



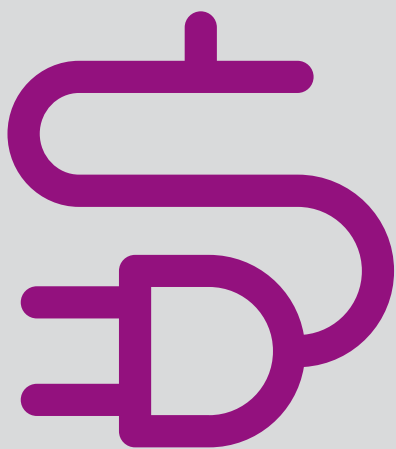
*A project funded by  
the European Union*



switch to  
**energy saving**  
-it's worth it!

**Find Affordable Energy-Saving Alternatives for your Industrial Installation**

This leaflet is intended for technical and financial staff managing industrial operations in manufacturing and agro-industry sectors.



# 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 necessary, in order to reflect the real cost of electricity. In industries, energy cost on turnover has been measured at 5% on average, with peaks of 14%. **Under the all too realistic scenario of doubling the energy cost, the cost of energy would bring a number of companies out of business.**



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

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

In the audited companies, energy cost on turnover was **5% on average, with peaks of 14%.**

When tariffs double, the cost of energy consumed will go up to a **staggering 10-28%.**





# Investing in energy efficiency is good business

**Energy conservation is the new norm.** Adopting energy efficiency measures does not impact on industrial operations. To the contrary, you can actually reduce your energy consumption, lower your maintenance needs, and greatly improve the economy of your operations.

During the inspection in seven factories sampled for energy audit, switching to more efficient solutions demonstrated the possibility of reducing the consumption of electricity by as much as 30%. This saving corresponds to 3% of the annual turnover. Assuming a 10% profit on turnover, these savings translate to increasing profit by 30%.

Simple measures can help you save energy, save money, and increase productivity:



- Use up to **30%** less electricity

- Save money, up to **3%** of your turnover

- Increase profit by up to **30%**



# Top energy efficiency actions in industry

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 relatively trouble-free option.**



## ENERGY WASTAGE FROM OVENS

\$ simple payback 4+ years  
Page 13



## POWER FACTOR CORRECTION

✓  
\$\$\$ Best performing action,  
simple payback less than 1 year  
Page 6



## IMPROVED FOUNDRY TECHNIQUES

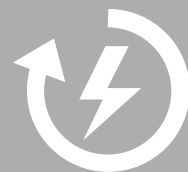
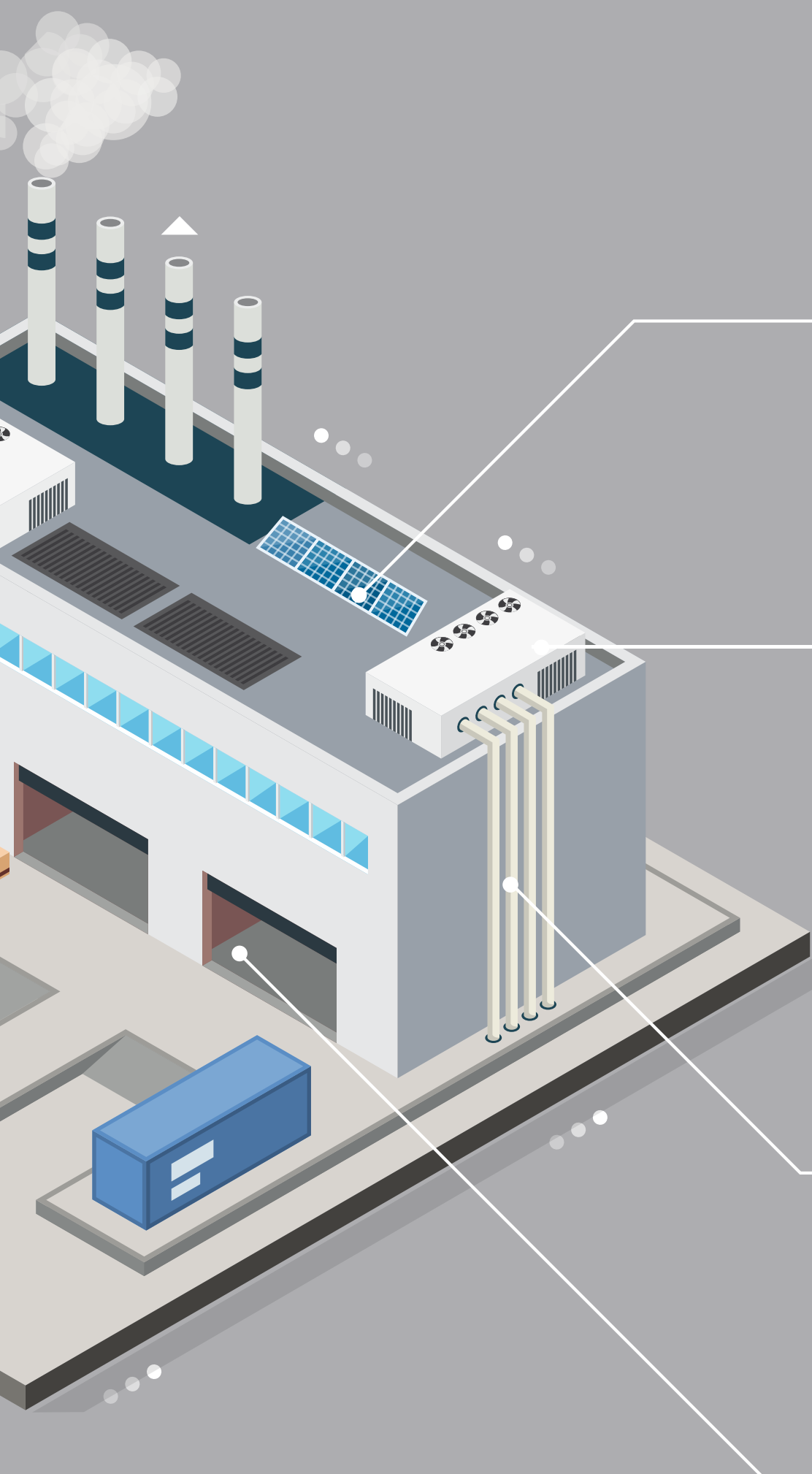
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simple payback less than 1 year  
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## COMPRESSED AIR

