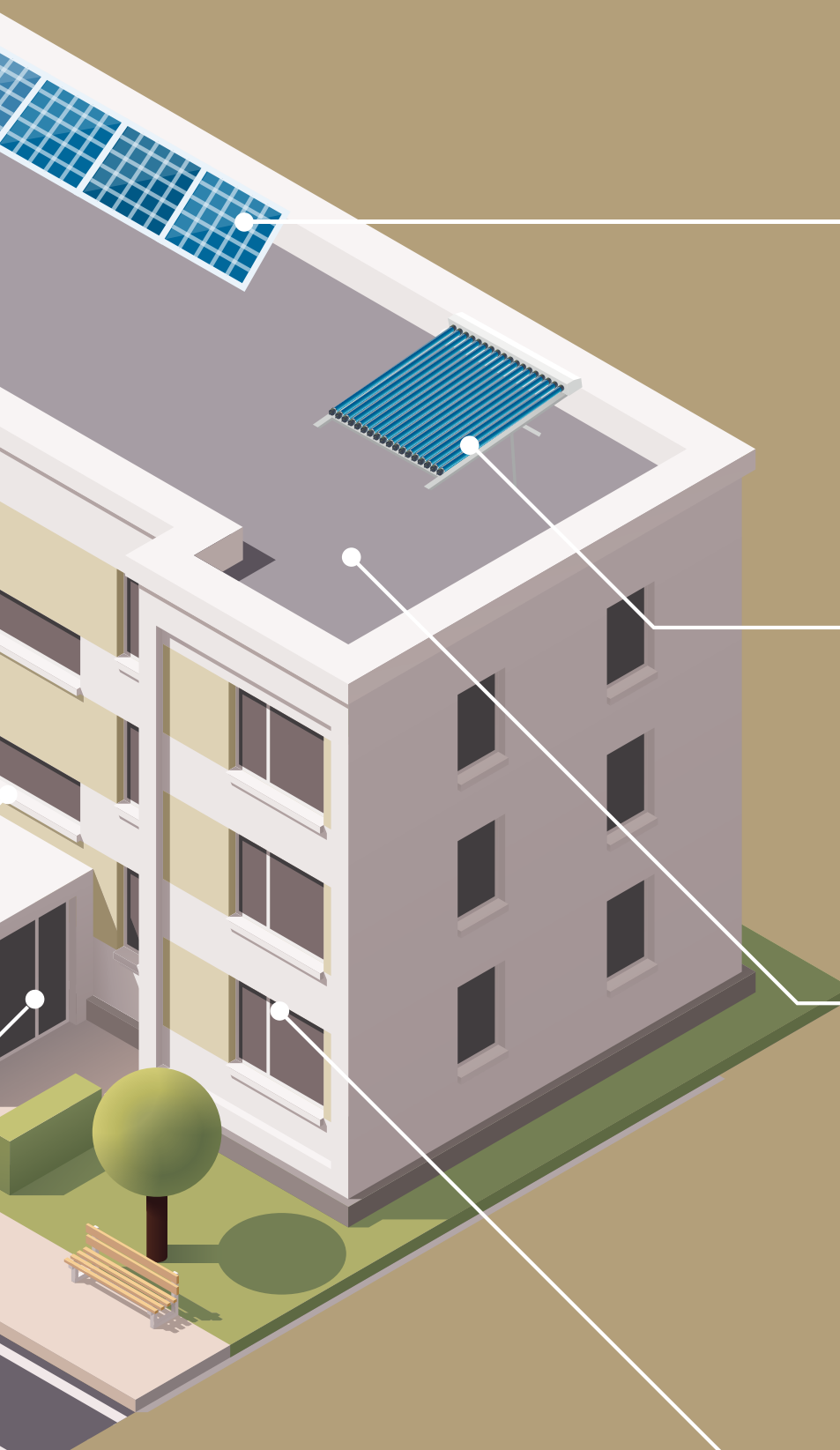
\$\$ simple payback 2 years
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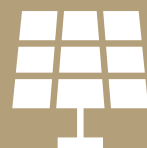
FREE COOLING

✓
\$\$\$ Best performing action,
simple payback less than 1 year
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**PV
ROOFS**
simple payback 5+ years
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**SOLAR WATER
HEATING**
simple payback 5+ years
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**COOL ROOF
PAINTING**
simple payback less than 2 years
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**SHADING
DEVICES**
simple payback less than 2 years
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1 correct your power factor losses -immediate payback!

