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# *RECP Experiences* in the Project Lake Victoria Environmental Management Programme (LVEMP II), Kibos Sugar and Allied Industries Factory

**The efficient and environmentally sound use of materials, energy and water - coupled with the minimization of waste and emissions - makes good business sense. Resource Efficient and Cleaner Production (RECP) is a way to achieve this in a holistic and systematic manner. RECP covers the application of preventive management strategies that increase the productive use of natural resources, minimize generation of waste and emissions, and foster safe and responsible production. Benefits are eminent in many enterprises, regardless of sector, location or size, as demonstrated by the experiences of Kibos Sugar and Allied Industries Factory, Kisumu County Kenya**

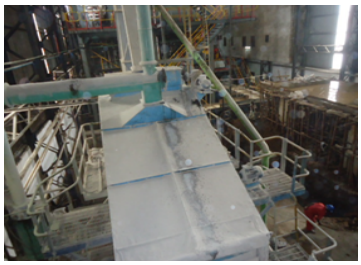
## Achievements at a Glance

Kibos Sugar & Allied Industries was established in October 2007. It produces Sugar and the by-products include bagasse, molasses, filter cake and ash. It has a crushing capacity of 1600TCD using the most modern vacuum pan technology. It is currently in the process of expanding this capacity to 3500 TCD. At present, the factory is crushing at 2200 TCD. The company boasts of the best wastewater treatment plant in the region, reducing BOD loads of up to 400mg/l to permissible levels of below 30mg/l.
The company was able to realize huge savings on water and waste water (Reverse Osmosis used for waste water treatment), overall reduction on energy use (Energy savings of up to 37% on overall energy use), 16% reduction in GHG emissions and 38% in water use reduction leading to a reduction in the amount of water used from 125,000 m3 to 75,000 $m^3$ per year.

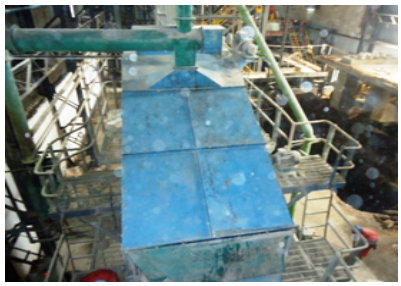
*Dark Waste water before treatment (BOD=112 & COD=242mg/l)*

***Clear Wastewater after Treatment (BOD=10mg/l &COD=32mg/l)***

Reverse Osmosis plant used for waste water treatment. Water is recycled for Non-production use



Before: Sugar dust accumulation on process shop floor



After: Sugar dust recovered for melting

50kg bags of sugar dust being recovered from packaging roof

## Overview

Since the formation of Resource Efficiency and Cleaner Production (RECP) and Energy Management Team, the company has been able to make savings on a number of areas which include energy savings of up to 37%, raw material savings in terms of cane and juice leakage elimination, reduced; water use, effluent load, effluent treatment costs and effluent quantity. The commitments of

the top management has enabled quick implementation of the low hanging fruits and further into developing policies i.e. Environmental policy, Energy Management policy, Health and Safety policy. Diversion of storm waters from the effluent line contributed a lot in lowering effluent quantity and amount of chemical used hence reduced cost of effluent treatment. It is notable that through implementation of Cleaner Production Technologies, savings of up to 50% can be made in a number of areas that contribute to production and eventually improves the bottom line. As a management tool, improvements made must be continually enhanced. Diversion of storm waters from the effluent drain line also contributed a lot in lowering effluent quantity and quantity of chemical used hence reduced cost of effluent treatment.