\$\$ simple payback  
less than 3 years  
Page 10





**CAPTIVE  
RENEWABLE  
ENERGY POWER**

simple payback

4+ years

\$ Page 12



**REFRIGERATION &  
AIR-CONDITIONING**

simple payback

less than 3 years

\$\$ Page 9



**MOTOR SPEED  
CONTROL**

simple payback

less than 3 years

\$\$ Page 8



**LED LIGHTING**

simple payback

less than 3 years

\$\$ Page 11

# 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, and penalties will apply for consumers who do not correct their poor power factor. Industries where poor power factors may occur include mills, pumping stations, cold stores with mechanical refrigeration, oil and lubricants blending, foundries operating induction furnaces, crushing processes in quarries and lime industry, etc.

## 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.

# 2 optimise your foundry's operational process

## The problem

Many foundries operating with induction ovens have high losses from unprotected furnace tops, manual pouring of molten material from the crucible, and melting equipment put 'on hold' for long periods of time, all of which increase energy consumption.

## The solution

Process improvements can collectively yield up to 10% energy saving at the foundry. Optimizing the process also improves productivity.



Best performing action-  
simple payback  
less than 1 year

## Take Action!

- Maximize equipment utilization, as short holding times reduce the energy consumption.
- Consider automating your foundry's pouring operations to increase charging speed, and quickly remove the slag during the melt cycle, by installing rails for the movement of trolleys supporting the moulds, for example.
- Avoid overfilling the furnace, and keep the properly maintained lid on, to minimize radiation heat losses.
- Use insulated furnace top covers with smaller openings, for smaller scrap size.



An energy management effort in the use of electric induction furnaces can produce **10% savings** of the total electric consumption.



A misconception exists among many metal casters that in making the refractory linings thicker, you will extend the operational life of your equipment and reduce energy consumption. In reality, thicker refractory linings in the furnace increase the distance between the metal and the coil, which actually leads to increased electrical consumption.

# 3 introduce motor speed control

## The problem

When the load of your motors varies, running the motor always at the nominal speed is a waste of energy. A pump or fan running at half speed can consume as low as 1/4 of the energy compared to one running at full speed.

## The solution

Variable Speed Drives (VSD) electronic controls applied to the motor vary the motor speed to respond to the load. The energy savings compared to fixed speed units are impressive. Using variable-speed drives can cut the energy bill by as much as 60%. Motor speed control would be applicable to many sectors of industry: irrigation pumping in farms, motors driving fluids or materials in a process, chillers, pumps, ventilation fans, air compressors, motors operating crushing and milling, and so on.



simple payback  
less than 3 years

## Take Action!

- Consult with your in-house engineer to check if variable motor speed is suitable for your operations.
- Replace motors older than 15 years with the more efficient ones available on the market, equipped with VSD drives.
- Install VSD controls on all motors having a variable load.



Through good motor energy management and replacing old motors, industries obtained an **8%** to **18%** reduction of electricity consumption.