The problem

Correcting **power factor losses** is key to improving electricity quality. In Zambia, consumers' power factor should meet a minimum measurement of 0.92*. The measure is mandatory, so penalties will apply for consumers who do not correct their poor power factor. Buildings where poor power factors may occur include those using motors, cooling compressors, fluorescent lamps and transformers.

The solution

You can correct your power factor by installing a **capacitor bank**, which brings immediate results.



Best performing action
simple payback
less than 1 year

Take Action!

- If you are tariff category MD1, MD2 and MD3, check if your company power factor (PF) is below 0.92, even before the penalty is applied to your bill.
- Ask for an offer for PF correction from a qualified electrician.
- While you are at it, correcting the PF to reach a 0.98 ratio, i.e. higher than the minimum set by ZESCO, could limit electric losses in your factory lines and make even more financial sense.



Apart from avoiding the penalty, correcting the power factor from **0.87** to **0.92** can bring savings of **9%** on the electricity bill.

Correcting a very poor power factor of lower than 0.75 yields savings as high as **25%**.



* Zambian Distribution Code, ERB, May 2016, article 2.6.4.



The power factor is the ratio of active power -i.e. power that an electrical or electronic device actually absorbs, to the power it draws from the supply -called apparent power, and is a measure of how efficiently electrical energy supplied is being utilised. An 'ideal' device would have a power factor of 1.0 and consume all the power that it draws.

plan a lighting upgrade

The problem

Lighting is very inefficient in most large buildings and dwellings, and represents up to 17% of electricity costs for commerce in Zambia.

'Traditional' lamps are typically used, which are less efficient and also energy intensive.

In some spaces such as hotel lobbies, supermarkets, public buildings, the lights have to be left on constantly.

The solution

When considering how to save electricity for your building or operation, a lighting upgrade should come early in the process. **LED technology** has come down in price and there are much more options. Incandescent and halogen lamps have very poor luminous efficacy compared to LED performance. LED bulbs also have a longer life: for instance, in order to keep up with LED, you will have to replace the fluorescent tubes 2.5 times. Typical lifetime figures: LED: 50,000 hours / Fluorescent: 20-30,000 hours / CFL: 10,000 hours / Incandescent: 1,200 hours.

Automatic control of lighting (after replacing with LED) based on occupancy and level of illumination, is another simple way to use less energy for lighting. Using the lights less can add years to the operational life your appliances and reduce the service intervals - so also cuts these costs.

Less heat emitted by lamps means less air conditioning needed, which translates to more savings in energy and money.



simple payback
2 years

Take Action!

- Gradually replace your light bulbs with LED as they die out. Sometimes, replacing the bulbs are enough; in other cases, especially for older lighting installations, a replacement of fixtures may also be required. In any case, the very attractive payback period for this measure certainly makes it worthwhile.
- Consider automatic control of lighting (after replacing with LED) based on occupancy and/or level of illumination for areas where the lights are on for long periods of time.



Replacing halogen with LED lamps in a hotel can save up to **82%** of lighting costs and **11%** of the total electric expenditure. Replacing fluorescent tubes with LED lighting in an office building can save up to **49%** of lighting consumption (including the reduced replacement cost), or **8%** of the total electric expenditure.



3 retrofit your air conditioning (ac) systems

The problem

Outdated AC chillers (more than 15 years old) have a much lower energy performance than the units now available on the market. Often the motors of distribution system pumps and fans are also outdated.

Lack of maintenance also worsens the performance of old technology.

On the other hand, when the load of your motors varies, constantly **running the motor at full speed** is a waste of energy. AC is used around the clock; fans and pumps often run at maximum speed regardless of the load in the system.

The solution

Chillers now on the market have a 19% better Energy Efficiency Ratio (EER) than most old units installed in Zambian buildings.

If your AC systems are old, they are probably inefficient.

Variable Speed Drives (VSD) electronic controls applied to the motor adjust the pump speed whenever possible and save energy -without compromising performance. The energy savings compared to fixed speed units are impressive: a pump or fan running at half speed can consume as low as ¼ of the energy compared to one running at full speed.

In AC systems based on air distribution, the same control can be applied to the fan motors, centralised fans in the air handling units, as well as small fans allowing air into individual rooms.



simple payback
average 3 years

Take Action!