## Benefits

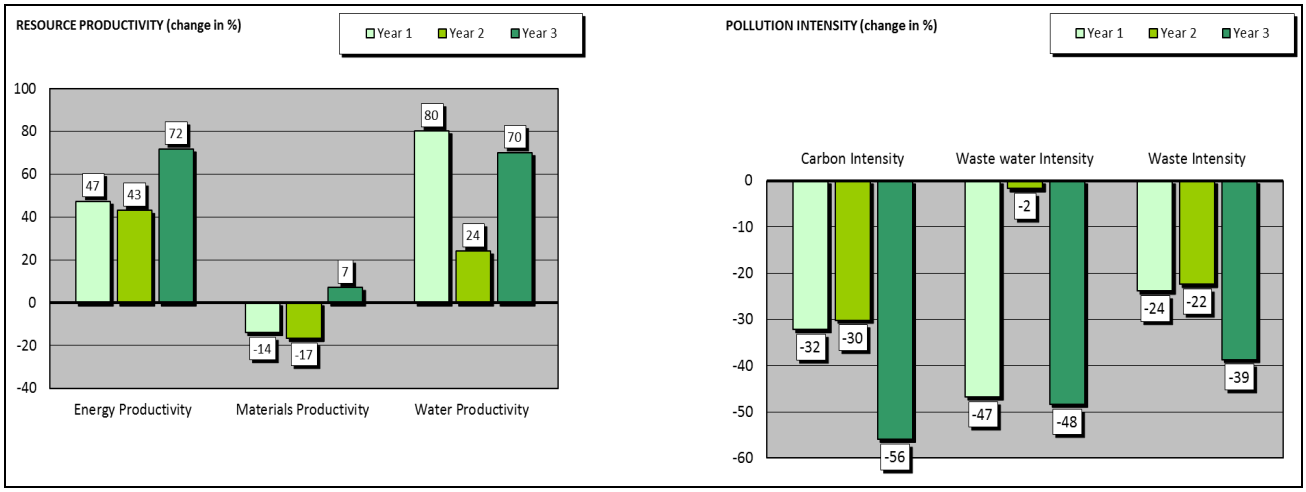
Through RECP implementation, Kibos Sugar Company has realized the following economic, environmental and social benefits namely;

1. By replacing 57 pieces of 400w bulbs with 57 pieces of 22w energy saving bulbs for street lighting in February 2011, The Company realized a saving estimated at KShs 2,792,364 per annum in electricity consumption which is 37% of the total energy cost. The extra savings enabled power connection to additional staff houses and other utilities.
2. Sugar juice leakages have been managed through repair of all leaking glands hence resulting into more sugar being produced per ton of cane and reduced cost of effluent treatment in terms of chemical use.
3. The environmental performance has also improved. The improvement in the quality of effluent discharge with BOD of approximately 10mg/l and COD of approx. 30mg/l has reduced the hue and cry of the neighboring community downstream since the quality of the waste water released meets the national standards.
4. Implementation of a closed loop has ensured that the company is now utilizing treated effluent for construction and road maintenance, which reduced the amount of water used for these purposes.
5. Sugar dust settling on the hand rails, sugar bins, pipes and other surfaces around the sugar house are recovered by scrapping, sweeping and cleaning with hot dampened clothes monthly and the large quantities of dry sugar dust, and the sugary warm waters and are emptied in the sugar melter vessel for reprocessing, thereby enhancing significant sugar recovery of up to 18 (50Kg) bags of finished product per month, translating to a saving of Kshs 108,000.00.

**RESULTS AT A GLANCE**

| Absolute Indicator | Change (%) year 1 | Change (%) year 2 | Change (%) year 3 | Relative Indicator | Change (%) year 1 | Change (%) year 2 | Change (%) year 3 |
|---|---|---|---|---|---|---|---|
| **Resource Use** | | | | **Resource Productivity** | | | |
| Energy Use | -24 | -21 | -2 | Energy Productivity | 47 | 43 | 72 |
| Materials Use | 31 | 0 | 57 | Materials Productivity | -14 | -17 | 7 |
| Water Use | -38 | -9 | -1 | Water Productivity | 80 | 2 | 70 |
| **Pollution Generated** | | | | **Pollution Intensity** | | | |
| Air Emissions (global warming, CO2 eq.) | -24 | -21 | -26 | Carbon Intensity | -32 | -30 | -56 |
| Waste Water | -40 | 12 | -13 | Waste-water Intensity | -47 | -2 | -48 |
| Waste | -14 | -12 | 3 | Waste Intensity | -24 | -22 | -39 |
| **Product Output** | 13 | 14 | 68 | | | | |

## RECP Profile




## Resource Efficient and Cleaner Production (RECP)

**Resource Efficient and CLeaner Production (RECP)** entails the continuous application of preventive environmental strategies to processes, products and services to increase efficiency and reduce risks to humans and the environment.

RECP addresses three sustainability dimensions individually and synergistically:

- *Production efficiency*
  > Through improved productive use of natural resources by enterprises

- *Environmental management*
  > Through minimization of the impact on nature by enterprises

*Human development*
> Through reduction of risks to people and communities from enterprises and supporting their development


## Success Areas

1. Before RECP intervention, glands of most pumps that transfer syrup and molasses had leakages. At the time, mitigation measures involved placing a can to collect the leakages and empty back to the respective recycling tanks. This practice had challenges since syrup spillages still occurred whenever the collecting containers filled up in the absence of an attendant. RECP team thereafter made follow ups have the glands replaced to stop leakages. Such leakages could end up into the effluent treatment plant and sharply increase the BODs and CODs. These parameters are now consistently low below prescribed NEMA quality standards.

