TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors

Project Overview and Audit Finding

Strictly Private and Confidential

November 2018
Agenda

Background & about project

Unit selection & training

Audit findings
Background & about project
In Zimbabwe, energy providers and water supply infrastructure struggle to meet the country’s increasing demand for energy and water.

Most plants were designed and built at a time when energy and water efficiency were not points of concern and therefore also lack metering (both at process and plant level) for electricity, steam or water.

TA includes conducting energy and water efficiency audits in ten (10) pilot companies, guidance on the implementation of ISO 50001 Energy Management System and awareness raising of the benefits of such measures for a sustainable business.

Lack of investment in new energy and water efficient technologies
Lack of awareness in key decision makers
Lack of economic incentives, such as appropriate tariff structures, and therefore of commitment by top management

Limited access to climate change mitigation/adaptation technologies
Limited availability of capacities and skills
Lack of compliance with energy and water management systems in industry
Key indicators – Energy Sector

Supply-demand mismatch at peak hours in Zimbabwe

600-1600 MW

Present share of renewable energy in the total energy consumption

<1%

Annual rate of growth of industrial sector in Zimbabwe

2%

Estimated GHG emissions reductions due to energy efficiency by 2030

1.278 MtCO2eq

Estimated cost of emission reduction through energy efficiency

46.9 US$/tCO2eq
Genesis of the Technical Assistance

Formal request to UNIDO by Government of Zimbabwe for technical assistance in developing a Green Industry Initiative - 2012

Green Industry Taskforce established as PPP between GoZ, BCSDZ and UNIDO - 2013

The Green Industry initiative officially launched at the BCSDZ Annual Conference followed by National Workshops in two cities (Bulawayo and Mutare) - Dec, 2013

Zimbabwe BCSDZ/NDE submits request to CTCN - 2015

UNIDO/CTCN Award PwC Contract to provide response to technical assistance to Zimbabwe - 2018

2012

2013

Dec, 2013

2015

2018

Nov, 2013

A ten member Zimbabwean delegation participated in a Green Industry Study Tour to South Korea in Nov, 2013

2014

UNIDO GI Expert from Vienna visited Zimbabwe to engage and consult key stakeholders on the proposed project

2016

Zimbabwe’s request accepted and approved by CTCN

2018

Major activities completed

TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors

PwC

November 2018
**Climate Technology Centre & Network (CTCN)**

"Connecting Countries to Climate Technology Solutions"

**What does CTCN do?**
Promotes accelerated, diversified and scaled-up transfer of environmentally sound technologies for climate change mitigation and adaptation, in developing countries, in line with their sustainable development priorities.

**Mission**
“To stimulate technology cooperation and enhance the development and transfer of technologies to developing country parties at their request”

**Donation amount (in Million US$)**
- UNIDO, 1.12, 25%
- GCF, 1.41, 31%
- GEF, 1.97, 44%

GEF is the biggest donor organization for CTCN (44%).

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TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors

PwC  November 2018
Objectives of the assignment

Identify energy, water efficiency and management improvement potential in 10 selected pilot companies

Create capacities to replicate and implement such interventions in companies across Zimbabwe in the future

Focus areas of Technical Assistance

- Technology identification and prioritization
- Feasibility of technology options
- Piloting and deployment of technologies in local conditions
- Private sector engagement and market creation
**Key Stakeholders**

**National Designated Entity**
- Ministry of Environment, Water and Climate Change

**Project Proponent**
- Business Council of Sustainable Development Zimbabwe

**Consultants:**
- PwC India and PwC Zimbabwe

**Key ministries**

**Other key stakeholders**
- Zimbabwe National Cleaner Production Centre, Standards Association of Zimbabwe, Scientific and Industrial Research and Development Centre (SIRDC), Zimbabwe, Environmental Management Agency, Zimbabwe Energy Regulatory Authority (ZERA)
## Linkage of assignment to key policies