- Plan your air conditioning retrofitting and maintenance.
- Plan a replacement of all old chillers - older than 10-15 years- with new generation models.
- In retrofitting, consider the change of technology. Opt for inverter-controlled chillers
- Pumps of the distribution system can be controlled electronically and their old motors replaced with the most efficient ones available on the market.
- Install VSD controls on all motors having a variable load.



Retrofitting AC in hotels and applying variable-speed drives in pumps can yield a **29%** reduction of AC electric cost, or **9%** of the total consumption.

Using variable-speed drives to control AC fans in an office building can cut the energy bill by as much as **8%**, and pays back in less than 1 year.



4 introduce free cooling - best performing action!

The problem

Chillers are used even when the **outside temperature is lower** than the inside temperature at night or in the early morning, or in the case of computer rooms.

The solution

Free cooling is an efficient way to reduce your air conditioning consumption. 'Free cooling' is a solution that lowers the air temperature in a building or data center by using naturally, ambient cool air or water instead of mechanical refrigeration. It can take effect when the difference between the outside supply and return temperatures is as low as 1°C. By using free cooling, the working life of your installed cooling systems can also be significantly extended. Reductions in cooling system use also mean drastic reductions in data center power consumption and service/repairs, lowering the energy and maintenance costs for facility owners.

All buildings having a ventilation system can be adapted to operate in a free cooling configuration.



simple payback
less than 1 year

Take Action!

- Check with your operations engineers on free-cooling solutions for your building and operations.



Installing free cooling in an office building can save up to **22%** energy.



5 switch to solar geysers

The problem

Water heating is extremely energy-intensive and relies mostly on electricity. Heating water can represent a huge cost in many operations, reaching up to 27% of total consumption in hospitals, and 24% in hotels.

The solution

Solar power is one of the most effective renewable energy sources available. By using solar power for water heating, you

can target one of your most electricity-hungry applications for a maximum power-saving effect. Solar water heaters can be fitted onto roofs, store hot water in insulated tanks, and provide hot water whenever required. Maintenance requirements are comparatively low, and the technology is simple and reliable. Large flat, or low slope, free roof surfaces provide ample space for installation of solar geysers.



simple payback
5+ years

Take Action!

- Consult with your in-house engineer on what applications a solar geyser could be used for in your case.
- Contact a solar geyser supplier to calculate the size/capacity of the system that you need to have installed, and to provide you with estimates of energy-saving prospects for your applications.



Replacing water heating systems with solar geysers in hospitals and hotels can cut electric consumption by **90%**, which translates to about **24%** on the total energy bill.



6 opt for shading solutions

The problem

The sun is a precious source of free energy. However, the sun can give off too much heat, and glaring can cause discomfort. Even when buildings are insulated, **intense solar radiation** can cause overheating internally. This is an issue for hospitals, hotels, office spaces, etc.

The solution

External solar shading is one of the most effective ways to control the internal conditions of a building. Solar heat gain is prevented from passing into the building, and so also helps reduce ventilation requirements and cooling loads. Solar shading systems are very effective in Zambia due to the high position of the sun. With many solutions available to suit your specific needs, shading systems can also be an opportunity for distinctive architectural impact, whilst reducing solar heat gains.

Reflecting films on window glazing are also a simple, quick solution to prevent rooms from overheating and reduce glaring. When you install reflecting films, you won't need to draw the window curtains to block all the external light, so there is an additional energy saving.



simple payback
less than 2 years

Take Action!

- Set up a 'line of defence' to prevent the indoor climate of your building from becoming unpleasant because of the sun.
- Check whether solar shading systems can be retrofitted onto the external façade of your building.
- Use reflecting adhesive films on window panes: they are an easy-to-install solution that will immediately bring results - a more comfortable room temperature, and a lower electricity bill.



Installing reflecting films has blocked solar radiation by **60%** in the buildings sampled. The air conditioning load can be reduced by more than **25%** if no other shading exists, and by more than **12%**, if a partial shading is already installed.



1 paint your roof - quick and easy!

The problem

Exposed to the sun, roofs and other external horizontal **surfaces get very hot**, and the heat flows into the spaces underneath. Low-rise buildings, up to 2-3 storeys high, are particularly affected.

The solution

Cool roofs are designed to reflect more sunlight and absorb less heat than a standard roof. Cool roofs are coated with a highly reflective type of paint.