2. Kibos sugar aims at ensuring that all cane arriving at the factory ends up in the mill for production .Cane trampling at the cane yard by trucks has been greatly minimized by employing the use of shovels and manual cane picking. This is still an area of continuous improvement.

3. Pedestrians pulling cane from tractors are a major concern, resulting in cane spillages. However, the company is putting into use cane carriers that are fully covered around the sides slowly replacing the open ones. This will completely eliminate pedestrians pulling out cane from the trucks and incurring losses and waste. Pollution of the roads will also cease.
4. Delamping has led to massive reduction on energy consumption. The company replaced some iron sheets with transparent sheets, allowing for plenty of light in the factory during the day, thereby eliminating use of lighting.

5. The company mainly uses its own generated power for sugar milling. Bagasse from cane milling is used to fire a 35-ton boiler to produce steam at high pressure. Steam turns turbine alternator, producing 3MW of electricity. A 90-ton boiler is being installed to boost energy production to 18MW. However, grid electricity is used whenever there is a repair or temporary breakdown in the boiler. In such events, milling is stopped and grid power is used for minor operations and lighting. With over 60 pieces of 400w bulbs previously in place before the RECP intervention, consumption from lighting alone in an hour would cost the company KShs 720.00 more, considering just sixty such bulbs compared to KShs 42.00 per hour after replacement with 22w bulbs (take average cost per kW at kshs30.00).

6. Capacitors at power house were found to be consuming power in the range of 11 to 28 Watts/kVAr. Replacing the Capacitors with new energy efficient capacitors was proposed and has now been installed. Saving potential was estimated at 141,926 kWh and KShs. 1.28 million respectively per year, with a payback period of one year and an investment of KShs 1.2million (US$14,000). This was a major area of improvement on energy efficiency.

7. Steam leakages and heat losses have been minimized by replacement of leaking valves and proper lagging of all steam pipes. Education of staff on need for energy conservation through notices and posters have made employees more conscious of energy savings than before. This is a continuous process. RECP team keeps working continuously on areas where improvement opportunities are feasible with minimum modifications and costs.

8. On water conservation, all process water is recycled back to the plant for cooling purposes. Hot water from process is directed to cooling tower where they are pumped up to three feet high and slowly runs back to plant over a 180m distance back to plant for cooling purposes. All leaking water pipes and taps have been replaced. Hose washing have also been eliminated. KSAIL installed a Reverse Osmosis water purifier, capable of changing treated effluent into portable water for drinking.
9. In general, most low cost investment interventions have already been implemented.

**Electrical Improvements based on RECP interventions**

10. Pre-Mills:-
    New cane kicker installed 55kw/75HP current 96 Amps
    Benefit: - Energy efficient motor installed
    Old chopper of 100HP which was squarell cage induction motor was replaced by 200HP slip ring motor with automatic liquid resistance starter (efficient motor)

11. Cane Carrier: - as was recommended by RECP to install energy efficient motors
    The cane carrier was enlarged in width to accommodate more cane feeding to mills. The 37KW/40HP motor was replaced with a new energy efficient motor 45KW/60 HP 81 Amps using variable frequency drive (VFD). The motor rating is 64 Amperes and is taking 44Amps on actual load because of VFD - a saving of 50%.

12. Mills
    i. Rake Elevator:- modified awaiting 3rd phase final which shall be PLC System along with VFD.
    A new energy efficient motor for rake elevator was installed 37 KW/40HP, 81 Amps a variable frequency drive (VFD) drawing 44 Amps only - a saving of 31%

ii. Mill No 5:

- A new energy efficient AC motor 450KW/600HP rated 850 Amps was installed with a variable frequency drive (VFD) drawing 700 Amp a saving of 12%.
- A new energy efficient AC motor for top roller pressure feed (TRPF) was also installed on the 5th mill as well which is operating with variable frequency type (VFD) Motor rating is 110 KW/150 HP with current of 184Amps drawing 66Amps which is 64% energy saving .

iii. Lighting Mills:-

After installation of translucent sheets on the factory mill house which is catering for 25% energy reduction plus a replacement of 250 watts instead of 400watts on high bay, high pressure mercury vapor lamp on the mill house six (6) numbers a reduction of 3% making a total of 27% energy saving.