<table>
<thead>
<tr>
<th>Zimbabwe’s National Policies</th>
<th>Linkages to current assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy</strong></td>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>Zimbabwe Climate Change Response Strategy</td>
<td>2014</td>
</tr>
<tr>
<td>Zim Asset (2013-2018)</td>
<td>2013</td>
</tr>
<tr>
<td>IDP (2012-2016)</td>
<td>2012</td>
</tr>
<tr>
<td>Third communication to UNFCCC</td>
<td>2016</td>
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<tr>
<td>ZUNDAF (2016-2020)</td>
<td>2015</td>
</tr>
</tbody>
</table>
Unit Selection & Training
Screening process of industrial units

Units from following sectors in Zimbabwe
- Food processing and Beverages
- Leather and Footwear
- Agrochemical Production
- Timber processing
- Mining, Mineral processing and Metal finishing
- Cement production
- Cable manufacturing
- Buildings and Construction
- Waste Management and Recycling
- Dairy Sector

Top 30 units with highest scores (Top 3 for each sector)

Final 10 industries for carrying out audits (1 unit per sector)

Preliminary rating criteria

Desirable criteria Discussion between UNIDO/CTCN and Project team
Shortlisted units for detailed energy & water audit

Agrochemical (2 units)
Cable (1 unit)
Cement (1 unit)
Food & Beverages (3 units)
Mining (3 units)
## Training details

<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th>Training programme on Energy &amp; water efficiency with focus on ISO 50001</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dates</strong></td>
<td>25th - 27th June 2018 (3 days)</td>
</tr>
<tr>
<td><strong>Venue</strong></td>
<td>PwC Training Hall, Arundel Office Park, Norfolk Road, Mount Pleasant, Harare</td>
</tr>
</tbody>
</table>

### Topics covered during the training program

- **Energy performance assessment**
- **Energy efficiency**
- **Water use efficiency and conservation**
- **Water balance**
- **Renewable resource assessment**
- **Potential estimation**
- **ISO 50001: Basics**
- **Implementation process**
- **Case studies Energy, Water and ISO 50001**
Some photos from training programme
Training demographics

Classroom training (Total no of people who attended: 42)

- Industry, 17, 40%
- Government Agencies, 12, 29%
- Others, 13, 31%

Majority of the participants were Industry officials (40%)

Hands on training (Total no of people who attended: 27)

- Government official, 14, 52%
- Industry personnel, 10, 37%
- Consultants, 3, 11%
- Others, 13, 31%

Majority of the participants were government officials (52%)
Hands on training
Audit findings
**Demonstration units**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Agrochemical</td>
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<td>Agrochemical</td>
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<td>Cables</td>
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</table>

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PwC
Water and energy consumption of demo. units

Water consumption
- 5.1 million cubic meter

Energy consumption
- 60,161 tonnes of oil equivalent

Combined peak demand equivalent to 3% of Zimbabwe’s total peak demand

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November 2018
Audit process
Energy and water saving recommendations

No. of energy and water recommendations identified: 161

- Leaks reduction: Water, compressed air
- Process optimization in boiler / Hot air generators
- VFD retrofit on compressor
- Cogged V-belt
- Boiler automation
- Reduce heat loss

Payback < 3 years 78%
Payback > 3 years 10%
No investment 12%

Replacement of
- Smelting furnace
- Boiler
- LED lighting
- Refrigeration compressor

- Rain water harvesting
- High pressure nozzle for ablution
- Flow restrictors

Audit findings
Unit Selection & Training
Background & about project
Agenda

TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors
PwC November 2018
Energy and water saving potential identified (%)
GHG Reduction Potential (tCO$_2$ equivalent)

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TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors

November 2018

PwC
Saving potential identified

- 72 thousand tonnes of cement production
- 300 million litres of soft drinks production
- 13,200 tonnes of copper cables production

**Energy saving:** 6,245 toe/year

**Water saving:** 0.61 million m³/year

**GHG reduction potential:** 22,760 tCO₂e

- 3.2 million tonnes of fertilizer production
- 930 kg gold production
- Powering 73 thousand households

Equivalent to avoided power generation capacity: 10 MW
**Investment potential and monetary saving**

