Energy Efficiency
in Industries

Energy efficiency measures in Nigeria are easy to identify and to implement. These measures show quick results in the form of higher productivity, increased resource management and reduced energy costs. About 10 – 30 % less electricity consumption in industry can be achieved with little or no investment.

Energy Efficiency has huge economic benefits in most sectors in Nigeria, including the industrial sector, where energy costs are extensively high. With energy being the key to economic development worldwide, this improvement in industrial productivity through energy conservation and energy efficiency will drive national economic output, creating jobs and reducing GHG emissions.

Due to the insufficient power supply in Nigeria and inefficient self-supply, per capita consumption is 144 kWh. The effects are clearly visible in the balance sheets of many industrial sectors, as their business costs are driven up by the high energy costs. For the majority of manufacturing industries in Nigeria, electricity costs account for between 30 and 40 % of total production costs. The country’s policy makers mainly rely on strategies to increase power generation capacity, but increasing energy efficiency — especially in industrial processes — also plays an important role in reducing the demand for grid electricity, thus creating additional available capacity for distributing DISCOs to other underserved regions.

The Nigerian industrial sector (in particular chemicals, pharmaceuticals, metals, cement and plastics) offers very good opportunities for energy savings; enormous savings can be achieved by improving load and energy management Companies that realise potential savings will reduce energy costs per unit of production, which will have a direct impact on their competitiveness.

Due to the use of inefficient machines and equipment, large saving potential is seen in industrial processes that require both heating and electric energy. For example, in many industries, the proportion of electricity consumed by electric motors represent up to 40 % for food industries and up to 70 % or higher for in the chemical or ceramic industries of the total electricity consumption. Therefore by replacing old electric motors with more efficient motors the savings are very significant with high returns on investment and short payback period of 2 to 3 years. Waste heat recovery systems also presents another opportunity for energy efficiency improvements as most of the heat generated by on site electricity production is wasted. The heat can be captured and used for hot water and preheating applications. Other areas of energy efficiency improvements include air conditioning and lighting.

The annual grid electricity consumption of Nigerian industry (mostly from the manufacturing sector) was estimated at 4.2 TWh in 2015. However, an assessment of the industrial energy sector in 2015 showed that 48 % of total annual electricity consumption in manufacturing industry is still generated by diesel generators themselves. This is a consequence of the frequent power cuts in the grid and the poor quality of electricity supplied to industry.

Power cuts in industry amounted to 196 hours per month, compared to an average of 15 to 36 hours per month in sub-Saharan Africa. In manufacturing, chemicals and pharmaceuticals, metal products and plastics are the three sub-sectors with the highest concentration of industrial units with high electricity consumption. They account for about 60 % of electricity consumption in the category >100,000 kWh per month, with the highest concentration of industrial units (71 %) in Lagos and its surroundings. This is a huge market for energy efficiency in industry in areas such as demand management, replacement of obsolete equipment with energy-efficient units and fuel switching. A study has analysed that investments in energy efficiency for small and medium sized industries can lead to energy savings of up to 32 TWh, equivalent to a reduction of 1 million tonnes of CO₂ equivalent, with an investment requirement of around US$2.2 billion.

Market Potential

The utilisation of energy in the Nigerian industrial sector is characterised by huge energy waste among many industries still making use of obsolete and inefficient machines and equipment such as electric motors, boilers and pumps. Despite the low performance outputs resulting from inefficient energy use, energy efficiency and conservation activities in industries are still limited. The high capital costs, a lack of regulatory framework and low awareness levels are some of the barriers responsible for the low levels of energy efficiency in Nigerian industries.
There have been several initiatives to promote energy efficiency in industry in Nigeria. Many of them are aimed at building know-how at all levels. For example, one existing project supports industrial companies in the implementation of the ISO 50001 energy management system, another trains SON employees in the field of renewable energy. Such initiatives are instrumental in developing the market for energy efficiency, thereby increasing the market potential for service and equipment providers.

**Legal Framework**

By maintaining a hierarchical relationship with Federal Ministry of Environment (FMENV), the National Environmental Standards and Regulations Enforcement Agency (NESREA) has begun to take a proactive role in promoting energy efficiency by establishing and ensuring compliance with energy policies and standards. The Standards Organisation of Nigeria (SON) has a mandate to set standards and ensure compliance of all energy consuming equipment and has started developing standards for specific electrical appliances such as lighting and refrigerators.

A national energy policy and a draft master plan with basic policies and strategies for energy saving were prepared. This includes, among other things, the promotion of energy efficiency and savings in the industrial sector, the establishment of codes and standards for energy efficiency and energy saving technologies and the enforcement of codes and standards for lighting, air conditioning and other household appliances. However, there are still no specific rules to promote energy efficiency in the industrial sector. Recent developments include a national standard for energy management systems according to ISO 50001, but SON is not yet able to certify equipment.

**Investment Promotion**

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**Business Models**

Many energy efficiency projects and plants are implemented directly by the promoters, who use the plant for their own use. However, there are also other models for financing energy efficiency measures in industry.

**Lease to Own** — In this model an equipment supplier provides the equipment/machine to the end user on a lease basis. Payment for the supply of the equipment is spread evenly over an agreed period (usually 1 to 5 years) and is payable by the user. Sometimes the transaction will be carried out directly between the supplier and the user. In most cases, however, the lessee’s bank makes the full payment to the supplier and charges the lessee the same amount (usually plus interest) over the same agreed period.