| **Principle Options Implemented** | **Benefits** | | |
|---|---|---|---|
| | **Economic** | **Resource Use** | **Environmental Impact** |
| | Investment($)<br>Cost Saving($/yr) | Reductions in energy use ,water use and /or materials use(per annum) | Reductions in waste water, air emissions and /or waste generation(per annum) |
| **Option 1: Water Management:**<br>• Repair of tap leakages<br>• Leaking water pipes and hoses replaced<br>• Pipe diameter reduction for car washing<br>• Ban of hose washing<br>• Flow meters fixed<br>• Recycling of process water<br>• Maximization of steam recovery. | Investment of US$ 5,625<br><br>Approx US$ 1,875 in cost savings per yr. | • Water use reduction from 400 $m^3$ /day to 250 $m^3$ /day i.e. 120,000$m^3$ to 75,000 $m^3$ /yr | • Reduction in wastewater.<br>• Improved waste water quality<br>• Reduced electricity costs |
| **Option 2: Waste Water Management:**<br>• Reduced wet washing<br>• Elimination of hose use to clean juice and molasses spills<br>• Redirection of storm waters away from effluent drainage line<br>• Constructed waste water storage tank for wastewater reuse | Investment Costs of US$ 4,200<br><br>Cost Savings US$ 1,606 p/a | • Reduction in waste water discharge<br>• Less chemical use<br>• Reduced usage of treated water for construction and road watering during dusty weather. | • Standard wastewater quality attained with reduced costs in terms of chemical in-put.<br>• Zero waste water discharge achieved |
| **Option 3: Materials Management:**<br>• Re-use of wooden wastes<br>• Use of bagasse for firing boiler to enhance power generation.<br>• Filter mud used as fertilizer. | Nil as per the time of baseline data. | • Low material waste load<br>• Larger storage area due to extra available space | • Aesthetic balance of the environment |
| **Option 4: Energy Management:**<br>• Energy management team formation<br>• Awareness creation to staff regarding energy management via posters and notices.<br>• Instill culture of turning off | Delamping Investment – US$ 8,047<br>Cost Savings US$ 32,851p/a | • Energy use reduction by up to 24%<br>• Lower KVA demand<br>• Optimum power factor of 9.6 on average. | • Less fossil fuel use hence lower green house gas emissions |

| | | | |
|---|---|---|---|
| equipment and lights when not in use.<br>• Delamping to rid off high energy consuming bulbs i.e. 400w to 22w energy saving bulbs<br>• Additional transparent polycarbonated sheets installed at mill house provide adequate light during the day, eliminating use of six (6) bright 250watt bulbs.-100% E saving day time.<br>• Capacitors installed for power storage<br>• New energy efficient cane kicker of 55kw/75hp installed. The old one was inefficient.<br>• Old 100HP squirrel cage induction motor for the cane chopper was replaced by more efficient 200HP slip ring motor with automatic liquid resistance starter. The old one being small, had a big load hence consumed much energy, with high inefficiency/ performance<br>• Old Cane carrier motor (37kw/40hp) was replaced by an energy efficient 45kw/60hp, 81 Amps, fitted with a VFD. Because of the VFD, the motor is only taking44Amps on actual load-a 46% energy saving.<br>• Another new efficient motor: 37kw/40hp/64 with VFD was installed for the Rake carrier, drawing only 44Amps, another 31% saving.<br>• New EE AC motor (450kw/600hp/ 850 Amps with VFD fixed for Mill 5and drawing only 700amps-12%saving.<br>• Top roller pressure feed (TRPF) motor (110kw/150hp/184 Amps) also installed for Mill 5 and draws only 66Amps-64% E savings. | US$445 investment<br>US$1,826 savings p.a.<br><br>Investment US$ 14,000<br>Cost Saving of US$ 15,028 p.a.<br><br>US$4,705 investment<br>US$13,065 savings/yr<br><br>US$5,588 investment<br>US$4,749.8 savings/yr<br><br>US$12,235 investment<br>US$19,823 savings/yr<br><br>US$2941 investment<br>US$10,715 savings/yr<br><br>US$9411 investment<br>US$80364 savings/yr<br><br>US$4705 investment<br>US$65,327 savings/yr | | |
| **Option 5: Solid Waste Management:**<br>• Re-use<br>• Recycling<br>• Donations /Free issuance to willing users i.e. filter mud, bagasse, waste concrete and ash | Investment cost US$ 212 (Manual labour)per month –US$ 2,544 per year<br><br>Returns of US$ 1,000 | • Activated recycling hence low solid waste buildup | • Cleaner environment |

| | | | |
|---|---|---|---|
| • Collection of sugar dust instead of waste | per month (US$ 12,000 per year) | | |
| **Option 6: Air Emissions:** Monitoring of stack emissions annually (tests) | Test costs of US$ 882.7 | • Environmental monitoring | • Environmental monitoring<br>• Reduced ozone depleting gases |
| **Total of all Implemented Options.** | **Investment US$ 72,996.7**<br><br>**Estimated cost savings of US$ 259,229.8** | | |