**Investment proposed:** US $ 4.53 million  
**Monetary saving potential:** US $ 3.85 million

<table>
<thead>
<tr>
<th>Investment ('000 US $)</th>
<th>Monetary saving ('000 US $)</th>
<th>SPP</th>
<th>years</th>
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</thead>
<tbody>
<tr>
<td>0</td>
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<td>1.6</td>
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<td>200</td>
<td>1.8</td>
<td>2.5</td>
<td>0.5</td>
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<tr>
<td>300</td>
<td>2.5</td>
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<td>500</td>
<td>0.5</td>
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<td>600</td>
<td>0.5</td>
<td>0.3</td>
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<tr>
<td>700</td>
<td>0.3</td>
<td>0.3</td>
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</tbody>
</table>

**Implementation prioritization**
- No investment measures
- Payback less than 1 year
- Payback less than 3 years
- Payback more than 3 years
Improving PF to 0.999 in all units will:
(a) Reduce demand by 5,700 kVA
(b) Reduce distribution losses by 0.2%
(c) Lead to monetary saving of > US $ 400 thousand
Energy Conservation Measure – Case Study

**Existing** - Flat V-belts used

**Proposed** - Use cogged V-belts

- Energy saving by improved transmission
- **Increased life of belt**

- Total belts replace – 12 motors
- Annual monetary savings – US $ 2,760

- Simple payback – 6 months
- Energy savings – 1 to 3%
Energy Conservation Measure – Case Study

Boiler Automation

Exiting operation

- $\textsuperscript{O}_2$ analyser at the flue path just before ID fan
- Pressure sensor of steam to control coal feed rate

Proposed operation

- Annual monetary savings – US $ 15,500
- Simple payback – 1 year
- Energy saving – 3 to 5%
Energy Conservation Measure – Case Study

Screw compressor for refrigeration system

Existing

Proposed

Savings

- Refrigeration load – 127.4 TR
- Power consumption – 208 kW
- Annual electricity saving – 275 MWh
- Annual monetary savings – US $ 27,750
- Simple payback – 2 years
- Energy savings – 32.5%

Specific Power Consumption (kW/TR)

Audit findings

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Energy Conservation Measure – Thermal Images
Water Balance of the Plant: Typical

Total supply 16,038 m³

- 5,950 Ablution & Domestic
- 7,390 PROCESS
- 2,697 Others

Production processes

Domestic processes

Effluent treatment

Input

Output

Audit findings

Unit Selection & Training

Background & about project

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**Water Conservation Measures – Case Example**

### Low flow showers

- **Standard showers**
- **Low flow showers**
- **Advanced low flow electric showers**

![Graph showing water usage (L) and energy usage (kWh) for different shower types]

### Rain water harvesting

- **Average annual rainfall in Harare 840 mm**
- **2.3 L/ft²/in rainfall**

- **Rainfall data for different months:**
  - **July:** 1.8 L
  - **August:** 2.0 L
  - **September:** 8.8 L
  - **October:** 36.8 L
  - **November:** 170.4 L
  - **December:** 191.4 L
  - **January:** 144.3 L
  - **February:** 95.7 L
  - **March:** 40.6 L
  - **April:** 10.0 L
  - **May:** 2.2 L
  - **June:** 2.2 L

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*TA for piloting rapid uptake of Industrial EE and Efficient Water utilization in the Industrial sectors*

*PwC*
**Solar Legislative Framework**

<table>
<thead>
<tr>
<th>GRID CODE</th>
<th>NET METERING</th>
<th>TARIFF CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Any user seeking to establish a new, or modified arrangements for connection to and/or use of the National Transmission System. Any Grid Tied system should comply with the technical and legal requirements of the Grid Code.</td>
<td>• Net Metering Regulations meant to govern the generation of electricity from small scale, grid tied renewable energy generators like solar PV on rooftops were gazetted by the Government of Zimbabwe in early 2018. Net metering regulations will apply up to a threshold of 100kW above this threshold the tariff code will apply.</td>
<td>• The tariff code has a methodology which was approved by ZERA in 2017. It stipulates a method of arriving to a particular tariff by looking at the cost of sales, cost of capital, depreciation and other production related costs. It has to be proven that the plant is operating efficiently.</td>
</tr>
</tbody>
</table>
**Solar PV**