All external roof surfaces can be turned into cool roofs. The paint is simple to apply. In terms of maintenance, a new coating is required every year or two.



simple payback
less than 2 years

Take Action!

- Get your roof painted! It's a cheap, fast way to get immediate results – especially if your building is up to 2 storeys high.



Large roof surfaces coated with cool roof painting can reduce sun-exposed roofs' external surface temperature from **80°C** to **35°C** and heat flow by **80%**.

New cool-roof paints reflect not only the visible part of the solar radiation, but also the near-infrared part, representing about **50%** of the total radiation.

Low-rise buildings have seen up to **17%** lower electric bills.





consider pv renewable energy solutions

The problem

Buildings need **autonomous power generation** in case of emergencies. Diesel-powered generators (gensets) are the most common solution, operated for long periods of time during power shedding. However, gensets have a huge electric kWh cost in Zambia, 10 times higher than the grid cost (as per September 2017).

The solution

A renewable energy or cogeneration solution is much more convenient if you are looking for an independent source of power.

Renewable energy (RE) power generators, like a solar photovoltaic (PV), can replace your genset to cover a large part of the load (the end-user daytime load) and inject excess power into the grid.

PV modules typically have a manufacturer-guaranteed performance for more than 80% of initial productivity for 20-25 years. This is why PV systems are extensively used in Europe, even though payback periods can be rather lengthy, extending beyond 8 years. As PV roofs are capital intensive, their size should match the remaining end-user load, after the other energy efficiency measures are put into place.

Under the intense Zambian sun, PV systems produce about 1,600 kWh per each kW peak installed, against just 1,000 kWh in Europe.



simple payback
5+ years

Take Action!

- Zambian buildings have ample roof surfaces and can easily accommodate PV systems. Consider installing a PV system, as it has much lower maintenance needs compared to gensets, and it is a very low risk investment.
- The more power needed, the larger the PV system. As the PV system is a comparatively costly intervention, get it sized according to your needs once your other energy efficiency measures are already in place, so that it covers only the 'unavoidable' energy consumption.



A sensitivity study has shown that this technology becomes cost effective - without public support - with a price of the electric kWh of about 10 cents USD. This price will be reached with the increases of tariff expected in 2018. PV roofs, designed on the remaining load after energy efficiency measures, satisfy an average of about **13%** of the present electricity consumption, but individual cases may reach an impressive **27%**.



Example A: Hospital



Reference Building: Hospital

Building description: The Hospital is not air conditioned, except the offices having small split systems, so the measure on chillers and pumps is not applicable.

Hospital size: 1,800 beds. Built surface area: approx. 40,000 m². Surface area of the plot: approx. 8 hectares.

Targeted energy efficiency actions: The Hospital is targeting energy efficiency actions for solar water heating, replacing electric geysers producing large hot water consumption in the wards, and cool roof painting in all 2-3 storey buildings, creating more comfortable conditions for patients now, and less expensive air conditioning in the future.

THE MAIN PROPOSED QUICK WIN ACTIONS ARE:

- **Installation of 174 thermosyphon circulation, 300 litres, solar units.**
- **Replacement of 2480 neon tubes with the same number of tubular LED lamps, and control of 15% of lights by occupancy or movement sensors.**
- **A solar photovoltaic roof, with batteries to improve the quality of electric supply. The PV system installed on the roof will cover 33% of the remaining electric load (after implementation of the previous actions).**

EXPECTED RESULTS

The total electric energy consumption will be reduced by **67%**. The total saving is around 67 kWh/m², out of a total initial baseline indicator of 111 kWh/m², or 60%. The Hospital's electric tariff is at 0.054 USD/kWh (there is no need of diesel generation as the hospital is a protected load); the PV roof remains too expensive until the electric rate reaches 0.10 USD/kWh (value obtained by a sensitivity study).