# 4 retrofit refrigeration and air conditioning systems

## The problem

Chillers and heat pumps are usually used for air conditioning. Chillers can also be used for refrigeration. Most chillers remain in operation for many years, even when they are badly performing, old and in need of maintenance. Inefficient chillers may be found in refrigerated stores, meat, vegetables or fish processing areas, shopping centres, and department stores. For air distribution in refrigerated or cooled processing /store areas, large fans are used, constantly operating at maximum speed -which is not energy efficient.

## The solution

Chillers now available on the market have an Energy Efficiency Ratio (called EER) 19% better than most old units installed in Zambian industries. If your air conditioning systems are old, they are probably inefficient. In retrofitting, consider the change of technology: opt for direct expansion units and a centralized compressor and condenser. Direct expansion systems improve the overall system EER because the temperature difference is lower, due to elimination of heat exchangers. Even evaporative towers should be better operated by direct expansion. The application of flexible perforated hoses for air distribution allows a lower fan speed, which is VSD-controlled. Perforated flexible hoses and VSD fan control keeps refrigerated cell temperature more uniform. VSD solutions can also be applied to most motors used in AC and refrigeration systems.



simple payback  
less than 3 years

## Take Action!

- Plan a replacement of all old chillers.
- Check with your operations engineers on whether the direct expansion systems or perforated hoses are applicable for your operations.
- Consider using VSD controls if suitable for your systems, and opt for chillers with 'inverter technology'.



Replacing the AC chiller and pumps in a large commercial building produced a **30%** reduction of AC consumption, and a **7%** lower total electricity cost.



# 5 schedule maintenance of your compressed air system

## The problem

Almost all industries have a centralised compressed air system. Chronic air leaks, a typical contributor of wasted energy in a compressed air system, can also lead to other operating losses. Air leaks affect the overall compressed air system pressure, and lower air pressure can reduce the mechanical output of air tools and equipment – and as a result, may decrease the productivity of your process.

## The solution

A properly managed compressed air system can save 10-20% energy, reduce maintenance, decrease downtime, increase productivity and improve product quality. Experience has shown that fixing air leaks is most often the top priority measure for compressed air system optimization.

\$\$

simple payback  
less than 3 years

## Take Action!

- Schedule regular maintenance. Select a qualified compressed air service company.
- Replace old air compressors with new products, driven by inverter controls.

“

The full revision of the compressed air production and distribution system in a mill was estimated to produce a **45%** reduction of the compressed air electric consumption

”

# 6 plan a lighting upgrade

## The problem

Lighting represents up to 17% of electricity costs for industries and commerce in Zambia. In industry, lighting is produced mostly by 4-feet fluorescent tubes, with an efficacy of 65 lumen/watt, or compact fluorescent lamps with 50 lumen/watt luminous efficacy. This is low performance compared to LED lighting efficacy of 90 lumen/watt.

## The solution

When considering how to save electricity for your business, a lighting upgrade should come early in the process. LED technology has come down in price and there are much more available options. LED bulbs have a longer life: in order to keep up with LED, you will have to replace 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.

\$\$

simple payback  
less than 3 years

## Take Action!

- Gradually replace your light bulbs with LED as they die out. Sometimes, replacement 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.

“

LED lighting yields savings of about **50%** of lighting consumption (including the reduced replacement cost), or **5-8%** of total electric expenditure.

”

# consider captive renewable energy power generation solutions

## The problem

Diesel-powered generators (gensets) are operated for long periods of time during power shedding periods. Gensets have an electric kWh cost 10 times higher than the grid cost. A renewable energy or cogeneration solution is much more convenient for an independent source of power.

## The solution

Diesel generators can be replaced or upgraded, to become combined heat and power (CHP) generators (co-generators) if some heat is required in your process, e.g. in paper, meat, bricks and tiles industries, and farms with heated greenhouses. Renewable energy (RE) power generators, like a solar photovoltaic (PV), wind, CHP or electric only biogas system, can replace the genset to cover a large part of the load (i.e., the end-user daytime load) and inject excess power into the grid.



simple payback  
4+ years

## Take Action!

- A PV system has much lower maintenance needs compared to gensets, and it is a very low risk investment: PV modules typically have a manufacturer-guaranteed performance for more than 80% of initial productivity for 20-25 years.
- As PV roofs are capital intensive, their size should match the remaining end-user load, after all other energy efficiency measures are put into place. PV roofs become cost effective once electric tariffs reach USD 0.10 per kWh.



The industrial operations sites studied were all suitable for PV generators. Impressive savings were found in a lubricant blending factory, reaching **48%** of initial baseline electricity consumption (without net metering).



A captive power plant is a power generation facility that industries and large office buildings use to generate electricity primarily for their own use, but can also export surplus power to the local electricity distribution network. In the case of Zambia, the annual electric generation of 1 kW-peak of PV is 1600 kWh.



