DALILA SCIENTIFIC SYMPOSIUM

TOPIC: ENERGY EFFICIENCY AND STORAGE APPLICATIONS

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Introduction

- Zanzibar is a semi-autonomous region of the United Republic of Tanzania.
- Zanzibar is part of Tanzania and has its own legislative assembly, judicial system, and an executive headed by the President.
- The Zanzibar archipelago consists of two main islands, Unguja and Pemba.
- The two islands are located roughly 35 kilometers (km) off the coast of Tanzania and are surrounded by a group of approximately 50 islets.
- In 2012, Zanzibar's population was 1.3 million, 900,000 in Unguja, and 400,000 in Pemba. By 2022, Zanzibar's population is expected to increase to 1.6 million people, given an estimated population growth rate of 3.1 percent per year.
- Currently, over 60 percent of the inhabitants live in urban areas, and the population density of this island nation is more than ten times higher than in Tanzania-mainland.

Status of Zanzibar Power Sector

- The Zanzibar power sector is led by three key players. The Ministry of Land, Housing, Water and Energy (MoLHWE), the Zanzibar Utilities Regulatory Authority (ZURA), and the vertically integrated utility, ZECO are the main actors in the electricity sector.
- Key sector legislation includes the ZECO Act (2006) that governs the operations of the utility, and the ZURA Act (2013) establishing the sector regulation.
- The Department for Energy and Minerals (DoEM) within MoLHWE is responsible for policy setting and overall sector coordination.
- ZURA established in 2013 is responsible for technical and economic regulation in the water, petroleum, and electricity sectors. ZURA's functions include tariff setting and review, licensing, promoting economic efficiency and performance monitoring of sector utilities, and promoting private sector participation.
- ZECO is fully owned by the Revolutionary Government of Zanzibar (RGoZ) through the MoLHWE.
- Its responsibilities include generation, transmission and distribution, and the sale of the electricity on both Unguja and Pemba.
- The ZECO Act (2006) gives the utility the mandate to sign Power Purchase Agreements (PPAs) with any public authority or independent power producer (IPP) for the bulk purchase of electricity.

- Zanzibar relies solely on power supply from Tanzania-mainland so far.
- Both Unguja and Pemba are completely reliant on power purchased from Tanzania-mainland through submarine cables of 100 MW and 25 MW capacity, respectively.
- The new 100 MW-132kV submarine cable was installed in 2013, when the demand for electricity was approaching its maximum capacity.
- Currently, there are abundantly and locally available resources of RE in Zanzibar including solar radiation, wind, hydro, biomass and wastes.

Energy Supply Situation in Zanzibar

- The majority of people in Zanzibar lives on biomass (40%) - against the other lower energy consumption shares (petroleum and diesel 20%, electricity 35% and others as solar, wind, etc. 5%).

- Biomass: Resources in Zanzibar include woody, biogas, liquid biofuel and biomass co-generation.

- Solar: Between 2800-3500 hours of sunshine per year with a global radiation between 4-7 kWh/m2/day. Average solar flux in some parts based on 24 hours can be as high as 300W/m2 or more.

- Wind: Proven wind power generation sites exist including Nungwi in Unguja and Micheweni in Pemba.
- Wind speeds recorded are in excess of 7m/s.

Cases of some RE projects already well functioning in Zanzibar

- Slaughter houses waste to energy – Kisakasaka village in Zanzibar, at 10 kW each.
- Uzi Island Solar battery charging stations for rural electrification – initially 10 SBCS system installed for every 5 households within 300 metres diameter @120 Wp each and batteries at 70 -100 Ah each.
- Verde Hotel in Zanzibar using solar energy supply for whole hotel buildings.
- Karume Institute of Science and Technology using solar energy in most of their daily activities in workshops.
- All road light poles and traffic light in Urban Zanzibar using Solar energy.

Energy storage requirements locally and globally

- Energy storage is the capture of energy produced at one time for use at a later time.
- Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms.
- Some technologies provide short-term energy storage, while others can endure for much longer.
- Common examples of energy storage are the rechargeable battery, which stores chemical energy readily convertible to electricity to operate a mobile phone and the hydroelectric dam, which stores energy in a reservoir as gravitational potential energy.
- Energy can be stored in water pumped to a higher elevation using pumped storage methods.

Other commercial mechanical methods include compressing air and flywheels that convert electric energy into kinetic energy and then back again when electrical demand peaks.

- Hydroelectric dams with reservoirs can be operated to provide electricity at times of peak demand.
- Water is stored in the reservoir during periods of low demand and released when demand is high.
- The net effect is similar to pumped storage, but without the pumping loss.
- While a hydroelectric dam does not directly store energy from other generating units, it behaves equivalently by lowering output in periods of excess electricity from other sources.
- In this mode, dams are one of the most efficient forms of energy storage, because only the timing of its generation changes.
- Hydroelectric turbines have a start-up time on the order of a few minutes.

Energy Efficiency in Buildings

- The energy consumption is distributed among four main sector: industrial, building (residential/commercial), transportation and agricultural areas.
- The building sector is the highest energy consumer area. Energy consumption rate is gradually increase due to urbanization, industrial growth and population growth.
- Population growth means contracting more buildings, which increases energy expenditure.
- The heat losses in buildings generally occur through external walls, ceiling, floor, windows and air infiltration, therefore energy efficiency in building is very important.

- The efficiency of a building envelope, which includes anything that encloses a building such as walls, ceilings, windows, foundations, is a key to improving the energy efficiency of structures.
- Basically, the envelope is anything that separates the inside of a building from the outside environment.
- A good energy efficiency program begins with having a building envelope that efficiently minimizes heat loss.
- Heating and cooling accounts for 50 to 70% of the energy used in an average home.
- Inadequate insulation and air leakage are leading causes of energy waste in most residential homes.
- The benefits of a good building envelope include:-
- Saves money, Makes the home more comfortable by helping to maintain a uniform temperature throughout the house, Makes walls, ceilings, and floors warmer in the winter and cooler in the summer.

- The amount of energy efficiency improvements depend on several factors: local climate; the size, shape, and construction of the house; the living habits; the type and efficiency of the heating and cooling systems; and the fuel used.
- The efficiency in building can be achieved by considering many aspects, among them are street design and urban microclimate, and energy insulation.
- Energy efficiency reduces the amount of energy required to provide products and services. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature.
- Installing LED lighting, fluorescent lighting, or natural skylight windows reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs.
- Improvements in energy efficiency are generally achieved by adopting a more efficient technology or production process or by application of commonly accepted methods to reduce energy losses.
- There are many motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of on sustainable energies and green economy in Africa
- Implementing an energy-efficient technology, reducing energy use is also seen as a solution to the problem of reducing green house gases(GHG).

THANK YOU FOR LISTENING