**Energy Performance Model** — This model involves a contractual agreement between the project host/user and an Energy Service Company (ESCO) that provides the energy efficiency measure, in which they give a performance guarantee that the installed measures will deliver cost savings. In this model, the ESCO does not necessarily provide the capital, but may raise capital from a third party lender or bank.

Energy-efficiency projects for buildings and households can be one or a combination of the following measures:

**Retrofits** — Standalone projects where the main purpose of installation is to improve energy efficiency. Examples include the changing of incandescent or fluorescent lighting to LEDs;

**Embedded** — These are projects that are usually a part of a wider project such as a renovation or a refurbishment project. Examples include improving production lines with energy-efficient technologies;

**New Build** — This includes utilising energy-efficient technologies in the design of new buildings rather than the traditional technologies.

**Risks**

**Regulatory and Policy Implementation** — One significant challenge for the wider development of energy efficiency market in Nigeria is the implementation of policies and regulations.

**Performance Risk** — Technical issues around identifying, appraising and implementing energy efficiency projects in a manner that yields the calculated savings affects the adoption of energy efficiency in Nigeria. If the energy efficiency project does not yield the cost savings that have been calculated, investors will not make full return on investment in due time or even at all.

**Economic vs Financial Viability** — Some of the technologies may be economically viable but not financially viable. The economic viability of these projects in addition to costs and savings also account for economic costs and benefits such as the resulting reduction in emissions which are expressed in net present values using a social discount rate. On the other hand, evaluating the financial viability of same project does not account for benefits gained by reducing emissions as no carbon credit program exists. Also, it uses a discount rate that reflects the commercial financing reality in Nigeria.
Key Performance Indicators

<table>
<thead>
<tr>
<th>Segment</th>
<th>Utility Tariff</th>
<th>Backup Generation Type</th>
<th>Energy End Uses</th>
<th>Average Energy Consumption per Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Industry</td>
<td>D1</td>
<td>Diesel</td>
<td>Machines (e.g. packaging, molding, tempering), mixers, water pumps, lighting, ACs</td>
<td>7,900 kWh per month</td>
</tr>
<tr>
<td>Medium Industry</td>
<td>D2</td>
<td>Diesel</td>
<td>Air compressors, machines, furnaces, lighting, ACs</td>
<td>23,000 kWh per month</td>
</tr>
<tr>
<td>Food Processing</td>
<td>D3</td>
<td>Gas, Diesel</td>
<td>Motors, air compressors, lighting, ACs, ventilation, cooling</td>
<td>1.34 GWh per month</td>
</tr>
<tr>
<td>Agro-allied</td>
<td>D3</td>
<td>Diesel</td>
<td>Motors, lights, machines, cold rooms, ACs, fans and blowers, pumps</td>
<td>182,000 kWh per month</td>
</tr>
<tr>
<td>Personal-care Product Manufacturers</td>
<td>D3</td>
<td>Gas</td>
<td>Steam (boilers), air compressors, lighting, ACs, ventilation and cooling</td>
<td>2.02 GWh per month (electricity and thermal)</td>
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Tariffs — Subsidies in electricity tariff serves as a disincentive for the adoption of energy efficiency in buildings and households. In recent times, the Nigerian Electricity Regulation Commission have released tariff templates for DISCOs which reduces the subsidies thereby increasing tariff that allows consumers pay the reflective cost of electricity.

Success Stories

BEL Papyrus Limited, situated in Lagos, Nigeria manufactures tissue products while BEL Impex Limited takes care of the converting aspects. With some of the best machines Europe has to offer, Group Boulos has been producing and distributing jumbo reels in Nigeria and nearby African countries and several lines and sub-brands of tissue paper to consumers since 2001. The company was part of the 5 participating companies in the Pilot Energy Efficiency Network of Nigeria organised by GIZ NESP. Energy use assessment in the mill revealed saving opportunities through heat recovery, shift to variable frequency drive and control of leakages, whether steam, air, water or chemicals.

Summary of Energy Efficiency Intervention Plans

<table>
<thead>
<tr>
<th>Action</th>
<th>Estimated Cost</th>
<th>Estimated Savings per year</th>
<th>Estimated Savings per year</th>
<th>Payback Period (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation Of Another Heat-Recovery Boiler For PM3 Gas Generator</td>
<td>₦200,000,000</td>
<td>1,400,000 kWh</td>
<td>₦35,000,000</td>
<td>6.8</td>
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<tr>
<td>Installation Of An Economizer For PM3 Boiler</td>
<td>₦42,000,000</td>
<td>970,000 kWh</td>
<td>₦24,250,000</td>
<td>1.7</td>
</tr>
<tr>
<td>Installation Of Variable Frequency Drive For PM2 Pulper</td>
<td>₦7,600,000</td>
<td>116,000 kWh</td>
<td>₦2,900,000</td>
<td>2.6</td>
</tr>
<tr>
<td>Insulating Of All Steam Valves</td>
<td>₦2,700,000</td>
<td>353,000 kWh</td>
<td>₦2,800,000</td>
<td>1.0</td>
</tr>
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