**Tariff code**
- LCOE
- 100 kW – 50 MW
- High investment
- High payback period

**Net metering**
- Restricted to 100 kWp
- Suitable for office and lighting load

**Battery inverter**
- Sized for office load
- Security system backup
- Replacement of admin block DG set

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity</th>
<th>Tariff (US $/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>100 kW - 1 MW</td>
<td>0.138</td>
</tr>
<tr>
<td></td>
<td>1 MW - 5 MW</td>
<td>0.131</td>
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<tr>
<td></td>
<td>5 MW - 50 MW</td>
<td>0.118</td>
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</tbody>
</table>
Solar Resource Assessment and Shading Analysis

[Diagram showing solar resource assessment and shading analysis with coordinates and measurements]
Solar PV – Grid tied

- Proposed size of grid tied solar PV few kW to 5 MW
- Typical Payback Period 6 - 7 years
- It’s a strategic investment
**Solar PV – Battery Inverter**

- Proposed based on office load and security lighting requirement
- Typical Payback Period 7 – 9 years
- It’s a strategic investment
Solar Thermal

Diagram showing a solar thermal system with various components such as solar panels, buffer storage tank, backup heating tank, boiler, and connections for hot and cold water supplies, feed water, steam to processes, condensate return flow, and make-up water.
Solar Thermal

Solar water heater applications: Boiler feed water, Pasteurization, etc.

- Proposed based on roof space available and hot water demand of unit
- Typical Payback Period about 5 years
**Biogas option**

Bio-gas is a type of biofuel which is produced by decomposition of organic waste naturally

**Biogas consists of:** 50 – 80% CH₄, 20 – 35% CO₂ and traces of H₂, N₂, H₂S

- Gas production rate: 0.3 m³/kg
- Hydraulic retention time of 30 days
- 1.1 m³ biogas can replace a 12 kW industrial stove

- Proposed based on kitchen waste available
- Typical Payback Period about a year
# Key points for policymakers

<table>
<thead>
<tr>
<th>Area/Sector</th>
<th>Key policy level observations and recommendations</th>
</tr>
</thead>
</table>
| Energy      | - *Capacity building programmes* are necessary to generate awareness among industries  
- *Cluster/Sector specific project* could be developed for farther penetration for enhancement of resource efficiency in industries  
- *Low Carbon Technology Transfer projects* to support implementation of pilot technologies to showcase benefits in the country  
- *Setting up Energy Management Centre* with support from international funding which would be equipped with audit instruments and trained professional to use them to conduct studies in large number of industries at lower cost  
- Promotion for adoption of *ISO 50001 Energy Management System*  
- *Low cost financing/ Line of credit* could be explored to implement high cost EE interventions in structured manner. |
## Key points for policymakers

<table>
<thead>
<tr>
<th>Area/Sector</th>
<th>Key policy level observations and recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tariff</td>
<td>▪ Tariff re-structure: <em>PF penalty/rebate system</em> could be introduced</td>
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<tr>
<td></td>
<td>▪ A number of industries are on <em>preferential tariffs</em>, operating at <em>power factors lower than 0.7</em>, leading to increased demand on the power system</td>
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<td></td>
<td>▪ <em>Demand Side Management programmes</em> could be proposed to help tariff structuring and managing the load, peak demand</td>
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<tr>
<td></td>
<td>▪ <em>Training programs for ZERA/ZESA employees on energy efficiency and management, demand side management</em></td>
</tr>
</tbody>
</table>
# Key points for policymakers

<table>
<thead>
<tr>
<th>Area/Sector</th>
<th>Key policy level observations and recommendations</th>
</tr>
</thead>
</table>
| Water       | ⚫ *Capacity building and training* of industries on water use efficiency and water conservation  
              ⚫ *Tariffs on water are very low* leading to inefficient use  
              ⚫ *Improper treatment of wastewater and almost no reuse of water*. Programmes could be developed to generate awareness on reuse of water  
              ⚫ No regulation on discharge of waste water, a program could be developed to *establish Specific Waste Water Discharge allowed* for different sectors |
Thanks!

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