UTH	Unit	Light Control	LED	Cool Roof	PV Roof	Solar Water Heating	ALL TOGETHER
ENERGY SAVING/ AREA	kWh/m ²	1.3	9.9	15	27	26	80
SAVED MONEY/ AREA	USD/m ²	0,07	0.64	0.47	1.2	1.4	3,9
ENERGY SAVING/ BASELINE	%	1.1%	8.4%	13%	23%	22%	67%
CAPITAL EXPENDITURE	thou.USD	8.9	39	57	542	348	995
SAVED EXPENDITURE	thou.USD/year	3.0	26	19	49	58	155
SIMPLE PAYBACK PERIOD	years	3.0	1.5	3.0	11	6.0	Average 4.9

Example B: Hotel



Reference Building: Hotel

The Hotel has already planned EE solutions, and is a good example of how savings can be obtained in the tourist sector. The Hotel has decided on an investment plan covering LED lighting, replacement of the AC chiller, circulating pumps to be equipped with electronic control, and solar water heaters replacing the oil boiler.

Nr of staff and guests: 300 staff and 293 guest rooms, annually 50% occupied.

Built surface area of the site: Built surface area of the site: 10,200 m² main building and 2,700 m² of ancillary spaces, for a total of 12,900 m² in a 2.6 hectares plot. The building was erected in 1979 and has been renovated several times.

PROPOSED MEASURES

Possible quick-win actions in the hotel, including the ones already planned by the administration, are:

- **Installation of LED lamps.** Installation of 3,177 LED lamps for 32% annual lighting energy saving.
- **New chiller installation with condensing heat recovery.** Substitution of the 15 year-old chiller with a more efficient, VSD-controlled chiller. Replacement of 5 water circulating pumps, also VSD-controlled. Heat recovery from the new chiller condenser foreseen, to pre-heat the sanitary water.
- **New chilled water pumps fed by a variable speed drive (VSD).** VSD control kit on 200 room internal fans (total power about 20 kW).
- **Solar water heaters.** Installation of 200 thermosyphon of 300 litres, solar systems, replacing an old 650 kW LFO (diesel) fed boiler.
- **Light control.** Occupancy driven control of 1,170 lights (corridors and areas of infrequent use) for a total 5.9 kW LED power.
- **Building envelope improvements.** Reflecting adhesive film on all guest rooms windows (1,620 m²); Solar reflecting coating ("cool roof" type) on 4,800 m² of hotel buildings surfaces.
- **PV system.** A 289 kWp photovoltaic system installed on hotel buildings roofs is recommended.

EXPECTED RESULTS

The total expected saving is around 237 kWh/m², and represents 62% of the initial baseline, which is 382 kWh/m² (electric + thermal). The electric tariff in 2017 is 0.051 USD/kWh (without considering the frequent use of the diesel generator). The PV roof remains too expensive until the new electric rate becomes about 0.10 USD/kWh (value obtained by a sensitivity study).

HOTEL CASE STUDY	Light Control	LED	Fan Control	AC	Reflecting Films	Cool Roof	PV Roof	Solar Water Heating	ALL TOGETHER
ENERGY SAVING/ AREA kWh/m ²	1.7	40	5.5	28	12	21	35	94	237
SAVED MONEY/ AREA USD/m ²	0.12	3.7	0.28	2.9	0.73	0.80	1.9	4.8	15.3
ENERGY SAVING/ BASELINE	0.44%	11%	1.5%	7.2%	3.1%	5.6%	9.2%	25%	62%
CAPITAL EXPENDITURE mill USD	5.9	58	10	225	16	14	232	201	761
SAVED EXPENDITURE mill USD/Y	1.6	48	3.6	37	9.4	10	25	62	197
SIMPLE PAYBACK PERIOD/years	3.7	1.2	2.8	6.0	1.7	1.3	9.3	3.2	Average 3.9

Learn more about Energy Efficiency in the building sector:

Energy Regulation Board: Energy Sector Report 2016, <http://www.erb.org.zm/downloads/esr2016.pdf>

SADC Energy Monitor 2016: https://www.sadc.int/files/1514/7496/8401/SADC_Energy_Monitor_2016.pdf

CCTN Development of a Regional Efficient Appliance and Equipment Strategy in Southern Africa;

<https://www.ctc-n.org/news/southern-african-countries-developing-action-plan-leapfrog-energy-efficient-appliances>

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The data presented in this leaflet derive from the 'Zambia - Energy Efficiency Quick-win actions and specific electricity indicators' study, implemented by the EU-funded 'SE4ALL Technical Assistance Facility (TAF)' for East and Southern Africa. The 'Quick Wins' initiative is aimed at supporting the national effort towards improving energy efficiency, based on prefeasibility studies for 14 reference sites, and illustrates the most cost effective actions to be implemented.

The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.



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