# use alternative fuels to operate large ovens

## The problem

The Zambian food industry mostly uses electricity as a heating source for ovens. This is very inefficient, as electricity is a high quality energy source not to be used for low level heat, where fuel is more suitable. With the increase of electric tariffs, electrical heating in ovens will become extremely expensive.

## The solution

Electricity should be used as a heating source for small baking ovens only. Fuel-fed burners are a better solution.



simple payback  
4+ years

## Take Action!

- Plan the replacement of large electric ovens with diesel oil burners.



In a bakery, heat recovery from flue gas used for pre-heating the combustion air was found to save **8%** of fuel. Burning waste-oil instead of using electric heaters reduced the total electric consumption by **30%**.



# Example A: Milling Plant

**Reference industry:** Milling.

**Main products:** corn flour, wheat flour. **Other products:** chapatti, stockfeed and cassava milling.

**Built surface area:** 4 + 2 hectares with built surfaces amounting to approximately 20% of the land. There is another 8 ha area at 0.5km distance, and 38 hectares for the new residential development (50% of available space). The industry also has a 5 MWp PV system.

**TURNOVER:** 400,000,000 ZMW / 44,000,000 USD

**BASELINE ENERGY CONSUMPTION:** 82,746 MWh

**BASELINE/ TURNOVER:** 0.22 kWh/USD



## EE ACTION TARGETED

**Phase 1.** Power factor correction, replacement of old neon tubes with LED, VSD control installation in the old blender, among others. **Phase 2.** To generate energy for the factory and a new residential development with a 5 MWp PV system, and to export part of the electricity to other clients and/or the ZESCO grid.

EE MEASURES	Unit	Motor Mgmt	LED Lighting	Compressed Air	PV Roof	TOTAL
ENERGY SAVING/ TURNOVER	kWh/USD '000	24	5.5	1.6	57	88
SAVED MONEY/ TURNOVER	USD /USD '000	2.2	0.51	0.13	4.8	7.6
ENERGY SAVING/ BASELINE	%	11%	3%	0.7%	26%	41%
CAPITAL EXPENDITURE	USD '000	138	71	20	1,066	1,295
SAVED MONEY/ per year	USD'000/a	82	19	5	183	289
SIMPLE PAYBACK PERIOD	Years	1.7	3.6	4.0	5.8	Average 4.5

**41%**  
ENERGY SAVINGS

**289,000** USD/YEAR  
MONEY SAVED

AVERAGE **4.5** YEARS  
SIMPLE PAYBACK

# Example B: Bakery

**Activity:** Bakery in Kitwe.

**Built surface area:** Overall plot: 8 ha, built 80%. Two industrial sites, 25 m. apart.

**TURNOVER:** 24,000,000 ZMW / 2,670,000 USD

**BASELINE ENERGY CONSUMPTION:** 4,997 MWhh

**BASELINE/ TURNOVER:** 2.1 kWh/USD



## KEY EE RESULTS

The investment project on baking ovens had a cost of about 500,000 USD, and reduced the electric consumption by 30%. The cost of waste oil is considerably less than the cost of electricity, and produced savings of some 55,000 USD per year. Considering that the reduction of electricity saves marginal-cost energy generated with oil combustion (the hydroelectric production is not sufficient), the net saved GHG emissions are 1000 tons of CO<sub>2</sub> equivalent per annum.

EE MEASURES	Unit	LED Lighting	Power Factor Correction	Ventilation Control	Heat Recovery	Waste Oil Burners	PV Roof	TOTAL
ENERGY SAVING/ TURNOVER	kWh/\$'000	36		16	166	630	170	1,017
SAVED MONEY/ TURNOVER	USD /\$'000	2.4	6.2	1.0	1.3	33	9.8	53
ENERGY SAVING/BASELINE	%	1.7%		0.77%	8.0%	30%	8.2%	49%
CAPITAL EXPENDITURE	\$'000	22	3.8	10	16	500	205	758
SAVED MONEY per year	\$'000/a	5.9	15	2.4	3.0	78	24	128
SIMPLE PAYBACK TIME	Years	3.8	0.3	4.2	5.4	6.4	8.7	Average 5.9

**49%**  
ENERGY SAVINGS

**128,000** USD/YEAR  
MONEY SAVED

**5.9** YEARS  
SIMPLE PAYBACK

**1,000** TONS OF CO<sub>2</sub>  
SAVED GHG EMISSIONS/YEAR

## **Learn more about Energy Efficiency in the industry 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](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>

Best available techniques - Reference document (BREFs): <http://eippcb.jrc.ec.europa.eu/reference/>

Compressed air good practices: [https://www.ceati.com/freepublications/7017A\\_guide\\_web.pdf](https://www.ceati.com/freepublications/7017A_guide_web.pdf)

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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.



*A project funded by  
the European Union*

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