## Approach taken

With the incorporation of RECP practices into the factory production, employees have been made conscious of resource management and waste minimization. Educative posters are constant reminders to the employees i.e. on turning off electrical equipment and water taps when not in use, reporting leaks, etc. Through RECP incorporation, the company has realized benefits in terms of energy savings, wastewater management, excellent waste water quality, lower waste treatment costs and elimination of environmental penalties.

## Business case

Before RECP implementation, approximately 3 tons of cane could be trampled on in a month leading to loss of 300kgs of sugar hence about KShs 315,000 (USD 3705). Furthermore, the company still incurred costs in treatment of sugar-loaded effluent due to losses of sucrose through gland leakages, and hose washing; further aggravating losses of sugar. Sugar dust was not considered a major avenue of losses until information on resource efficiency brought about a change in thinking and management. Losses in electricity through the use of high voltage appliances and lighting were never quantified nor taken care of due to the mistaken idea that the company was generating its own power and therefore, KPLC use was not efficiently managed.

RECP implementation has lead to a reduction of electricity cost hence making it possible to provide lighting to staff quarters from the generated power. Reduction in loses of sugar juice from trampling and gland leakages from minimal improvements and change of management systems, considerably saved raw material loss that would never have been recovered, and recorded savings in the treatment of effluent improving on the quality of effluent discharged. This has also improved our relations with the local community downstream.

Recovery of sugar dust through the employment of manual labour has ensured savings of KShs 984,000.00 p.a (USD 11576). which would hitherto have been lost. If extrapolated, KSAIL has thus reaped benefits from RECP interventions particularly in taking advantage of the low hanging fruits. The current estimation of savings is approximately KShs 22 million/yr ( USD 258,823)
For continued benefits, more interventions and continued observation of progress made is being enhanced. The 90-ton boiler installation program planned will eliminate extra bagasse currently stored as solid waste. Energy production will also go up by 600%. Once the boiler is installed, the installation of 11kg mortar of 750KW (2No.) (Fibrizer) will draw less current at a tune of 35 to 40 AMP each which is 70 to 80 amps. This will further reduce energy demand. The company's allied industries include the installation of a pulp and paper industry to mop up all the bagasse which will further enhance Cleaner Production and Resource Efficiency by ensuring complete use of waste material generated for value addition.

| **Testimony Box** |
|---|
| **Kenya National Cleaner Production Centre (K NCPC)** |
| The Kenya National Cleaner Production Centre (KNCPC) is a Trust under the Ministry of Industrialization and Enterprise Development. It was established in July 2000 as part of the global UNEP/UNIDO National Cleaner Production Centre program |

under the UNDP-Government of Kenya Country Co-operation Framework of 1999-2002. Currently, it is being transformed into a semi-autonomous government agency. The Centre is a nodal Government agency in building capacity and providing advisory services in Resource Efficient and Cleaner Production (RECP) so as to increase the productivity of enterprises by reducing wastage of resources (water, energy and raw material) and their associated negative environmental impacts. The Centre offers consultancy and training on environmental impact assessment, environmental audit, energy management training and audit, Clean Development Mechanism and climate change (CDM), amongst others. These programmes are implemented in service and manufacturing enterprises including hotels, hospitals, households, municipalities, water services and sewerage companies, supermarkets among others.

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**English Abstract** (where applicable)

N/A

## ABOUT *RECP EXPERIENCES*

Through the joint Resource Efficient and Cleaner Production (RECP) Programme, the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) cooperate to improve the resource productivity and environmental performance of businesses and other organizations in developing and transition countries. The Programme is implemented in partnership with the Global Network for Resource Efficient and Cleaner Production (RECP*net*). This series of enterprise success stories documents the resource productivity, environmental and other benefits achieved by enterprises in developing and transition countries through the implementation of RECP methods and practices.

These successes were achieved with the assistance of the National Cleaner Production Centres, which are part of RECP*net* established with support of the UNIDO and UNEP. The success stories employ the indicator set described in *Enterprise Level Indicators for Resource Productivity and Pollution Intensity*, UNIDO/UNEP, 2010. The primer with accompanying calculator tool and further case studies are available at www.recpnet.org, as well as on www.unido.org/cp and www.unep.fr/scp/cp.